HAZARD MITIGATION PLAN

Mitigating Risk for a Safe, Secure, and Sustainable Future

DECEMBER 2015

CITY OF SAN ANTONIO

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SECTION 1: INTRODUCTION

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Background

San Antonio is the county seat of Bexar County, the seventh most populous city in the United States, and the second most populous city in the state of Texas, with a population of 1,409,019, according to the U.S. Census Bureau's 2013 Population Estimates. It was the fastest growing of the top 10 largest cities in the United States from 2000 to 2010, and the second from 1990 to 2000. The city is located in the American Southwest, the south–central part of Texas, and the southwestern corner of an urban region known as the Texas Triangle. This term is derived from the fact that the three main cities in the Texas Triangle are connected by a highway system of Interstate 45, Interstate 10, and Interstate 35, which form a triangle when connected. The Triangle is anchored by the metropolitan areas of Houston, Dallas-Fort Worth, Austin, and San Antonio.

Texas is prone to extremely heavy rains and flooding with half of the world record rainfall rates (48 hours or less).[1] Central Texas, known as Flash Flood Alley, is particularly vulnerable because storms tend to stall out along the Balcones escarpment. While the City of San Antonio is susceptible to a wide range of natural and human-caused hazards, including flooding, tornadoes and wildfires, San Antonio is considered one of the most flash flood prone regions in North America. These life-threatening hazards can destroy property, disrupt the economy, and lower the overall quality of life for individuals.

This was most recently evident with flash flooding that occurred May 25, 2013, resulting in over 200 citizen rescues, and 3 casualties.[2] While it is impossible to prevent a hazard event from occurring, the impact of hazards can be lessened in terms of their effect on people and property through effective hazard mitigation planning and implementation. This Hazard Mitigation Action Plan, or *the Plan,* provides an opportunity for the city to

[1] http://floodsafety.com/texas/regional_info/regional_info/sanantonio_zone.htm
[2] http://www.theblaze.com/stories/2013/05/25/flood-waters-rising-quickly-in-san-antonio-60-rescued/

evaluate successful mitigation actions and explore opportunities to avoid future disaster loss.

The Federal Emergency Management Agency (FEMA) defines mitigation as, "any action taken to reduce or eliminate the long term risk to human life and property from natural hazards.[3]" Mitigation differs from emergency preparedness and protective measures, which focus on activities designed to make communities more prepared to take appropriate action in a disaster with emergency response and equipment. Mitigation activities involve alteration of physical environments to reduce risks and vulnerabilities to hazards and make it more cost-effective to respond to, and recover from, disasters.

Scope and Participation

The City of San Antonio's Hazard Mitigation Action Plan, or *the Plan,* is a single jurisdictional Plan. Numerous entities and businesses participated as stakeholders in the Plan, including H-E-B, The University of Texas at San Antonio, San Antonio River Authority (SARA), and the United Services Automobile Association (USAA). These groups, and others, provided valuable input into the planning process.

The focus of the Plan is to mitigate those hazards selected from the State Hazard Mitigation Plan which are deemed to pose a risk to the planning area. For each of the hazards selected, a detailed risk assessment was conducted as part of the hazard mitigation planning process. The risk assessment enables the City to prioritize mitigation actions based on hazards that pose the greatest risk to lives and property.

Purpose

The Plan, prepared by the City of San Antonio and H2O Partners, Inc., is an opportunity for the City of San Antonio's planning team members to evaluate successful mitigation actions and explore opportunities to avoid future disaster loss.

In developing the Plan, the City of San Antonio identified 13 hazards to be addressed in developing mitigation projects, as the goal of the Plan is to minimize or eliminate long-term risk to human life and property from known hazards, and identifying and implementing cost-effective mitigation actions. Therefore, the purpose of the Plan is to develop successful mitigation projects to reduce future risk in the community, including loss of life and property damage throughout the City of San Antonio.

Through this process, the City of San Antonio seeks to:

- Assess any previous mitigation projects and develop unique mitigation strategies to meet future development and risks;

[3] www.fema.gov

- Encourage improvements in floodplain management, participation in the National Flood Insurance Program (NFIP); and qualifying for FEMA's Community Rating System, thereby reducing flood insurance premiums for citizens;
- Devise solutions to strengthen emergency management by addressing moderate and high risk natural hazards; and
- Develop and implement comprehensive mitigation planning activities for the City of San Antonio, and integrate these activities into existing planning mechanisms.

Authority

The Plan will be tailored specifically for the City of San Antonio. When complete, the Plan will comply with all requirements promulgated by the Texas Division of Emergency Management (TDEM) and 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). It will also comply with FEMA's February 26, 2002 Interim Final Rule ("the Rule") at 44 CFR Part 201, which specifies 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). The Plan will also be 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 outline the purpose and the process of development. Section 3 profiles the City of San Antonio in terms of population and economy.

Sections 4 through17 present a hazard overview and information on individual hazards. For each hazard, the Plan presents a description of the hazard, a list of historical hazard events, and the results of the vulnerability and risk assessment process.

Section 18 presents mitigation goals and objectives. Mitigation actions for the City are presented in Section 19, while Section 20 identifies plan maintenance mechanisms.

The list of planning team members and stakeholders is located in Appendix A. Public survey results are analyzed in Appendix B. Appendix C contains a detailed list of critical facilities for the area, and Appendix D lists dam locations. Appendix E contains information regarding workshops and meeting documentation. Capability Assessment results for the City are located in Appendix F.

SECTION 2: PLANNING PROCESS

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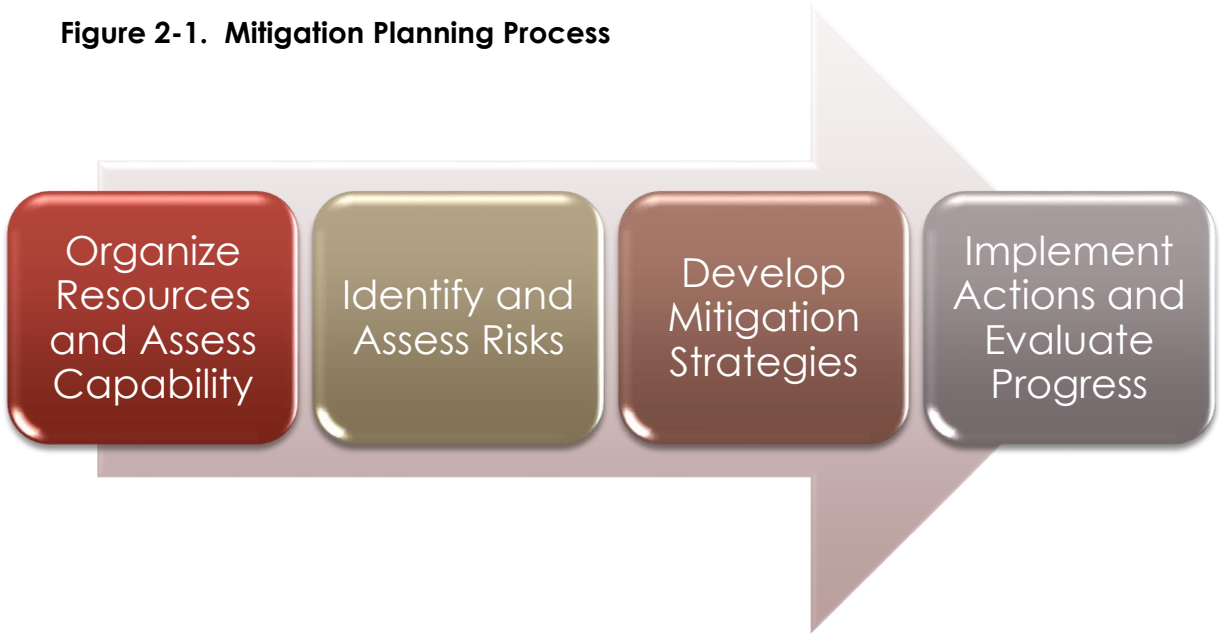
Plan Preparation and Development

Mitigation planning involves bringing together multiple components and players to create a more disaster-resistant community. This section provides an overview of the planning partners and key steps of the planning process, as well as providing a detailed description of how stakeholders and the public were involved.

Overview of the Plan

The City of San Antonio solicited bids and hired the consultant team of H2O Partners, Inc. to provide technical support and oversee the development of the Hazard Mitigation Action Plan, or *the Plan*. In developing the Plan, the consultants used the October 2011 *Local Multi-Hazard Mitigation Planning Guidance*, *the State and Local Mitigation Planning How-to Guides* (FEMA Publication Series 386), and the March 2013 *Local Mitigation Planning Handbook* to create the Plan in accordance with the process, as shown in Figure 2-1 below.

Figure 2-1. Mitigation Planning Process



The City of San Antonio and the consultant team met in April 2014 to begin organizing resources by identifying Planning Team members and conducting a Capability Assessment.

Planning Team

The Planning Team was established using a direct representation model. Key members of H2O Partners, Inc. developed the Plan in conjunction with the Executive Planning Committee comprised of the San Antonio Office of Emergency Management staff. The Advisory Planning Team consisted of key City staff from various departments and officials from area organizations that assisted in identifying mitigation goals and developing mitigation strategies. A large Stakeholder Working Group was invited to participate via email, met on a monthly basis, and was an integral component in the development of mitigation actions for the Plan. Appendix A provides a complete listing of all participating Planning Team members and stakeholders by organization and title.

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

- The nature/magnitude of risks currently affecting the community;
- Mitigation goals to address current and expected conditions;
- Whether current resources will be appropriate for implementing the Plan;
- Implementation problems, such as technical, political, legal, or coordination issues that may hinder development;
- Anticipated outcomes; and

- How the City of San Antonio, agencies, and partners will participate in the implementation process.

Based on results of completed Capability Assessments, the City of San Antonio also described methods for achieving mitigation in the future by expanding on their existing capabilities. The City of San Antonio developed mitigation actions for mitigating risk from potential flooding and wildfire, to include joining the FireWise program. Sample mitigation actions developed with similar hazard risk by planning team members were shared at the meetings. These important discussions resulted in development of multiple mitigation actions that are included in the Plan to further mitigate risk from natural hazards in the future.

In an effort to expand on their capability to achieve mitigation in the future, the City of San Antonio has included city-wide actions for channelization and upgrading drainage systems to reduce the city-wide flooding that occurs during heavy rain periods.

Table 2-1. Executive Planning Team

ORGANIZATION	TITLE
Office of Emergency Management	Emergency Management Coordinator
Office of Emergency Management	Assistant Emergency Management Coordinator (1)
Office of Emergency Management	Assistant Emergency Management Coordinator (2)
Office of Emergency Management	Special Projects Manager
Office of Emergency Management	Senior Management Analyst (1)
Office of Emergency Management	Senior Management Analyst (2)
Office of Emergency Management	Department Fiscal Administrator

Table 2-2. Advisory Planning Team

ORGANIZATION	TITLE
Alamo Area Council of Governments (AACOG)	Public Safety Planning Coordinator
Alamo Area Council of Governments (AACOG)	Public Safety Director
Alamo Colleges	Emergency Management Coordinator
CPS Energy	Assistant Chief System Operator
Federal Executive Board	Executive Director
Local Emergency Planning Committee (LEPC)	Emergency Management Coordinator

ORGANIZATION	TITLE
National Weather Service (NWS)	Coordinator
San Antonio Department of Planning and Community Development	Director
San Antonio Development Services – Field Services	Assistant Director
San Antonio Development Services – Land Development	Assistant Director
San Antonio Development Services – Plan Review	Assistant Director
San Antonio Economic Development Office	Assistant Director
San Antonio Economic Development Office	Director
San Antonio Fire Department (SAFD)	Senior Management Analyst
San Antonio Fire Department (SAFD)	Assistant Fire Chief
San Antonio Fire Department (SAFD) Hazmat	Assistant Chief
San Antonio Fire Department (SAFD) Hazmat	Battalion Chief
San Antonio Fire Department (SAFD) Hazmat	Fire Captain
San Antonio Fire Department (SAFD) Hazmat	HazMat Specialist
San Antonio Fire Department (SAFD) Wild-land Fire	Fire Captain
San Antonio Human Services	Senior Management Analyst
San Antonio International Airport	Operations Supervisor
San Antonio Metropolitan Health District (SAMHD)	Special Projects Manager
San Antonio Office of Emergency Management	Project Coordinator
San Antonio Office of Emergency Management	Battalion Chief
San Antonio Office of Emergency Management	Homeland Security Consultant
San Antonio Office of Sustainability	Chief Sustainability Officer
San Antonio Police Department	Police Captain
San Antonio Police Department (SAPD)	Coordinator
San Antonio River Authority (SARA)	Project Administrator

ORGANIZATION	TITLE
San Antonio River Authority (SARA)	Watershed Engineer
San Antonio River Authority (SARA)	Watershed Engineering Manager
San Antonio River Authority (SARA)	Project Manager
San Antonio River Authority (SARA)	Project Manager
San Antonio Voluntary Organizations Active in Disaster	Coordinator
San Antonio Water System (SAWS)	Assistant Engineer
San Antonio Water System (SAWS)	Chief Operating Officer
Southwest Texas Fusion Center – San Antonio Fire Department (SAFD)	Battalion Chief
Southwest Texas Fusion Center – San Antonio Police Department (SAFD)	Director
Southwest Texas Fusion Center – San Antonio Police Department (SAPD)	Police Captain
Southwest Texas Regional Advisory Council on Trauma	Executive Director
Texas Division of Emergency Management	District Coordinator
The University of Texas at San Antonio	Business Continuity/EMC
Transportation & Capital Improvements (TCI)	Assistant Director, Storm Water
Transportation & Capital Improvements (TCI)	Special Projects Manager
University Health System	Emergency Preparedness Manager
VIA Metropolitan Transit	Emergency Coordinator

Planning Process

The process to prepare this Plan included following the four major steps included in Figure 2-1. After the Planning Team was organized, a Capability Assessment survey 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 hazard risk and vulnerabilities to the planning area, specific mitigation strategies were discussed and created at the Mitigation Workshop. Finally, Section 20 includes Plan Maintenance and Implementation procedures that were developed in conjunction with the planning process. Documentation for participation at each workshop is found in Appendix E.

Kickoff Workshop

The Kickoff Workshop was held at the City of San Antonio/Bexar County Emergency Operations Center on May 5, 2014. This initial meeting was an opportunity to inform City officials and key department personnel about how the planning process pertained to their distinct roles and responsibilities, and also methods to involve stakeholder groups such as the San Antonio River Authority, the National Weather Service, and area businesses. 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 high to low in terms of perceived level of risk, frequency of occurrence, and potential impact.

Hazard Identification

At the close of the Kickoff Meeting, and through a series of email and phone correspondences, the Planning Team conducted preliminary hazard identification. The group reviewed and considered a full range of natural and human-caused hazards, then narrowed the list to significant hazards by reviewing hazards affecting the area as a whole, the State of Texas Hazard Mitigation Plan, and initial study results from reputable sources such as federal and state agencies. Based on this initial analysis, the team identified a total of nine natural hazards and four human-caused hazards that pose risk to the planning area.

Risk Assessment

An initial risk assessment for the city was completed in August 2014. The results of the assessment were presented at a workshop held on August 11, 2014. Participants and stakeholder groups were invited to the Risk Assessment Workshop. At this workshop, the characteristics and consequences of each hazard were evaluated to determine how much of the area would be affected, in terms of potential danger to property and citizens.

Potential dollar losses from each hazard were estimated using the Federal Emergency Management Agency's Hazards U.S. Multi-Hazards (MH) Model (HAZUS-MH) and other modeling techniques. The assessments examined the impact of various hazards on the built environment, including general building stock (e.g., residential, commercial,

industrial), critical facilities, lifelines, and infrastructure. 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 was also provided a risk ranking sheet at the Risk Assessment workshop and were asked to rank hazards in terms of perceived level of risk, frequency of occurrence, and potential impact.

The assessments were also used to set priorities for mitigation strategy based on potential dollar losses and loss of lives. A hazard profile and vulnerability analysis for each of the hazards can be found in Sections 5 through 17 in this Plan.

Mitigation Review and Development

The mitigation strategy development for the Plan involved developing mitigation goals and new mitigation actions. A Mitigation Workshop was held at the San Antonio/Bexar County Emergency Operation Center on September 8, 2014. As with the Risk Assessment Workshop, stakeholder groups were invited.

An inclusive and structured process was used to develop and prioritize new mitigation actions for the Plan, including the following steps:

- A "menu" of optional mitigation actions was developed based on plan reviews, studies, and interviews with federal, state, and local officials. The participants reviewed the optional mitigation actions, and narrowed the list down to those that were most applicable to their area of responsibility, most cost-effective in reducing risk, could be effectively implemented, and would be most likely to receive institutional and community support.
- The participants inventoried federal and state funding sources that could potentially assist in implementing the proposed 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, matching requirements, application deadlines, and points of contact for participants. Mitigation Planning Team members considered benefits that would result from the mitigation actions, versus the cost of those projects. Detailed cost-benefit analyses were beyond the scope of this Plan; however, economic evaluation was one factor that helped Team Members select one mitigation action from competing actions.
- Team Members then selected and prioritized mitigation actions.

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 of this exercise, an overall priority was assigned to each mitigation action by each Team Member. The overall priority of each action is reflected in the mitigation actions found in Section 19.

Planning Team members identified proposed actions, costs and benefits, the responsible organization(s), effects on new and existing buildings, implementation schedules, priorities, and potential funding sources.

Mitigation actions identified in the process were made available to the Planning Team for review. In addition, the Plan will be made available for review and comment on the City of San Antonio's website.

Review of Existing Plans, Plan Integration, and Updates

A variety of existing studies, plans, reports, and technical information were reviewed as part of the planning process. Sources of the information included FEMA, the United States Army Corps of Engineers (USACE), the U.S. Fire Administration, the National Oceanic and Atmospheric Administration (NOAA), the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), the State Comptroller, the Texas State Data Center, Texas 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 5-17) summarize the findings from these sources. Some of these documents, including those from FEMA, provided information on risk, existing mitigation actions currently underway, and ideas for possible future mitigation actions. Other documents, including those from NOAA's National Climatic Data Center (NCDC), provided previous hazard occurrences and descriptions of the events in the area. 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. Materials from FEMA and TDEM were reviewed for guidance on plan development requirements. The preliminary results were also presented at the Risk Assessment Workshop in order to facilitate a discussion on risk to help participants appropriately complete Mitigation Action worksheets. Furthermore, these studies were used as a starting point for suggesting grant and mitigation activities based on flood-related funding availability. The State Comptroller materials were reviewed for county economic projections, which were also used to fully develop Section 3 of the Plan. Information from the Texas Forest Service was used to appropriately rank the wildfire hazard, and to help identify potential grant opportunities. The State of Texas Mitigation Plan, 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 State Mitigation Plan was also used as a guidance document, along with FEMA materials, in the development of the Plan.

Incorporation of the HMAP into Other Planning Mechanisms

Team members will integrate implementation of the Plan with other planning mechanisms for the City, such as the Emergency Management Plan. Existing plans for the City will be reviewed in light of the Plan, and incorporated into the hazard mitigation

plan, as appropriate. This section discusses how the Plan will be implemented by the City. It also addresses how the Plan will be evaluated and improved over time, and how the public will continue to be involved in the hazard mitigation planning process.

A major element of fiscal responsibility, as it pertains to incorporating existing studies and other planning mechanisms into the Plan, rests in the budgeting process, which is the process of allocating resources and prioritizing needs of a local jurisdiction, school district, or other organizations. In most cases, for a governmental entity, the budget represents the legal authority to spend money, and implied set of decisions by city administrators or other governing Boards that match resources found in existing planning mechanisms, and with objectives and goals of the Plan. As such, the budget is a product of the planning process, including mitigation planning and reducing risk from natural hazards. The annual Budget Review is an important tool in controlling and executing mitigation goals and objectives, and funding identified mitigation actions. The City of San Antonio, and the identified contact person for the city, will participate in their local budgetary process for tracking identified mitigation actions, recommending prioritization for grant funding, and updating and maintaining the mitigation strategy developed for the community.

The City will be responsible for implementing mitigation actions contained in Section 19. Each action has been assigned to a specific person or local government office that is responsible for tracking and implementing the action.

A funding source has been listed for each identified action. This source may be used when the jurisdiction begins to seek funds to implement the action. An implementation time period has also been assigned to each action as an incentive for seeing the action through to completion and to gauge whether actions are implemented on a timely basis.

The City will integrate implementation of its mitigation action plans with other, existing planning mechanisms such as the Capital Improvement Plans, long range Comprehensive Development Plans, Master Storm Water and Drainage Plans, Flood Studies, and other local and area planning efforts. The City of San Antonio will work closely with Bexar County, the San Antonio River Authority, and other area organizations to coordinate implementation of mitigation actions that benefit the metropolitan planning area in terms of financial and economic impact. The City will ensure that the actions contained in the mitigation plan are integrated into these coordinated planning efforts.

Table 2-3. Designated Planning Team Members Responsible for Plan Review, Integration, and Updates

DEPARTMENT	TITLE
Office of Emergency Management	Emergency Management Coordinator

DEPARTMENT	TITLE
Office of Emergency Management	Assistant Emergency Management Coordinator(1)
Office of Emergency Management	Assistant Emergency Management Coordinator(2)
Office of Emergency Management	Special Projects Manager
Office of Emergency Management	Senior Management Analyst(1)
Office of Emergency Management	Senior Management Analyst (2)
Office of Emergency Management	Department Fiscal Administrator

Upon formal adoption of the Plan, Planning Team members from the City will review existing plans identified here, along with building codes to guide and control development. Planning Team members, shown in Table 2-3, will be responsible for coordinating periodic review of the Plan with members of the Advisory Planning Team to ensure integration of hazard mitigation strategies into these planning mechanisms and codes. The designated Planning Team (Table 2-3) will also conduct periodic reviews of its various existing planning mechanisms and analyze the need for any amendments or updates in light of the approved Plan. The City will ensure that future long-term planning objectives will contribute to the goals of this hazard mitigation plan to reduce the long-term risk to life and property from moderate and high risk hazards. Within one year of formal adoption of the hazard mitigation plan, existing planning mechanisms will be reviewed and analyzed as they pertain to the hazard mitigation plan.

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 mitigation plan.

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

Table 2-4 identifies types of planning mechanisms and examples of methods for incorporating the Plan into other planning efforts.

Table 2-4. Examples of Methods of Incorporation

PLANNING MECHANISM	METHOD OF INCORPORATION
Grant Applications	The City will consult the Plan whenever there are yearly grant funding cycles available through FEMA, including the Pre-Disaster Mitigation (PDM) cycle, and when there is a Disaster Declaration for Texas triggering Hazard

PLANNING MECHANISM	METHOD OF INCORPORATION
	Mitigation Grant Program (HMGP) funds. Mitigation actions for each jurisdiction will be reviewed by the planning team members and information will be updated for completing applications, such as maps and risk assessment data. If a project is not in the Plan, an amendment may be developed.
Annual Budget Review	The City will review the Plan and mitigation actions therein when conducting its annual budget review. When allocating funds for upcoming operating and construction budgets, high priority mitigation actions will be reviewed during City Council meetings. Each identified staff member/planning Team member will be responsible for bringing mitigation actions to the meeting to discuss feasibility of the potential project in terms of the availability of funds, grant assistance, and preliminary cost benefit review.
Emergency Planning	The Plan will be consulted during updates to the local emergency and/or disaster recovery plan. Risk assessment and vulnerability data will be pulled from the plan and analyzed in conjunction with the review, renewal, or re-writing of an Emergency Operations or Management Plan. This data will either be included within the new emergency planning mechanism or included as an appendix. Mitigation projects that relate to prevention and protection will also be reviewed for relevance to determine if they should be included.
Comprehensive/Capital Improvements	Before any updates to the Comprehensive/Capital Improvement Plans (CIP) are conducted, the City will review the risk assessment and mitigation strategy sections of the Plan, as limiting public spending in hazardous zones is one of the most effective long-term mitigation actions available to local governments. Profile information and data regarding NFIP compliance and maintenance will be reviewed in conjunction with any CIP that is developed. If new census or land use data is available, this information should be added to the Plan Update.

PLANNING MECHANISM	METHOD OF INCORPORATION
Floodplain Management Plan and Fire Protection	The Plan will be utilized in updating and maintaining floodplain management and fire protection plans, as the goals of both planning mechanisms are similar. In updating or maintaining these plans, the Plan will be consulted for NFIP compliance, flood risk, wildfire risk, and extent. Information from these sections will be reviewed for inclusion. In addition, mitigation actions that address wildfire and flood will be reviewed for inclusion.

Plan Review and Plan Update

As with the development of this Plan, the City of San Antonio will oversee the review and update process for relevance and to make adjustments, as necessary. The title of the person(s) responsible for Plan review and updates are found above in Table 2-3. At the beginning of each fiscal year, Team Members will meet to evaluate the Plan and review other planning mechanisms to ensure consistency with long-range planning efforts. In addition, participants will also meet twice a year, by conference call or presentation, to re-evaluate prioritization of the mitigation actions.

Timeline for Implementing Mitigation Actions

Both the Executive Planning Team (Table A-1, Appendix A), and the Advisory Planning Team (Table A-2, Appendix A), will engage in discussions regarding a timeframe for how and when to implement each 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 based on prioritization of each action, as identified on individual Mitigation Action worksheets included in the Plan for the City of San Antonio.

Both the Executive and Advisory Planning Team will evaluate and prioritize the most suitable mitigation actions for the community to implement. The timeline for implementation of actions will partially be directed by the city's comprehensive planning process, Capital Improvements Plan, budgetary constraints, and community needs. For example, the City of San Antonio has identified a multitude of storm water and flood projects to improve drainage and reduce flooding. These are high priority actions for implementation and will be addressed as such with respect to other existing plans and budgetary constraints that need to be considered. The City is committed to addressing and implementing mitigation actions that may be aligned with and integrated into the hazard mitigation plan.

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

Stakeholder and Public Involvement

An important component of 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 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 hazards present in their community and take steps to reduce their impact.

Public and stakeholder input in the development of the City of San Antonio Hazard Mitigation Action Plan was sought at separate periods, throughout the planning process, and prior to official Plan approval and adoption. Input was sought using three methods: (1) open public meetings, (2) survey instruments, and (3) ensuring the draft Plan deliverables were available for public review on the City of San Antonio's website, in government offices, and distributed during the 2015 Citizens Preparedness Workshop. Additionally, a series of open public meetings were held during the development of the Plan, as described below.

Stakeholder Involvement

Stakeholders provide an essential service in hazard mitigation planning; therefore, throughout the planning process, members of community groups, local businesses, neighboring jurisdictions, schools, and hospitals were invited to participate. The first Monday of each month, the City hosts a round-table at the San Antonio/Bexar County Emergency Operation Center, inviting an extensive list of area agencies, neighboring communities, and businesses to participate. This "Stakeholder Working Group" (Table A-3, Appendix A, and Table 2-5, below), is formed from a broad range of representatives from both the public and private sector, and served as a key component in the City's outreach efforts for development of the Plan. Documentation of stakeholders meetings is found in Appendix E. A list of organizations invited to attend via email may be found below.

Table 2-5. Stakeholder Working Group

ORGANIZATION	TITLE	PARTICIPATED
American Red Cross	Assistant Director	
American Red Cross	Local Program Coordinator	
Angel Staffing	Director	

ORGANIZATION	TITLE	PARTICIPATED
Association of Contingency Planner – Alamo Chapter/Security Service Federal Credit Union	Planning Coordinator	
AT&T	Regional Manager	
Baptist Child and Family Services	Assistant Director	
Bexar County Emergency Management	Emergency Management Coordinator	
Bexar County Sheriff's Office	Sheriff	X
Bexar Metro 9-1-1 Network District	Coordinator	
Brooks Development Authority	Operations Supervisor	
Center for Health Care Services	Assistant Director	X
Chamber of Commerce	Executive Director	
Christus Health System	Director	
City of Live Oak	Emergency Manager	
Community Emergency Response Teams	Emergency Management Coordinator	
Department of State Health Services	Program Manager	
Education Service Center, Region 20	Assistant Director	
Family Endeavors	Assistant Director	
Federal Bureau of Investigation	Regional Bureau Chief	
Federal Executive Board	Manager	X
HAM Operators	Volunteer	
Haven for Hope	Volunteer	
HEB	Business Development	X
Joint Base San Antonio	Assistant Director	X
Port San Antonio	Port Chief	X
Port San Antonio	Program Coordinator	X
Randolph Brooks	Director of Programs	
San Antonio Airport Fire (SAFD) – Airport	Fire Chief	X
San Antonio Airport Police (SAPD) – Airport	Police Chief	X

ORGANIZATION	TITLE	PARTICIPATED
San Antonio Aviation Department	Aviation Administrator	X
San Antonio Food Bank	Director	
San Antonio Library	Senior Librarian	
San Antonio Metropolitan Health District	District Supervisor	X
San Antonio Solid Waste Management	Assistant Director	X
San Antonio Transportation & Capital Improvements (TCI)	Director	X
South Texas Blood and Tissue Center	Operations Manager	X
Southwest Texas Regional Advisory Council	Council President	X
St. Mary's University	Risk Manager	
Texas A&M Forest Service	Biologist	
Texas A&M University – San Antonio	Risk Manager	
Texas Commission on Environmental Quality	Assistant Director	
Texas Division of Emergency Management	Senior Manager	
Transportation Security Administration	Chief Operating Officer	X
TxDOT	Transportation Engineer	
United States Marshals Service	Regional Director	
United States Postal Service	Program Coordinator	
United States Secret Service	Regional Director	X
University Health System	Emergency Manager	X
University of Texas at San Antonio	Risk Manager/EMC	X
University of Texas Health Science Center at San Antonio	Emergency Management Coordinator	
United Services Automobile Association	Program Administrator	X
VIA Metropolitan Transit	Supervisor	X

Stakeholders and the general public that attended the various Planning Team and public meetings played a key role in the planning process and were key to identifying areas of concern and potential mitigation actions. Some examples include the utilization of HAM Radio operators to assist with Public Outreach, posting to the SAFD website, and promoting a Lightning strike phone application.

Public Meetings

A series of open public workshops were held at local library branches, which were scheduled specifically for seeking public and stakeholder input. Topics of discussion for the meetings included the purpose of hazard mitigation, discussion of the planning process, and types of hazards, both natural and human-caused. Representatives from area neighborhood associations were invited to participate, as well as residents located in and around the area. In an effort to further engage the public, the City utilized social media such as Facebook, Twitter, and the local media. The City also posted notices of meetings at City Hall and kiosks in public gathering places.

Public meetings were held on the following dates and locations:

- June 23, 2014, Brook Hollow Branch Library
- June 24, 2014, Carver Branch Library
- July 1, 2014, Guerra Branch Library
- July 3, 2014, Mission Branch Library

Additionally, on September 20, 2014, the City hosted a "Community Planning Workshop" at the San Antonio/Bexar County Emergency Operation Center. Over 200 residents, business leaders, and representatives from across the greater San Antonio area attended.

Documentation of public outreach meetings are found in Appendix E.

Public Participation Survey

In addition to the open public meetings, the City of San Antonio was able to solicit input from citizens and stakeholders through the use of a public survey, which was designed to obtain data and information from the residents of the San Antonio planning area. The survey was promoted by local officials and a link was made available for citizens to access the survey by visiting the City of San Antonio's website. A total of 34 surveys were completed online, and an additional 130 surveys were completed at City offices and at public meetings, 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 jurisdiction to identify any potential actions or problem areas. The City of San Antonio reviewed and incorporated input from the survey into the Plan as mitigation actions. For example, many citizens mention public education and awareness, as a result several mitigation actions were added on conducting public education and awareness through a variety of mechanisms for different hazards.

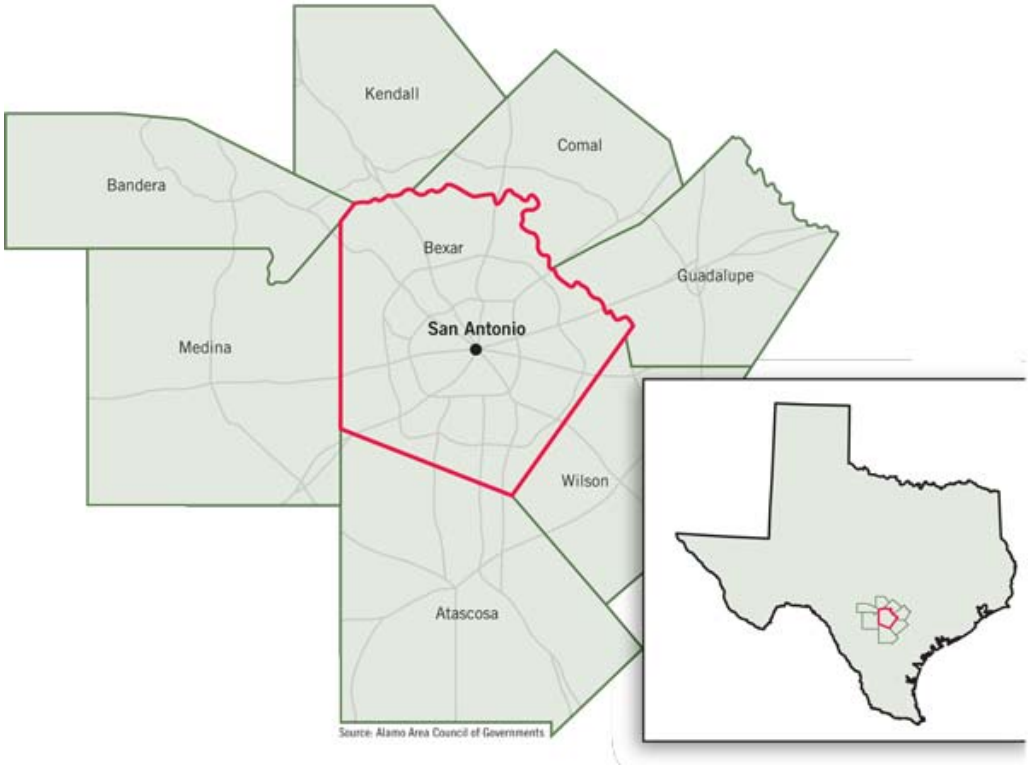
SECTION 3: CITY PROFILE

Overview 1
Population and Demographics 4
Population Growth 5
Future Development 6
Economic Impacts 6
The San Antonio River Walk 7
Existing and Future Land Use and Development Trends 7
Building Permits 9

Overview

The City of San Antonio is located in, and is the county seat of Bexar County. The City has characteristics of other western urban centers in which there are sparsely populated areas and a low density rate outside of the city limits. San Antonio is the center of the San Antonio–New Braunfels Metropolitan Statistical Area, Figure 3-1.

Figure 3-1. San Antonio-New Braunfels Metropolitan Statistical Area (MSA)



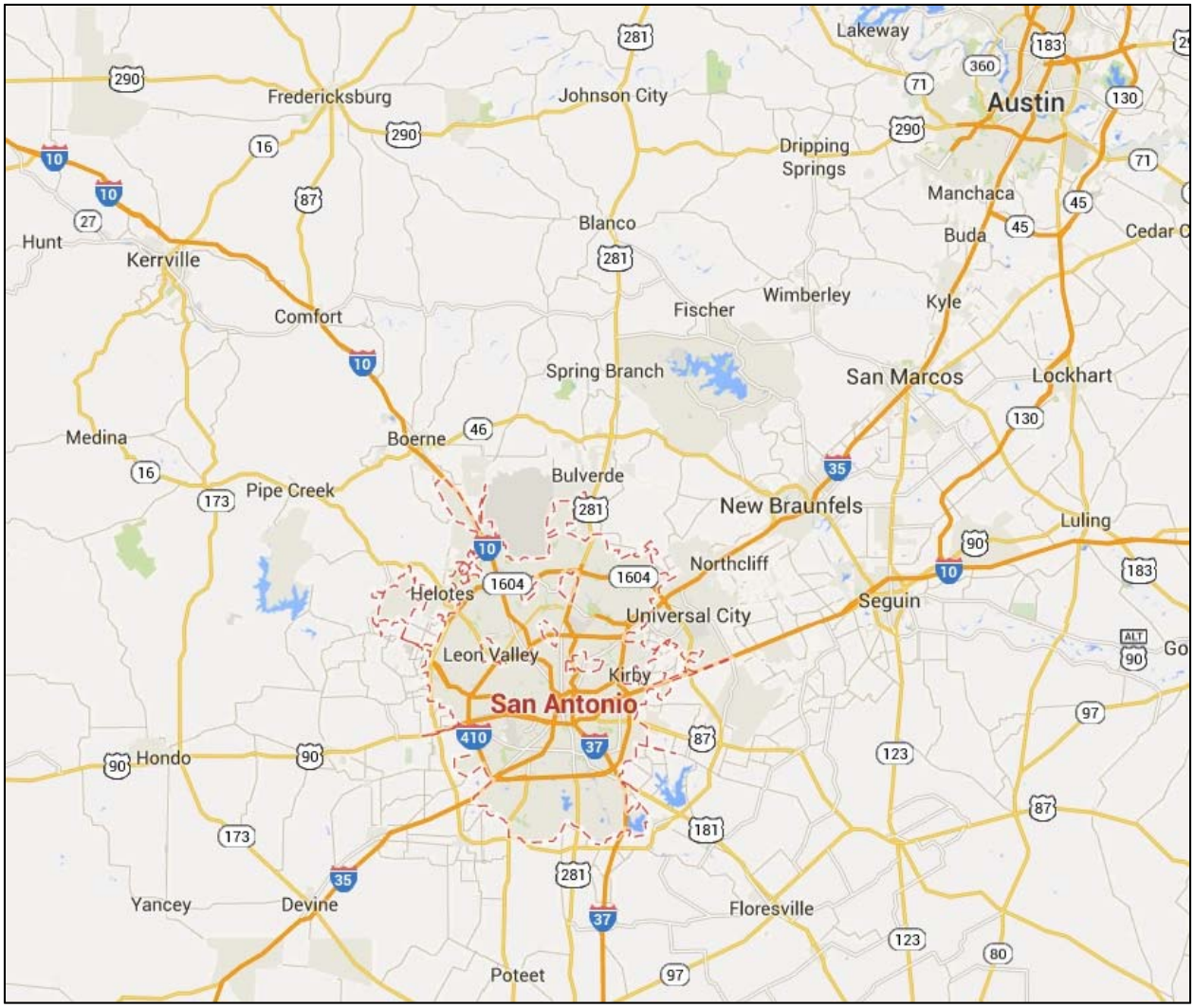
Officially, the City of San Antonio is the seventh most populous city in the United States and the second most populous city in the state of Texas, with a current population estimate of 1,409,019.[1]

This section profiles the City as a whole, providing data, including:

- Population and Demographics;
- Economy and Industry; and
- Land Use and Development Trends.

Figure 3-2 shows the general location of the City of San Antonio relative to the Interstate Highway 35 corridor and other area communities within and adjacent to Bexar County.

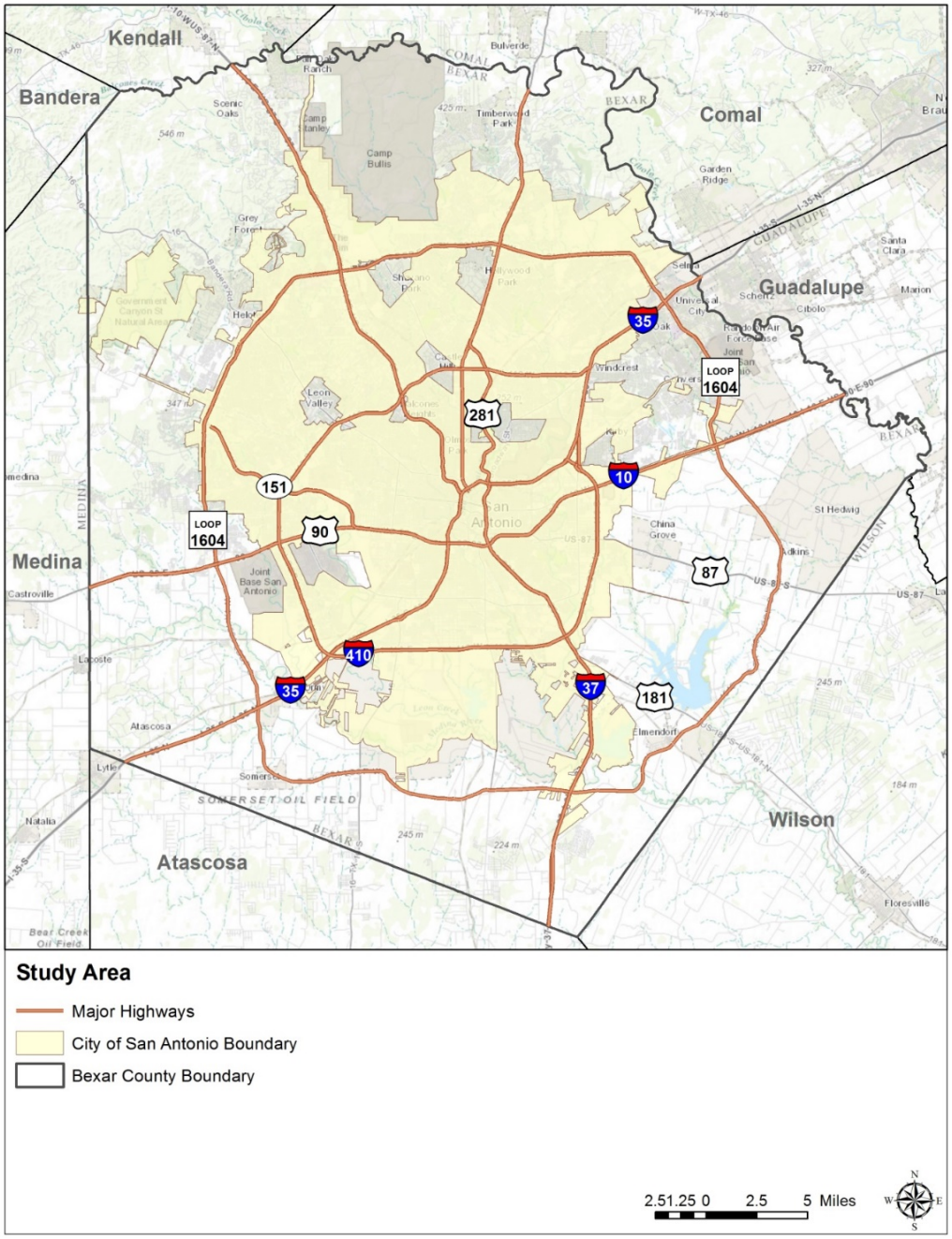
Figure 3-2. Location of San Antonio and New Braunfels Metro Area



[1] http://en.wikipedia.org/wiki/San_Antonio#cite_note-population-1

Figure 3-3 shows the City Limits of the City of San Antonio, which makes up the Study Area. All areas of the City's corporate limits are covered in the risk assessment analysis of the Plan.

Figure 3-3. City of San Antonio City Limits Study Area



Population and Demographics

In the official Census population count, as of April 1, 2010, San Antonio had 1,327,407 residents. By July 2012, the number had grown to 1,383,641, and by July 2013, the population was 1,409,019. New residential building permits are increasing every month as the general population of Central Texas continues to increase. Table 3-1 highlights special needs populations in the City of San Antonio. [2]

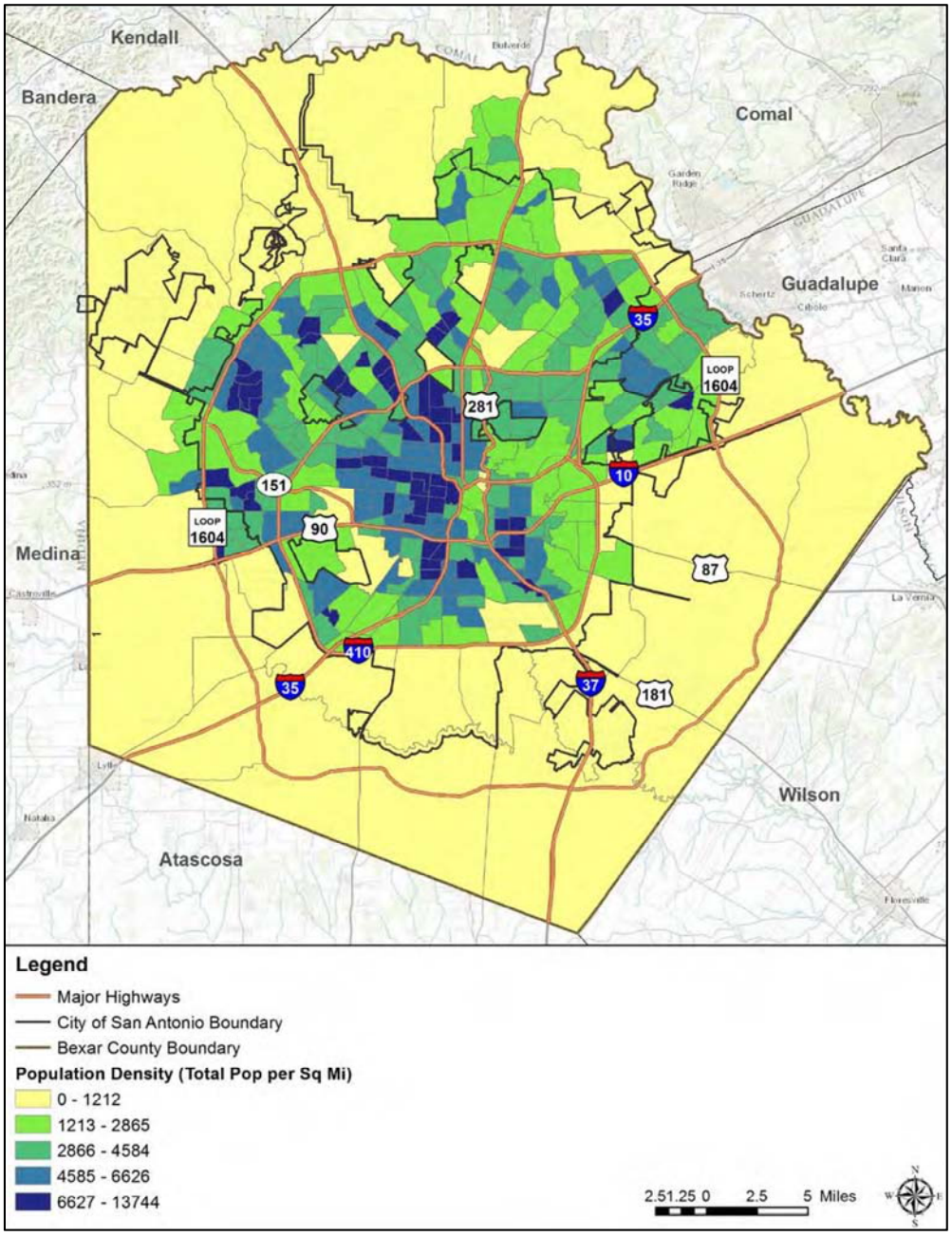
Between official U.S. Census population counts, the estimate uses a formula based on new residential building permits and household size. It is simply an estimate and there are many variables involved in achieving an accurate estimation of people living in a given area at a given time.

Table 3-1. Population Distribution for the City of San Antonio

TOTAL 2010 POPULATION	ESTIMATED VULNERABLE OR SENSITIVE POPULATIONS	
	Elderly (Over 65)	Below Poverty Level
1,327,407	138,604	235,481

[2] http://quickfacts.census.gov/qfd/states/48/4865000.html

Figure 3-4. Census 2010 Population Map for City of San Antonio



Population Growth

Figure 3-4 indicates the distribution of San Antonio's population. The official 2010 San Antonio population is 1,327,407. Since the 2000 Census, San Antonio's population count has increased by 15.97% from a population of 1,144,159. The population of San Antonio is growing within the city limits. Table 3-2 provides historic and current growth rates in San Antonio.

The City of San Antonio experienced an increase in population between 1980 and 2010 by 68.9 percent, or 541,486 people. The City continued to have population growth between 2000 and 2010 by 15.97% percent, or 182,761 people.

Table 3-2. Population for the City of San Antonio, 1980 – 2010

1980	1990	2000	2010	POP CHANGE 1980-2010	PERCENT OF CHANGE	POP CHANGE 2000-2010	PERCENT OF CHANGE
785,921	935,739	1,144,646	1,327,407	541,486	68.9%	182,761	15.97%

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, the number of permits that have been issued throughout the county, 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 land area and in population density for the County, which would mean overall growth for the City San Antonio.

Table 3-3. Bexar County Population Projections

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)
1,239.82	1,714,774	1,383.1	1,967,590	1,587	2,216,912	1,788.1	2,442,098	1,969.7

Economic Impacts

Building and maintaining infrastructure depends on the economy; therefore, protecting infrastructure from risk due to natural hazards in the planning area is important to the City of San Antonio. Whether it's expanding culverts under a road that washes out during flash flooding, shuttering a fire station, or flood-proofing a wastewater facility,

infrastructure must be mitigated from natural hazards in order to continue providing essential utility and emergency response services in a fast-growing planning area.

Major employers in the area are critical to the health of the economy, as well as effective transportation connectivity.

The San Antonio River Walk

In Texas, water has been a lifeline for many generations for centuries past. The San Antonio River is a source of a South Texas treasure, The San Antonio River Walk. While boasting as the number one tourist destination in Texas, the River Walk also serves as a complex and effective flood control project. Development of San Antonio and its most popular tourism attraction has come a long way. The San Antonio River Walk is a public park, open 365 days a year. It is a network of walkways along the banks of the San Antonio River, one story beneath approximately five miles of the downtown San Antonio area. Lined by bars, shops, and restaurants, the River Walk is an important part of the City's urban fabric and a tourist attraction in its own right.

The River Walk links the major tourist draws from the Alamo to Rivercenter Mall, Arneson River Theatre and La Villita, the San Antonio Museum of Art, and the Pearl Brewery.

Over 20 events take place on the River Walk every year.[3]

Existing and Future Land Use and Development Trends

The City of San Antonio Office of Economic Development has a Comprehensive Management Plan (Comp Plan 2040) that will be coordinated with mitigation strategies to determine how they can best be integrated into comprehensive plan updates pertaining to future development regulations or link with other public or private efforts, such as open space preservation or other capital improvement projects. The assurance of integration of the hazard mitigation plan into the comprehensive planning process can help make certain that the appropriate hazard assessment information is considered during future land use and development planning.

The City's Office of Sustainability is engaged in future land use and development trends as well, proposing to lead an annual assessment and update of the hazard mitigation plan and the Comp Plan 2040. The annual assessment will include, but are not limited to:

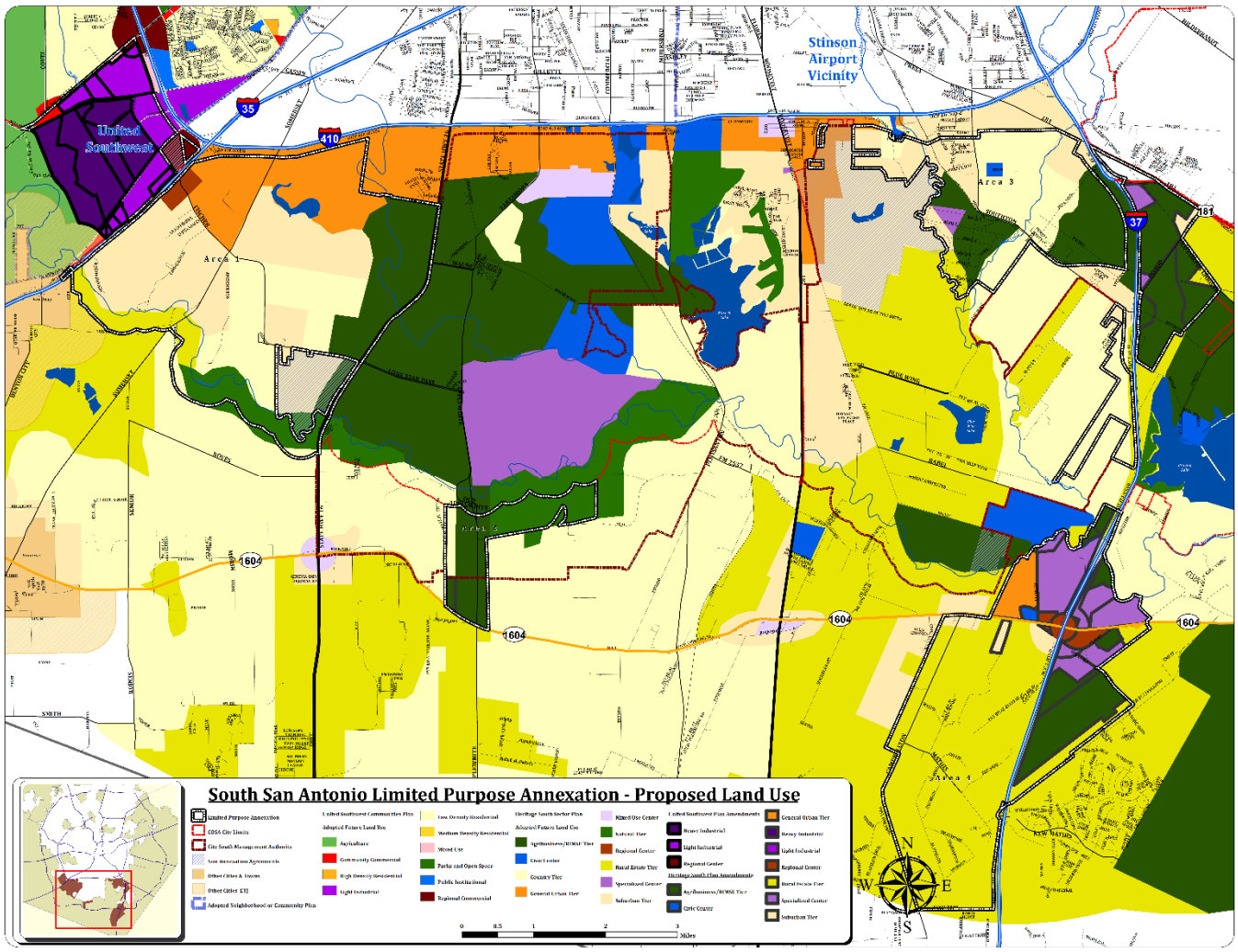
[3] http://www.thesanantonioriverwalk.com/about/the-san-antonio-river-walk

- Conducting climate and vulnerability assessment addressing storm water management, road operations, and maintenance;
- Policy recommendations to enable identification of parcels or areas to be designated as high risk; and
- Identification of related capital improvement or land acquisition projects and strengthening at-risk public facilities, such as fire and police stations, and utility systems, or to resist floods and geological hazards or incorporate interconnection service networks, such as roads, pipelines, and cables, and to allow more than one route to any point so that they are less vulnerable to local failures.

The City has also adopted smart growth initiatives that will be integrated into the hazard mitigation plan in long-term community development planning activities. This is beneficial to attracting new business to the City through the City's Economic Development Department's Industry Development Division, which assists with start-up ventures, existing businesses, and those relocating to San Antonio with expansion needs. The Industry Development Division offers local, state, or federal financial incentives in the form of tax credits, grants, low interest loans, tax exemptions, training funds or programs, and reduced utility costs to attract and cultivate target industries.

Figure 3-5 provides an example of proposed future expansion for land use and annexations for the south San Antonio Metro area.

Figure 3-5. Proposed Land Use South San Antonio Metro Area



Building Permits

Building permits indicate what types of buildings are being constructed and their relative uses. Table 3-4 lists the number of residential building permits for the City of San Antonio that have been granted between 1996 and 2013. The data includes all sizes of family homes for reported permits, as well as the construction costs, to show the potential increase in vulnerability of structures to the various hazards reviewed in the risk assessment. The increase in vulnerability can be attributed to the higher construction costs that would be factored into repairing or replacing a structure using current market values. Permits are reported annually in September; data reflects permits for years 2010, 2011, 2012, and 2013 to demonstrate growth rates.

Table 3-4. City Residential Building Permits[4]

CITY OF SAN ANTONIO			
Year	Buildings	Units	Construction Cost
1996	4,585	6,968	$332,205,695
2000	5,766	7,667	$485,075,512
2005	8,699	15,176	$1,752,452,339
2010	2,414	3,574	$491,039,699
2011	1,707	4,070	$456,039,299
2012	2,102	4,643	$546,727,250
2013	2,110	2,118	$375,615,980

[4] http://censtats.census.gov/cgi-bin/bldgprmt/bldgdisp.pl

SECTION 4: RISK OVERVIEW

Hazard Identification 1
Natural Hazards and Climate Change 4
Overview of Hazard Analysis 4
Hazard Ranking 6

Hazard Identification

This section begins the risk assessment, which also includes hazard descriptions and vulnerability assessments found in Sections 5 through 17. The purpose of this section is to provide background information for the hazard identification process, as well as descriptions for the hazards identified.

Upon a review of the full range of natural hazards suggested under FEMA planning guidance, the City of San Antonio identified nine natural hazards and four human-caused hazards that are to be addressed in the Hazard Mitigation Action Plan, or *the Plan.* These hazards were identified through an extensive process utilizing input from planning team members, and a review of the current State of Texas Hazard Mitigation Plan ("State Plan"). Readily available online information from reputable sources such as federal and state agencies were also evaluated to supplement information as needed. Based on this review, eight natural hazards and one quasi-technological hazard (dam failure) were identified as significant, as shown in Table 4-1.

Atmospheric hazards are events or incidents associated with weather generated phenomenon. Atmospheric hazards identified as significant from Table 4-1 include: extreme heat, extreme wind, tornado, hail, and winter storm.

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 includes flood and drought. For the purposes of the risk assessment, the wildfire hazard is considered "other," since they may be natural or human-caused, and are neither atmospheric nor hydrologic.

The term, "technological hazards," refers to the origins of incidents that can arise from human activities, such as the construction and maintenance of dams. Incidents are distinct from natural hazards primarily in that they originate from human activity. While 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, referred to as "technological," in Table 4-1 for purposes of description.

Table 4-1. Hazard Descriptions

HAZARD	DESCRIPTION
ATMOSPHERIC	
Extreme Heat	Extreme heat is the condition whereby temperatures hover ten degrees or more above the average high temperature in a region for an extended period.
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.
Extreme Wind	Extreme winds can have gusts of 100 mph or more, and are often accompanied by hail or rain. Windstorms have a broader path that is several miles wide and can cover several counties.
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 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.
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.

HAZARD	DESCRIPTION
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, or shallow flooding.
OTHER	
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	
Hazardous Materials (Transportation & Fixed-Site)	A hazardous material (as solid, liquid, and/or gaseous contaminants) of flammable or poisonous material that would be a danger to life or to the environment if released without precaution.
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 one of two types - domestic or international.
Pipeline Failure	Fuel pipeline breach or pipeline failure addresses the rare, but serious hazard of an oil or natural gas pipeline that, when

HAZARD	DESCRIPTION
	breached, has the potential to cause extensive property damage and loss of life.
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.

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, and also directly endangers property due to sea level rise and biological organisms due to habitat destruction.

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 fourfold in the past 200 years, from .5 millimeters per year to 2 millimeters per year. With a higher sea level, storm surges will be bigger and coastal erosion will accelerate.

All communities along the Texas coast face similar futures, according to some scientists, and 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.

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 the water resources, as Texas experienced during 2011-2012.

Texas also has thousands of miles of coastline that are highly vulnerable to the combined impact of sea-level rise and the potential increase of storm intensity. Paleoclimate records also show that the climate over Texas had large swings 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 change could occur again, and may even be occurring now.

Overview of Hazard Analysis

This risk assessment was conducted using two distinct methodologies: HAZUS-MH (FEMA's loss estimation software) and a statistical approach. Each approach provides estimates of potential impact by using a common, systematic framework for evaluation.

The HAZUS-MH risk assessment methodology is parametric, in that distinct hazard and inventory parameters (e.g., wind speed and building types) were modeled using the

HAZUS-MH software to determine the impact (e.g., damages and losses) on the built environment. The HAZUS-MH software was used to estimate losses from flooding.

HAZUS-MH is FEMA's standardized loss estimation software program built upon an integrated geographic information system (GIS) platform. This risk assessment applies HAZUS-MH to produce regional profiles and estimate losses for flooding.

Records retrieved from National Climatic Data Center (NCDC) and Sheldus are reported for the named participating city. Remaining records occurring in a named area in a county were considered in the total for County events and maximum recorded magnitude of event.

The risk assessment includes four general parameters that are described for each hazard; 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 4-2, and impact statements are defined in Table 4-3 below.

Table 4-2. Frequency of Return Statements

PROBABILITY	DESCRIPTION
Highly Likely	Event is probable in the next year.
Likely	Event is probable in the next 3 years.
Occasional	Event is probable in the next 5 years.
Unlikely	Event is probable in the next 10 years.

Table 4-3. 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/or illnesses result in permanent disability. Complete shutdown of critical facilities for at least two weeks. More than 25 percent of property destroyed or with major damage.
Minor	Injuries and/or illnesses do not result in permanent disability. Complete shutdown of critical facilities for

POTENTIAL SEVERITY	DESCRIPTION
	more than one week. More than 10 percent of property destroyed or with major damage.
Limited	Injuries and/or illnesses are treatable with first aid. Minor quality of life lost. 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 in order to find out the percentage of damage that each hazard can cause to the community.

Hazard vulnerability for the City of San Antonio was reviewed based on recent development changes that occurred throughout the City. 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.

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.

Hazard Ranking

Table 4-4 portrays the results of the City's self-assessment for hazard ranking, based on the preliminary results of the risk assessment presented at the Risk Assessment Workshop. This table also takes into account local knowledge regarding frequency of occurrence and the potential impact of each hazard.

Table 4-4. Hazard Risk Ranking

HAZARD	FREQUENCY OF OCCURENCE	POTENTIAL SEVERITY	RANKING
Drought	Highly Likely	Minor	High
Flood	Highly Likely	Substantial	High
Wildfire	Highly Likely	Minor	High
Extreme Heat	Highly Likely	Minor	Moderate
Extreme Wind	Highly Likely	Minor	Moderate

HAZARD	FREQUENCY OF OCCURENCE	POTENTIAL SEVERITY	RANKING
Hail	Highly Likely	Minor	Moderate
Hazardous Materials	Highly Likely	Major	Moderate
Infectious Disease	Likely	Major	Moderate
Pipeline Failure	Likely	Major	Moderate
Terrorism	Unlikely	Major	Moderate
Tornado	Highly Likely	Major	Moderate
Winter Storm	Highly Likely	Minor	Moderate
Dam Failure	Unlikely	Substantial	Low

SECTION 5: DROUGHT

Hazard Description 1
Location 2
Extent 2
Historical Occurrences 4
Significant Past Events 6
Probability of Future Events 7
Vulnerability and Impact 7
Assessment of Impacts 8

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 5-1 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 5-1. Drought Classification Definitions[1]

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.

Location

Droughts occur regularly throughout Texas and San Antonio, and are a normal condition. However, they can vary greatly in their intensity and duration. There is no distinct geographic boundary to drought; therefore, it can occur throughout the City of San Antonio planning area equally.

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 5-2 depicts magnitude of drought, while Table 5-3 describes the classification descriptions.

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

Table 5-2. 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 5-3. Palmer Drought Category Descriptions[2]

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

[2] Source: National Drought Mitigation Center

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

Based on the historical occurrences for drought and the location of the City of San Antonio in south central Texas between the Edwards Plateau to the northwest and the Gulf Coastal Plains to the southeast, the area can anticipate a range of drought from abnormally dry to exceptional, or D0 to D4, based on the Palmer Drought Category.

Historical Occurrences

The City of San Antonio may typically experience an extreme drought. Table 5-4 and 5-5 lists historical events that have occurred in Bexar County, as reported in the National Climatic Data Center (NCDC). Historical drought information, as provided by the NCDC, shows drought activity across a multi-county forecast area for each event; therefore, the drought data for the City of San Antonio is included with the Bexar County data. 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.

Table 5-4. Historical Drought Years, 1996-2014

DROUGHT YEAR
1996
1997
2000
2011
2012
2013
2014
7 unique events

Table 5-5. Historical Drought Events, 1996-2014

JURISDICTION	DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Bexar County	4/1/1996	-	0	0	$0	$0
Bexar County	5/1/1996	-	0	0	$0	$0
Bexar County	6/1/1996	-	0	0	$0	$0
Bexar County	7/1/1996	-	0	0	$0	$0
Bexar County	8/1/1996	-	0	0	$0	$0
Bexar County	9/1/1996	-	0	0	$0	$0
Bexar County	10/1/1996	-	0	0	$0	$0
Bexar County	11/1/1996	-	0	0	$0	$0
Bexar County	12/1/1996	-	0	0	$0	$0
Bexar County	1/1/1997	-	0	0	$0	$0
Bexar County	2/1/1997	-	0	0	$428,571	$857,143
Bexar County	7/1/2000	D2	0	0	$0	$0
Bexar County	8/1/2000	D2	0	0	$0	$0
Bexar County	9/1/2000	D2	0	0	$0	$0
Bexar County	10/1/2000	D2	0	0	$0	$0
Bexar County	5/1/2011	D4	0	0	$0	$0
Bexar County	6/1/2011	D4	0	0	$0	$0
Bexar County	7/1/2011	D4	0	0	$0	$0
Bexar County	8/1/2011	D4	0	0	$0	$0
Bexar County	9/1/2011	D4	0	0	$0	$0
Bexar County	10/1/2011	D3	0	0	$0	$0
Bexar County	11/1/2011	D3	0	0	$0	$0
Bexar County	12/1/2011	D3	0	0	$0	$0
Bexar County	1/1/2012	D2	0	0	$0	$0
Bexar County	6/1/2012	D2	0	0	$0	$0
Bexar County	3/1/2013	D2	0	0	$0	$0
Bexar County	4/1/2013	D2	0	0	$0	$0

JURISDICTION	DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Bexar County	8/1/2013	D2	0	0	$0	$0
Bexar County	8/1/2014	D2	0	0	$0	$0
Bexar County	9/1/2014	D2	0	0	$0	$0
Bexar County	10/1/2014	D2	0	0	$0	$0

Significant Past Events

August 1, 2013

The drought worsened across much of South Central Texas in August. With the exception of a small part of the southeast and a few other isolated spots, most of the region received near or below normal rainfall. Atascosa, Bexar, Karnes, Llano, and Wilson Counties moved into Stage D2. Fire danger at the end of the month was low to moderate. The Texas Crop and Weather Report issued by Texas A&M Agricultural Program indicated extremely dry conditions continued in most of the region with rangeland and pastures in poor condition. The Nueces, Rio Grande, Lower Guadalupe, and San Antonio River basins reported below normal (10 to 24 percent) flow. Area lakes and reservoirs continued well below normal pool elevations. The Edwards Aquifer Authority remained in Stage 3 water restrictions as the aquifer dropped to 26 feet below normal, and 8.6 feet below the level at the end of July 2012. This meant that large water users were required to reduce pumping by 35%. The San Antonio Water System remained at stage 2 water restrictions.

September 1, 2011

El Nino Southern Oscillation conditions moved back into a La Nina phase and the drought continued over South Central Texas. Most of the area remained in exceptional drought conditions (Stage D4). Fire danger in South Central Texas was high to very high and burn bans continued for all of the counties. The Texas A&M Agricultural program report indicated ranchers continued to provide heavy supplemental feeding for livestock or began to liquidate herds. There was little or no sign of appreciable forage growth. At the end of the month, the seven day stream flow average remained in the below or much below normal range for basins across South Central Texas and the Rio Grande Plains. Area lakes and reservoirs remained below normal pool elevations with the Edwards Aquifer 21.5 feet below normal and 32.8 feet below the level from one year ago. The San Antonio Water System (SAWS) and the City of San Marcos remained in Stage 2 water restrictions. Many other communities across South Central Texas continued with some level of water restrictions.

October 1, 1996

Drought persisted October through January across the southwestern part of South Central Texas, although heavy rainfall alleviated conditions over much of the Hill Country near the end of the month in October. Brief periods of light rain, sleet, and snow during the month again added some moisture to soils across the area December through January.

Probability of Future Events

Based on 31 recorded drought events over seven extended time periods within an 18 year reporting period, the City of San Antonio averages two droughts every year. This lends to a highly likely frequency of occurrence, meaning a drought can be expected on an annual year cycle.

Vulnerability and Impact

Loss estimates were based on 18 years of statistical data from the NCDC. 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 5-6 shows annualized exposure.

Table 5-6. Drought Event Damage Totals, 1996-2014

JURISDICTION	NUMBER OF EVENTS	PROPERTY DAMAGES	CROP DAMAGES	PROPERTY DAMAGES (2014 DOLLARS)	CROP DAMAGES (2014 DOLLARS)
Bexar County	7	$428,571	$857,143	$632,138	$1,264,278
TOTAL LOSSES:		**$1,285,714**		**$1,896,416**	

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.

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. Based on the seven reported previous occurrences and potential exposure for the hazard, the potential severity of impact of droughts is "Minor," with more than 10 percent of property destroyed

and injuries and/or illnesses will not result in permanent disability. In terms of vulnerability, population, agriculture, property, and environment are all vulnerable to drought. The average person will survive only a few days without water, and this timeframe can be drastically shortened for those people with more fragile health – typically children, the elderly, and the ill. The population is also vulnerable to food shortages when drought conditions exist and potable water is in short supply. Potable water is used for drinking, sanitation, patient care, sterilization, equipment, heating and cooling systems, and many other essential functions in medical facilities.

Drought presents a signifcant threat to agricultural property and lands, which are typically dependent on a large, reliable supply of water for irrigation and livestock support. Perhaps the greatest vulnerability to property is the decrease in the supply of water for fire suppression purposes. While fire is not necessarily a result of droughts, the loss of available water, and the resulting loss of available water pressure within delivery systems, makes fire suppression more challenging.

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.

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. Table 5-7 lists the drought impacts to Bexar County from 2005 to 2013, based on reports received by the Drought Impact Reporter.

Table 5-7. Drought Impacts, 2005-2013

DROUGHT IMPACTS 2005-2013	
Agriculture	210
Business & Industry	24
Energy	10
Fire	150
Plants & Wildlife	76
Relief, Response & Restrictions	143
Society & Public Health	64
Tourism & Recreation	7
Water Supply & Quality	77

Drought has the potential to impact people in the City of San Antonio. 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:

- Health-related low-flow issues (e.g., diminished sewage flows, increased pollution concentrations, reduced firefighting capacity, cross-connection contamination);
- Public safety from forest/range/wildfires;
- Increase in respiratory ailments;
- Increase in disease due to wildlife concentrations (e.g., rabies, Rocky Mountain spotted fever, Lyme disease);
- Increase in conflict over water use/water rights;
- Increase in political conflicts between municipalities, counties, states, and regions;
- Water management conflicts between competing interests; and
- Increased law enforcement activities to enforce water restrictions.

Potential impacts on response personnel include those that could affect the population as a whole. In addition, response personnel would also be impacted by increased health risks associated with reduced water supplies and in the event of increased conflict or social unrest, either among the members of the population or in inter-jurisdictional disputes or conflicts.

Firefighters would likely be impacted first, as they respond to higher fire risk and may have limited water resources to aid in firefighting and suppression activities. This would likely result in significantly increased risk and frustration as the ability of the personnel to perform their job functions would be decreased. In addition, law enforcement personnel could be called upon to enforce water restrictions or rationing, which would result in an increase in work load. Emergency Medical Services (EMS) personnel could also see an increase in work load, as illness and disease related to drought become more common. Finally, City utility personnel would likely be negatively impacted, either through increased work load (e.g., repairs, modification of delivery systems) or through layoffs, which could result from dramatic decreases in revenue as water supplies diminish.

Drought is not an immediate threat to the ability to operate and deliver City services, outside of a few departments and areas (discussed below). While some services may need to be cut back, the actual ability to operate and deliver some level of service should not be at risk for most departments. Firefighting and suppression could be heavily impacted, as the delivery of this service is dependent on the availability of both water and water pressure. As water/water pressure availability decreases, the ability of the fire department to fight or suppress large fires could be compromised at a time of increased probability of fire, as the environment becomes drier. An increase in the number of fires may tax the fire department's ability to respond to fires, which may cause the fire department to increase its reliance on mutual aid agreements. This may be problematic if mutual aid agreements are with communities whose drought conditions are similar, or worse. Though firefighting and suppression activities will continue, the risk is that they will do so at a decreased level and with increased help from outside agencies and communities.

The service that will be the most directly impacted will be utilities, both water delivery and electric (for those producers that rely on hydroelectric production or nuclear power

generation methods, as some providers in the region do). Without a steady supply of water, utilities may cut back energy generation and service to their customers and possibly to prioritize the service that they are able to provide. For example, utility providers may be pressed to provide water or electricity to critical facilities (such as hospitals) before providing power to residential or commercial areas. Smaller providers may be unable to absorb the increase in costs associated with seeking alternate water sources and may be forced to cease operations.

Hydroelectric power generation facilities and infrastructure would likely be affected the most. As the amount of water available for power generation diminishes, the generation equipment will decrease the output, which will result in less electricity produced. Dams simply cannot produce as much electricity from low water levels as they can from high water levels.

Though drought is a naturally occurring phenomenon, this does not mean that it does not pose risks to the natural environment. A variety of environmental issues and changes are associated with long-term drought, including:

- Reduction and degradation of fish and wildlife habitat;
- Loss/lack of feed and water;
- Increased mortality due to increased contact with agricultural producers as animals seek food/water from farms and producers become less tolerant of intrusions;
- Disease;
- Increased vulnerability to predation (from species gathering in concentrations near water);
- Increased migration and concentration (loss of wildlife in some areas, and too many wildlife in other areas);
- Increased stress to endangered species; and
- Loss of biodiversity.

Plants suffer from long-term drought, possibly resulting in loss of biodiversity and trees from landscapes, shelterbelts, and conservation areas. Wind and water erosion of the soil also poses a long-term risk to plants as they result in reduced soil quality. Air quality is also affected by drought because of an increase in both dust and pollutants. Finally, plants are also exposed to the increased danger of wildfire that may follow long-term drought.

Drought also poses a significant risk to the hydrological environment of the area. Low water levels, reduced flow, loss of wetlands, increased salinity – all of these are risks to the area's water supply as a result of long-term drought. In addition, the area may experience increased groundwater depletion, land subsidence, and reduced recharge areas as a result and there may be a decrease in the water quality, by way of increased salinity, temperature, pH, dissolved oxygen, and turbidity.

While the historic/cultural resources of the area are not directly at risk from a drought, the tourism industry that they rely on for support may be. As recreational activities that rely on water are curtailed (such as hunting, fishing, and bird watching), fewer tourists may be inclined to visit the area. Less tourism means less revenue, which means less support for those historic and cultural resources that rely on tourism for their maintenance.

Cultural sites that rely on water can also be at risk from drought, such as aqueducts and dams. Some historic and cultural sites and structures could be subject to damage from subsidence or wildfire that can accompany or follow drought.

Drought poses risk to agricultural and livestock producers. Drought is associated with a variety of issues, such as:

- Annual and perennial crop losses;
- Degradation of crop quality;
- Reduced productivity of land and animals;
- Insect infestation, plant/animal disease;
- Increased costs of irrigation; new costs for supplemental water resource development;
- Decreased livestock weight;
- Increased livestock mortality/forced reduction in livestock; and
- Increased costs for feed; closure of land for grazing.

Food suppliers can also anticipate an increase in food costs because of increases in production costs and crop and livestock losses. All of these issues lead to a potential reduction in income for these sectors of the economy, which can have an overall negative effect on the economy as a whole.

Sectors that rely on timber or timber production also may be impacted by drought. The timber industry is usually directly impacted by drought through wildfires, tree disease, or both, leading to a decrease in supply while the demand level generally remains stable.

Fisheries also will be negatively impacted as they will suffer 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.

The energy sector may see an increase in demand and a reduction in supply due to drought-related water curtailments. This often leads the energy industry, and by extension consumers, to substitute more expensive energy sources, such as oil, for less-available hydroelectric power.

Water suppliers often experience dramatic revenue shortfalls or windfall profits, depending on their level of advance planning for drought conditions. For those that did not plan accordingly and suffer revenue shortfalls, increased costs are also common, resulting from the need for water transport/transfer and/or new/supplemental water resource development.

The general economy can suffer from a variety of drought-related impacts, including:

- Decreased land values;
- Loss to industries directly dependent on agriculture production, such as machinery and fertilizer manufacturers, food processors, dairies, etc.;
- Increase in unemployment from drought-related declines in production;
- Increased strain on financial institutions, in the form of foreclosures, increased credit risks, and capital shortfalls;
- Revenue losses to federal, state, and local governments, due to reductions in the tax base;
- Reduction of economic development;

- Reduction in agricultural producers, due to bankruptcies, people leaving the profession, etc.; and
- Loss of rural population.

Public dissatisfaction with government drought response will typically increase as water becomes more restricted and/or scarce. Perceptions of inequality in relief, particularly if those inequalities are based on socioeconomic status, ethnicity, age, gender, or seniority, will lead to increased dissatisfaction with government and leadership, and may result in a weakening of social order. Rationing, if necessary, should be implemented with a clear and fair process to avoid the appearance of bias or impropriety.

The San Antonio Water System has permanently implemented water conservation programs. The agency's public website provides the public with specific, detailed information regarding the current water conservation efforts, drought restrictions, rebate programs, and City ordinance information. In addition, the website provides information on landscaping ideas, success stories and best practices, and a mechanism for the public to report water waste. This website serves to keep the public involved in conservation efforts, and eliminates "surprise" water use restrictions or conditions. As a result, the public confidence in the ability to supply sufficient water resources is maintained.

SECTION 6: EXTREME HEAT

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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, including the City of San Antonio. The City of San Antonio 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 individual safety and welfare. The major human risks associated with severe summer heat include: heat cramps, sunburn, dehydration, fatigue, heat exhaustion, and heat stroke. The most vulnerable population to heat casualties are children, and the elderly or infirmed. The elderly or infirmed frequently live on low-fixed incomes and cannot afford to run air-conditioning on a regular basis. Additionally, they are sometimes isolated, with no immediate family or friends to look out for their well-being.

Location

Though deaths from extreme heat have been recorded in Bexar County, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur in any area of the City of San Antonio.

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 6-1. This index measures how hot it feels outside when humidity is combined with high temperatures.

Figure 6-1. Extent Scale for Extreme Summer Heat[1]

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

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

The Extent Scale in Figure 6-1 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 and the humidity level is at or above 40 percent, caution should be exercised.

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 6-1.

[1] Source: NOAA

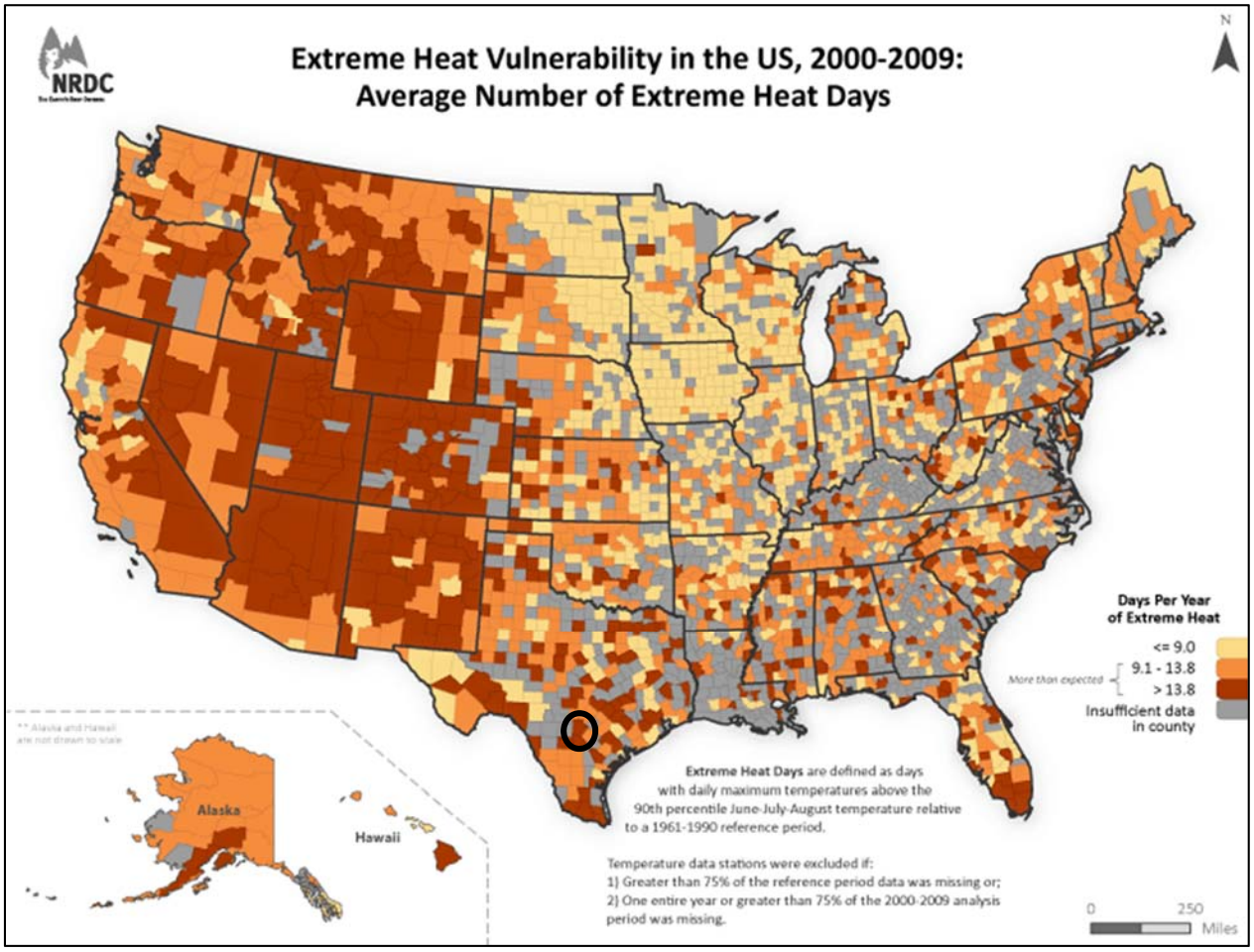
Table 6-1. Heat Index & Warnings

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

The City of San Antonio is a gently rolling terrain and is located in South Central Texas between the Edwards Plateau to the northwest and the Gulf Coastal Plains to the southeast. Northwest of the area, the terrain slopes upward to the Edwards Plateau, and to the southeast it slopes downward to the Gulf Coastal Plains. Soils are black-land clay and silt loam on the Plains and thin limestone soils on the Edwards Plateau. The area's gently rolling terrain is dotted with oak trees, mesquite, and cacti. Due to its geography, and its warm, muggy semitropical climate with hot summers, the City of San Antonio can expect an extreme heat event each summer. 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.

According to the daily maximum Heat Index, as derived from NOAA and based on data compiled from 1849 to 2013, the City of San Antonio has an average daily maximum Heat Index of 90-95°F. Since the City of San Antonio's average daily maximum Heat Index falls into the "Danger" category, the City should mitigate for sunstroke, muscle cramps, and heat exhaustion. Figure 6-2 displays the average number of extreme heat days per year according to the Natural Resources Defense Council. The City of San Antonio can expect on average over 13.8 days per year of extreme heat.

Figure 6-2. Average Number of Extreme Heat Days[2]



Historical Occurrences

Every summer, the hazard of heat-related illness becomes a significant public health issue throughout much of the U.S. 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. Data from the Texas Department of State Health Services (TDSHS) suggest that between 2003 and 2008, record high summer temperatures in Texas resulted in 439 heat-related deaths statewide. Bexar County residents comprised nine of these deaths between 2000 and 2009. Table 6-2 depicts historical occurrences of mortality from heat from 2000 to 2008 from the TDSHS, and 2009 to 2014 from the NCDC database.

[2] Source: NRDC and the black circle indicates the City of San Antonio.

Table 6-2. Extreme Heat Related Deaths in Bexar County

YEAR	DEATHS
2000	1
2001	0
2002	0
2003	2
2004	1
2005	1
2006	1
2007	0
2008	1
2009	2
2010	0
2011	0
2012	0
2013	0
2014	0

Because the TDSHS reports only deaths related to heat, previous occurrences for extreme heat are derived from the San Antonio Metropolitan Health District (SAMHD) and NCDC databases. According to the SAMHD between 2011 and 2014 the City of San Antonio has reached Readiness Levels II or III every summer, meaning the heat index value was 105°F or greater for at least two hours. For heat related incidents located solely within Bexar County there are two heat waves[3] on record according to the NCDC (Table 6-3). Historical extreme heat information, as provided by the NCDC, 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.

[3] Even though the City experiences heat waves each summer, NCDC data only records events reported. Based on reports, only two events are on record.

Table 6-3. Historical Extreme Heat Events, 2000-2014

JURISDICTION	DATE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Bexar County	5/27/2000	-	1	0	$0	$0
Bexar County	7/2/2009	Extreme Caution	2	0	$0	$0

Significant Past Event

July 2, 2009

A prolonged heat wave from the end of June through early July brought record temperatures and heat advisories to South Central Texas. 82 year old twins died in their home in San Antonio. The cause of death was heat stroke according to the medical examiner. The twins did not want to use a fan or air conditioning, stating that they were on a fixed income and were trying to save money. High temperatures were at or near 100°F in San Antonio that day and previous days as well.

Probability of Future Events

According to historical records and local data by the SAMHD, Bexar County, including the City of San Antonio experiences an extreme heat event every year. Hence, the likelihood or future probability of excessive summer heat in the City of San Antonio is highly likely.

Vulnerability and Impact

There is no defined geographic boudary for extreme heat events. While all of the planning area is exposed to extreme temperatures, existing and future buildings, infrastructure and critical facilities are not considered vulnerable to significant damage caused by extreme heat events. Therefore, estimated property losses associated with extreme heat are aniticpated to be minimal across the planning area.

Although heat can cause minimal damage to buildings and facilities, it presents a more significant threat to individual safety and welfare. The major human risks associated with severe summer heat include: heat cramps, sunburn, dehydration, fatigue, heat exhaustion, and heat stroke. The most sensitive population segment to extreme heat includes the elderly or the infirmed that live within the City of San Antonio planning area and cannot afford to run air conditioning. Also area mobile home housing may not be equipped to cool residents. Thus, these individuals may need a place to go during the hottest daytime hours.

Students in the Independent School Districts are also susceptible as sporting events and practices are often held outside during early fall or late spring when temperatures are at

the highest. 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.

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.

Typically more than 12 hours of warning time would be given before the onset of an extreme heat event. Only minor property damage would result. The potential impact of excessive summer heat is considered "Minor" as injuries and/or illnesses do not result in permanent disability.

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.

The potential impact of extreme heat for the City of San Antonio can be considered "Minor," resulting in few injuries and minimal disruption to the quality of life. Based on historical records over a 14-year period, annualized losses for the City of San Antonio are negligible.

Assessment of Impacts

The greatest risk from extreme heat is to public health and safety. Exposure to high temperatures, even indoors, can cause serious or life-threatening health problems, particularly for children and the elderly, who are less able to regulate body temperature than healthy adults are. Human health concerns associated with hot temperatures include: hyperthermia; heat cramps; heat exhaustion; and heat stroke (or sunstroke).

Response personnel are subject to the same risks and impacts as the general public. For this particular hazard, the risk to response personnel includes utility workers, public works personnel, and any other professions where individuals are required to work outside. Response personnel would be more affected to extreme heat than the general population since their exposure would be greater.

The services that will be the most directly impacted are energy utilities. The Electric Reliability Council of Texas (ERCOT) manages the flow of electric power to 23 million Texas customers. According to ERCOT, air conditioning drives summer peak demands. During hot summer days, residential consumers use more than half the power consumed. These high demand periods can outpace the supply of energy. ERCOT urges conservation from consumers during these heat related events. If supply exceeds demand, rolling brownouts could be necessary.

Highways and roads are damaged by excessive heat causing asphalt roads to soften. Concrete roads have been known to "explode," lifting three to four foot pieces of concrete from the surface. During the 1980 heat wave, hundreds of miles of highways buckled (Source: *National Oceanic and Atmospheric Administration*). Stress is also placed on automobile cooling systems, diesel trucks, and railroad locomotives which can ultimately lead to an increase in mechanical failures. Additionally, rail refrigerated goods experience a significant greater rate of spoilage due to extreme heat.

The environment can be affected if extreme heat is combined with a drought. Habitat damage is possible during periods of drought, for both aquatic and terrestrial species. Severe and prolonged drought can result in the reduction of a species, or cause the extinction of a species altogether. This is especially true for those species and habitats that are already experiencing distress from other factors, such as urbanization. There are also air quality impacts associated with rising temperatures.

The term "air pollution" refers to a number of different possible pollutants. Particulate Matter (PM) pollution, includes particles of soot and dirt from coal combustion, diesel engines, or fires. PM in combination with Carbon Monoxide or Sulfur Dioxide, add to air pollution. Extreme heat increases "ground-level ozone." Ground-level ozone "smog", is formed by the photochemical reaction of sunlight, heat and nitrogen oxides, facilitated by photochemically reactive hydrocarbons, produced by vehicles, power plants, and other sources. If there is more sunlight and heat, there will be more ground-level ozone in the air. This has a direct impact on respiratory illnesses.

The San Antonio area is home to a large number of cultural and historic resources. These cultural and historic resources are largely immune to the effects of extreme heat. 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 for services and programs, which benefit residents and the community. If the demand for energy exceeds the supply, it could lead to rolling brownouts. If an interruption in tourism occurs because of an extreme heat event, it is likely to be short lived and have a temporary impact on historic and cultural resources that depend on tourism.

The economic and financial impacts of extreme heat on the City of San Antonio will depend on the duration of the event, demand for energy, drought associated with extreme heat, and many other factors. If the demand for energy exceeds the supply, it could lead to rolling brownouts.

Food suppliers can anticipate an increase in food costs due to increases in production costs and crop and livestock losses. All of these issues lead to a potential reduction in income for these sectors of the economy, which can have an overall negative impact on the economy as a whole.

Sectors that rely on timber or timber production may also be negatively impacted by drought as a result of extreme heat. The timber industry is usually directly impacted by

wildfires, tree disease, or both, which leads to a decrease in supply, while the demand generally remains stable.

Fisheries can also 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.

Water suppliers can experience dramatic revenue shortfalls or windfall profits, depending on their level of advance planning for such conditions. For suppliers that did not plan accordingly, increased costs can result from the need for water transport/transfer and/or new/supplemental water resource development.

The level of preparedness and the amount of planning done by businesses and citizens will also impact the overall economic and financial conditions before, during, and after an extreme heat event.

Public dissatisfaction with government could result from higher energy utility bills, water scarcity, and other economic and financial impacts as a result of the reduction of services by local government due to extreme heat. Perceptions of inequality in relief, based on socioeconomic status or ethnicity, could lead to increased dissatisfaction with government and leadership.

SECTION 7: FLOOD

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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. Due to The City of San Antonio's inland location, only inland flooding is profiled in this section. 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

Locations of flood Zones A, AE, AO, and the 0.2% Annual Chance Flood Hazard in the City of San Antonio based on the Digital Flood Insurance Rate Map (DFIRM) from FEMA, are illustrated in Figures 7-1 through 7-4 below.

Figure 7-1. Estimated Flood Zones in the City of San Antonio

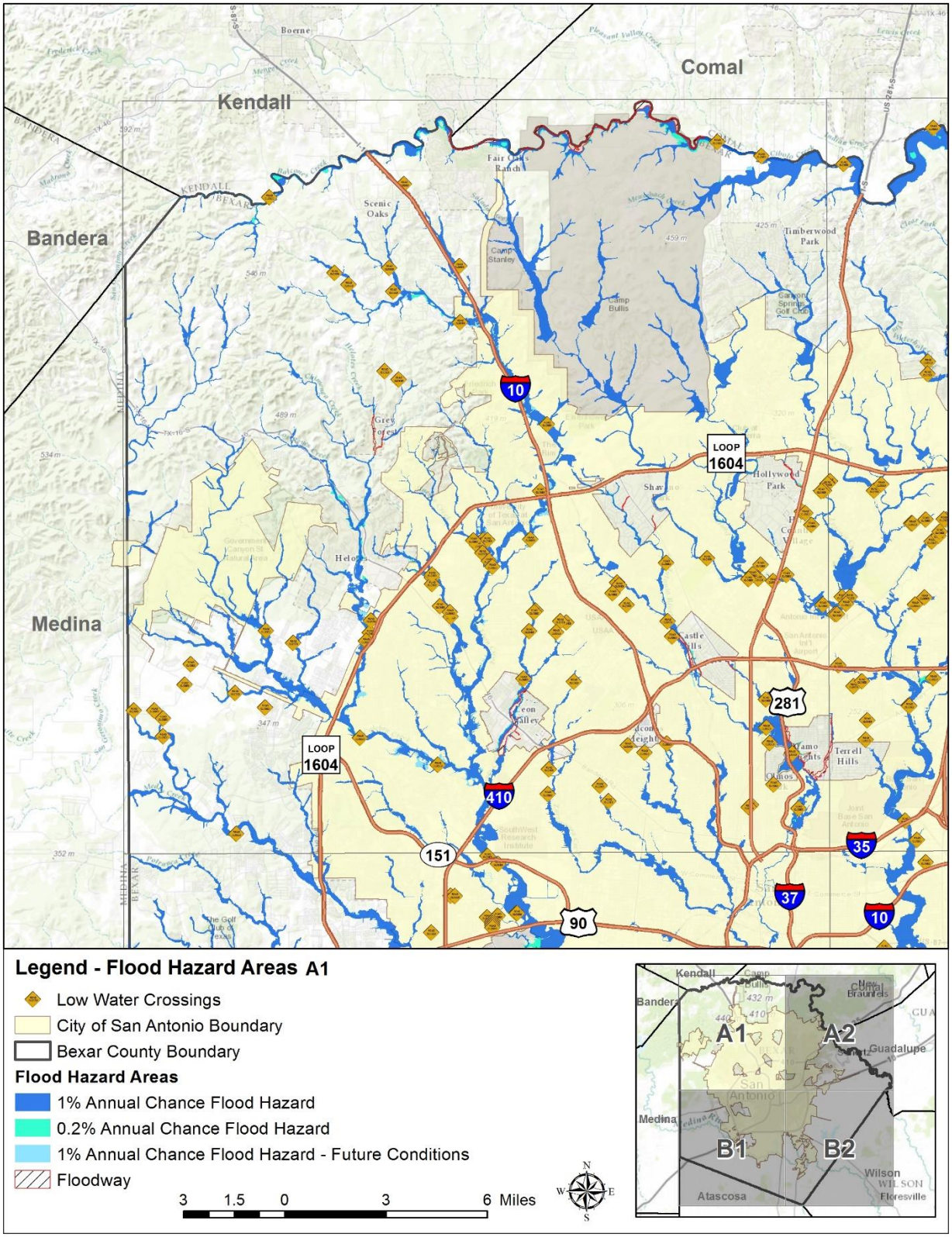


Figure 7-2. Estimated Flood Zones in the City of San Antonio

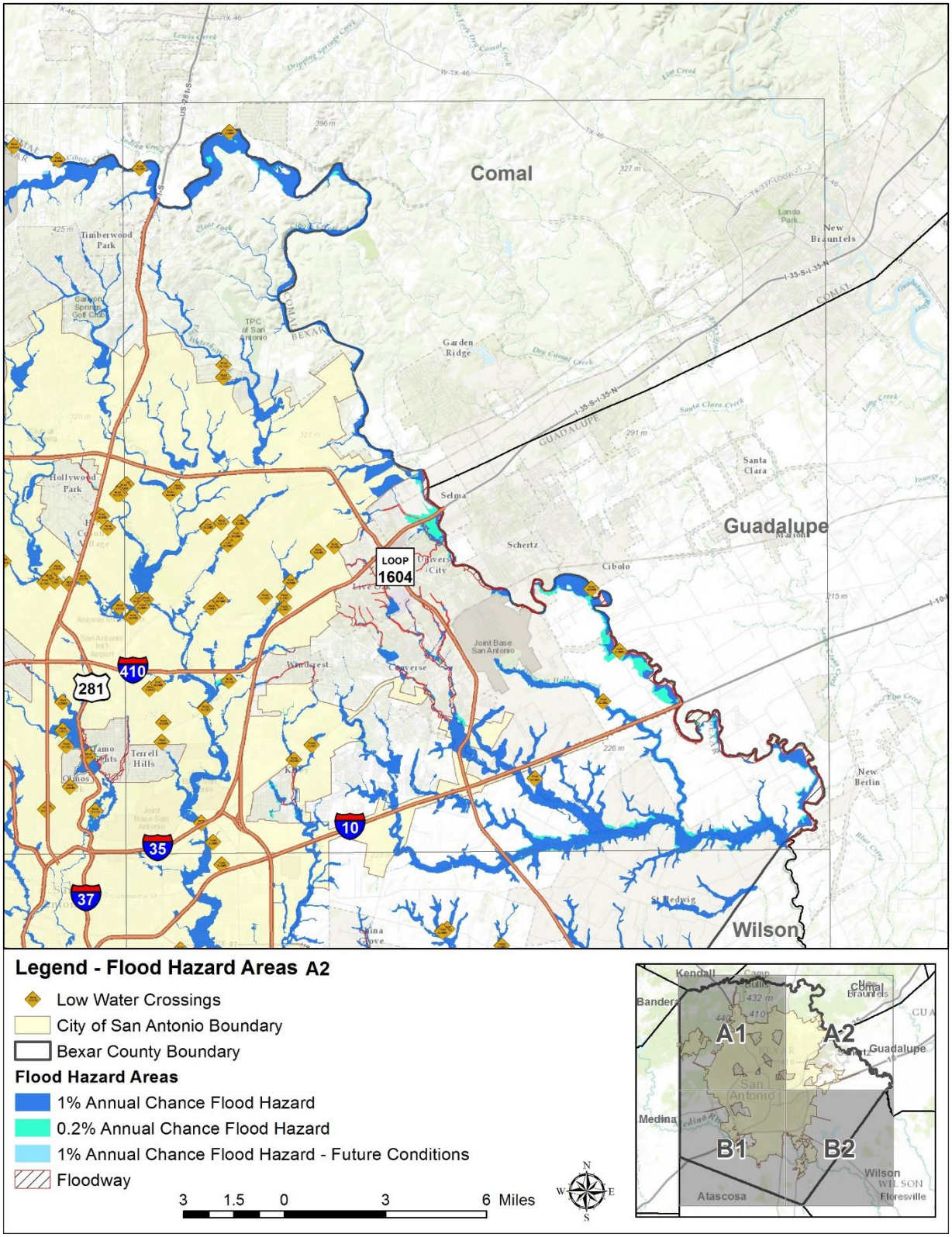


Figure 7-3. Estimated Flood Zones in the City of San Antonio

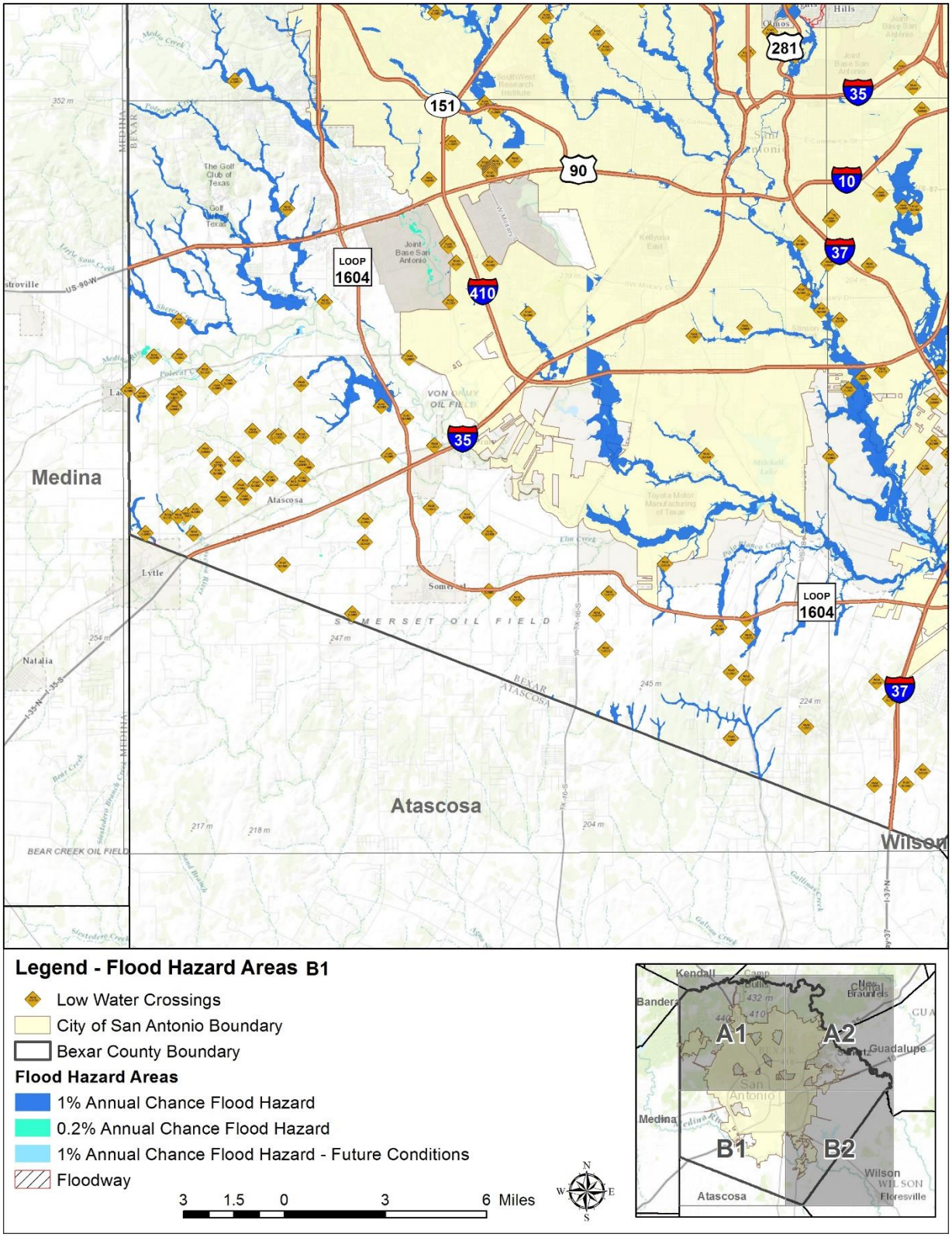
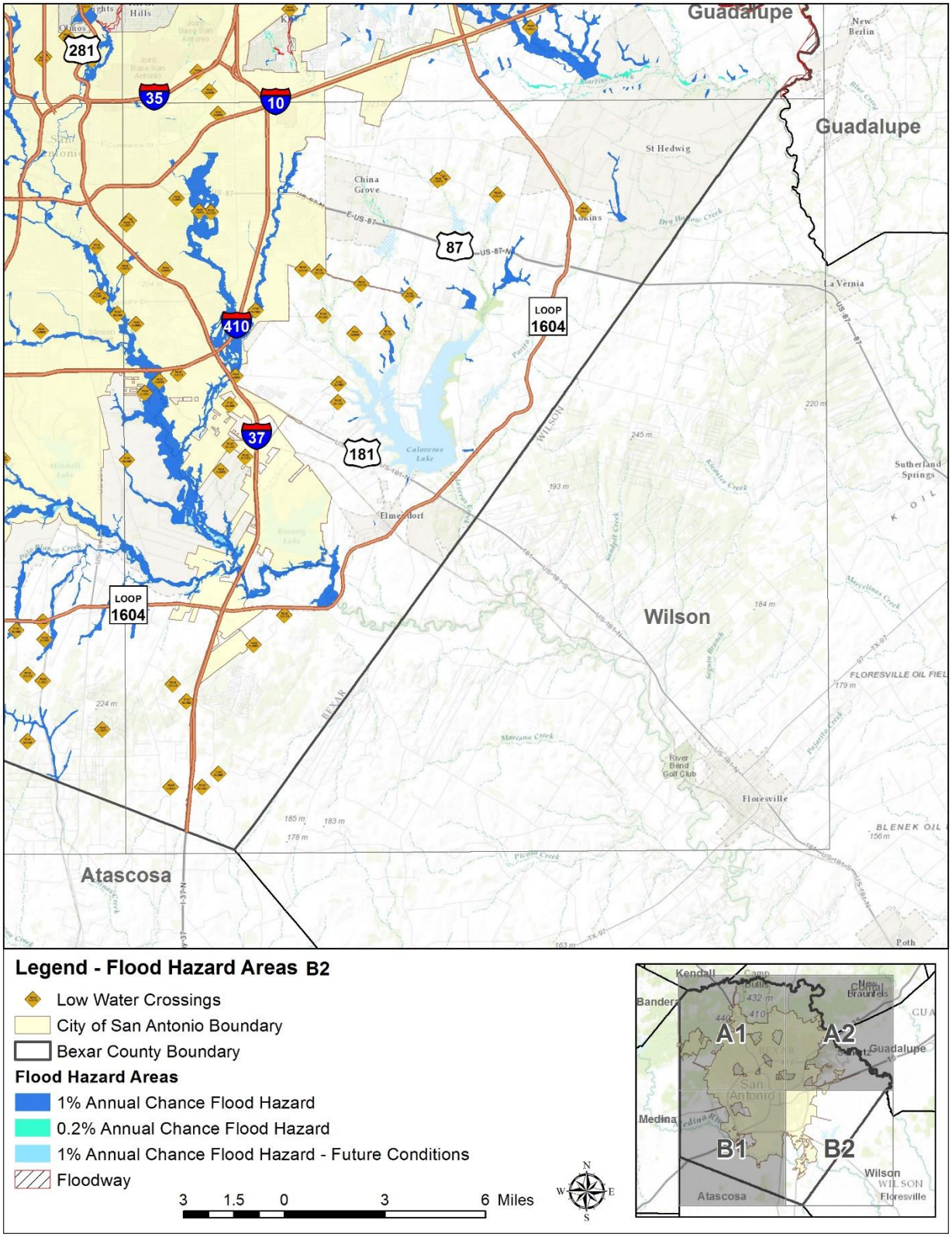


Figure 7-4. Estimated Flood Zones in the City of San Antonio



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, and the depths of flood waters. FEMA categorizes areas according to how the area will convey flood water. FEMA categorizes areas on the terrain according to how the area will convey flood water. Figures 7-1 through 7-4 should be read in conjunction with the extent for flooding in Tables 7-1, 7-2, and 7-3 to determine the intensity of a potential flood event.

Table 7-1. 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

INTENSITY	ZONE	DESCRIPTION
		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.
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, or 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 7-2 below describes the category of risk and potential magnitude of an event in correlation to water depth. The water depths depicted in Table 7-2 are an approximation based on elevation data (above sea level). Table 7-3 describes the extent associated with stream gauge data provided by the United States Geological Survey (USGS).

Table 7-2. Extent Scale – Water Depth (Mean Sea Level, MSL)

SEVERITY	MSL (in feet)	DESCRIPTION
BELOW FLOOD STAGE	0 to 15	Water begins to exceed low sections of banks and the lowest sections of the floodplain.
ACTION STAGE	16 to 23	Flow is well into the floodplain, minor lowland flooding reaches low areas of the floodplain. Livestock should be moved from low lying areas.
FLOOD STAGE	24 to 28	Homes are threatened and properties downstream of river flows or in low lying areas begin to flood.
MODERATE FLOOD STAGE	29 to 32	At this stage the lowest homes downstream flood. Roads and bridges in the floodplain flood severely and are dangerous to motorists.
MAJOR FLOOD STAGE	33 and above	Major flooding approaches homes in the floodplain. Primary and secondary roads and bridges are severely flooded and very dangerous. Major flooding extends well into the floodplain, destroying property, equipment and livestock.

Table 7-3. Extent for the City of San Antonio

JURISDICTION	ESTIMATED SEVERITY PER FLOOD EVENT[1]	PEAK FLOOD EVENT
City of San Antonio	Action Stage, 16 to 23 feet, 28.83	Major Action Stage: Medina River at San Antonio had floodwaters reach 49.47 feet in October 1999 and San Antonio River at Loop 410 had floodwaters reach 34.21 feet in May 2013.

The range of flood intensity that the City can experience is high, or Zone A. Based on reporting from the USGS peak MSL data, the City's average flood event places the City at the "Action Stage" as shown in Tables 7-2 and 7-3. However, the City of San Antonio has experienced flooding over 33 feet MSL. Based on historical occurrences, the

[1] Severity estimated by averaging floods at certain stage level over the history of flood events.

planning area could experience nine to 16 inches of water within a 24-hour period due to flooding.

The data described in Tables 7-1 through 7-3, together with Figures 7-1 through 7-4, and historical occurrences for the area, provides an estimated potential magnitude and severity for the City of San Antonio. The City may experience a range of flooding events from below 15 feet to above 33 feet or from "Below Flood Stage" to almost a "Major Flood Stage."

Historical Occurrences

Historical evidence indicates that areas within the City are susceptible to flooding, especially in the form of flash flooding. 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 7-4 identifies historical flood events that resulted in damages, injuries, or fatalities within the City of San Antonio. For countywide historical events, 77.4 percent of property damages and 38.7 percent of crop damages have been allocated to the City of San Antonio.

Historical Data is provided by the Storm Prediction Center (NOAA), NCDC, and SHELDUS databases for the City of San Antonio.

Table 7-4. Historical Flood Events, 1993-2014

DATE	TIME	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
5/5/1993	-	$387,000	$19,350	$634,027	$31,701
10/7/1994	-	$7,740	$0	$12,364	$0
6/6/1997	5:00 p.m.	$11,610	$0	$17,125	$0
6/21/1997	7:00 a.m.	$19,350	$0	$28,541	$0
6/22/1997	2:30 a.m.	$2,322,000	$19,350	$3,424,928	$28,541
10/7/1997	6:00 p.m.	$61,920	$0	$91,331	$0
1/6/1998	2:00 p.m.	$3,870	$0	$5,621	$0
1/31/1998	11:00 a.m.	$11,610	$0	$16,862	$0
2/21/1998	5:00 p.m.	$3,870	$0	$5,621	$0
3/16/1998	1:00 a.m.	$23,220	$0	$33,724	$0

DATE	TIME	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
8/6/1998	7:45 a.m.	$20,000	$0	$29,133	$0
8/14/1998	4:05 p.m.	$38,700	$0	$56,207	$0
8/22/1998	7:30 a.m.	$38,700	$3,870	$56,207	$5,621
8/23/1998	5:00 p.m.	$7,740	$0	$11,241	$0
9/11/1998	10:30 a.m.	$11,610	$0	$16,862	$0
10/17/1998	5:30 a.m.	$6,192,000	$38,700	$8,993,063	$56,207
6/15/1999	9:00 a.m.	$30,000	$0	$42,755	$0
6/15/1999	9:30 p.m.	$10,000	$0	$14,252	$0
6/21/1999	10:00 a.m.	$10,000	$0	$14,252	$0
4/3/2000	12:30 a.m.	$10,000	$0	$13,788	$0
5/19/2000	8:20 p.m.	$10,000	$0	$13,788	$0
10/17/2000	1:30 p.m.	$30,000	$0	$41,365	$0
10/23/2000	3:30 a.m.	$50,000	$10,000	$68,941	$13,788
11/2/2000	8:00 p.m.	$38,700	$0	$53,204	$0
4/23/2001	7:30 a.m.	$61,920	$0	$82,771	$0
8/30/2001	10:00 a.m.	$38,700	$0	$51,732	$0
8/31/2001	8:00 p.m.	$40,000	$20,000	$53,627	$26,813
8/31/2001	4:00 a.m.	$23,220	$0	$31,039	$0
9/5/2001	5:30 p.m.	$61,920	$0	$82,771	$0
11/15/2001	7:00 a.m.	$77,400	$0	$103,463	$0
4/8/2002	1:30 a.m.	$80,000	$50,000	$105,584	$65,990
6/30/2002	9:30 a.m.	$11,610	$0	$15,278	$0
7/1/2002	4:30 p.m.	$0	$0	$0	$0
9/8/2002	4:30 p.m.	$61,920	$0	$81,482	$0
9/8/2002	3:45 a.m.	$38,700	$0	$50,927	$0
9/19/2002	2:00 p.m.	$38,700	$0	$50,927	$0

DATE	TIME	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
10/23/2002	2:50 a.m.	$80,000	$0	$105,584	$0
10/24/2002	5:30 a.m.	$38,700	$0	$50,927	$0
7/5/2003	6:30 a.m.	$10,000	$0	$12,904	$0
7/15/2003	10:30 p.m.	$7,740	$0	$9,958	$0
9/5/2003	12:30 p.m.	$77,400	$0	$99,584	$0
9/22/2004	9:00 p.m.	$0	$0	$0	$0
11/16/2004	6:30 p.m.	$0	$0	$0	$0
11/22/2004	1:30 a.m.	$0	$0	$0	$0
8/20/2008	2:20 a.m.	$10,000	$0	$11,028	$0
2/4/2010	12:00 a.m.	$0	$0	$0	$0
5/25/2013	6:00 a.m.	$0	$0	$0	$0

Table 7-5. Summary of Historical Flood Events, 1993-2014

EVENTS	DEATHS	INJURIES	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
129 events	**16**	**507**	**$14,694,785**	**$228,662**

Significant Events

Flash Flood on May 25, 2013 – City of San Antonio

Thunderstorms produced heavy rain that caused flash flooding in and around San Antonio and Bexar County. There was record rainfall in the San Antonio area with the San Antonio International Airport recording 9.87 inches of rain (2nd highest 24-hour total record) and CoCoRAHS observers reporting over 11 inches. Most of the rain fell in about six hours with four inches in one hour between 6:00 and 7:00 a.m. A USGS stream and rain gauge on Olmos Creek and Dresden Drive reported 2.58 inches in 15 minutes between 6:15 and 6:30 a.m. The gauge reported 6.13 inches in one hour, 9.46 inches in two hours, and totaled 15.31 inches in five hours. A 24-hour total at this gauge was 17 inches of rain.

This led to massive flooding in the Olmos Basin/Creek just inside Loop 410 near the Quarry. Most of the flooding across the City was in north central and northwest San Antonio along and just inside Loop 410. This rain event occurred a day after another heavy rain event with parts of the City receiving over two inches. This resulted in major flooding of Olmos Creek, the Medina River, Leon Creek, the San Antonio River and Salado Creek, all of which reached major flood stage. There were many roads closed including Hwy 281 at Olmos Creek which remained closed for several days. At 10:00 a.m., there was one foot of water over Ingram and Callaghan Rds. San Antonio creeks and streams saw big rises in water levels which led to additional flooding downstream in the southern portion of Bexar County. Areas that were hit the hardest included the Espada Rd. area near the San Antonio River and Loop 410 intersection. A mobile home park on Plumnear Rd., off Leon Creek, on the southwest side of the City was flooded. Several hundred rescues and calls for rescue occurred during the morning of the 25th. Two fatalities occurred inside Bexar County. A woman was killed when her car was swept away in flood waters along Leon Creek at the 5800 Block of U.S. Highway 90. Another woman was killed in her car when her car was swept away in the 400 Block of Rhapsody Drive about 7:30 a.m. In all, the City of San Antonio and Bexar County Emergency Management agencies found over 350 impacted residences with 15 of those being destroyed and 27 suffering major damage. The other residences suffered minor damages. Most of the destroyed residences were in the Espada area along the San Antonio River in southeast Bexar County.

Flash Flood on October 23, 2002 – City of San Antonio

A line of thunderstorms moving eastward across Bexar County stalled just after midnight, producing general one inch rainfall with isolated totals up to three inches. The City of San Antonio reported several rescues along US90 in the downtown area. Numerous roads were closed across the City due to flash flooding through the early morning hours.

Flash Flood on April 8, 2002 – City of San Antonio

Flash flooding erupted over large sections of San Antonio as general two inch rain amounts fell over the northern part of the County, with up to four inches in the north central portion. Damage was mainly to roads across the City.

Flash Flood on October 17, 1998 – City of San Antonio

In advance of a very slow-moving upper level trough of low pressure over West Texas, a cold front drifted slowly southeastward into West Central Texas during the evening of Friday, October 16th. Deep moisture was in place across South Central Texas as the two systems approached, being fed at the mid and upper levels by two nearly stationary hurricanes, Madeline near the tip of Baja Mexico, and Lester, anchored just off Acapulco, Mexico, and in the low levels by a strong flow from the Gulf of Mexico. A very moisture-rich environment was in place across South Central Texas as the flood event developed. Near 3:00 a.m., with the cold front still west of San Angelo, scattered showers and

thunderstorms began to break out over Bexar County beneath the mid and upper level moisture plume and quickly became widespread as a low level rain-cooled boundary formed along the south and east edge of the County. It was upon this boundary that subsequent showers and thunderstorms continued to form and the deep convection became sustained. A level of 10.63 inches of rain was measured at the Airport in the first few hours.

All rivers, creeks, and streams along and east of a San Antonio to Austin line remained at or above flood stage from Saturday, October 17th through Sunday, October 18th, with a majority continuing to flood through Monday, October 19th. The rainfall amount varied from ten inches as a base throughout San Antonio and reached levels of 19 inches in certain areas.

This event broke rainfall records across South Central Texas, producing 18 floods of record in South Central Texas streams. October became the wettest of any month in climate records for San Antonio since 1885. October 17th became the wettest day and wettest 24-hour period in San Antonio climatic records, nearly doubling both previous records.

The event was widespread and impacted the safety of all emergency service personnel throughout the City of San Antonio. The storm taxed all resources available to the Police and Fire Departments, and other public safety entities in the surrounding communities. The SAPD received 5,184 calls for service and handled 123 major accidents. Unlike any other incident, this event resulted in 192 water rescues by the Fire Department, saving 461 men, women, and children from rising waters. Unfortunately, 11 deaths occurred when vehicles in the flooded areas were swept away.

The floodwaters also caused substantial damage to more than 1,150 dwelling units and 49 commercial properties. There was over $115 million in damages to public and private property throughout San Antonio, including utilities, roadways, and communication systems, and more than $71 million to City of San Antonio facilities. The extensive runoff resulted in the collection of 480 tons of debris from 576 miles of street. Also collected were 21,375 tons of debris from approximately 8 miles of channels such as creeks, tributaries, and rivers.

Probability of Future Events

Based on recorded historical occurrences and extent within the San Antonio planning area, flooding is highly likely and an event will 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.

Due to the generally flat terrain of Bexar 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 San Antonio River and other major creeks and minor waterways.

Although the City has encouraged development outside of the floodplain, impact for flood is "Substantial" with multiple fatalities. A flood event in the City could result in the shutdown of facilities for 30 days or more, depending on the scale of the storm and more than 50 percent of property destroyed or with major damage.

Figure 7-5. Critical Facilities Vulnerable to Flooding

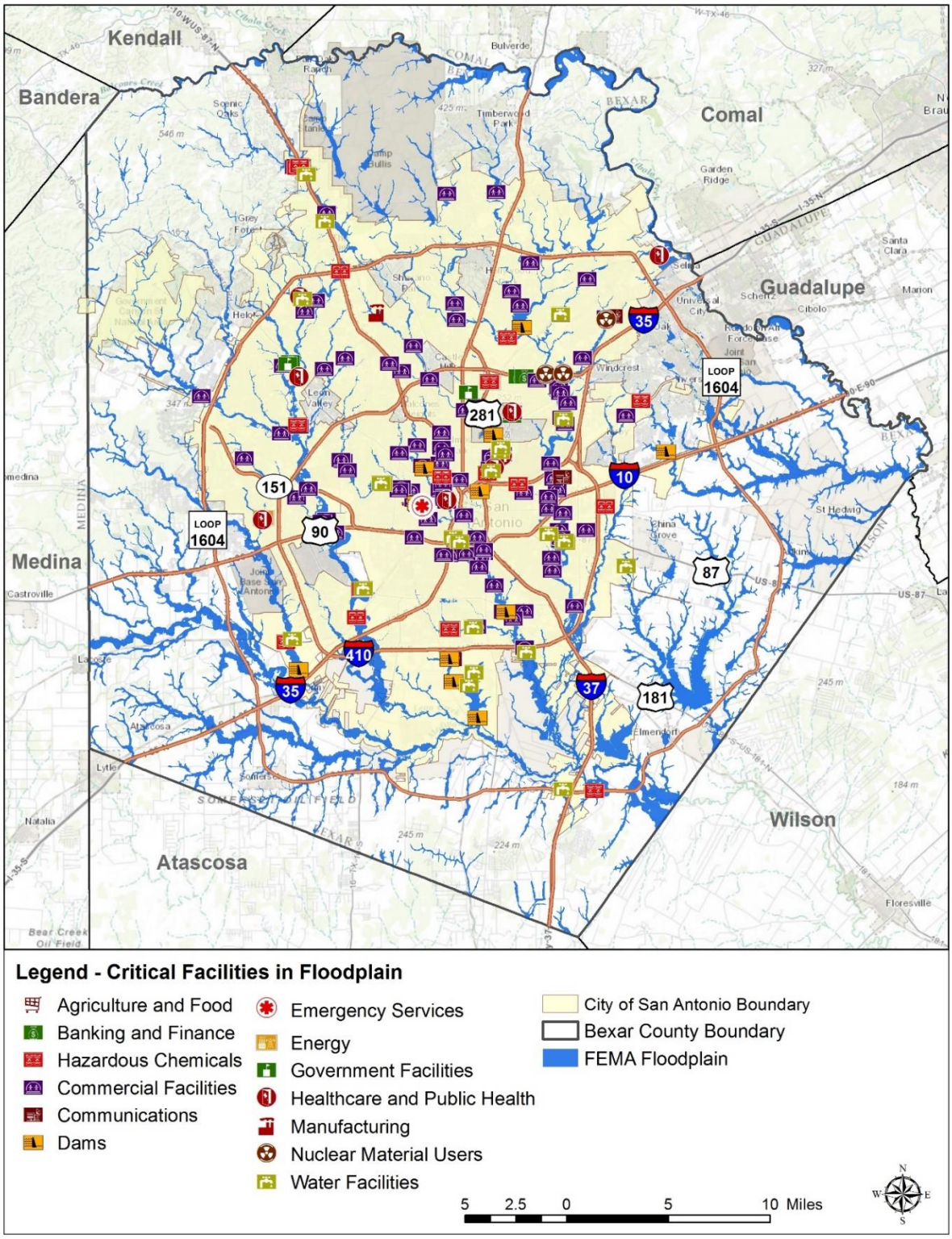


Table 7-6. Critical Facilities Located within the Floodplain[2]

DHS INFRASTRUCTURE SECTOR	NUMBER OF FACILITIES
Agriculture and Food	1
Banking and Finance	7
Chemical and Hazardous Materials Industry	21
Defense Industrial Base	N/A
Energy	3
Emergency Services	2
Information Technology	N/A
Communications	4
Postal and Shipping	-
Healthcare and Public Health	11
Transportation	-
Water	23
National Monuments and Icons	-
Commercial Facilities	107
Government Facilities	2
Dams	11
Nuclear Reactors, Materials, and Waste	4
Manufacturing	1

There are 8,406 structures in the floodplain. Historic loss estimates due to flood (in 2014 dollars) total $14,923,447,997 having an approximate annual loss estimate of $710,640. Historic loss estimates are based on recorded data, therefore there could be damages that were not included in the estimates because they were not reported. Considering 129 flood events over a 21-year period, frequency is approximately five to six events every year.

[2] Source: HIRA, 2014

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 San Antonio area. According to FEMA and the NWS, the majority of deaths attributed to flooding occur in vehicles; San Antonio is no exception to this statistic. According to the NWS, the City of San Antonio and Bexar County area hold the highest number of fatalities resulting from flash flooding in Texas, with at least 26 fatalities attributed to flooding/flash flooding since 1996. Additionally, more than 852 injuries have been sustained due to flooding in the same time period.

Flood-related rescues often occur at swift water and low water crossings. Swift water rescues are rare, since most calls for assistance are related to stalled or stranded vehicles in or near low water crossings. New low water crossings may and do emerge as a result of increased development or changes to the hydrology and floodplain of an area.

Flooding can also pose health risks and threats to people after the flood waters have receded. Mold spores will grow in wet, organic materials, such as bedding, clothing, or wall insulation. Untreated sewage and hazardous chemicals may be present in flooded buildings, homes and automobiles; these toxins may also be present as a layer of residue over property. Water and food sources may be contaminated by flood waters and the pollutants they bring; electric power is often interrupted temporarily. While some flooding situations may cause little more than a clean-up effort and a short-term utility interruption, even those situations will have an impact on the overall quality of life for people, and can present a long-term safety threat if left unresolved or untreated.

Other impacts include the potential need to evacuate a location because of rising floodwaters and the potential for displacement from residences because of flood damage.

Response personnel are exposed to greater risks and impacts than the general public in a flood event because of their roles. They are responsible for performing high and swift water rescues when flooding occurs and may encounter hazards in floodwaters including submerged or water-borne debris and hazardous materials. A total of 935 high and swift water rescues have been performed by first responders from January 2000 through February 2014 in San Antonio area. Analysis of the data shows that the months May through November appear to have higher numbers of water rescues compared to the rest of the year.

Flooding is a threat to operations and service delivery and has the potential to significantly impact City operations. While the San Antonio Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible to all staff, as they may be unable to leave their neighborhood due to roadway debris or other obstructions. Staff members unable to access the protected

facility would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the SAOEM and may suffer more interruptions as a result of flooding. If files (hard or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively impact its ability to respond to and recover from the flooding event. Without a Continuity of Operations Plan (COOP) that takes these issues into account and considers how best to work around them, and without regular exercise of that COOP, city departments may not be able to function, and may be unable to provide necessary services.

Additionally, private sector entities on which the City and its residents rely, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if flooding resulted in the closure of roadways over a large area, this would result in a temporary halt to repair of damaged infrastructure, delayed emergency response activities, and interruption in the normal delivery of goods and services. Flooded electrical substations, downed power lines, contaminated wells, broken pipelines are common occurrences during flood events, and would impact the City's normal operations and service delivery. It is imperative that both public and private entities plan for these events and address how they will be able to function and provide services until normal operating conditions can be resumed.

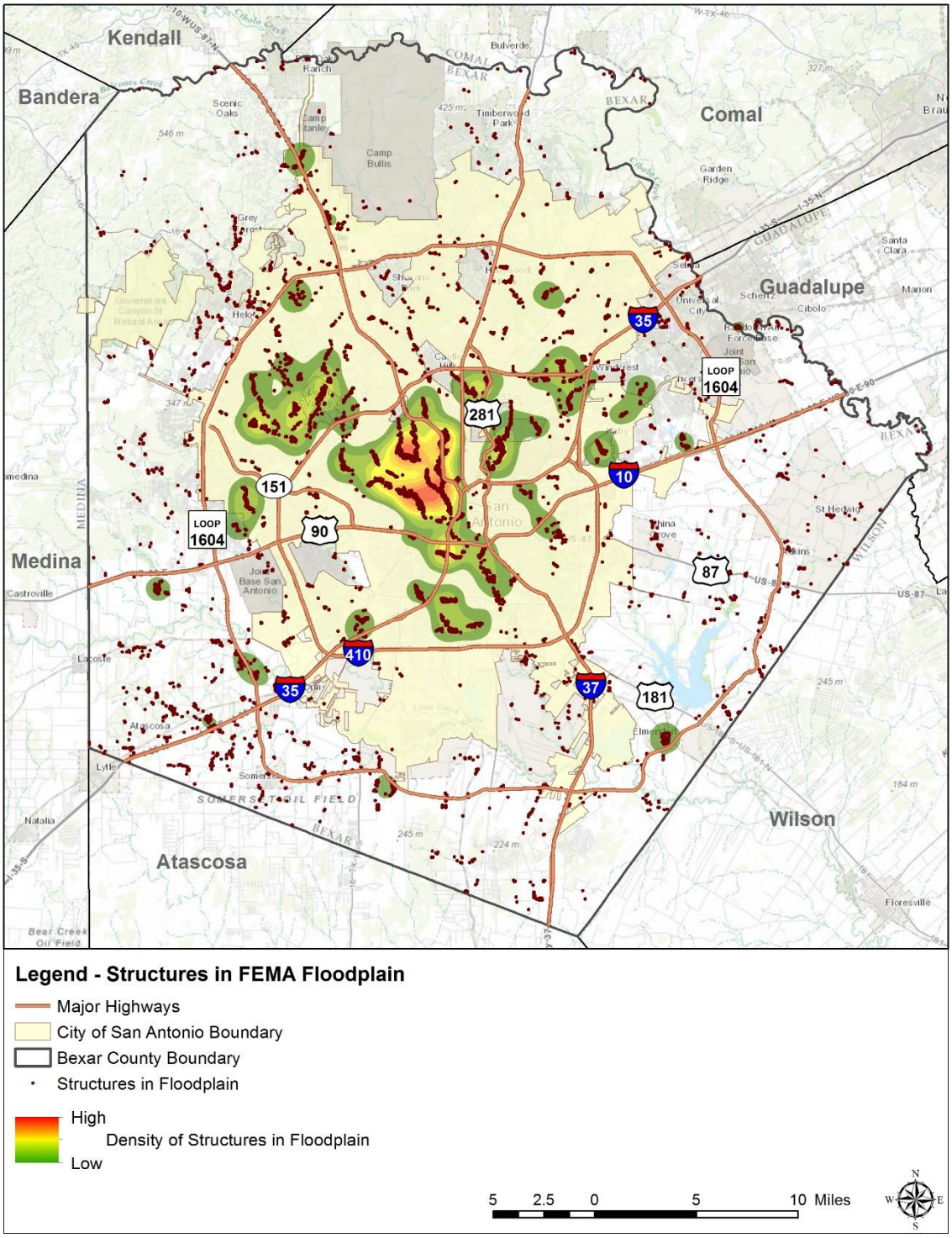
The City, state, and federal government have invested heavily in flood control infrastructure in the City of San Antonio area. This investment has significantly reduced the potential impacts and vulnerability of City property, facilities, and infrastructure to riverine, flash flooding, and storm water flooding, but it has not eliminated it entirely.

SAOEM performed an analysis to determine how many structures are in the flood plain, excluding miscellaneous residential improvements, such as detached open porches, detached garages, and detached carports and sheds. The results show that 11,937 structures are within Bexar County and 8,406 of those structures are located in the City of San Antonio and are within or intersect with the FEMA 100 year floodplain. (Source*: San Antonio Office of Emergency Management, 2014 Floodplain Study*)

The quantitative risk assessment of a flood event for San Antonio, based on a HAZUS-MH model, is presented below. HAZUS-MH is a regional multi-hazard loss estimation model that was developed by the FEMA and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS-MH is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates are then used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The model run for the City of San Antonio is based on the one percent flood event, or base flood. The damages in these conditions are significant, as would be expected in a flood of this magnitude; in addition, this is the level of flooding to which NFIP regulations are written and enforced.

Figure 7-6. Structures located in FEMA 100 Year Floodplain, 2014[3]



[3] Source: San Antonio Office of Emergency Management, 2014 Floodplain Study

Table 7-7. Parcels Located within the Floodplain[4]

PARCEL USE DESCRIPTION	NUMBER OF PARCELS
Agricultural	15
Commercial	717
Electric Companies	1
Exempt	3
Gas Companies	1
Improved – Farm/Ranch	39
Industrial	35
Mineral Reserves	1
Other	34
Pipelines Companies	2
Residential	6,458
Vacant	98
Total	**7,404**

The most similar historical event to compare the simulation to is the 1998 flood. However, the 1998 flood was documented as being a one percent flood in most areas of San Antonio and Bexar County, with some areas reaching 0.2 percent levels; therefore, the actual flooding in 1998 exceeded what the HAZUS-MH model forecast, at least in some areas. The following is a summary of the HAZUS-MH flood evaluation followed by a description of the impacts from 1998 floods and a comparison analysis.

Flooding is a natural occurrence, and is often beneficial for the environment, as it aids in the nourishment of the soil and helps to maintain the water table. However, flood waters are not limited to water; they also contain all of the human artifacts that were encountered upstream of the flood's current location. This can include household chemicals and toxins, household items, industrial materials, agricultural products, and untreated sewage. Long-term environmental hazards, such as hazardous chemicals, toxins, or sewage that are left behind by the flood waters can create an unsafe environment for workers and can have negative consequences for the natural environment.

[4] Source: San Antonio Office of Emergency Management, 2014 Floodplain Study

The impacts to the environment from a major flood event could include:

- Erosion of stream or river banks;
- Damage to overwhelmed flood control structures;
- Loss of native plants and animals; and
- Contamination from chemicals, sewage, and other noxious materials picked up, transported and deposited by flood waters.

The contamination of rivers, watersheds, and the flooded landscape from chemicals and debris from agriculture, homes, and businesses is a serious potential problem. Industrial chemicals, oil and gas, sewage, old tires, etc., can pollute the landscape where they come to rest as the water recedes. Many of these materials may take years, decades or even longer to break down and become harmless and some materials may never fully break down. Until these materials become harmless, they can continue to degrade the environment and in some cases leach into ground water, spreading contamination away from the site. Without proper clean-up, these materials may continue to harm the environment for years.

The HAZUS-MH run was performed to aid in quantifying the amount and type of damage that a one percent flood event could generate in Bexar County. The following information was determined by HAZUS-MH, regarding debris:

Debris Generation

HAZUS-MH estimated the amount of debris that would be generated by the flood. The model breaks debris into three general categories:

1. Finishes (dry wall, insulation, etc.);
2. Structural (wood, brick, etc.); and
3. Foundations (concrete slab, concrete block, rebar, etc.).

The categories are based on the different types of equipment required to handle the debris.

The model estimated that a total of 229,358 tons of debris will be generated. Of the total amount, "finishes" comprises 39 percent of the total and "structural" comprises 30 percent of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 9,174 truckloads (25 tons/truck) to remove the debris generated by the flood.

The amount and type of debris that is likely to be generated by a one percent flood event would certainly have environmental ramifications, though what exactly those ramifications would be depends on the areas that were inundated by floodwaters.

Regarding impact to the environment, not all flooding of rivers is bad. Floods are natural events that have changed the course of rivers, flooded low areas, and uprooted or drowned vegetation as part of the changing natural environment. When a river changes

course lakes and ponds can form, attracting water fowl and other animals. Where the river once ran the river gravels gradually develop a layer of topsoil forming a perfect area for flora and fauna to flourish. These species attract a growing diversity of animal life that continues to change, along with the landscape.

Flood waters traditionally have replenished the soil by bringing silt from upstream areas and depositing it across the landscape in the downstream areas of watersheds, adding a new quantity of nutrients to the soil. This contributes to the fertility of the lower watershed, aiding the growth of both natural vegetation and agricultural products.

The San Antonio area is home to a large number of cultural and historic resources. These resources, and the history they represent, are significant to the area because they remind the community of its past and help to define its persona. The City's historic and cultural resources are a significant draw for tourists and visitors to the area and help to generate revenue through jobs, taxes and fees. This revenue pays for services and programs, which benefit residents and the community.

Many of the City's historic homes and neighborhoods could be impacted. Property damage to a historic neighborhood could have long-term economic impacts both for the property owners and for the City, since historic neighborhoods often attract tourists and generates revenue, and tourists and visitors are unlikely to want to visit flood-damaged historic structures and neighborhoods.

The financial and economic risks associated with flooding are dependent on the scale and location of the flooding, and can be serious. While the flood damage to an individual residential structure can be significant or devastating to the residents, it has a negligible economic impact on the community's overall economic health. However, after a significant flood event, such as the 1998 flood, a large number of structures can be damaged or destroyed by flooding and pose serious economic and financial consequences for a community.

The City of San Antonio planning area could sustain significant economic impacts from a one percent flood event. HAZUS-MH estimated the total economic loss for such an event at more than $276.2 million, or slightly more than 20 percent of the total replacement value of the buildings in the scenario. For any jurisdiction, an economic loss equal to one-fifth of existing stock would be difficult to absorb and would almost certainly require outside assistance from the state and/or federal governments.

Large-scale flood events can cause significant property damage to homes, businesses, industrial properties, and government buildings. This can result in a significant negative alteration of the tax base for that community, at the same time the community must fund unbudgeted expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, in addition to normal day-to-day operating expenses. Lost business days and resulting lost wages can also affect the local economy in the form of reduced tax receipts. While there are often state and federal programs

that can help with these expenses, the majority of these programs are reimbursement programs, meaning that the community must still fund the initial expenses out of pocket.

Significant flood events can also result in dramatic population fluctuations, as people are unable to return to their homes or jobs and possibly seek shelter and/or work outside of the community. They may require temporary relocation assistance, and some of them may choose not to return to the community.

Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. A loss of jobs affects the financial and economic health and stability of the community, and could result in an increase in the unemployment rate.

Flooding typically damages the infrastructure of a community, including roads, bridges, power lines, and plants. It can take a significant amount of time to fully repair these facilities and infrastructure, depending on the nature of the damage and the resources available that can be dedicated to the project. Damage to infrastructure will generally slow down the economic recovery of the community, the re-opening of businesses, and can limit the cleanup effort. Damage from a flood event can force some businesses to close temporarily, even those that were not directly impacted by the flooding. For some businesses, the loss of infrastructure can result in the termination of their business.

Some businesses are more heavily reliant on utility infrastructure than others. For example, Grocery stores are typically reliant on electricity to maintain the safety of their food supply. Some larger chain stores may have emergency power generators and fuel on hand, but smaller, independent stores often do not.

The economic and financial impacts of flooding will ultimately depend on the scale of the flooding, 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 flooding.

Public confidence in local government may be impacted by how the response and recovery efforts resulting from the flood event are handled. A response demonstrating that the City, its leaders, and officials were prepared for the event, anticipated the magnitude, and understood what could happen, will boost the City's reputation and standing with its residents. However, if the perception developed, correctly or incorrectly, that the response was slow, needs or complaints of its residents were ignored, or failure to anticipate the magnitude of the event, then public confidence will decline.

HAZUS-MH Results

General Building Stock Damage

HAZUS-MH estimates that there are 457,149 buildings in the region, which have an aggregate total replacement value of $85.033 million (2006 dollars). HAZUS-MH estimated that about 10,653 buildings will be at least moderately damaged. This is over 40 percent of the total number of buildings in the scenario. There are an estimated 1,073 buildings that will be completely destroyed.

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 6,636 hospital beds available for use. On the day of the scenario flood event, the model estimated that 6,243 hospital beds were available in the region.

Table 7-8. Expected Damage to Essential Facilities

CLASSIFICATION	TOTAL DESTRUCTION	MODERATE DAMAGE	SUBSTANTIAL DAMAGE	FACILITIES EXPERIENCING LOSS OF USE
Fire Stations	28	2	0	2
Hospitals	30	2	0	2
Police Stations	40	3	0	3
Schools	566	21	1	16

1998 Flood Summary

The following information was obtained from the City of San Antonio and a United States Army Corp of Engineers (USACE) study from 2001.

Flood level

Data indicated that the water flow measured 66,000 cubic feet per second (cfs) in Salado Creek during the peak period of the storm. The Salado Creek Watershed Study adopted in 1997 indicated a 100-year flood flow of 57,946 cfs and a 500-year discharge rate of 73,634 cfs. (Source: *San Antonio Office of Emergency Management*)

During a flooding event in 1998, an estimated 17 inches of rainfall was recorded within a 30-hour period. The devastation from that flood event resulted in 11 deaths and more than 1,150 homes and 49 businesses damaged or destroyed in the City of San Antonio, with significant damage occurring along the Leon Creek Watershed. Flood damage was estimated at ($300 - $500) million in the City of San Antonio and the surrounding county area. (Source: *City of San Antonio Office of Emergency Management*)

Debris removal as documented in December 1998 in the After Action Report included:

- 480 tons of debris collected from 576 miles of streets; and
- 21,375 tons of debris collected from approximately 8 miles of channels.

Analysis

The simulation provided fairly accurate information when it came to structures damaged in a one percent flood event, with approximately 1,100 structures forecasted as substantially damaged compared to approximately 1,200 substantially damaged in the 1998 event. Even though property values are variable, the costs associated are similar.

The amount of debris projected in the simulated flood produced significantly more tonnage. A possible explanation for the difference may be the result of variances in building stock and building codes between the City of San Antonio, and the way that those differences are accounted for in the stock data found in HAZUS-MH.

The simulation, while considering a larger area, closely follows one of San Antonio's most significant flood events, providing additional understanding of potential impacts to property.

National Flood Insurance Program (NFIP) Participation

The City of San Antonio is a current participant in the National Flood Insurance Program (NFIP). Flood insurance offered through the NFIP is the best way for home and business owners to protect themselves financially against a flood hazard. Serious flooding continues to be present in San Antonio, prompting the City to develop a public education and flood preparedness program called the SAFE (San Antonio Flood Emergency) System. SAFE may be accessed via the City's website. The mission of SAFE is to educate the public on actions necessary to protect life and property.

As an additional indicator of floodplain management responsibility, communities may choose to participate in FEMA's Community Rating System (CRS). This is an incentive-based program that allows communities to undertake flood mitigation activities that go beyond NFIP requirements. The City of San Antonio is not currently participating in CRS, but has begun the application process, including documenting tasks and projects to prevent and reduce flood losses. These include measures such as updating codes as a preventative measure, acquisition of flood-prone structures, and implementation of other structural flood control projects. The City has acquired over 300 flood-prone or repetitive flood loss properties in previous years and has plans to acquire additional structures that have previously experienced one or more floods, in an effort to protect open space adjacent to floodplains. Additionally, they have identified and included over 85 flood mitigation projects in the current hazard mitigation plan underway. Based on current and proposed activities that qualify for CRS credit, the City of San Antonio is positioned to become a CRS community in the near future, which will provide flood insurance incentives to expand the community's current NFIP policy base, reduce risk through

adoption of higher regulatory standards and other flood mitigation measures, and reduce flood insurance premiums to residents.

The legislature of the State of Texas has, in Section 16.315, Texas Water Code, delegated the responsibility of local government units to adopt regulations designed to minimize flood losses. The City of San Antonio has adopted ordinances to regulate the floodplain, or any land area susceptible to being inundated by water from any source.

The flood hazard areas of San Antonio 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.

Overall loss resulting from a flood event is caused by the cumulative effect of flood waters to obstructions in floodplains; flood hazard areas; habitats vulnerable to floods; and hazardous to other landforms that are inadequately elevated, flood-proofed or otherwise protected from flood damage. For example, flood plain obstructions cause an increase in flood water heights and velocities.

It is the purpose of the City to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas by 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, the City of San Antonio follows these guidelines:

- 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 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 part of continual compliance with the NFIP, the City has developed a Floodplain Management Plan and has a current NFIP ordinance. The City also works closely with the San Antonio River Authority in public outreach efforts, including periodically conducting education programs for area homebuilders, business organizations, and through public contact with citizens to bring awareness to the FEMA requirements for Floodplain Management.

As part of the NFIP Program, and in conjunction with developing new mitigation actions to include in the mitigation plan, the City has implemented previous mitigation projects related to compliance and maintenance associated with the NFIP program.

The City of San Antonio has also developed new mitigation actions that relate to NFIP compliance. These actions can be found in Section 19.

Flooding was identified as a high risk hazard during hazard ranking activities at the Risk Assessment Workshop by the Planning Team and many of the mitigation actions were developed with flood mitigation in mind. A majority of these flood actions address reducing flood risk through structural alterations and drainage projects, and implementing flood awareness programs. The City of San Antonio recognizes the need and is adopting higher NFIP regulatory standards to further minimize flood risk in their community.

The prioritization method for implementing actions was based on FEMA's Social, Technical, Administrative, Political, Legal, Economic, Environmental (STAPLEE) criteria. As a result of this exercise, an overall priority was assigned to each mitigation action by each Team Member. The overall priority of each action is reflected in the mitigation actions found in Section 19 of the Plan. In prioritizing actions a community must consider many factors. Of primary consideration is targeting specific mitigation actions for implementation following a major disaster. Other factors that determine prioritization are ease of implementation by the community, cost of the project compared to perceived benefit, timeframe for implementing the action, and available personnel to oversee and implement the project.

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.

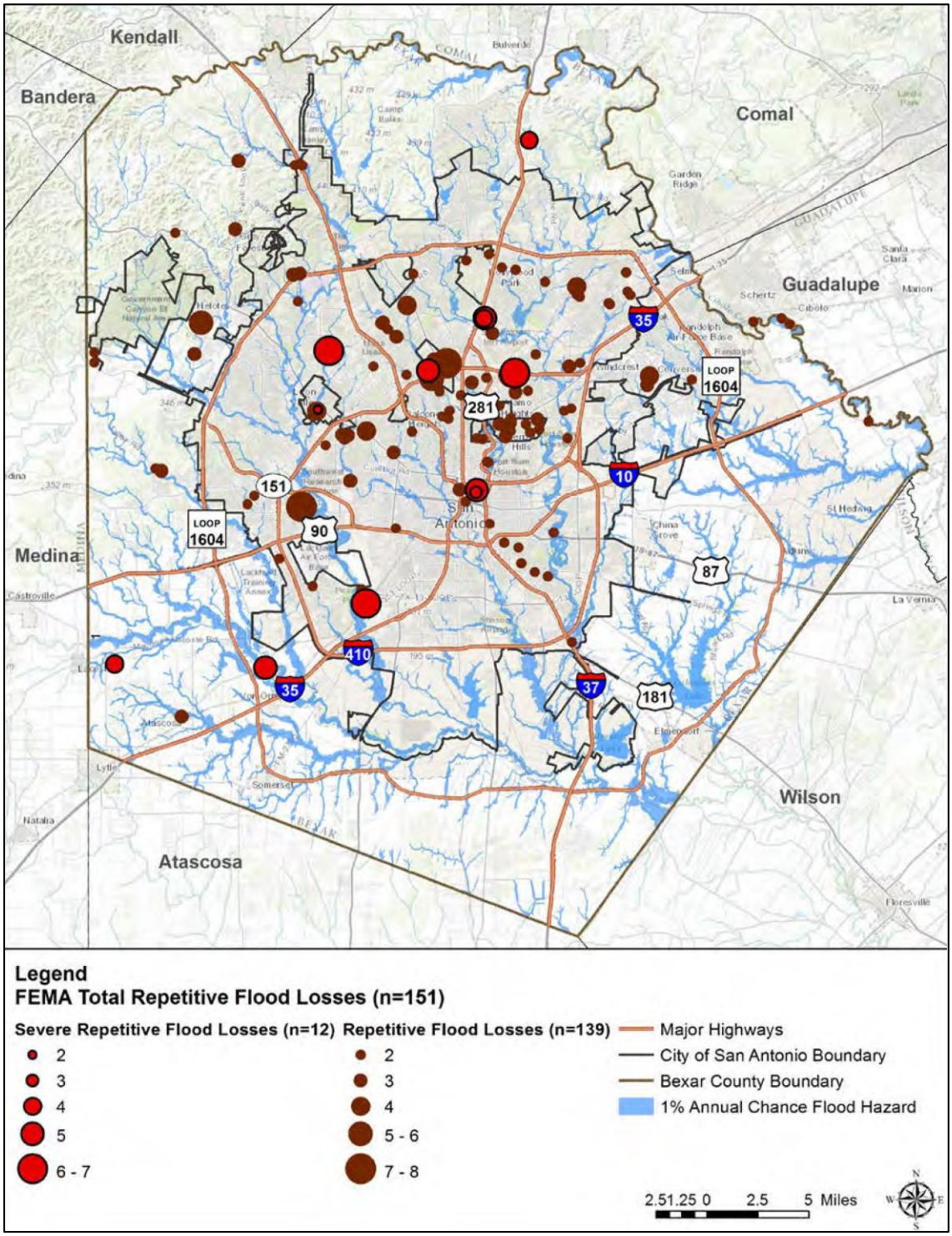
Severe Repetitive Loss properties are defined as residential properties that are:

- 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 claims 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.[5]

[5] Source: Texas Water Development Board

Figure 7-7. Repetitive Loss and Severe Repetitive Loss Properties in San Antonio [6]



[6] Source: Federal Emergency Management Administration, National Flood Insurance Program, San Antonio Office of Emergency Management, Texas Water Development Board

SECTION 8: WILDFIRE

Hazard Description 1
Location and Historical Occurrences 1
Significant Past Events 4
Extent 6
Probability of Future Events 9
Vulnerability and Impact 9
Assessment of Impacts 11

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.

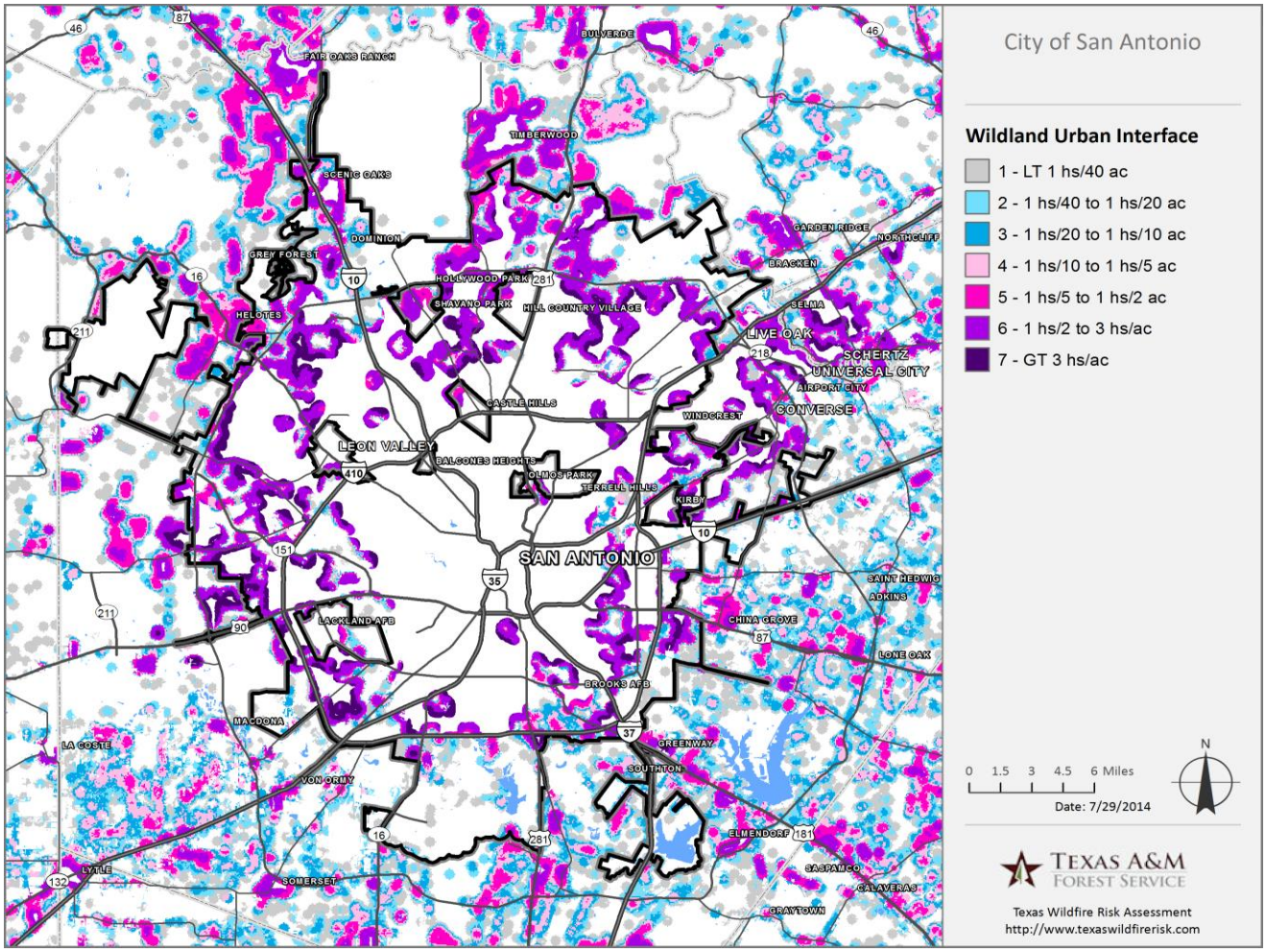
A wildfire event often begins unnoticed and spreads quickly, lighting brush, trees and homes on fire. For example, a wildfire may be started by a campfire that was not doused properly, tossed cigarette, burning debris, or arson.

Texas has seen a significant increase in the number of wildfires in the past 30 years, which included wildland, interface, or intermix fires. Wildland Urban Interface or Intermix (WUI) fires occur in areas where structures and other human improvements meet or intermingle with undeveloped wildland or vegetative fuels.

Location and Historical Occurrences

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 8-1). It is estimated that 22 percent of the total population in the City of San Antonio live within the WUI. However, the entire City of San Antonio planning area is equally at risk for wildfires.

Figure 8-1. Wildland Urban Interface Map – City of San Antonio



The San Antonio Fire Department reported 83 wildfire events between 2007 and October 2014 and two wildfire events reported by the National Climatic Data Center (NCDC) in 2011 and 2014, which resulted in $250,000 of property damages. The Texas Forest Service (TFS) started collecting wildfire data in 1985 and volunteer fire departments started reporting events until 2005. Due to a lack of recorded data for wildfire events prior to 2005, frequency calculations are based on a seven-year period, using only data from recorded years. Figure 8-2 illustrates the approximate locations of wildfires according to the San Antonio Fire Department. Tables 8-1 and 8-2 identify the number of wildfires, ignition cause, and acreage of suppressed wildfire by year, according to the TFS.

Figure 8-2. Location and Historic Wildfire Events for San Antonio

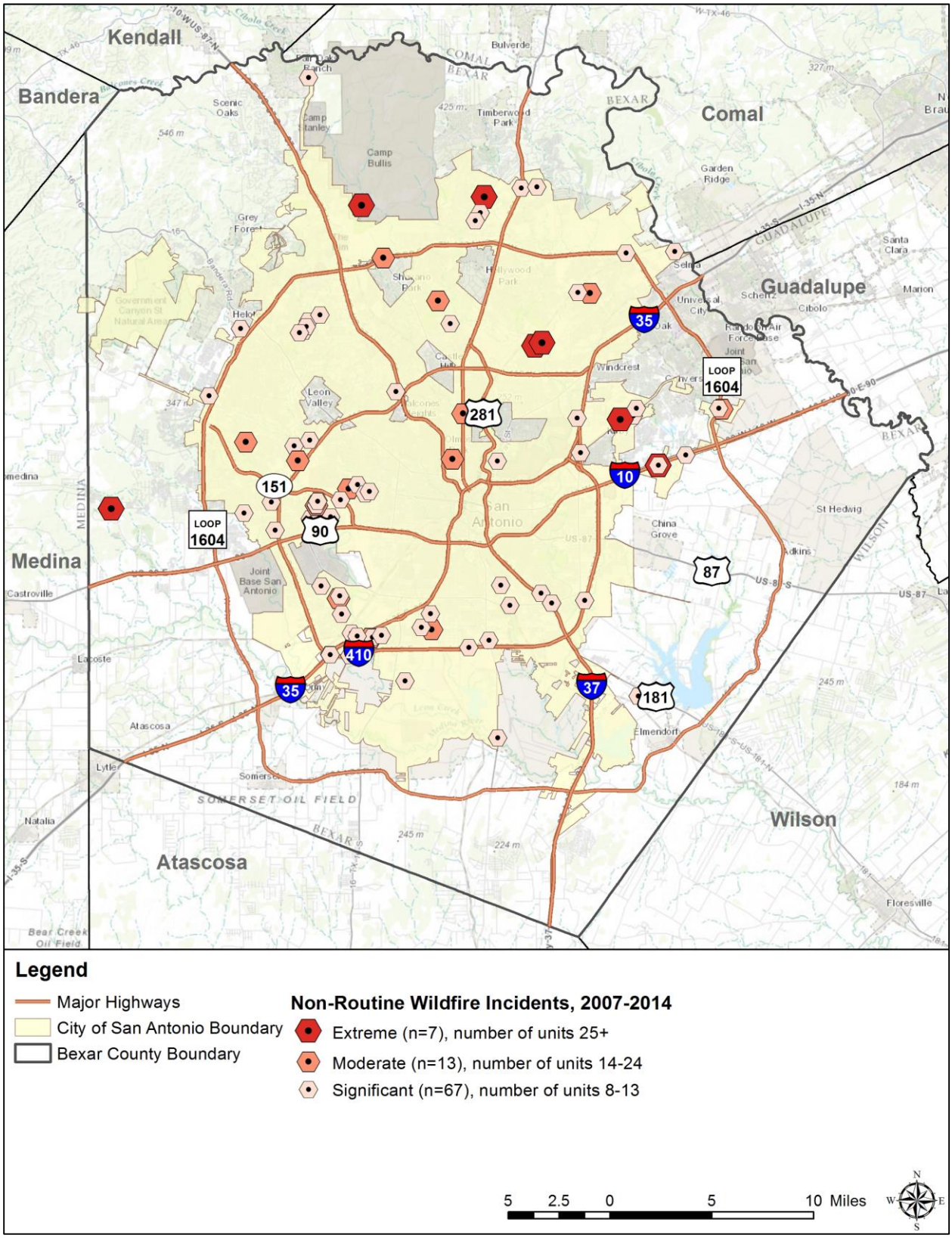


Table 8-1. Number of Wildfires by Cause for San Antonio

CAUSE	NUMBER
Miscellaneous	51
Debris Burning	17
Equipment Use	6
Children	1
Campfire	1
Smoking	3
Lightning	0
Incendiary	1
TOTAL	**81**

Table 8-2. Acreage of Suppressed Wildfire by Year

JURISDICTION	2005	2006	2007	2008	2009
City of San Antonio	1	82.1	0	115.15	39.88

Significant Past Events

September 11, 2011 – Wetmore Wildfire

More than 100 firefighters worked to contain a fast-moving fire, which ignited on September 11, 2011 around 1:00 p.m., behind homes in the 10000 block of Merritime Court, near Wetmore Rd and Broadway. Winds blowing from south to north intensified the flames through the greenbelt until the wind shifted to the east.

The wind caused the fire to spread through a densely-populated residential area. Many residents were seen watering their yards to avoid the spread of fire, and San Antonio police officers drove through neighborhoods with loudspeakers announcing mandatory evacuations. Several structures were damaged and Several hundred people were evacuated from their homes. The San Antonio Area Chapter of the American Red Cross opened a temporary shelter at 10700 Nacogdoches Rd.

A CPS Energy primary line experienced an outage near where the fire originated. According to CPS Energy 3,200 customers were without power.

A number of volunteer fire departments and the Texas Forest Service also responded to the fire, and a helicopter assisted by spraying liquid over the area.

September 9, 2011 – Potranco Wildfire

Firefighters from more than a dozen agencies worked to contain a 250 acre brush fire on September 9, 2011 in west Bexar County. There was no threat to structures during the wildfire event, but the event triggered a series of precautionary evacuations. The fire originate in rugged, hilly terrain near the intersection of Zeta Drive and Potranco Rd at about 1:30 p.m. Texas 211 from U.S. 90 to Potranco Road was closed to traffic until 10 a.m. the following morning.

York Duncan, president of the Texas Research and Technology Foundation, and Jim Dublin, its board chairman, said they rushed to the nearby Texas Research Park and helped evacuate more than 70 apartments, the University of Texas Health Science Center research facilities, and bioscience and technology companies.

As the fire moved west, about 100 residents in the Pioneer Estates neighborhood and along Mechler Road were evacuated to Medina Valley High School. CitiBank also closed its campus, evacuating 2,600 employees. The wildfire then turned to the north, and another 100 residents along Landa Road and in the Potranco Run subdivision were ordered to leave. No injuries were reported.

The Texas Forest Service provided aerial assistance dropping fire retardant on the blaze.

September 7, 2011 – Camp Bullis Wildfire

Flames erupted on Camp Bullis on Thursday September 7, 2011 about 4:15 p.m. in an area where a grass fire had previously ignited Tuesday afternoon. The fire had burned about 150 acres, but no structures were damaged. Aircrafts were dropping retardant on the eastern portion and fire crews were preparing to abate the rest of the blaze overnight. It was predicted to take four days to fully contain the fire.

Residents were evacuated from about 100 homes in Fair Oaks Ranch within a quarter-mile of Wednesday's fire, along Ralph Fair Road, Pimlico Lane and Ruffian Drive. According to the CPS Energy the utility had to reduce power at the Fair Oaks Ranch substation to allow firefighters to continue working, affecting about 4,500 customers.

Although Camp Bullis has its own fire department, firefighters from San Antonio, Bexar County and numerous other agencies assisted.

September 5, 2011 – Stone Oak Wildfire

On September 5, 2011, a wildfire fire started around 1:30 p.m. near Stone Oak Parkway and Evans Road on the north side of San Antonio. There were reportedly several fires burning in the area. Winds at 21 miles per hour, with gusts of up to 35 miles per hour were making it more difficult for firefighters to extinguish the flames.

A San Antonio Water System truck that accidentally caught fire around 1:30 p.m. sparked the Stone Oak wildfire. The fire spread quickly to Stone Oak Parkway and Evans Road,

prompting mandatory evacuations at The Abbey at Stone Oak Apartments, The Estates at Canyon Ridge Apartments and Champion Village Apartments. Smoke from the fire slowed down traffic on U.S. 281. Parts of Stone Oak Parkway and Canyon Gulf Road were closed. According to the CPS Energy outage map, at least 2,000 people were left without power.

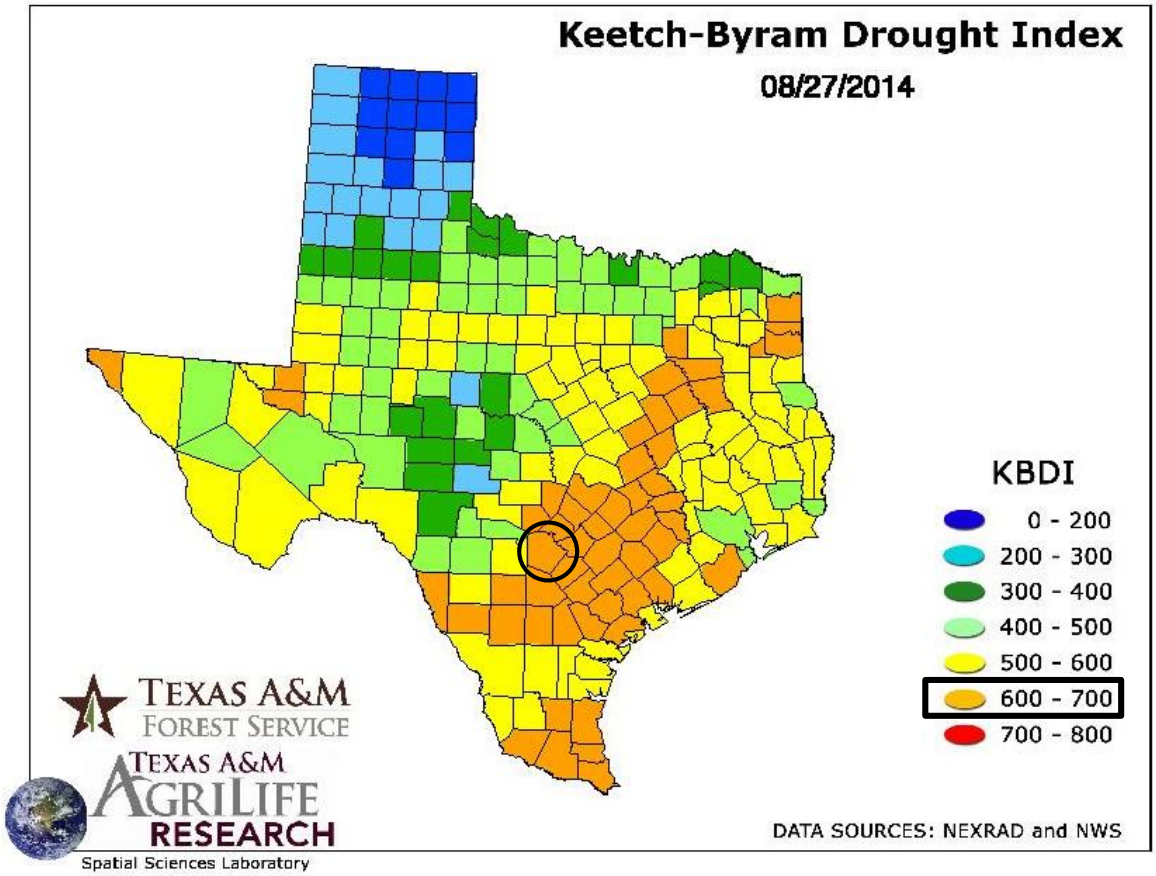
Firefighters from 75 units contained the blaze by 5:00 p.m. and then helicopters arrived to drop water from the sky. The San Antonio Chapter of the American Red Cross set up a temporary shelter at Barbara Bush Middle School for those displaced.

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.

Each color in Figure 8-3 represents the drought index at that location. The drought index ranges from 0 to 800. A drought index of 0 represents no moisture depletion, and a drought index of 800 represents absolutely dry conditions.

Figure 8-3. Keetch-Byram Drought Index (KBDI) for the State of Texas, 2014[1]



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

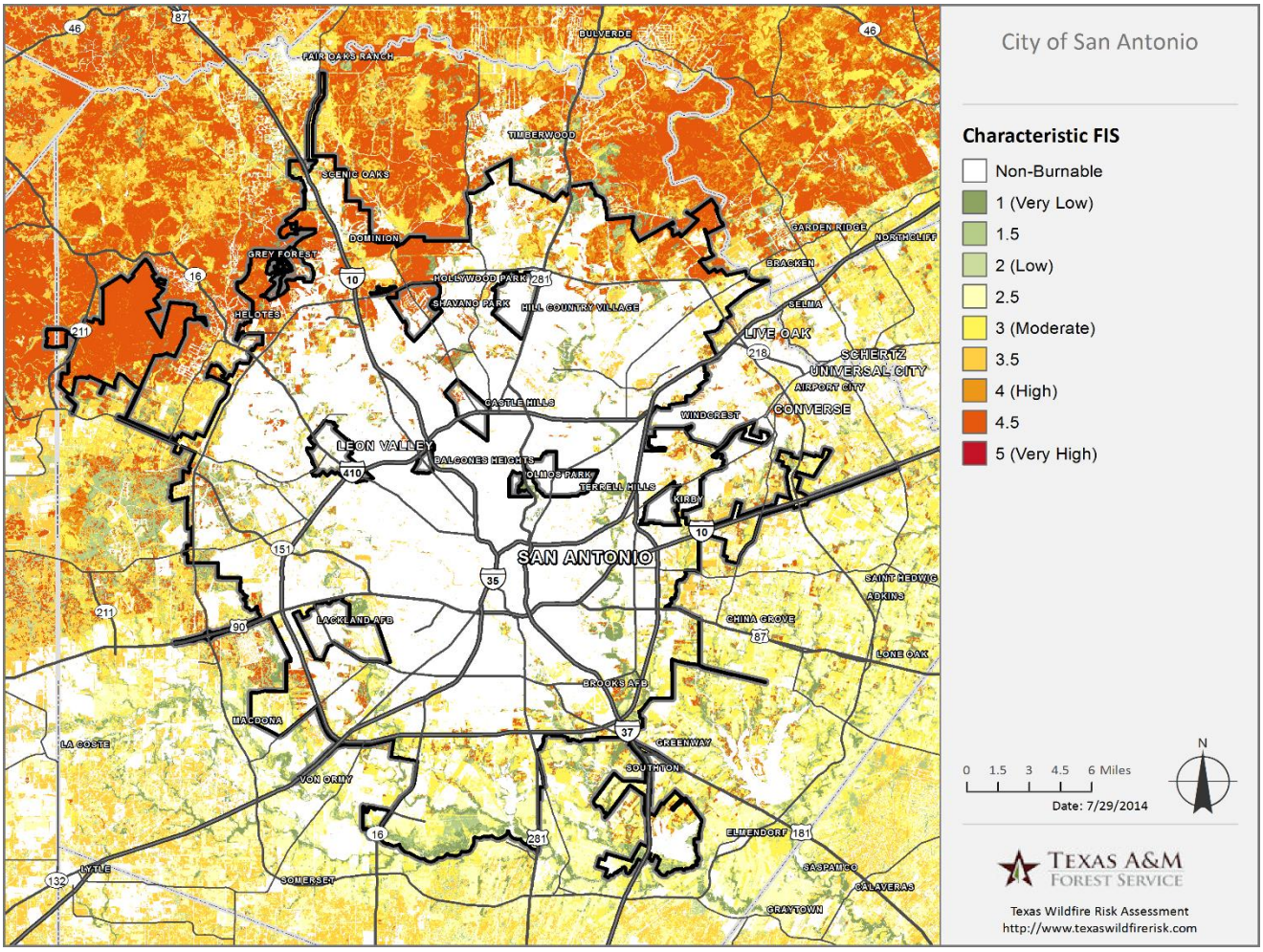
- **0 - 200:** Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
- **200 - 400:** Fires more readily burn and will carry across an area with no gaps. Heavier 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.

[1] The City of San Antonio is located within the black circle.

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

The range of intensity for the City of San Antonio in a wildfire event is within 600 to 800. The average extent to be mitigated for the City of San Antonio planning area is a KBDI of 605. At 605 KBDI, fires will burn readily, exposing mineral soils. Wildfires will burn through the night and heavier fuels will actively burn and contribute to wildfire intensity. Figure 8-4 identifies the wildfire intensity for the City of San Antonio.

Figure 8-4. Fire Intensity Scale Map – City of San Antonio



Probability of Future Events

Wildfires can occur at any time of the year. As the City grows and develops into wild land, the potential area for a wildfire event increases. With 83 events in a seven-year period, an event within the City of San Antonio is highly likely and 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 San Antonio are not likely to experience large, sweeping fires. Areas outside of the City in the unincorporated areas of Bexar County are vulnerable. 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 WUI.

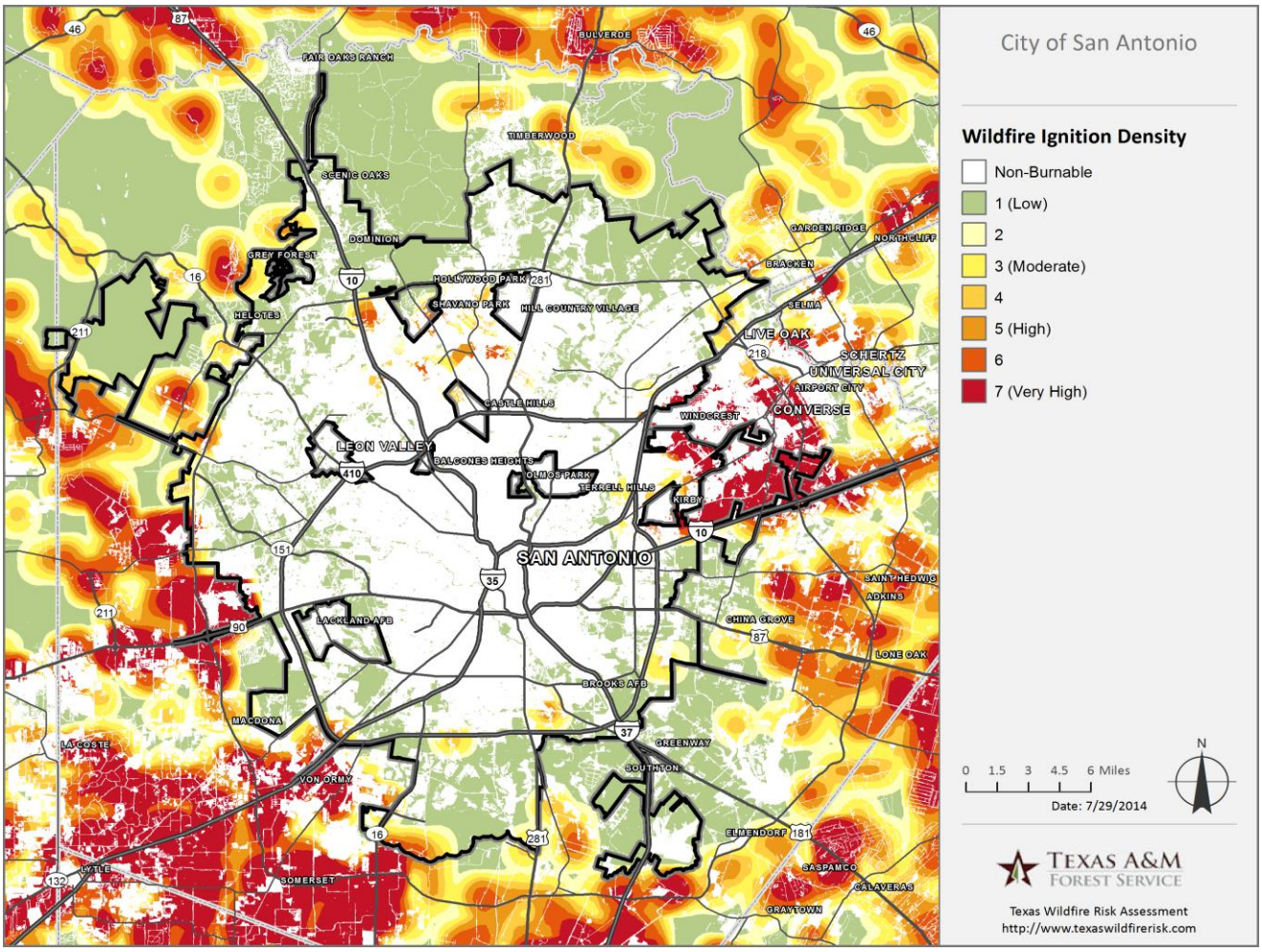
Within the City of San Antonio, a total of 83 fire events were reported from 2007 to 2014. All of these events were suspected wildfires. Historic loss and annualized loss estimates due to wildfires are presented in Table 8-3. The frequency is approximately nine events every year. Figure 8-5 illustrates the likelihood of a wildfire event in the City of San Antonio.

Table 8-3. Historic Loss Estimates Due to Wildfire[2]

JURISDICTION	NUMBER OF EVENTS	ACRES BURNED	INJURIES	DEATHS	ANNUAL LOSSES	ANNUAL ACRE LOSSES
City of San Antonio	83	238.13	0	0	$27,778	26.46

[2] Events divided by 7 years of data.

Figure 8-5. Likelihood of Wildfire Starting – City of San Antonio



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 microscopic 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.

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 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 San Antonio planning area, the impact from a wildfire event can be considered "Minor," and injuries are possible but may not result in permanent disability, complete shutdown of critical City area facilities for more than one week, and more than ten percent of property destroyed or with major damage.

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. Persons in the area at the time of the fire are at risk for injury or death from the variety of threats present during a wildfire event. Burns to the human body and smoke inhalation are the foremost threats.

Response personnel face the same potential impacts as the general public. Response personnel can also be at increased risk of physical injury because the nature of their responsibilities may bring them closer to the hazard. Response personnel can experience more long-term impacts resulting from prolonged exposure to smoke, chemicals, and heat. 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. While the San Antonio Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible in the event of a fire near the facility. If the SAOEM office was inaccessible, then staff members would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the SAOEM and may suffer more interruptions as a result of damages from a wildfire. If hard or electronic files are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively impact its ability to respond to and recover from the wildfire event. Without a Continuity of Operations Plan (COOP) that takes into account department-specific issues, or regular exercise of that COOP, critical departments may not be able to function and provide necessary services.

Damage from a wildfire even can have an impact on utility infrastructure. This could result in a temporary loss of function for businesses in the 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 outs of control or shifts unexpectedly. This could negatively impact other businesses in the area that were not otherwise damaged.

Most property, facilities, and infrastructure within the planning area are at risk from damage or destruction from a wildfire event, including residential and commercial

structures and their supporting utilities, vehicles and transportation infrastructure, and community buildings, such as hospitals, police stations, and schools. Table 8-4 identifies critical facilities according to their location within the WUI. These facilities were mapped in relation to the High Density Intermix Area and High Density Interface Zones.

Table 8-4. Critical Facilities Located within the Wildland Urban Interface

DHS INFRASTRUCTURE SECTOR	NUMBER OF FACILITIES
Agriculture and Food	6
Banking and Finance	26
Chemical and Hazardous Materials Industry	21
Defense Industrial Base	N/A
Energy	1
Emergency Services	20
Information Technology	N/A
Communications	-
Postal and Shipping	4
Healthcare and Public Health	138
Transportation	1
Water	11
National Monuments and Icons	-
Commercial Facilities	251
Government Facilities	34
Dams	-
Nuclear Reactors, Materials, and Waste	1
Manufacturing	-

Roadways in or near the WUI could also be impacted by wildfire because of damage or closure resulting from smoke and limited visibility.

Wildfires are often a natural phenomenon and part of the normal cycle of the natural environment. Wildfires 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. Fire returns nutrients to the soils, encourages growth of more fire-resistant fauna and trees, and promotes the establishment of seedlings. Many wildlife species thrive in the aftermath of wildfire. The grasses, seedling shrub, and trees that reestablish in a burned area provide an ideal environment for many small seed-eating mammals and

birds, such as voles and sparrows. The abundance of small prey attracts predators like foxes, hawks, and weasels. Burned trees provide sites for cavity-nesting birds like flickers, kestrels, and chickadees, and woodpeckers thrive on the insects that inhabit fire-killed trees. (Source: *Property and Environment Research Center*)

The San Antonio 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 generally exempt from modern building code requirements, which may require fire suppression equipment in the structure, and are often constructed close together. In addition, 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 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 businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of a wildfire event.

Public confidence in local government may be impacted by how response and recovery efforts resulting from the event are handled. A response demonstrating that the City, its leaders, and officials were prepared for the event, anticipated the magnitude, and understood what could happen, will boost the City's reputation and standing with residents. However, if the perception develops, correctly or incorrectly, that the response was slow, needs or complaints of its residents were ignored, or failure to anticipate the magnitude of the event, then public confidence may decline.

A wildfire that is responded to and handled with little damage to structures or infrastructure can enhance public perception. Visual images of the firefighting and suppression effort can be a powerful tool to aid in the public trust and confidence regarding firefighting and public safety.

SECTION 9: TORNADO

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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, with 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." Supercell 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.

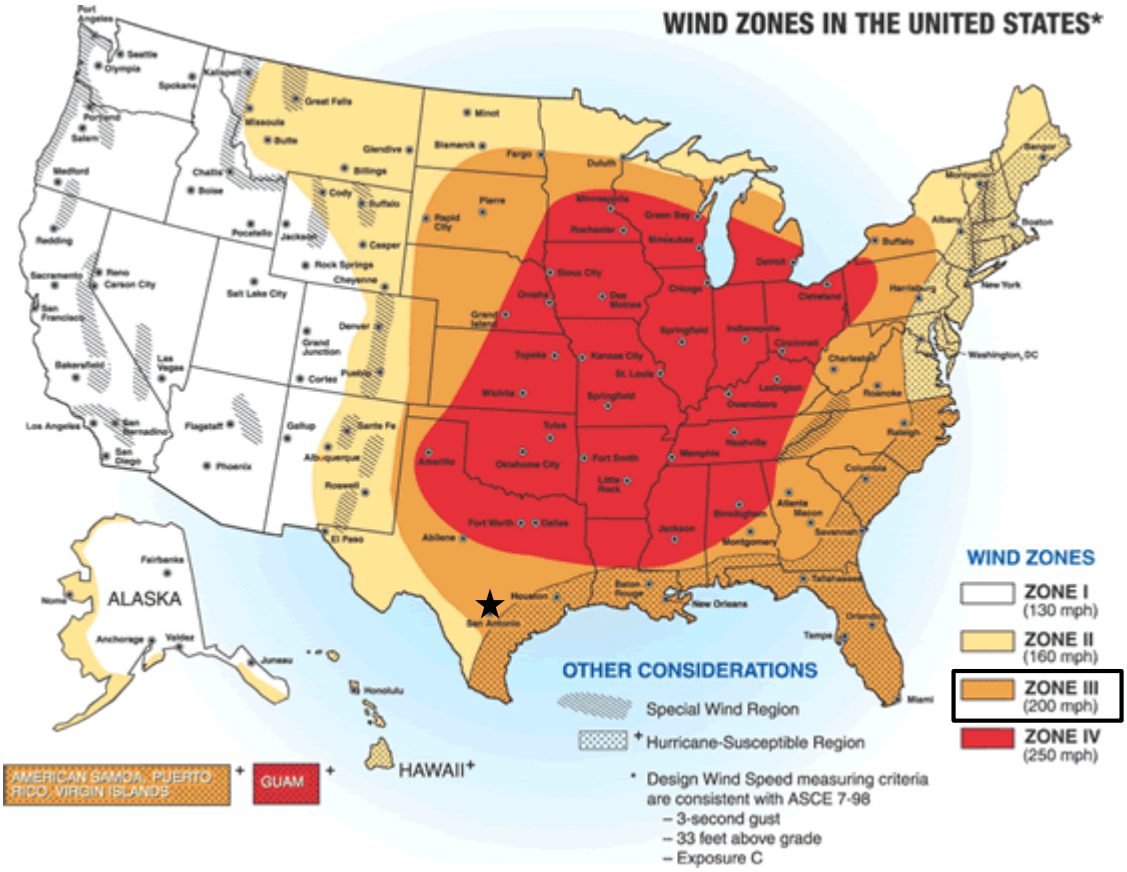
Table 9-1. Variations Among Tornadoes

WEAK TORNADOES	STRONG TORNADOES	VIOLENT TORNADOES
• 69% of all tornadoes • Less than 5% of tornado deaths • Lifetime 1-10+ minutes • Winds less than 110 mph	• 29% of all tornadoes • Nearly 30% of all tornado deaths • May last 20 minutes or longer • Winds 110 – 205 mph	• 2% of all tornadoes • 70% of all tornado deaths • Lifetime can exceed one hour • Winds greater than 205 mph

Location

As with thunderstorms, tornadoes do not have any specific geographic boundary and can occur throughout the City uniformly. It is assumed that the City of San Antonio planning area is uniformly exposed to tornado activity. The City of San Antonio is located in Wind Zone III (Figure 9-1), where tornado winds can be as high as 200 mph.

Figure 9-1. FEMA Wind Zones in the United States[1]



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] The City of San Antonio is indicated by the star.

Table 9-2. The Fujita Tornado Scale[2]

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.tornadoproject.com/fscale/fscale.htm

Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (Table 9-2). Since February 2007, the Fujita Scale has been replaced by the Enhanced Fujita Scale (Table 9-3), 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 9-3. 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 magnitude reported within the City of San Antonio planning area is F4 on the Fujita Scale, a "Devastating Tornado." Based on this data, the planning area could experience anywhere from an EF0 to an EF5 depending on the wind speed.

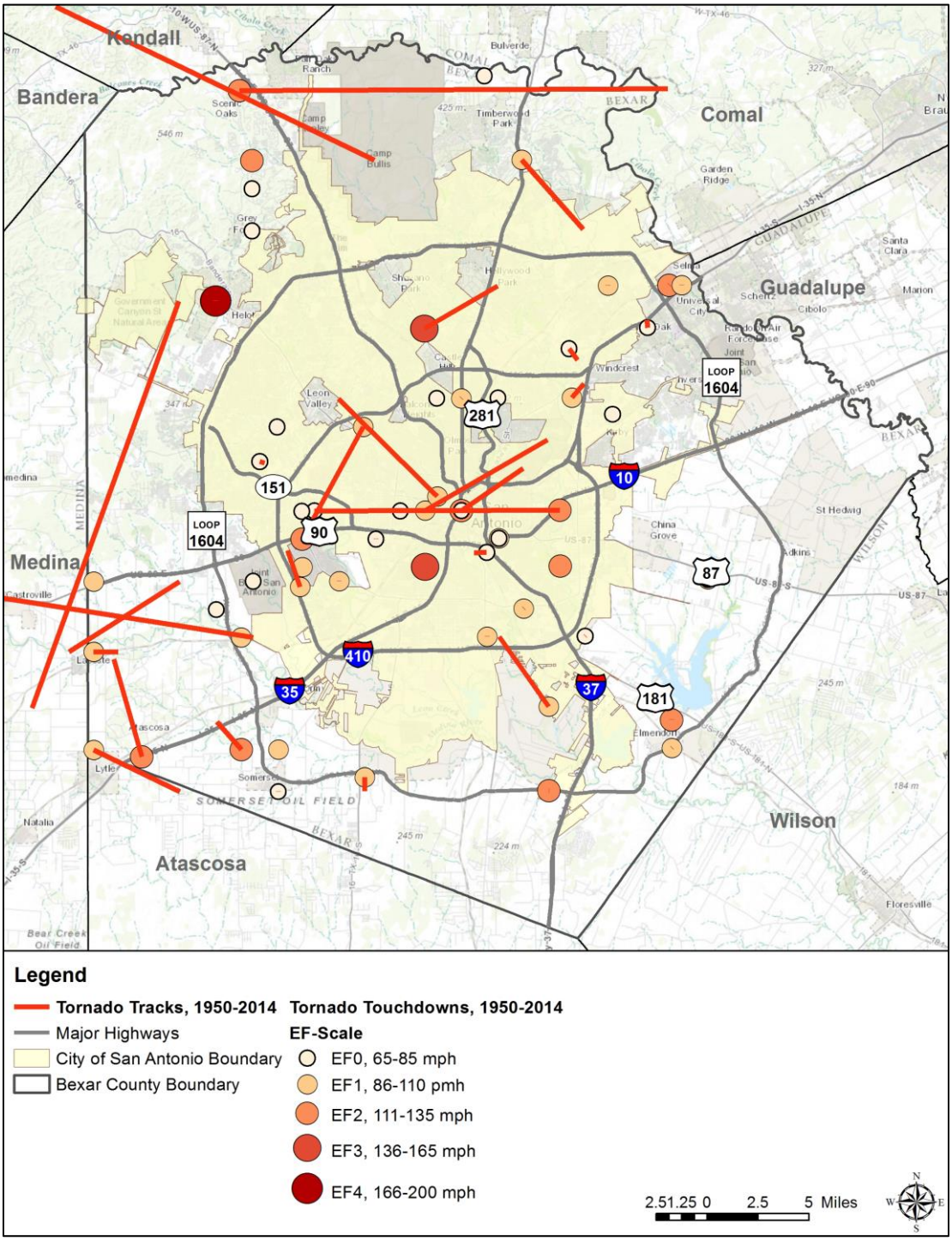
Although the City has experienced tornadoes as devastating as an F4 on the Fujita Scale, the majority of storms only rise to a level of EF0 to an EF2 (Table 9-4). Therefore, the range of intensity that the City of San Antonio planning area would be expected to mitigate is a tornado event that would be a moderate to high risk, an EF0 to EF5.

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 64 years.

Figure 9-2 identifies the locations of previous occurrences in the City of San Antonio planning area from 1950 to 2014. A total of 65 events have been recorded by the Storm Prediction Center (NOAA) and NCDC databases for Bexar County. In the City of San Antonio, 34 events occurred; one event was categorized as a "Devastating Tornado" (F4), one event was a "Severe Tornado" (F3), five events were "Significant Tornadoes" (F2), 11 events were "Moderate Tornadoes" (F1), and 16 events were "Gale Tornadoes" (F0).

Figure 9-2. Spatial Historical Tornado Events, 1950–2014[3]



[3] Source: NOAA Records

Table 9-4. Historical Tornado Events, 1950-2014

DATE	TIME	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 Dollars)	CROP DAMAGE (2014 Dollars)
4/28/1953	9:00 p.m.	F4	$0	$0	$0	$0
11/22/1961	7:30 a.m.	F3	$2,500	$0	$19,902	$0
6/21/1965	6:30 p.m.	F1	$25,000	$0	$187,886	$0
9/24/1967	7:13 p.m.	F1	$2,500	$0	$17,720	$0
9/9/1968	4:00 p.m.	F1	$2,500	$0	$17,100	$0
5/3/1969	5:00 a.m.	F2	$250,000	$0	$1,612,643	$0
5/16/1969	7:30 a.m.	F2	$250,000	$0	$1,612,643	$0
5/14/1970	5:40 p.m.	F1	$25,000	$0	$152,536	$0
9/13/1970	3:00 p.m.	F2	$2,500	$0	$15,254	$0
9/26/1972	4:00 p.m.	F1	$2,500	$0	$14,159	$0
11/1/1977	12:15 p.m.	F1	$250,000	$0	$976,634	$0
8/10/1980	8:57 a.m.	F2	$250,000	$0	$718,252	$0
8/10/1980	9:50 a.m.	F1	$25,000	$0	$71,825	$0
2/12/1984	3:10 a.m.	F0	$25,000	$0	$573	$0
2/12/1984	3:20 a.m.	F0	$250	$0	$57,274	$0
2/12/1984	3:25 a.m.	F0	$2,500	$0	$573	$0
9/17/1988	4:45 a.m.	F1	$2,500,000	$0	$5,030,241	$0
9/17/1988	5:49 a.m.	F2	$25,000,000	0	$50,302,409	$0
3/29/1992	2:50 p.m.	F0	$25,000	$0	$42,415	$0
3/27/1994	1:05 a.m.	F0	$500	$500	$803	$803
5/19/2000	7:50 p.m.	F0	$40,000	$0	$55,292	$0
10/23/2000	2:35 a.m.	F0	$50,000	$0	$69,115	$0
7/15/2007	1:30 a.m.	F1	$50,000	$0	$57,401	$0
7/24/2008	8:20 a.m.	F0	$800,000	$0	$884,450	$0
10/9/2011	12:10 a.m.	F1	$1,000,000	$0	$1,058,202	$0

Table 9-5. Summary of Historical Tornado Events, 1950-2014

EVENTS	MAGNITUDE (Fujita)	DEATHS	INJURIES	PROPERTY DAMAGE (2014 Dollars)	CROP DAMAGE (2014 Dollars)
34 events	F4 (max extent)	3	27	$62,980,455	$803

Significant Past Events

October 9, 2011 – City of San Antonio

A tornado touched down on the southwest side of San Antonio near the intersection of Loop 410 and Medina Base Road. The tornado moved toward the north-northwest and dissipated near the intersection of Allenhurst and Springvale Drives. The path of tornado was 1.9 miles long with a maximum width of 50 yards. The damage from the tornado was rated EF1 with maximum winds estimated at 90 to 100 mph. The tornado caused roof damage to a number of homes along its path including the Ridgestone subdivision, along Parallel Drive, near the intersection of Cedarhurst and Gage Drives, and on north to its end. It also hit near the United States Postal Service Post Office at 5510 SW Loop 410 where it destroyed 15 postal trucks and damaged seven others. In addition, it damaged two office buildings on Valley Hi Drive and damaged the roof and a new building at Sam Rayburn Middle School. In all, over 71 properties were impacted by the tornado and three homes received major damage. No injuries or deaths were reported.

September 17, 1988 – City of San Antonio

A tornado hit Kelly Air Force Base (Base) and stayed on the ground for about two miles. It continued northwest for three more miles, moving off and on the ground, and resulting in scattered damage to residential homes. The tornado first touched down just outside the Base on the east side and then moved northwest over the Base. The hardest hit structures were rows of warehouse storage buildings. About 12 of the buildings in the path suffered major damage. Damage was mostly to roofs and a few outside walls. Two of the warehouses or large sections were totally destroyed which supported a borderline F2 assessment. The warehouses were constructed of concrete block and large wooden support beams for the roofing. Scarring of outside walls by flying debris suggested an intense vortex. However, most of the damage could be considered as F1. At least 20 vehicles were damaged. There were roughly 15 employees in the warehouse area and three were injured. They were treated at a local hospital and released. Base officials stated that it was extremely fortunate that the tornado hit on a Saturday. During that week there is normally 1,500 employees in the area impacted. Estimated damage at the base was near $28 million ($3 million to warehouses and $25 million to contents).

March 15, 1972 – City of San Antonio

A small tornado threaded its way through a northeast San Antonio mobile home park (near Selma) and caused $20,000 damage to structures. A couple was standing 30 feet apart when the small funnel swept between them. The tornado then shredded the walls and roof of their 47-foot mobile home before lifting to hopscotch its way across the Mobile View Estates Trailer Park on IH-35 just south of Doser Lane. Nine other mobile homes were damaged by the erratic funnel which disappeared into the cloud after ten minutes of destruction.

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 San Antonio experiences a tornado touchdown every one to two years. Hence, the probability of future tornado occurrences affecting the City of San Antonio planning area is highly likely and an event may occur within the next year.

Vulnerability and Impact

Existing and future buildings, facilities, and populations in the City of San Antonio are considered to be exposed to tornadoes and could potentially be impacted because tornadoes often cross jurisdictional boundaries. The damage caused by a tornado is typically a result of high wind velocity, wind-blown debris, 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.

The average loss estimate of property and crop is $62,981,258 (in 2014 dollars), having an approximate annual loss estimate of $984,082. Based on historic loss and damages, the impact of tornado on the City of San Antonio planning area can be considered "Major," with more than 25 percent of property to be destroyed with major damage, injuries and/or illnesses resulting in permanent disability, and critical facilities shut down for at least two weeks.

Assessment of Impacts

Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations. Often providing and preserving public health and safety is difficult. Individuals who are exposed to the storm can be struck by flying debris, falling limbs, or downed trees. Residential structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.

Large amounts of debris, such as downed trees, can result in emergency response vehicles being unable to access areas of the city. 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 power outages over widespread areas. Individuals who rely on power for health and/or life safety, such as those on life support systems, could be placed in jeopardy if no generator is available. Also, 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. Tornadoes can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.

In addition to the potential impacts faced by the general public, response personnel must enter the damage area shortly after the tornado passes to begin rescue operations and to organize cleanup and assessment efforts. During these efforts, response personnel are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.

Tornadoes are a threat to operations and service delivery in the San Antonio area and have the potential to significantly impact the continuity of operations. While the San Antonio Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible to all staff, as they may be unable to leave their neighborhood due to roadway debris or other obstructions. Staff members unable to access the protected facility would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the SAOEM and may suffer more interruptions as a result of damages from tornadoes. If files (hard or electronic) are damaged, destroyed, or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively impact its ability to respond to and recover from the tornado event. Without a plan that takes into account department-specific issues, or regular exercise of that plan, critical departments may not be able to function and provide necessary services.

Additionally, private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if debris produced by tornadoes resulted in the closure of roadways over a large area, this would result in a temporary halt to any repair of damaged infrastructure; impede emergency response activities, and interruption in the normal delivery of goods and services. Damaged electrical substations, downed power lines, and roadway obstructions are common occurrences after tornadoes, and all of these will impact the City's normal operations and service delivery. It is imperative that both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed.

Tornadoes typically damage the infrastructure of a community, including buildings, facilities, roads, bridges, power lines, and power plants. It can take a significant amount of time to fully repair these facilities and infrastructure, depending on the nature of the damage and the availability of resources dedicated to the project. During Hurricane Dolly in 2008, an EF0 tornado damaged 84 properties in the San Antonio area. This is fairly typical, as the historical record shows fairly low intensity tornado events, as is expected for the region, but relatively high property damage levels in relation to intensity.

Damage to infrastructure will generally slow down the economic recovery of the community, the re-opening of businesses, and can limit the cleanup effort. It can force some businesses to close temporarily, even those that were not directly impacted by the event. For some businesses, loss of infrastructure can result in the failure of their business.

Some businesses are more heavily reliant on utility infrastructure than others. For example, grocery stores are typically reliant upon electricity to maintain the safety of their food supply. Some larger chain stores may have emergency power generators and fuel on hand, but smaller, independent stores often do not.

While tornadoes pose a risk to the environment, it is not so much the hazard itself, as the effect of the hazard on the built environment that poses the risk. Tornadoes are a natural phenomenon and are unlikely to result in catastrophic or prolonged natural or environmental damage. Damages to the built environment, however, may result in both catastrophic and prolonged damage. For example, a chemical facility that is damaged by a tornado and leaks hazardous or dangerous chemicals into the environment could pose a significant and long-term risk. Depending on what is affected, the living organisms that rely directly and in-directly on that environment for health and survival may also be affected. Some harmful materials may take years, decades, or longer to become harmless and some materials may never fully break down. Until the chemicals break down into harmless products, they can continue to degrade the environment, and potentially leach into a water course or ground water, thus spreading contamination away from the site. Without clean-up, this may continue for years.

The San Antonio area is home to a large number of cultural and historic resources. These resources are a significant draw for tourists and visitors to the area, and help to generate revenue through taxes and fees. This revenue pays for services and programs, which benefit residents and the community.

The potential financial and economic risks associated with tornadoes may be significant for the City. While an individual residential structure that is damaged by a tornado can be devastating to the residents, the damage and cost of repair has a negligible impact on the community's overall economic health. However, a major tornado, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community.

Large or intense tornadoes can cause significant property damage, to homes, businesses, industrial properties, and government buildings, resulting in significant economic impact on the affected area. A community affected by significant property damage would need to fund infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, and normal day-to-day operating expenses. While there are often state and federal programs that can help with these expenses, the majority of these programs are reimbursement programs, and require the local government to fund the initial expenses.

Large or intense tornadoes can also result in dramatic population fluctuations, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area. They may require temporary relocation assistance, and some of them may choose not to return to the community. Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. A loss of jobs affects the financial and economic health and stability of the community and may result in an increase in the unemployment rate.

In addition to property damage and revenue interruptions, tornadoes often result in additional, unexpected costs to the local government. Debris removal, staff overtime, additional personnel, services, and repairs to damaged structures will result in unexpected costs. Even with the best financial planning and management, unanticipated expenses will have an impact on the financial condition of a municipality.

The economic and financial impacts of a tornado in the City of San Antonio 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 planning, including continuity planning that is accomplished by the City, businesses, and residents will contribute to the overall economic and financial conditions after an extreme wind event.

Public confidence in local government may be impacted by how response and recovery efforts resulting from the event are handled. A response demonstrating that the City, its leaders, and officials were prepared for the event, anticipated the magnitude, and

understood what could happen, will boost the City's reputation and standing with residents. However, if the perception developed, correctly or incorrectly, that the response was slow, needs or complaints of its residents were ignored, or failure to anticipate the magnitude of the event, then public confidence will decline.

SECTION 10: EXTREME WIND

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Hazard Description

Extreme wind events, include thunderstorms, hurricanes, and 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

Thunderstorms are created when heat and moisture near the Earth's surface are transported to the upper levels of the atmosphere, producing clouds, precipitation, and wind.

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.

Hurricanes/Tropical Storms

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 greater. 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 begin to resemble a hurricane. Tropical storms can be equally problematic without ever becoming a hurricane, resulting in high winds and heavy rainfall. Once sustained winds reach or exceed 74 mph, the storm becomes a hurricane. The intensity of a land-falling hurricane is expressed in categories of wind speeds and potential damage. Tropical storm-force winds are strong enough to be a danger as well.

Straight Line Winds

Straight line winds can have gusts of 100 mph or more, and are often accompanied by hail or rain. Unlike tornadoes, windstorms have a broader path that is several miles wide and can cover several counties. Straight line wind may down trees and power lines, overturn mobile homes, and cause damage to well-built structures.

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

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

Extent

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

Table 10-1. Beaufort Wind Scale[1]

FORCE	WIND (KNOTS)	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	4-7	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	8-12	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	13-18	Moderate Breeze	Dust, leaves and loose paper lifted, small tree branches move
5	19-24	Fresh Breeze	Small trees in leaf begin to sway
6	25-31	Strong Breeze	Larger tree branches moving, whistling in wires
7	32-38	Near Gale	Whole trees moving, resistance felt walking against wind
8	39-46	Gale	Whole trees in motion, resistance felt walking against wind
9	47-54	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	55-63	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	64-72	Violent Storm	If experienced on land, widespread damage
12	73+	Hurricane	Violence and destruction

Hurricanes are categorized by wind strength and intensity, using the Saffir-Simpson Hurricane Scale (Table 10-2). A Category one storm, has the lowest wind speeds, and a Category five hurricane has the highest. Lower category storms can inflict greater damage than higher category storms depending on where they strike, the amount of storm surge, other weather interaction, and how slow they move.

[1] Source: World Meteorological Organization

Table 10-2. Extent Scale for Hurricanes[2]

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+

On average, the planning area experiences one to two thunderstorm events every year. The City of San Antonio has experienced a significant wind event, or an event with winds in the range of "Force 12" on the Beaufort Wind Scale. However, the average measurement of severe winds related to thunderstorm in San Antonio is a "Force 11," with winds at 64-72 knots. The City, on average, can experience a range of wind speeds that cause widespread damage.

Based on the historical storm tracks for hurricanes and the location of the City of San Antonio outside of the hurricane wind hazard area, the average extent to be mitigated for the planning area is for tropical storm winds.

Historical Occurrences

Tables 10-3 and 10-4 depict historical occurrences of thunderstorm events for the City of San Antonio according to the National Climatic Data Center (NCDC) data. Since January 1955, 158 severe thunderstorm events are known to have impacted Bexar County, based upon NCDC records, with 72 of those events occurring in the City of San Antonio. Table 10-3 presents information on known historical events impacting the City of San Antonio, with resulting damages. High wind events associated with tornadoes are not accounted for in this section.

[2] Source: National Hurricane Center

Table 10-3. Historical Thunderstorm Wind Events, With Reported Damages, 1955-2014

DATE	TIME	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
3/27/1994	12:56 a.m.	56 knots	$500,000	$50,000	$801,056	$80,106
3/8/1995	12:37 a.m.	50 knots	$50,000	$0	$77,898	$0
6/3/1995	10:41 p.m.	Unknown	$0	$10,000	$0	$15,580
7/3/1995	7:10 p.m.	56 knots	$5,000	$0	$7,790	$0
7/3/1995	10:41 p.m.	Unknown	$20,000	$2,000	$31,159	$3,116
5/27/1997	7:03 p.m.	106 knots	$50,000	$0	$73,967	$0
5/27/1997	7:03 p.m.	62 knots	$20,000	$0	$29,587	$0
6/10/2003	6:00 a.m.	55 knots	$50,000	$0	$64,520	$0
6/13/2003	6:45 p.m.	55 knots	$30,000	$0	$38,712	$0
8/8/2003	4:10 p.m.	60 knots	$30,000	$0	$38,712	$0
8/6/2006	4:10 p.m.	65 knots	$50,000	$0	$58,887	$0
4/24/2007	11:50 p.m.	70 knots	$50,000	$0	$57,256	$0
7/15/2007	1:20 a.m.	80 knots	$80,000	$0	$91,610	$0
5/14/2008	3:30 a.m.	50 knots	$5,000	$0	$5,514	$0
8/19/2008	6:05 p.m.	50 knots	$1,000	$0	$1,103	$0
6/2/2010	7:15 p.m.	56 knots	$150,000	$0	$163,329	$0
6/2/2010	7:39 p.m.	52 knots	$10,000	$0	$10,889	$0
6/2/2010	7:40 p.m.	43 knots	$10,000	$0	$10,889	$0
7/26/2010	6:45 p.m.	65 knots	$1,000	$0	$1,089	$0
7/26/2010	6:46 p.m.	43 knots	$1,000	$0	$1,089	$0
9/2/2010	6:54 p.m.	43 knots	$20,000	$0	$21,777	$0
9/2/2010	8:30 p.m.	43 knots	$50,000	$0	$54,443	$0
9/18/2011	8:00 p.m.	50 knots	$25,000	$0	$26,389	$0
7/13/2012	4:25 p.m.	39 knots	$500	$0	$517	$0
8/10/2012	4:30 p.m.	65 knots	$10,000	$0	$10,341	$0
8/10/2012	4:30 p.m.	52 knots	$10,000	$0	$10,341	$0

Table 10-4. Summary of Historical Thunderstorm Wind Events, 1960-2014

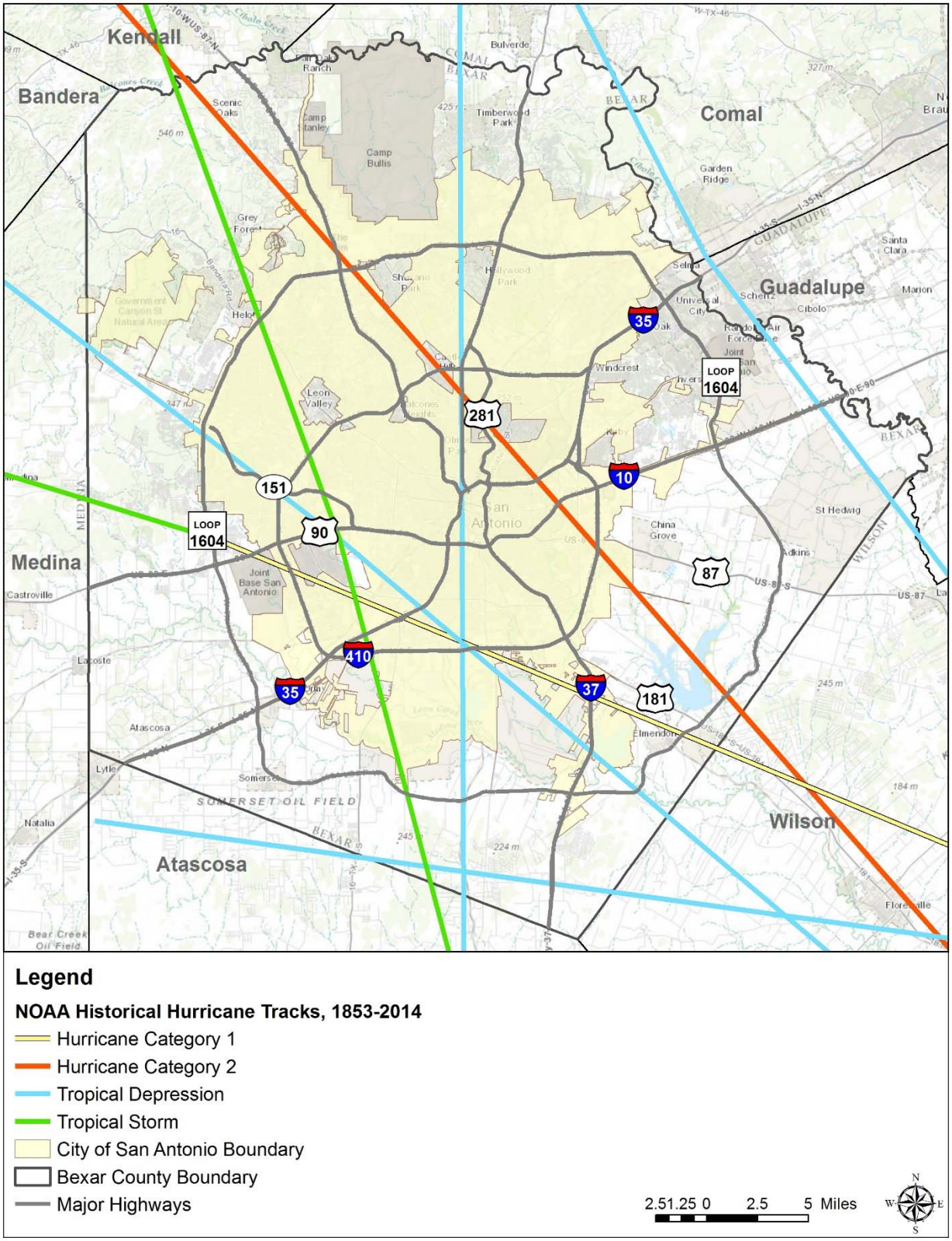
EVENTS	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
72 events	106 knots (max extent)	1	20	$1,688,864	$98,801

Although hurricanes and tropical storms have appeared at various magnitudes and categories in the City of San Antonio area, the storms have usually weakened to tropical storms or depressions by the time they near the end of their life cycle. When reduced winds occur, extreme rainfall is the hazard of concern. Table 10-5 lists storm tracks through the planning area, as shown in Figure 10-1.

Table 10-5. Historic Storms

YEAR	STORM NAME	CATEGORY
1874	Not Named	Tropical Depression
1881	Not Named	Tropical Depression
1886	Not Named	Category 2
1929	Not Named	Category 1
1960	Not Named	Tropical Storm
2007	Erin	Tropical Depression
2010	Hermine	Tropical Storm

Figure 10-1. Hurricane/Tropical Storm Tracks



Significant Past Events

March 15, 2007 – City of San Antonio

A short, curved line of thunderstorms, approaching from the northwest, intersected near 1:25 a.m. with a second line of thunderstorms building westward from Seguin and Gonzales. For the next 20 minutes the storms appeared to strengthen near this intersection and spread southwestward. By 1:50 a.m. the storms at this intersection began moving toward the southeast and by 1:55 a.m. all storms were weakening rapidly. The greatest damage was located along Knollcreek Drive on the north side from Jung Road to Classen Road. On the south end the damage was located parallel to and about one quarter mile northwest of Nacogdoches Road from its intersection with Bell Drive to its intersection with O'Connor Road. The most typical kind of damage over the area consisted of broken tree limbs and branches that had been tossed toward the southeast, indicating wind gusts of 45 to 60 mph. However, in a number of locations large trees were snapped off or knocked over. A few trees showed signs of weak root systems, but most of the trees were healthy. This level of damage indicated wind gusts of 80 to 100 mph.

May 27, 1997 – City of San Antonio

Severe downburst winds estimated in excess of 100 mph produced widespread damage across much of the southwest part of San Antonio. Widespread minor damage was reported to roofs and outbuildings, windows, signs and trees in the area. Wind gusts to 62 knots were measured by an NWS employee at his home in San Antonio. Power lines were blown down, with power out for several hours to over 100,000 persons.

March 27, 1994 – City of San Antonio

Hail first began falling in extreme northwestern Bexar County near 12:30 p.m., increasing to golf ball-size by 12:50 a.m. At 12:56 a.m., winds gusted to 56 knots at the San Antonio International Airport. Shortly after 1:00 a.m., residents in north-central San Antonio reported hearing a "roaring train" sound near the airport. Power lines were downed in the area, trees were blown over and a sturdy metal sign was knocked down. Windows were blown out at Broadway and Interstate 410. Shortly afterward, wind gusts to 58 knots were recorded at Randolph Air Force Base. Leaves were stripped from trees in north Bexar County. Considerable damage was reported to roofs of homes and to windows of cars and houses across the northern half of Bexar County. Some of the roof damage was due to broken tree branches being blown over onto houses. Power was knocked to 30,000 homes and businesses for several hours.

Probability of Future Events

Most thunderstorms occur during the spring, in the months of March, April and May, and in the fall, during the month of September. Even though the intensity of extreme wind events is not always damaging for the City, the frequency of occurrence for an extreme wind event is highly likely, meaning that an event is probable within the next year for the City of San Antonio planning area.

Based on historical occurrences and the infrequency of significant hurricane wind events, the probability of future events is unlikely for the City of San Antonio planning area, meaning it is possible that the area will be impacted by a hurricane event in the next 10 years.

Vulnerability and Impact

Vulnerability is difficult to evaluate since extreme wind events can occur at different strength levels, in random locations, and can create relatively narrow paths of destruction. Hurricane-force winds can cause major damage to large areas. Due to the randomness of these events, all existing and future structures, and facilities in the City of San Antonio 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 recepticles, brick facades, and vehicles, unless reinforced, are vulnerable to extreme 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.

An extreme wind can also result in traffic disruptions, injuries and in rare cases, fatalities. Impact of extreme wind events experienced in the City of San Antonio planning area would be “Minor,” and injuries and illnesses do not result in permanent disabilty, the quality of life lost would be minor, and facilities would be shut down for more than 1 week. Overall, the average loss estimate (in 2014 dollars) is $1,787,665, having an approximate annual loss estimate of $33,105.

While Storm track data is available for the past 150 years, property and crop loss data is only available from 1950 to present, and there are no damages recorded for the previous 65 year reporting period. Therefore, the average annual loss estimate for the City of San Antonio is considered negligible. The potential severity of impact from a hurricane for the City of San Antonio planning area is classified as limited, meaning injuries would be

treatable with first aid, critical facilities would not be shut down for more than 24 hours, and less than ten percent of property would be destroyed.

Assessment of Impacts

Extreme wind and 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. Individuals who are exposed to the storm can be struck by flying debris, falling limbs, or downed trees. Residential structures can be damaged, or crushed by falling trees, which can result in physical harm to the home's occupants.

Large amounts of debris, such as downed trees, can result in emergency response vehicles being unable to access areas of the City planning area. Downed power lines may result in roadways being unsafe for use, which may prevent first responders from responding to calls for assistance. 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.

Extreme wind and hurricane events often result in power outages over widespread areas. Individuals who rely on power for health and life safety, such as those on life support systems, could be placed in jeopardy if generators are not available. Also, 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.

Response personnel are subject to the health and safety concerns that can impact the general public. In addition, downed power lines, damaged structures, hazardous spills, and unrecognizable or unusual debris that often accompany an extreme wind event can pose a significant risk to response personnel.

Extreme wind and hurricane events are a threat to operations and service delivery within the City, and have the potential to significantly impact local government's continuity of operations. While the City Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible to staff unable to leave their neighborhood due to roadway debris or other obstructions. In that case, those staff members would be limited to performing work with available resources from their remote location.

Other City departments may not be as protected as the SAOEM, and may suffer more interruptions as a result of damages from extreme winds. If files (hard or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. An interruption could have significant impacts throughout the planning area, and could negatively impact response and recovery from an extreme wind and hurricane events. Without a Continuity of Operations Plan (COOP) that takes these issues into account, and a training program to

regularly practice COOP procedures, departments may not be able to function, and may be unable to provide necessary services.

The same is true for private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers. If, for example, debris downed by extreme winds resulted in the closure of roadways over a large area, this would result in a temporary halt to any repair of damaged infrastructure, impede emergency response activities, and result in a complete interruption in the normal delivery of goods and services. Damaged electrical substations, downed power lines, and roadway obstructions are all common occurrences during extreme wind events, and all of these will impact a community's normal operations and service delivery. It is imperative that the community, both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed.

While extreme wind does pose a risk to the environment, it is not so much the hazard itself that poses the risk. Rather, it is the effect of the hazard on the built environment that poses the risk. Extreme winds are a natural phenomenon, and are unlikely to result in catastrophic or prolonged natural or environmental damages. Damages to the built environment, however, may result in both catastrophic and prolonged damage to the environment. For example, a chemical facility that is damaged by extreme winds and begins leaking hazardous chemicals into the environment could pose a significant and long-term risk to the environment, and, depending on what is affected, to the human, animal, and plants that rely on that environment for health and survival. Some of these materials may take years, decades, or even longer to break down and become harmless; some materials may never fully break down. Until the chemicals break down, they can continue to degrade the environment where they have come to rest, in some cases leaching back into the water course or into ground water spreading contamination away from the site. Without clean-up this may continue for years.

San Antonio is home to a large number of cultural and historic resources. Many of the historic neighborhoods may be at risk from an extreme wind event, as they are of a construction type and material that is more vulnerable to extreme winds. These 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 for City services and programs, which benefit residents and the community.

Extreme wind and hurricane events to the planning area can also include potentially significant financial and economic risks. While an individual residential structure that is damaged by wind can be devastating to the residents, it has a negligible impact on the community's overall economic health. However, a significant extreme wind event, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community.

Large scale wind events can cause significant property damage, to homes, businesses, industrial properties, and government buildings. This 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. While there are often state and federal programs that can help with these expenses, the majority of these programs are reimbursement programs, meaning that the local government must still fund the initial expenses out of pocket.

Significant wind events can also result in dramatic population fluctuations, as people are unable to return to their homes or jobs and may seek shelter and work outside of the affected area. They may require temporary relocation assistance, and some of them may choose not to return to the community. Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. This loss of jobs affects the financial and economic health and stability of the community, and may result in an increase in the unemployment rate.

Extreme wind and hurricane events typically damage the infrastructure of a community, including roads, bridges, power lines, and power plants. It can take a significant amount of time to fully repair such facilities and infrastructure, depending on the nature of the damage and the resources available that can be dedicated to the project. Damage to infrastructure will generally slow down the economic recovery of the community, as it often slows the re-opening of businesses and can limit the clean-up effort. It can force some businesses to close temporarily, even those that were not directly impacted by the event. For some businesses, the loss of infrastructure can result in the loss of their business.

Some businesses are more reliant on utility infrastructure than others. Grocery stores, for example, are typically reliant on electricity to maintain the safety of their food supply. Some larger chain stores may have emergency power generators and fuel on hand, but smaller, independent stores often do not.

The economic and financial impacts of extreme wind 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 businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of any extreme wind event.

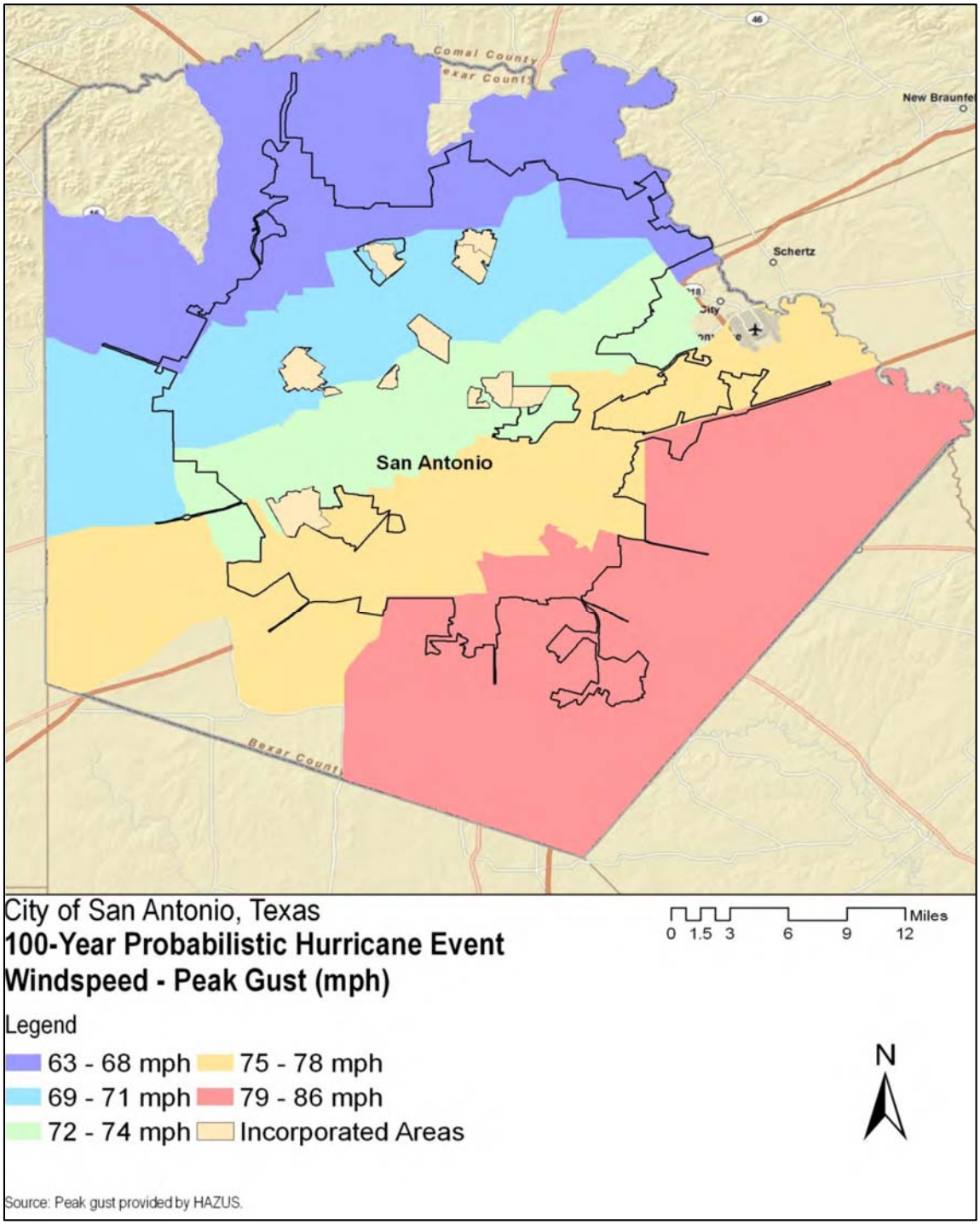
Public confidence in local government may be impacted by how the response to an extreme wind event is perceived, and dependent on how the recovery from the event is handled. A response that demonstrates to residents that the City and its leaders/officials were prepared for the event, anticipated the magnitude, and responded appropriately, will promote goodwill among its citizens. Conversely, public confidence will decline if the perception of residents is that the City was not prepared, response was slow, and needs of residents were ignored.

HAZUS-MH Results

The impact assessment for the San Antonio planning area is based on a HAZUS-MH model. The model run is based on a probabilistic 100-year wind event scenario. The most similar historical event to compare the simulation to is the 1886 Indianola Hurricane, which did impact the San Antonio planning area with at least tropical storm force winds.

The following map was generated from the HAZUS-MH, and shows the peak wind gusts associated with the scenario. As illustrated in this image, the entire area would be subject to tropical storm force winds, with a significant portion of it subject to hurricane-force winds.

Figure 10-2. HAZUS-MH Wind Speed Results - Peak Gusts



General Building Stock Damage

HAZUS-MH estimates that there are 445,000 buildings in the region which have an aggregate total replacement value of $82,951 million (2006 dollars), excluding contents. An estimated 93% of the buildings are associated with residential housing, which accounts for 78% of the building value estimate. Other categories of buildings are estimated as followed:

- Agricultural - 0.2%
- Commercial - 15%
- Education - 1.4%
- Government - 0.4%
- Industrial - 3%
- Religious - 1.6%

HAZUS-MH estimated that approximately 202 buildings will be at least moderately damaged, and that 8 of those buildings will be completely destroyed. The table below shows the expected building damage by occupancy type, as determined by HAZUS-MH.

Table 10-6. Expected Building Damage by Occupancy Type

OCCUPANCY	NO DAMAGE		MINOR		MODERATE		SEVERE		DESTRUCTION	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	1,054	98.41	14	1.35	2	0.17	1	0.07	0	0
Commercial	21,772	98.89	228	1.03	17	0.08	0	0	0	0
Education	699	99.06	6	0.91	0	0.02	0	0	0	0
Government	401	98.99	4	0.98	0	0.03	0	0	0	0
Industrial	5,185	98.94	53	1.01	2	0.04	0	0	0	0
Religion	1,660	99.12	14	0.85	1	0.03	0	0	0	0
Residential	410,503	99.08	3,627	0.88	171	0.04	1	0	8	0
Total	**441,274**		**3,947**		**193**		**2**		**8**	

The table below shows the expected building damage by construction type, as determined by HAZUS-MH.

Table 10-7. Expected Building Damage by Construction Type

OCCUPANCY	NO DAMAGE		MINOR		MODERATE		SEVERE		DESTRUCTION	
	Count	%	Count	%	Count	%	Count	%	Count	%
Concrete	4,665	98.63	62	1.32	2	0.05	0	0	0	0
Masonry	58,521	98.75	673	1.14	64	0.11	2	0	0	0
Mobile Home	18,495	99.57	55	0.3	17	0.09	0	0	7	0.4
Steel	9,291	98.65	117	1.24	10	0.1	0	0	0	0
Wood	350,471	99.20	2,748	0.78	72	0.02	2	0	2	0

As evident in the above table, mobile homes would be expected to suffer the majority of the damage in a 100-year wind event in the San Antonio planning area. Mobile homes are more susceptible to the effects of extreme winds, and are more prone to failure from these events. Wood frame homes would also suffer damage, though most of it would be expected to be minor.

Essential Facility Damage

Before the event analyzed in this scenario, the region had an estimated 30 hospitals, with an estimated 6,636 beds available for use. HAZUS-MH estimated 553 schools, 25 fire stations, and 38 police stations. On the day of the scenario event, the model estimated that all hospital beds were available in the region.

Table 10-8. Expected Damage to Essential Facilities

CLASSIFICATION	TOTAL AVAILABLE	PROBABILITY OF AT LEAST MODERATE DAMAGE (>50%)	PROBABILITY OF COMPLETE DAMAGE (>50%)	EXPECTED LOSS OF USE (<1 DAY)
Fire Stations	25	0	0	21
Hospitals	30	0	0	30
Police Stations	38	0	0	37
Schools	553	0	0	535

As demonstrated by the scenario, essential facilities are expected to fare well in an event similar to that of the scenario.

Debris Generation

Based on the scenario event, HAZUS-MH estimated the amount of debris that would be generated by the extreme wind event. The model breaks debris into three general categories:

1. Brick/wood;
2. Reinforced concrete/steel; and
3. Trees.

This distinction is made due to the different types of equipment required to handle the debris.

The model estimates that a total of 125,943 tons of debris will be generated. Of the total amount, brick/wood comprises 11% of the total, reinforced concrete/steel comprises 0% of the total, with the remainder – approximately 89% of all debris generated is tree debris.

If the building debris tonnage is converted to an estimated number of truckloads, it will require 555 truckloads (@25 tons/truck) to remove the debris generated by the scenario event.

Shelter Requirement

HAZUS-MH estimated the number of households that could be expected to be displaced from their homes due to the scenario event, and the number of displaced people that will require accommodations in temporary public shelters.

The model estimates 2 households to be displaced due to the event. Of these, 1 person (out of a total population of 1,359,126) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the scenario event is $100.1 million, which represents 0.12 % of the total replacement value of the region's buildings.

Building Related Economic Loss

HAZUS-MH estimated building related economic losses, broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to buildings and their contents. The business interruption losses are the losses associated with inability to operate because of the damage sustained during the scenario event. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the event.

The total property damage losses were estimated to be $100 million, with 1% of the estimated losses related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up over 95% of the total loss. The table below provides a summary of the losses associated with the building damage.

Table 10-9. Building-Related Economic Loss Estimates (in thousands of dollars)

CATEGORY	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	OTHER	TOTAL
Property Damage					
Building	$91,209.74	$2,955.72	$549.97	$601.21	**$95,316.63**
Contents	$786.14	$121.24	$65.56	$56.22	**$1,029.16**
Inventory	$0	$3.02	$15.44	$7.23	**$25.70**
Subtotal	$91,995.88	$3,079.98	$630.97	$664.66	**$96,371.49**
Business Interruption Loss					
Income	$0	$191.11	$1.47	$9.56	**$130.14**
Relocation	$2,417.58	$166.83	$10.06	$27.99	**$2,622.46**
Rental	$845.92	$61.56	$0.73	$1.01	**$909.23**
Wage	$0	$65.19	$2.28	$37.67	**$105.14**
Subtotal	$3,263.50	$412.70	$14.54	$76.23	**$3,766.97**
Total	**$95,259.38**	**$3,492.68**	**$645.51**	**$740.89**	**$100,138.46**

Analysis

The scenario demonstrated that, with the exception of mobile homes and wood frame structures, the building stock should fare well in a 100-year extreme wind event, with the scenario peak gusts. It is important to note, however, that these winds are not tornadic, and would not exert the same type of pressure or force on the existing building stock that tornadic winds would impact. Business losses, however, could be expected to be fairly significant, particularly if the businesses affected were uninsured or underinsured.

SECTION 11: HAIL

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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 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 not confined to any specific geographic location, and can vary greatly in size, location, intensity and duration. All areas for the City of San Antonio are considered to be exposed to this hazard equally.

Extent

The National Weather Service (NWS) classifies a storm as "severe," if there is hail three-quarters of an inch in diameter 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 Climatic Data Center (NCDC) Intensity Scale in Table 11-1.

Table 11-1. Hail Intensity and Magnitude[1]

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, 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 San Antonio planning area may experience hailstorms ranging from an H0 to an H9. The City can mitigate a storm from low risk or hard hail to a severe, super hailstorm with tennis ball size hail that leads to extensive structural damage and could cause fatal injuries.

[1] NCDC Intensity Scale, based on the TORRO Hailstorm Intensity Scale.

Historical Occurrences

Historical evidence shown in Figure 11-1 shows that the planning area is vulnerable to hail events overall, which typically result from severe thunderstorm activity. A total of 208 reported historical hail events impacted the City of San Antonio between 1955 and 2014 (Table 11-2). These events were reported to NCDC and NOAA databases, and may not represent all hail events to have occurred during the past 59 years. Only those events for Bexar County with latitude and longitude available were plotted (Figure 11-1).

Figure 11-1. Spatial Historical Hail Events, 1955–2014

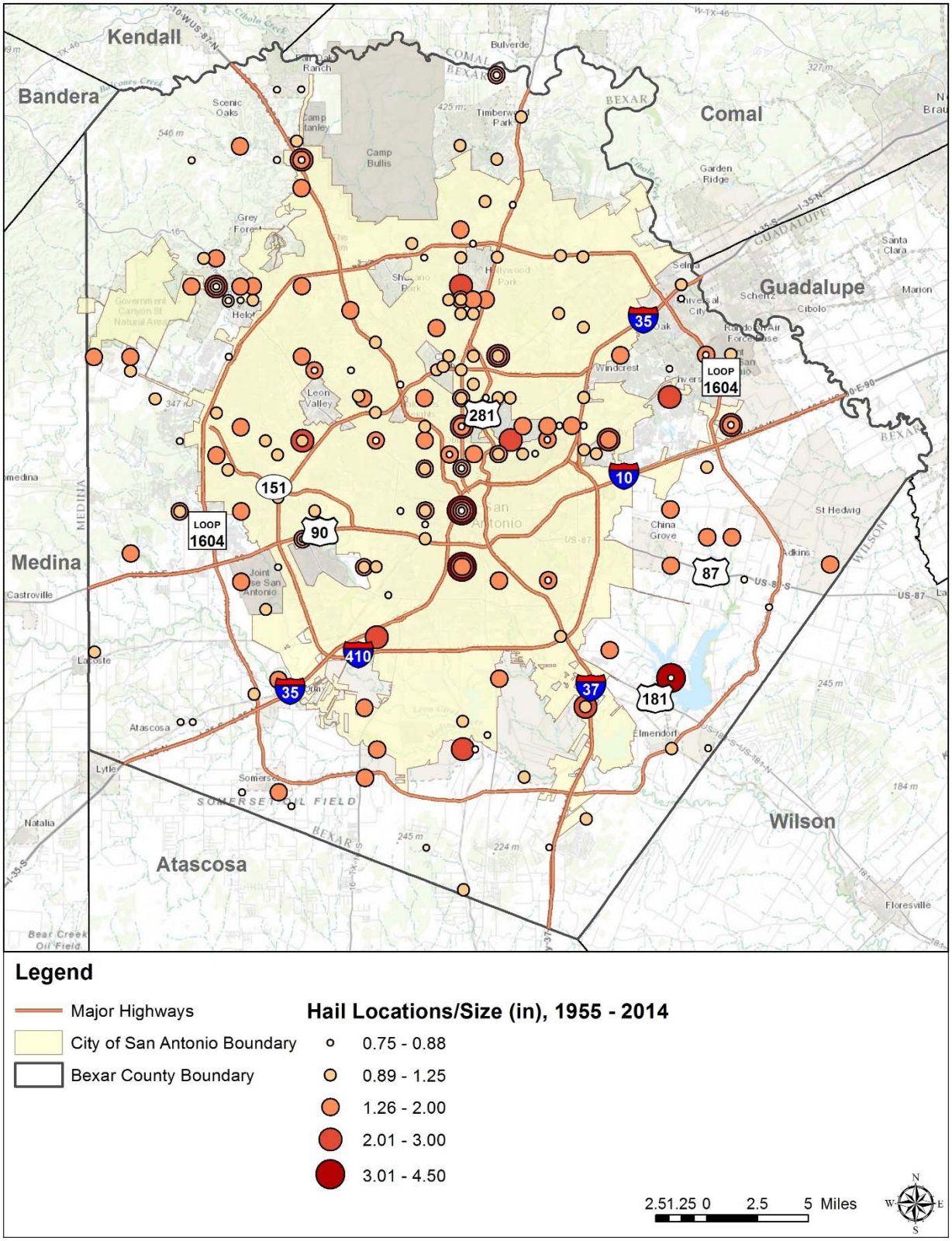

Table 11-2. Historical Hail Events, 1955-2014

DATE	TIME	MAGNITUDE (Inches)	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 Dollars)	CROP DAMAGE (2014 Dollars)
3/27/1994	12:50 a.m.	1.75	$5,000,000	$50,000	$8,010,560	$80,106
3/27/1994	2:50 a.m.	1.00	$500,000	$50,000	$801,056	$80,106
4/5/1994	7:45 p.m.	0.88	$50,000	$50,000	$80,106	$80,106
3/16/2000	6:40 p.m.	1.25	$50,000	$0	$68,941	$0
3/16/2000	9:30 p.m.	2.50	$50,000	$0	$68941	$0
5/6/2001	6:38 p.m.	4.00	$120,000,000	$30,000,000	$160,880,632	$40,220,158

Table 11-3. Summary of Historical Hail Wind Events, 1955-2014

EVENTS	MAGNITUDE (Inches)	DEATHS	INJURIES	PROPERTY DAMAGE (2014 Dollars)	CROP DAMAGE (2014 Dollars)
208 events	4.5 (max extent)	0	0	$169,910,236	$40,460,475

Significant Past Events

March 31, 2013 – City of San Antonio

On March 31, 2013 a weak cold front and upper level short wave trough combined to cause thunderstorms across South Central Texas. Some of these storms produced large hail mainly over the western half of the area.

May 6, 2001 – City of San Antonio

On May, 2001 a storm developed into one of the most devastating hail-and-wind storms in the history of San Antonio. Hail in sizes up to four inches, accompanied by winds estimated to be over 60 mph, destroyed roofs of hundreds of homes, severely damaged hundreds of vehicles and broke thousands of windows in houses. The damage was reported to have been the worst in the northwestern part of the City, where hail reached at least four inches in diameter. Damages were estimated to reach at least $60,000,000 for homes, and an additional $60,000,000 for cars. Additional severe thunderstorm wind

struck the western part of Bexar County just before 8 p.m. and destroyed around a dozen power lines along Grissom Road near Culebra.

March 27, 1994 – City of San Antonio

On March 27, 1994 hail began falling in northwestern Bexar County near 12:30 p.m. CST, increasing to golf ball-size by 12:50 a.m. CST. At 12:56 a.m. CST, winds gusted to 56 knots at the San Antonio International Airport. Shortly after 1 a.m. CST, residents in north-central San Antonio reported hearing a "roaring train" sound near the airport. Power lines were downed in the area, trees were blown over and a sturdy metal sign was knocked down. Windows were blown out at Broadway and Interstate 410. Shortly afterward, wind gusts to 58 knots were recorded at Randolph Air Force Base. Leaves were stripped from trees in north Bexar County. Considerable damage was reported to roofs of homes and to windows of cars and houses across the northern half of Bexar County. Some of the roof damage was due to broken tree branches being blown over onto houses. Power was knocked out to 30,000 homes and businesses for several hours.

Probability of Future Events

Based on the 208 reported events over the last 59 years (1955 – 2014), a hail event is a highly likely occurrence with approximately two to three events each year. Most hailstorms occur during the spring months of March, April and May, and in the fall during the month of September. Warning time for a hailstorm is generally minimal or there is no warning.

Vulnerability and Impact

Damage from hail approaches $1 billion 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.

Hail has been known to cause injury to humans, and occasionally has been fatal. Overall, the average loss estimate of property and crop (in 2014 dollars) is $210,370,711, having an approximate annual loss estimate of $3,287,042. Based on historic loss and damages, the impact of hail damages on the City of San Antonio planning area can be considered "Minor" severity of impact meaning injuries and illness do not result in permanent disability, City area facilities shut down for more than one week, and more than ten percent of property destroyed or with major damage.

Assessment of Impacts

Hail events have the potential to pose a significant risk to people, and can create dangerous situations and difficulty for first responders in providing for or preserving public health and safety. Individuals who are exposed to the storm can be struck by hail, falling

branches, or downed trees. Residential structures can be damaged by falling trees, which can result in physical harm to occupants.

Hail events can result in power outages over widespread areas. Individuals who rely on power for health and life safety, such as those on life support systems, could be placed in jeopardy if no generator is available. An extended power outage can result in an increase in structure fires and carbon monoxide poisoning, as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.

Response personnel are subject to health and safety concerns that can impact the general public. Downed power lines, damaged structures, hazardous spills, and debris often accompany hail events, and can pose a significant risk to response personnel because they may come into closer contact with these hazards during response operations.

Large debris, such as downed trees, can result in the inability of emergency response vehicles to access areas of the City. 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 hail, first responders may be prevented from responding to calls, as the hail may be so large that it is unsafe to operate vehicles and equipment.

Hail is a threat to operations and service delivery in the San Antonio planning area, and has the potential to significantly impact the continuity of operations. While the City Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible to all staff, and they may be unable to leave their neighborhood due to roadway debris or other obstructions. The situation may result in the inability of staff members to reach residents that need help.

Other City departments may not be as protected as the SAOEM and may suffer more interruptions as a result of damages from a hail event. If hard or electronic files are damaged, destroyed, or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruptions could have significant impacts throughout the City and could negatively impact the City's ability to respond to and recover from the hail event. Without a specific plan within each critical department that takes these department-specific issues into account and considers how best to work around them, and without regular exercise of that plan, departments may not be able to function and may be unable to provide necessary services.

The same is true for private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers. For example, if debris downed by hail resulted in the closure of roadways over a large area, this could result in a temporary halt to any repair of damaged infrastructure, impede emergency response activities, and interrupt the normal delivery of goods and services. Damaged electrical

substations, downed power lines, and roadway obstructions are common occurrences during and after a hail event, impacting a community's normal operations and service delivery. It is imperative that the community, including public and private entities, plan for service interruptions, and address how they will be able to function and provide services until normal operating conditions can be resumed.

Hail typically causes damage to the infrastructure of a community, including buildings, facilities, and power lines. It can take a significant amount of time to fully repair damaged facilities and infrastructure, depending on the nature of the damage and the resources available that can be dedicated to the project.

Damage to infrastructure will generally slow down the economic recovery of the community, delaying the re-opening of businesses and limiting the cleanup effort. Damage from a hail event can force some businesses to close temporarily, even those that were not directly impacted by the event. For some businesses, loss of infrastructure can result in the failure of their business. Some businesses are more heavily reliant on utility infrastructure than others, such as grocery stores, which are typically reliant on electricity to maintain the safety of their food supply. Some larger chain stores may have emergency power generators and fuel on hand, but smaller, independent stores often do not.

Damages from a hail event to the natural environment, may result in both catastrophic and prolonged damage. For example, a chemical facility that is damaged by hail and begins leaking hazardous chemicals into the environment could pose a significant and long-term risk. Some hazardous materials may take years, decades, or even longer to break down and become harmless; and some materials may never fully break down. Until hazardous materials fully break down they can continue to degrade the environment where they have come to rest, in some cases leaching back into the watercourse or into ground water, spreading contamination away from the site. Without proper remediation, contamination into the environment may continue for years.

The San Antonio planning area is home to a large number of cultural and historic resources. Many of the historic neighborhoods may be at risk from a hail event, as they are of a construction type and material that is more vulnerable to hail. 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 for services and programs which benefit residents and the community.

The financial and economic risks associated with hail may be significant. While an individual residential structure that is damaged by hail can be a significant or devastating financial loss to the residents, it has a negligible impact on the community's overall economic health. However, a significant hail event, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community.

Large scale hail events can cause property damage to homes, businesses, industrial properties, and government buildings. While there are often state and federal programs that can help offset expenses, the majority of these programs are reimbursement programs and the community must still fund the initial expense out of pocket.

Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. A loss of jobs affects the financial and economic health and stability of the community, and may result in an increase in the unemployment rate.

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 businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of any hail event.

Public confidence in local government may be impacted by how the response to a hail event is perceived, and dependent on how the recovery from the event is handled. A response that demonstrates to residents that the City's leaders and officials were prepared for the event, anticipated the magnitude, and responded appropriately, will promote goodwill among citizens. Conversely, public confidence will decline if the perception of residents is that the City was not prepared, response was slow, and needs of residents were ignored.

SECTION 12: DAM FAILURE

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Hazard Description

Dams are water storage, control or diversion structures that impound water upstream in reservoirs. Dam failure can take several forms, including a collapse of or breach in the structure. While most dams have storage volumes small enough that failures have few or no repercussions, dams storing large amounts can cause significant flooding downstream. Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which cause most failures;
- Inadequate spillway capacity, resulting in excess overtopping of the embankment;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, or maintain gates, valves, and other operational components;
- Improper design or use of improper construction materials;
- Failure of upstream dams in the same drainage basin;
- Landslides into reservoirs, which cause surges that result in overtopping;
- High winds, which can cause significant wave action and result in substantial erosion;
- Destructive acts of terrorism; and,
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, leading to structural failure.

Benefits provided by dams include water supplies for drinking, irrigation and industrial uses; flood control; hydroelectric power; recreation; and navigation. At the same time, dams also represent a risk to public safety. Dams require ongoing maintenance, monitoring, safety inspections, and sometimes even rehabilitation to continue safe service.

In the event of a dam failure, the energy of the water stored behind the dam is capable of causing rapid and unexpected flooding downstream, resulting in loss of life and substantial property damage. A devastating effect on water supply and power generation could be expected as well. The terrorist attacks of September 11, 2001 generated increased focus on protecting the country's infrastructure, including ensuring the safety of dams.

One major issue with the safety of dams is their age. The average age of America's 84,000 dams is 52 years. More than 2,000 dams near population centers are in need of repair, according to statistics released in 2009 by the Association of State Dam Safety Officials[1]. In addition to the continual aging of dams there have not been significant increases in the number of safety inspectors resulting in haphazard maintenance and inspection.

The Association of State Dam Safety Officials estimate that $18.2 billion will be needed to repair all high-hazard dams, but the total for all state dam-safety budgets is less than $11 million[2]. The current maintenance budget does not match the scale of America's long-term modifications of its watersheds. Worse still, more people are moving into risky areas. As the American population grows, dams that once could have failed without major repercussions are now upstream of cities and development.

[1] Association of State Dam Safety Officials, Journal of Dam Safety
[2] www.damsafety.org

Location

The State of Texas has 7,126 dams, all regulated by the Texas Commission on Environmental Quality (TCEQ). Of these, 1,046 are considered "high-hazard," 725 are considered "significant-hazard," and 5,355 are considered "low-hazard." According to the American Society of Civil Engineers "Report Card," the Association of State Dam Safety Officials reports that there are 403 unsafe dams in Texas.[3] For dams in the City of San Antonio location, volume, elevation, condition, and classification information was factored into the risk ranking in Figure 12-1, which illustrates general locations for each dam in the area. Currently, there are 27 dams located in the San Antonio planning area: 18 are classified as "high-hazard", 1 as "significant-hazard", and 8 as "low-hazard" dams. All dams are listed in Table 12-1 along with regulation information.

[3] Source: http://www.asce.org/reportcard/pdf/tx.pdf

Figure 12-1. Dam Locations in San Antonio

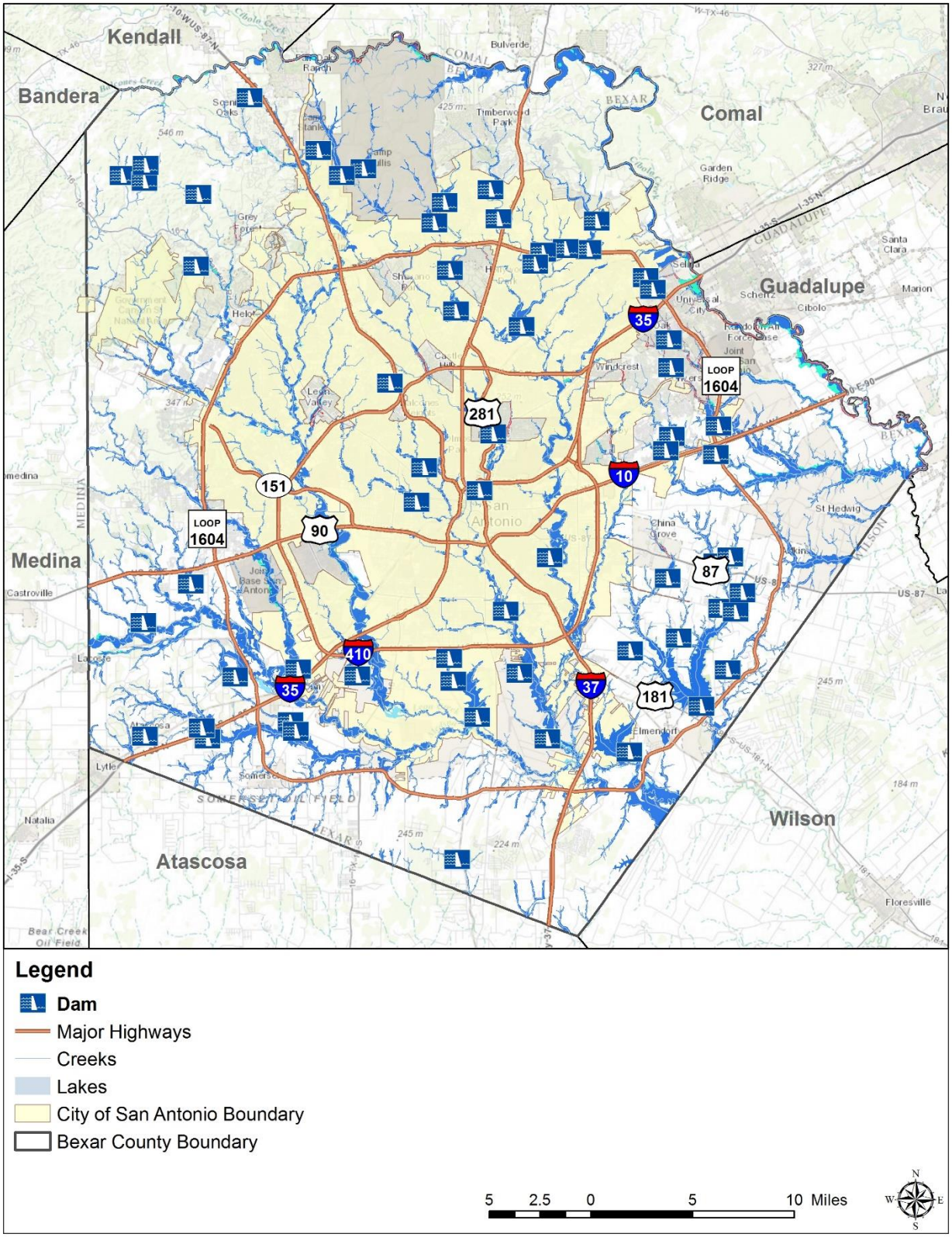

Table 12-1. City of San Antonio Dam Survey

JURISDICTION	DAM NAME	HEIGHT (Ft.)	STORAGE (Acre Ft.)	CONDITION[4]
San Antonio	BALLASETAL LAKE DAM	14	450	Not Rated
San Antonio	BROOKLYN STREET LOCK AND DAM	13.5	28	Not Rated
San Antonio	CANVASBACK LAKE DAM	19	730	Not Rated
San Antonio	CREA BROTHERS LAKE DAM	18	80	Not Rated
San Antonio	DENMAN PARK DAM	20	19	Not Rated
San Antonio	ELMENDORF LAKE DAM	10	105	Satisfactory
San Antonio	HIDDEN SPRINGS DAM	25	46	Not Rated
San Antonio	LIONS PARK LAKE DAM	32	145	Satisfactory
San Antonio	MARTINEZ CREEK WS SCS SITE 2 DAM	27	1,085	Satisfactory
San Antonio	MITCHELL LAKE DAM	10	5,000	Not Rated
San Antonio	NEW ESPADA LAKE DAM	12	120	Not Rated
San Antonio	OLMOS DAM	58	21,970	Not Rated
San Antonio	OR MITCHELL LAKE 1 DAM	32	520	Not Rated

[4] Condition provided if available.

JURISDICTION	DAM NAME	HEIGHT (Ft.)	STORAGE (Acre Ft.)	CONDITION[4]
San Antonio	SALADO CREEK WS NRCS SITE 15R DAM	49	8,741	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 4 DAM	57	3,957	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 5 DAM	57	5,807	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 6 DAM	62	2,830	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 7 DAM	47	6,864	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 8 DAM	61	7,100	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 9 DAM	50	2,612	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 10 DAM	65	4,063	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 11 DAM	64	6,318	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 12 DAM	71	7,837	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 13A DAM	42	3,053	Satisfactory
San Antonio	SALADO CREEK WS SCS SITE 13B DAM	46	1,898	Satisfactory
San Antonio	VICTOR BRAUNIG DAM	76	32,324	Fair
San Antonio	WOODLAWN LAKE DAM	20	460	Fair

For dams with a maximum storage capacity between 10,000 and 100,000 acre-feet, all census blocks within three miles are considered to be at risk to potential dam failure hazards. For dams with a maximum storage capacity of less than 10,000 acre-feet, all census blocks within one mile are considered to be at risk to potential dam failure hazards. With developments downstream of the dams, all populations located downstream of the dams are considered to be at risk to potential safety hazard if a dam failure occurred, especially areas downstream at a lower elevation.

Extent

The extent or magnitude of a dam failure event is described in terms of the classification of damages that could result from a dam's failure; not the probability of failure. The National Interagency Committee on Dam Safety defines high hazard dams as those where failure or mis-operation would cause loss of human life. Prior to 2009, high hazard dams were defined as those at which failure or mis-operation would probably cause loss of human life. Dams classified as "significant" were those at which failure or mis-operation probably would not result in loss of human life but could cause economic loss, environmental damage, and disruption of lifeline facilities or other significant damage. Low hazard potential dams are those at which failure or mis-operation probably would not result in loss of human life but would cause limited economic and/or environmental losses. Losses would be limited mainly to the owner's property. Classifications for extent after 2009 are found in Table 12-2 below.

Table 12-2. Extent Classifications

HAZARD POTENTIAL CLASSIFICATION	LOSS OF HUMAN LIFE	DAM STORAGE CAPACITY
Low	None Expected	Less than 10,000 acre-feet
Significant	Probable (1 to 6)	Between 10,000 and 100,000 acre-feet
High	Loss of Life Expected (7 or More)	100,000 acre-feet or more

Table 12-3 represents the "average" extent or magnitude of a dam failure event that could be expected for the City of San Antonio planning area. The 'Extent Classification' column was determined by taking the average of dams in the City and weighing low hazard dams as a one, significant hazard dams as a two, and high hazard dams as a three based on the potential severity, warning time, and duration.

Table 12-3. Extent for the City of San Antonio

JURISDICTION	DAMS & CLASSIFICATION	EXTENT CLASSIFICATION	LEVEL OF INTENSITY TO MITIGATE
San Antonio	27 – Total 8 – Low 1 – Significant 18 – High	High	Dam failure presents a high threat for the City as there are 18 high hazard dams located within the City of San Antonio. Loss of life is expected and economic loss is significant in the event of a dam failure.

Historical Occurrences

There are approximately 84,000 dams in the United States today.[5] Catastrophic dam failures have occurred frequently throughout the past century. Between 1918 and 1958, 33 major U.S. dam failures caused 1,680 deaths. From 1959 to 1965, nine major dams failed worldwide. Some of the largest disasters in the U.S. have resulted from dam failures. More than 90 dam incidents, including 23 dam failures, were reported in the past ten years to the National Performance of Dams Program, which collects and archives information on dam performance from state and federal regulatory agencies and dam owners.

The State of Texas has not experienced loss of life or extensive economic damage due to a dam failure since the first half of the twentieth century. However, there may be many incidents that are not reported and, therefore, the actual number of incidents is likely to be greater.

There has been one reported historical occurrence for dam failure in Bexar County, which occurred in 2002. There have been no historical occurrences recorded for the City of San Antonio.

Probability of Future Events

No historical events of dam failure have been recorded in the City of San Antonio planning area, though the risk of dam failure is monitored closely. Due to the lack of historical occurrences, the probability of a future event is unlikely, meaning an event is possible in the next ten years.

[5] Federal Emergency Management Agency, Dam Safety Program, available at: http://www.fema.gov/hazards/damsafety/

Vulnerability and Impact

There are 27 dams in the City of San Antonio planning area; eight of them considered low hazard dams, one considered a significant hazard dam and 18 considered high hazard dams based on their classification. While low hazard dams are those at which failure or mis-operation probably would not result in loss of human life and would cause limited economic and/or environmental losses, damage to agriculture and housing is possible due to the number of low hazard dams in the City.

Flooding is the most prominent effect of dam failure. If the dam failure is extensive, a large amount of water would enter the downstream waterways forcing them out of their banks. There may be significant environmental effects, resulting in flooding that could disperse debris and hazardous materials downstream that can damage local ecosystems. If the event is severe, debris carried downstream can block traffic flow, cause power outages, and disrupt local utilities, such as water and wastewater, which could result in school closures. For specific vulnerability, please refer to the narratives below each high hazard dam in this section.

Annualized loss-estimates for dam failure are not available; neither is there a breakdown of potential dollar losses for critical facilities, infrastructure and lifelines, or hazardous-materials facilities. If a major dam should fail, however, the severity of impact could be substantial.

A dam breach could result in multiple deaths with facilities being shut down for 30 days or more, and more than 50 percent of property destroyed or damaged. For these reasons, creating mitigations actions to remove or protect people and structures from the path of destruction is necessary in order to minimize impact from dam failure.

Assessment of Impacts

Any individual dam has a very specific area that will be impacted by a catastrophic failure. The 19 dams identified as high or significant hazard can directly threaten the lives of individuals living or working in the inundation zone below the dam. The impact from any catastrophic failure would be similar to that of a flash flood. Lives could be lost. There could be injuries from impacts with debris carried by the flood.

Response to a dam failure is a response to a hazardous situation. Swift-water rescue of individuals trapped by the water puts the immediate responders at risk for their own lives. After the water has receded, those involved in the cleanup may be at risk from the debris left behind.

Continuity of operations for any jurisdiction outside the direct impact area could be very limited. Unlike most flood situations, a dam failure's impact will be limited to an area within a single watercourse. In addition, the failure, while sending a surge of water downstream will not usually continue to direct water downstream over an extended period of time.

Typically there will be an initial surge of water and then, as with most dam breach situations, the quantity of floodwaters will taper off relatively quickly.

Exceptions would include the partial failure of one of the large dams in the county, or the failure of a major dam during a severe rain event causing major flooding. In either of these cases there could be a flood hazard already in existence when the dam fails.

Having the damage located within a single watercourse, while limiting the area directly impacted, could still cause major disruption of operations and the delivery of services. The heavy onrush of water associated with an event of this type could, through the destruction of infrastructure in the impacted area, put a total halt on our jurisdiction's ability to respond to many of the day-to-day needs.

No matter the size of the dam, the large quantity of water associated with the failure of a dam creates a scouring force in the area immediately below it. For small dams this may cover only a few dozen to hundreds of yards not impacting much, if any, infrastructure. For large dams, like Olmos and Braunig, scouring could go for miles.

Depending on the quantity of water, the force caused by its surge could take out buildings, power lines, including the towers, and destroy roads. A large dam with a high head of water could effectively scour the terrain below it for miles, taking out all buildings, and other infrastructure. This scouring force could also erode soil and any buried pipelines. Any dam that fails has a detrimental impact on the environment. This will vary depending on the size of the failure. Small dams will probably only impact a very small portion of the environment downstream. In the other extreme, the scouring action of a large quantity of water will destroy all vegetation in its path. Like any flash flood, this will destroy any wildlife caught in the flow. Fish habitat could be destroyed as well. In some areas it will take off most, if not all, topsoil limiting the ability of the environment to return to normal. It could take years for the natural restorative processes to bring back an ecosystem similar to what was there beforehand.

A large dam that fails, depending on the quantity of water released, could have an impact far beyond what is normally expected from a flood on its watercourse. Part of this is due to the volume of water that at its peak may have a flow many times that of even a record flood. Added to this is the large quantity of material, both natural, like logs and other vegetation, and human related, like fertilizer, sewage, livestock, vehicles, and other hazardous materials. This material, as it is deposited, may cause further pollution of not just the areas normally flooded, but also land that lies far above or away from the normal floodplain.

The San Antonio area is home to a large number of cultural and historic resources. These resources, and the history they represent, are significant to the area, as they remind the community of its past and help to define its persona. In addition, the City's historic and cultural resources are a significant draw for tourists and visitors to the area and help to

generate revenue through jobs, taxes and fees. This revenue in turn pays for services and programs, which benefit residents and the community.

Many of the City historic homes and neighborhoods could be impacted in the same ways as any other property or residence. In addition to the property damage, the flooding due to dam failure of historic neighborhoods, which often attract tourists and generate revenue, could have long-term economic impacts, both for the property owners and for the City, as tourists and visitors are unlikely to want to visit flood-damaged historic structures and neighborhoods.

The economic impact from the failure of many of the smaller, low hazard dams is minimal. Impact would be to the owner of the dam and potentially to a small local group, probably geographically located directly downstream from the dam. The impacted area would be small, and in most cases isolated, so that a failure of one of the smaller dams may go unnoticed by the residents outside the directly affected area.

As the size of the dam increases and the proximity to the public and/or critical infrastructure increases, the probability of damage to economy increases. Any of the 19 dams identified could have an impact on either the overall economy or on the financial condition of many of the businesses or homeowners located in the inundation zones from those dams.

A worst case scenario would include a failure of Olmos Dam during peak storage. This scenario could not only kill many people, but could irrevocably damage the infrastructure. Roads and bridges would be lost. This includes damage to US-281 and IH-35 highways. Businesses in the downtown area would be damaged or in many cases destroyed, and municipalities in the inundation zones would have a long-term process of rebuilding. All of this would not only impact those areas in the inundation zone, but any area relying on either the infrastructure or businesses located in that zone. For many of the small dams whose failure would have no impact on the general public, there would be little change in the public's confidence in local governments or any agency overseeing their safety or operation.

The failure of any dam causing considerable damage to the community will be under scrutiny by the press and the public. The organizations most in the line of fire will be those responsible for the dam and those responsible for overseeing its licensing and safety. When the ownership of the dam is a public agency the confidence in that agency will be adversely affected.

Dam safety inspections fall to the Dam Safety Program managed by the TCEQ.

The TCEQ currently focuses its inspection program of existing dams primarily on high and significant hazard dams as required by rule in 30 TAC §299.42(a)(2). According to the rule, high and significant hazard dams and large, low hazard dams are scheduled to be inspected every five years, while small and intermediate dams, and low hazard dams,

are only to be inspected at the request of an owner, as a result of a complaint, at the request of someone other than the owner, following an emergency such as a flooding event, or, for determining the hazard classification.

SECTION 13: WINTER STORM

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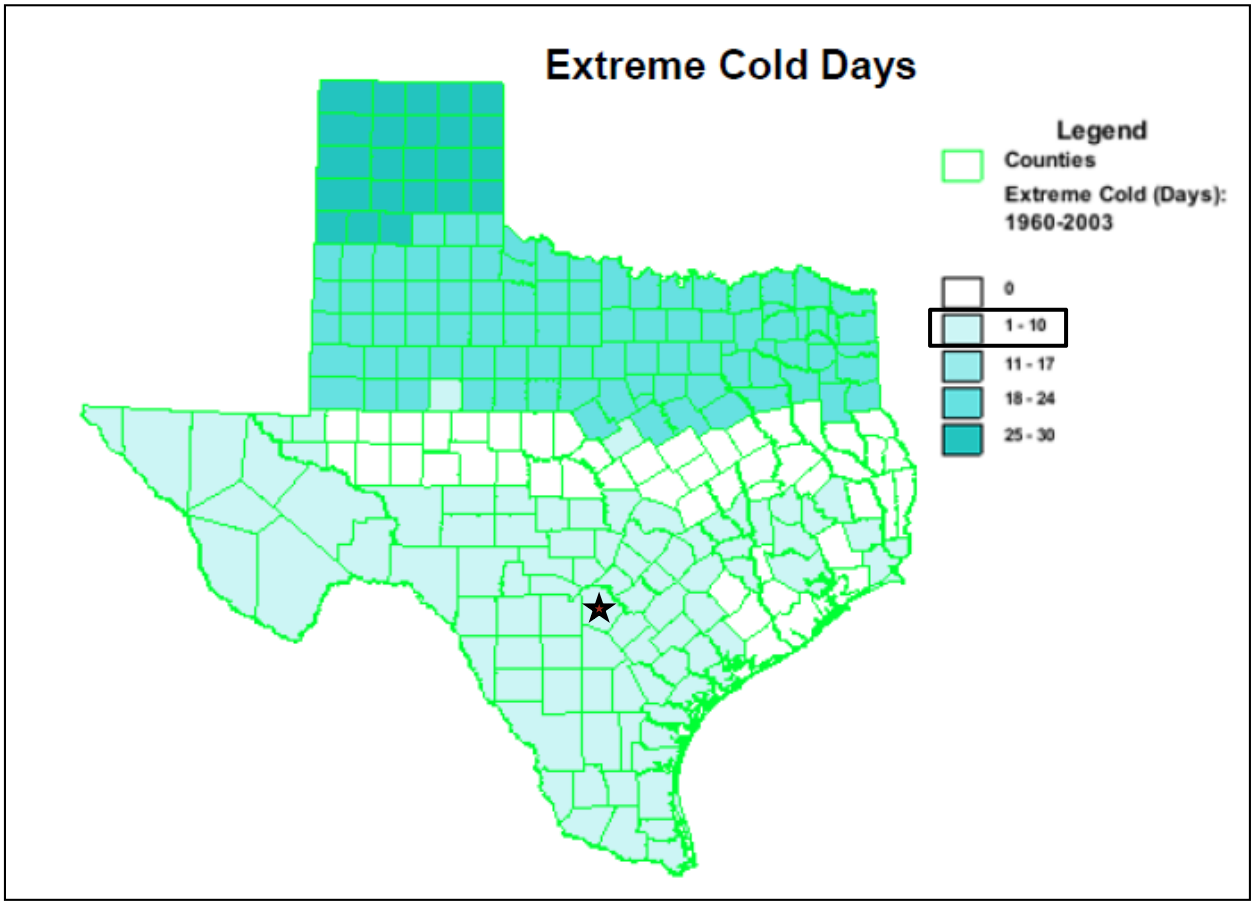
Hazard Description

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 San Antonio 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 13-1, on average, the area experiences less than ten extreme cold days a year, meaning one to ten 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 13-1 describes the types of winter storms possible to occur in the City of San Antonio.

Figure 13-1. Extreme Cold Days 1960-2003[1]



[1] Source: National Weather Service. The City of San Antonio indicated by star.

Table 13-1. 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.
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 San Antonio are considered to be exposed to a winter storm hazard and could potentially be impacted.

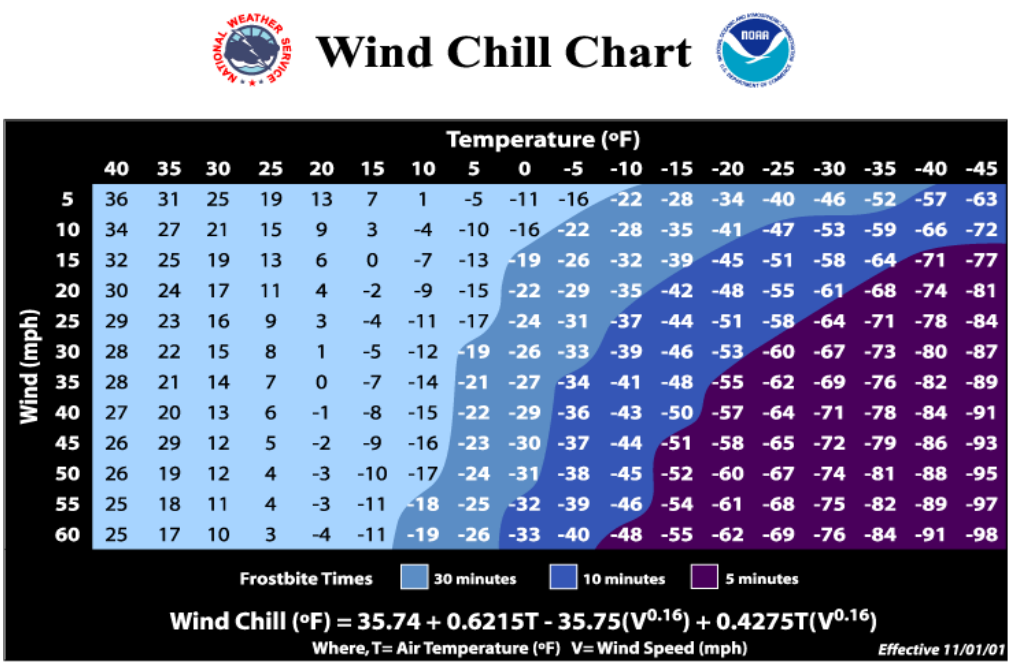
Extent

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 13-2. Table 13-2 should be read in conjunction with the wind-chill factor described in Figure 13-2 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 13-2. 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

Figure 13-2. Wind Chill Chart



Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

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 San Antonio has never experienced a blizzard, but based on 12 previous

occurrences recorded from 1996 to 2014 for Bexar County, it has been subject to winter storm watches, warnings, freezing rain, sleet, snow and wind chill.

Based on historical data for the City of San Antonio area, the average event to mitigate would be a mild to moderate winter storm. The City can expect anywhere between 0.1 to 3.0 inches of ice and snow during a winter storm event and temperatures between 30°F and 50°F with winds ranging from zero to 15 mph.

Historical Occurrences

Table 13-3 shows historical occurrences for Bexar County from 1996 to 2014 provided by the NCDC database. There have been 12 recorded winter storm events in Bexar County. Historical winter storm information, as provided by the NCDC, 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.

Table 13-3. Historical Winter Storm Events, 1996-2014

DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2014 DOLLARS)	CROP DAMAGE (2014 DOLLARS)
2/1/1996	0	0	$1,500,000	$50,000	$2,263,250	$75,442
1/11/1997	0	0	$1,000,000	$20,000	$1,474,991	$29,500
12/23/1998	0	0	$0	$0	$0	$0
12/12/2000	0	0	$0	$0	$0	$0
11/28/2001	0	0	$0	$0	$0	$0
2/24/2003	0	0	$0	$0	$0	$0
1/16/2007	0	0	$0	$0	$0	$0
11/23/2007	1	0	$0	$0	$0	$0
12/9/2008	0	0	$0	$0	$0	$0
2/3/2011	0	0	$0	$0	$0	$0
12/7/2013	0	0	$0	$0	$0	$0
2/7/2014	0	0	$0	$0	$0	$0

Significant Past Events

February 7, 2014 – Bexar County

Southerly low level winds and an approaching upper level trough, allowed warm and moist air to move over a cold air mass at the surface. This lead to freezing drizzle and light freezing rain developing during the early morning hours on February 7th. The first report of freezing drizzle was at 2:50 a.m. CST in Kerr County. Icy roads were reported in several counties. The Shin Oak Drive Bridge over I-35 was closed in Live Oak as were the flyover ramps connecting Highway 281 and Loop 1604 in San Antonio, both of these in Bexar County. The precipitation transitioned from freezing to liquid during the late morning hours as temperatures warmed above freezing.

January 16, 2007 – Bexar County

A combination of freezing rain and drizzle began falling over the county near 6:00 p.m. on January 15th and continued through noon of the following day. Overpasses and elevated roads became iced-over and were closed on the evening of January 15th. City and County offices and schools, which had been closed for the Martin Luther King Holiday, remained closed on January 16th. Main offices and schools did not re-open until January 18th. The ice caused power outages to more than 65,000 persons, along with widespread traffic accidents. The City of San Antonio reported over 500 accidents in one 12-hour period alone. Ironically, the American Meteorological Society was holding its annual conference in San Antonio at the time.

December 23, 1998 – Bexar County

Temperatures in the 70°Fs on the afternoon of December 21st plunged into the 20°Fs through the evening as an arctic cold front crossed through South Central Texas on its way to the Gulf of Mexico. North winds gusting to 30 and 35 mph brought chill indices near the zero-mark. Cold and cloudy weather persisted through December 22nd and 23rd, with daytime temperatures holding in the 20°Fs over the Texas Hill Country and in the low 30°Fs to near 30°F for the remainder of South Central Texas. Spotty freezing rain and freezing drizzle on the morning of the 23rd began to cover roads and bridges, making driving very difficult. As ice continued to accumulate, driving became very dangerous for the northern half of South Central Texas. Nearly 200 vehicle accidents were reported in the San Antonio area.

Probability of Future Events

According to historical records, the City of San Antonio experiences one winter storm event every one to two years. Hence, the probability of a future winter storm event affecting the City 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.

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 City of San Antonio planning area are vulnerable to severe winter events. 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 rural areas 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.

Based on the level of risk and historical occurrences for winter storms in the City of San Antonio, the impact for winter storm is "Minor." Overall, the average loss estimate of property and crop (in 2014 dollars) is $3,843,183, having an approximate annual loss estimate of $213,510. Loss estimates were based on 18 years of statistical data from the NCDC. Table 13-4 shows annualized exposure.

Table 13-4. Winter Storm Event Damage Totals, 1996-2014

JURISDICTION	NUMBER OF EVENTS	PROPERTY DAMAGES	CROP DAMAGES	PROPERTY DAMAGES (2014 DOLLARS)	CROP DAMAGES (2014 DOLLARS)
Bexar County	12	$2,500,000	$70,000	$3,738,241	$104,942
TOTAL LOSSES:		**$2,570,000**		**$3,843,183**	

Assessment of Impacts

The greatest risk from a winter storm hazard is to public health and safety. Exposure to cold temperatures, can cause serious or life-threatening health problems; particularly for infants and the elderly, who are less able to regulate body temperature than healthy adults. Human health concerns associated with cold temperatures include hypothermia and frostbite.

The U.S. Centers for Disease Control and Prevention has published a guide for the public that provides helpful advice and tips for preparing for and dealing with cold weather. The guide recommends that individuals gather and maintain the following cold weather supplies for use in the event that the severe winter weather event lasts for more than a day or in the event that a loss of power lasts for an extended period:

- Alternate way to heat an area of the home, such as space heater with automatic shut-off;
- Blankets;
- Multi-purpose, dry chemical fire extinguisher;
- First aid kit;
- Flashlight or battery powered lantern;
- Battery powered radio and clock, with extra batteries;
- Non-electric can opener;
- Shovel and rock salt; and
- Any special needs items, such as medications and infant or elderly supplies. (Source: *Centers for Disease Control and Prevention*)

Loss of electric power, normal sources of heat, or both can result in increased potential for health risks associated with fire injuries or hazardous gas inhalation because residents burn candles for light or use fires or generators to stay warm.

Response personnel are subject to the same impacts and risks as the general public. For this particular hazard, the risk to response personnel includes utility workers, public works personnel, debris removal staff, tow truck operators, and any other group responding to the effects of the severe winter storm.

Response personnel exposure to winter storm event hazards and impacts would be greater than would be experienced by the general population. While residents would be advised to stay indoors and off roadways, response personnel could work in cold weather and winter precipitation conditions and would be required to travel in potentially hazardous conditions. Responders may also encounter downed power lines, which may be live.

Operations or service delivery may experience impacts from electricity blackouts due to winter storms. Ice and snow can down trees and power lines, creating power outages for portions of the area. Excessive strain on the power grid can also result in failures of the system, making electricity unavailable to the normal customer base. Rolling blackouts, which are generally planned periodic outages to alleviate stress on the power grid, are also possible. Lack of electricity, or interruptions in the delivery of electricity, can pose risks to service delivery and operations for agencies and departments that are unprepared for electricity interruptions and may not own emergency power generators.

The San Antonio/Bexar County Emergency Operations Center (EOC) has full emergency generator backup. Other City departments may not be as well-equipped as the EOC

and may suffer more interruptions as a result of loss of power. If files (hard copy or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively impact its ability to respond to and recover from the winter storm. Without a Continuity of Operations Plan (COOP) that takes these issues into account and considers how best to work around them, and without regular exercise of that COOP, departments may not be able to function, and may be unable to provide necessary services.

Private sector entities on which local government and its residents rely, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if blackouts result in a loss of power to medical centers, there could be dire consequences to patients and patient care, if no emergency power is available. It is imperative that both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed. Operations may also be impacted by limitations on access and mobility if roadways are closed, unsafe, or obstructed.

While severe winter storms themselves tend to be rather short-lived events, their effects can linger long after the storm has passed. Ice that falls and coats facilities, utilities, and roadways will not melt until the temperature rises above freezing, which can create prolonged periods of utility outages and hazardous road conditions. Power loss from damaged lines will affect properties and facilities and may create hazardous conditions for those that occupy the facilities. Roadways and other infrastructure that are affected by ice and freezing temperatures will not be able to function normally until the temperatures rise to more normal levels and the ice melts.

The impact to infrastructure, particularly utilities, will likely be more severe if the winter storm is accompanied by high winds because the winds will cause additional breakage and downing of already compromised power lines. 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.

There are potential impacts to wildlife that are unaccustomed to living in colder temperatures. However, risks to wildlife would be mild because winter storm events tend to be of a short duration in the area.

Native plant and tree species can also experience a potential impact form winter storm events. The species that are native to the area are not accustomed to severe cold weather for an extended period of time. A winter storm event could lead to tree, shrub, and plant damage or death. Severe cold and ice could also damage agricultural crops.

The San Antonio area is home to a large number of cultural and historic resources. These cultural and historic resources are largely immune to the effects of severe winter storms. Historic and culturally significant structures could experience the same potential impacts

as other property, including downed trees, possible roof or structural damage, and potential damage to paved areas and water pipes.

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 pays for services and programs that benefit residents and the community. Should an interruption in tourism occur because of a severe winter storm, it is likely to be short lived and have a temporary impact on historic and cultural resources that depend on tourism for support.

The economic and financial impacts of winter weather on the City of San Antonio 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. Cleanup and repair costs would impact local government and the private sector. However, cleanup and repair costs would likely be addressed with insurance coverage, available state and federal assistance, operating reserves, or all of the above.

Insufficient response to winter storm events can seriously undermine the public's confidence in its government and leaders. Perceived slow response to snow removal and winter storm-related power outages in other areas of the U.S. have become points of strident criticism in the impacted communities. In some cases, a lack of timely and realistic communication with the public was identified as a contributor to frustration and distrust that developed among the population. Perceptions of inequality in response or relief, particularly if those inequalities are based on socioeconomic status, ethnicity, age, gender, or seniority, can lead to increased dissatisfaction with government and leadership, and may result in a weakening of social order. If necessary, rationing of electricity needs to be conscientiously implemented to avoid the appearance of bias or impropriety.

SECTION 14: HAZARDOUS MATERIALS

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Hazard Description

In a hazardous materials incident, solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers. This profile focuses on fixed sites. 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.

Tier 2 data is a publicly available database from the Texas Department of State Health Services Tier 2 Chemical Reporting Program. Under EPCRA, all facilities which store significant quantities of hazardous chemicals must share this information with state and

local emergency responders and planners. Facilities in Texas share this information by filing annual hazardous chemical inventories with the Texas Department of State Health Services (DSHS), Local Emergency Planning Committees (LEPCs), and local fire departments. The Texas Tier 2 Report contains facility identification information and detailed chemical data about hazardous chemicals stored at the facility.

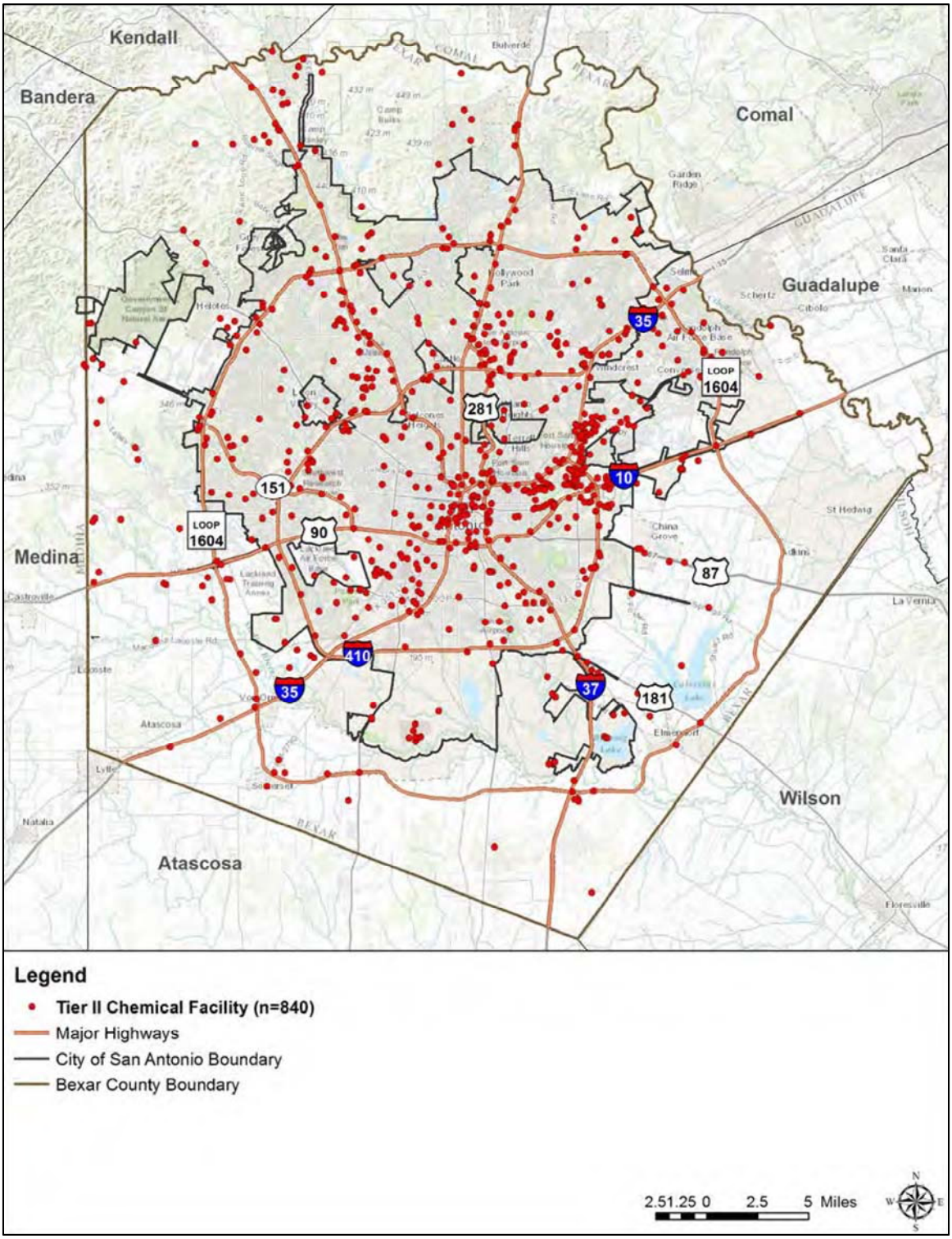
A facility must report if it meets the following criteria:

- Any company using chemicals that could present a physical or health hazard must report them, according to Tier 2 requirements.
- If an industry has an Occupational Safety and Health Administration (OSHA) deemed hazardous chemical that exceeds the appropriate threshold at a certain point in time, then the chemical must be reported. These chemicals may be on the list of 356 Extremely Hazardous Substances (EHS) or could be one of the 650,000 reportable hazardous substances (not on the EHS list). This reporting format is for a "snapshot in time." EHS chemicals have to be reported if the quantity is either greater than 500 pounds, or if the Threshold Planning Quantity (TPQ) amount is less than 500 pounds.

Location

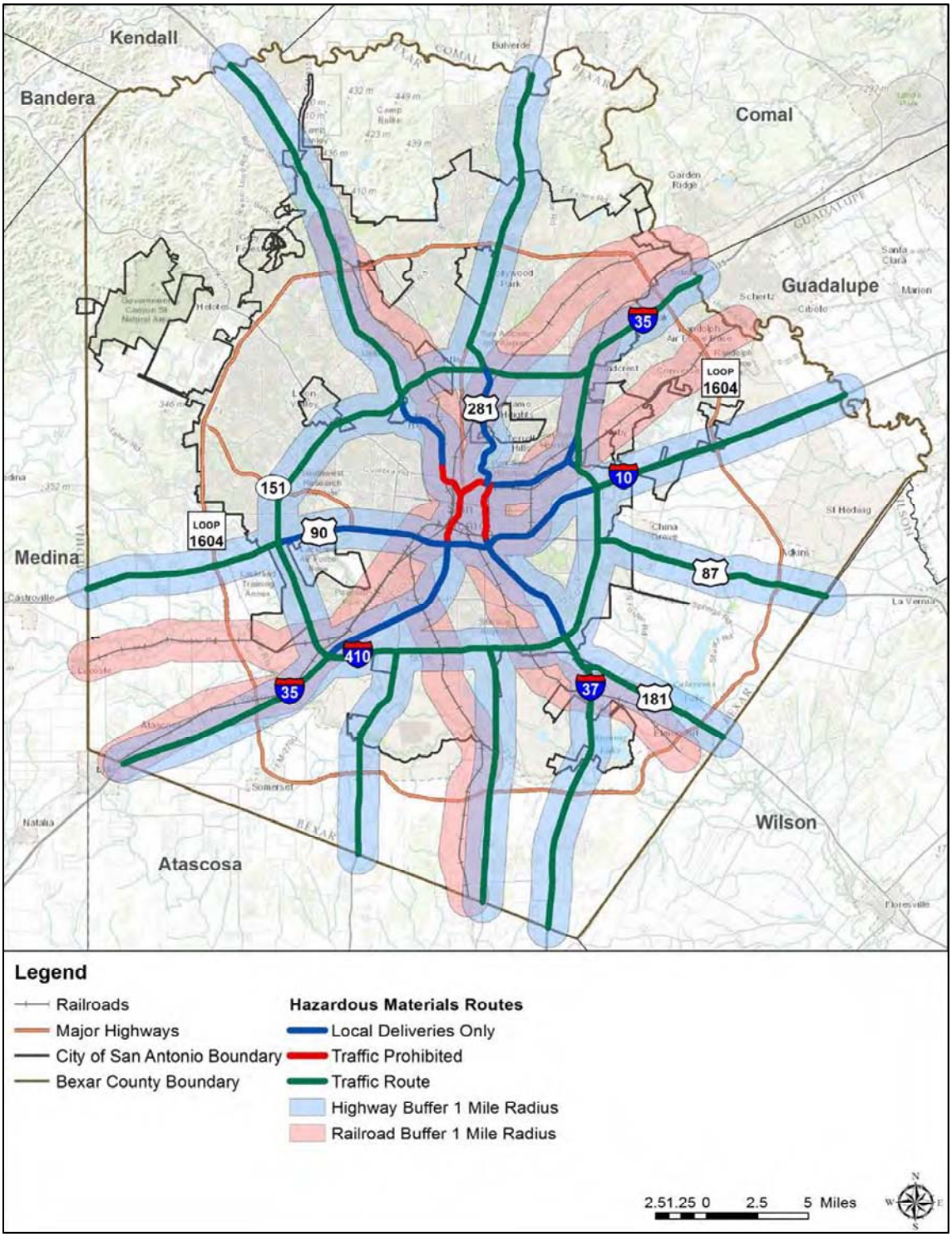
The locations of available TRI and Tier 2 toxic sites in the City of San Antonio planning area are shown below in Figure 14-1. In Figure 14-2 it shows the locations of hazardous materials transportation corridors.

Figure 14-1. Toxic Sites in the City of San Antonio[1]



[1] Source: Texas Department of State Health Services

Figure 14-2. Hazardous Materials Transportation Corridors in the City of San Antonio[2]



[2] Source: San Antonio Office of Emergency Management

Extent

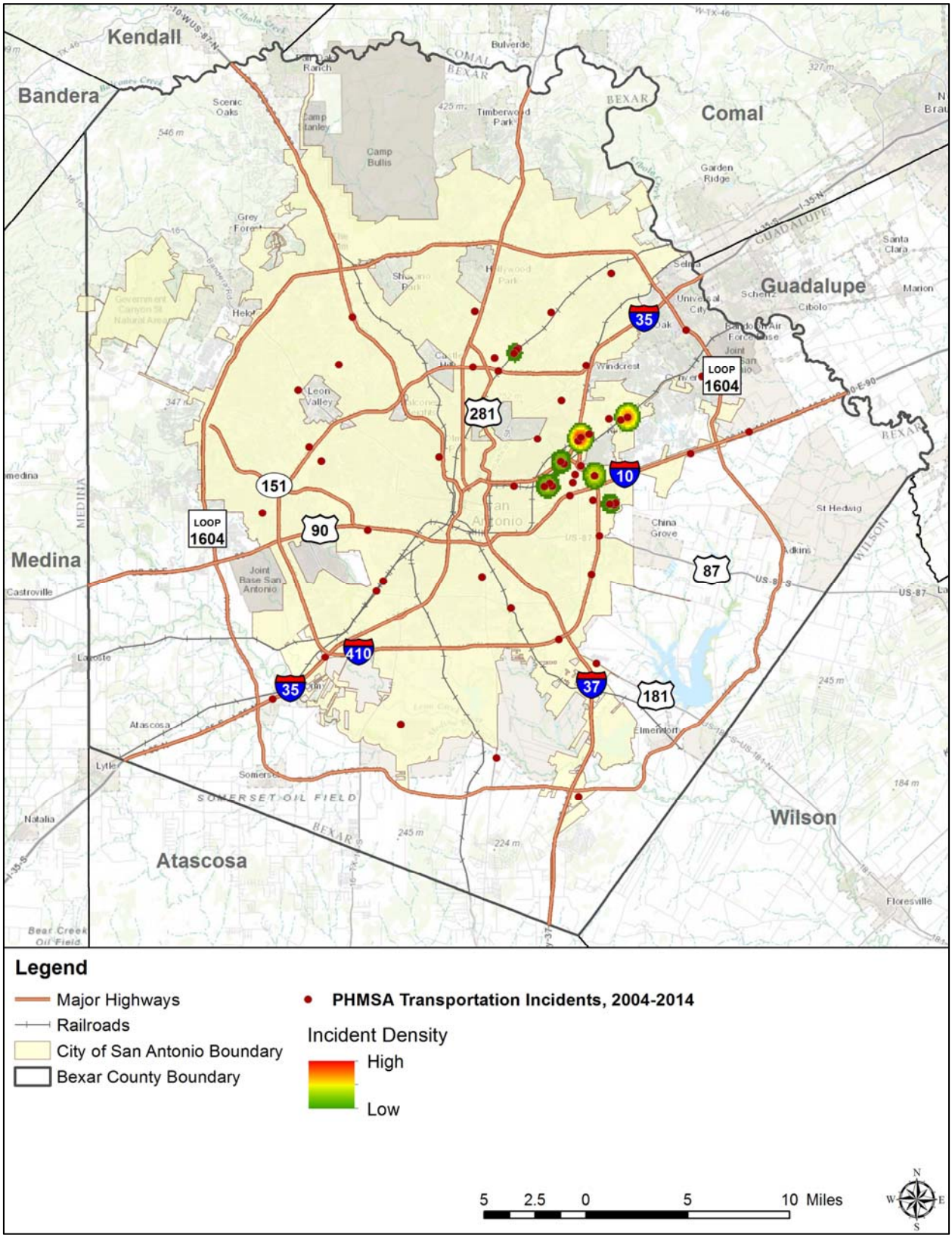
The micro-meteorological effects of buildings and terrain can alter travel and duration of agents from a hazardous materials incident. Shielding, in the form of sheltering-in-place, can protect people and property from the harmful effects of hazardous materials. Non-compliance with fire and building codes, and failure to maintain existing fire and containment features can substantially increase the damage from a hazardous materials incident. The duration of a hazardous materials incident can range from hours to days. Warning time for hazardous materials incidents is minimal to none.

The San Antonio Fire Department Hazardous Materials Response Teams handle responses to hazardous materials transportation accidents and chemical spills in business and manufacturing facilities. The response teams are trained to take corrective actions to stop or mitigate the release of hazardous materials while safeguarding the welfare of residents, emergency response personnel, and the environment. The response teams are also trained to deliver basic fire suppression and emergency first aid service, as required. Team members participate in ongoing training for special situations, such as highway transportation emergencies, railroad tank car incidents, and chlorine emergencies.

Historical Occurrences

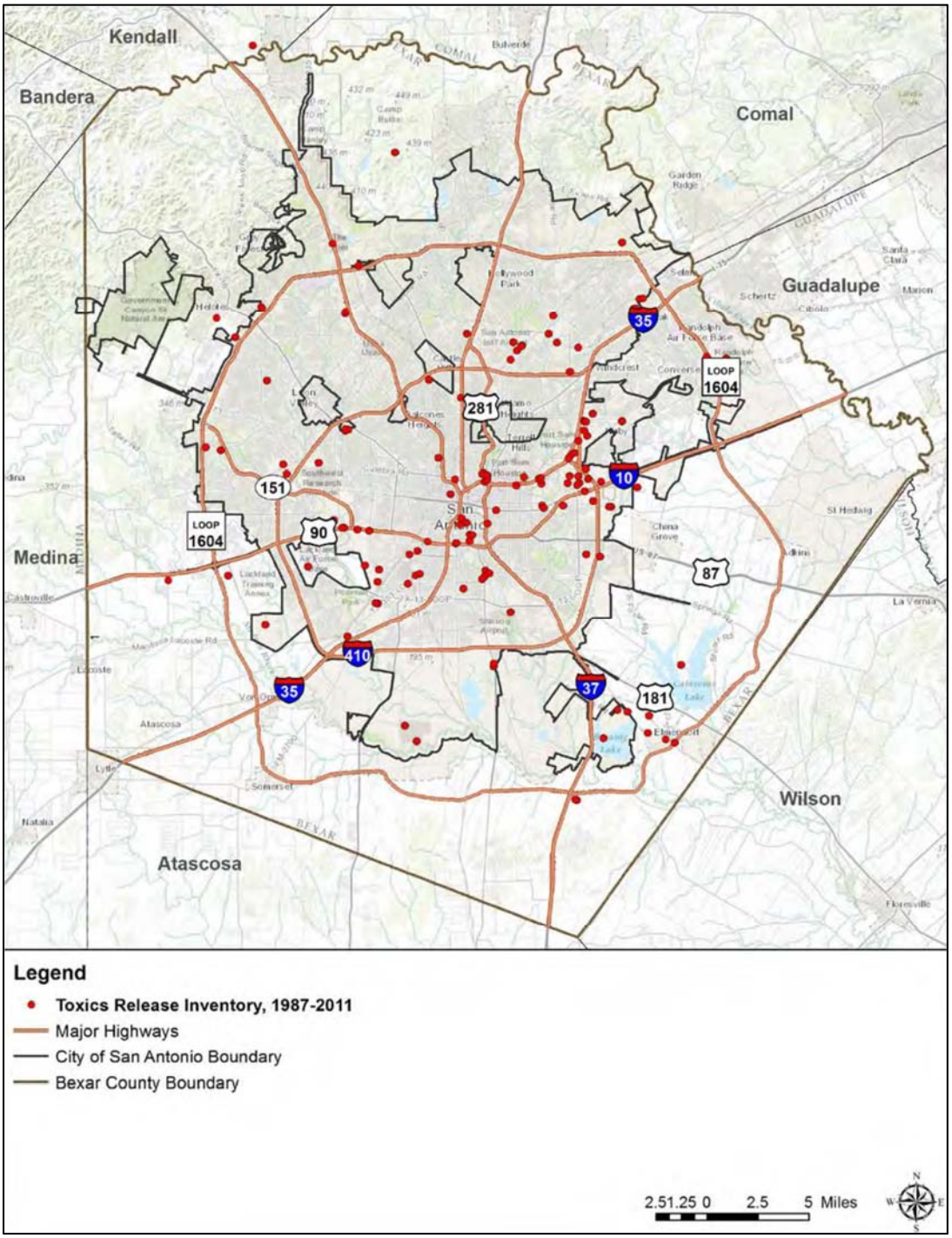
A total of 611 transportation incidents have been recorded by the DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) in Bexar County over the last ten years. The data collected is from 2004 to 2014 and identifies the hazardous materials transportation incidents as in-transit, loading, and unloading of transport vehicles. Figure 14-3 shows the PHMSA transportation incidents.

Figure 14-3. PHMSA Transportation Incidents, 2004 – 2014



According to the EPA's TRI database, a total of 3,676 toxic chemical releases have been recorded in Bexar County over the last 24 years. The data collected is from 1987 to 2011 and identifies fixed facilities that have reported toxic chemical releases in the County as shown in Figure 14-4.

Figure 14-4. Toxics Release Inventory, 1987 – 2011



Probability of Future Events

Based on the historic incident records, the frequency of occurrence is highly likely and an event can be expected annually for the City of San Antonio.

Vulnerability and Impact

Based on the prevalence and geographic proximity of hazardous materials transportation routes and fixed locations, the majority of the City of San Antonio 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.

Hazardous materials or toxic releases can have a "major" impact on the San Antonio planning area. Hazardous material incidents can cause injuries and/or illnesses that result in permanent disability, complete shutdown of facilities for at least two weeks, or both. Additionally, a hazardous materials incident can cause more than twenty-five percent of affected properties to be destroyed or suffer major damage.

Assessment of Impacts

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.

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. Below in Table 14-1 is a summary of the demographics according to their location within transportation corridors.

Table 14-1. Demographics in Transportation Corridors[3]

Population	985,658
Households	351,047
Housing Units	386,433
Businesses	55,154

Response personnel are also at risk from more concentrated or prolonged exposure to the agent involved in the hazardous materials incident. Through response efforts, response personnel can come in contact with hazardous materials before the nature of the hazard is determined. Response personnel also have a greater likelihood of being impacted by secondary explosions or leaks. Roadway damage resulting in unstable foundations or bridge and overpass instability, may create an impact and more dangerous situations in which response personnel must work.

Generally, hazardous materials incidents will interrupt operations and services within a limited area. The incident may result in the closure of multiple facilities and transportation infrastructure until the area can be remediated and made safe and habitable.

The nature of an operational and service interruption will depend on the facilities in the impacted area. For example, if the incident results in the temporary closure and evacuation of a hospital, this will also impact all hospitals in the area because area hospitals may be expected to assume the patient load for the now-inaccessible facility. However, if the incident is near non-essential businesses, the operational or service interruption might not be as far-reaching. While the closure of businesses would result in negative impacts for those businesses, this scenario would not have the same community impacts as the first example.

Damage to roadways, railways, and physical infrastructure resulting from a transportation hazardous materials can impair normal operations and delivery of services.

Property, facilities, and infrastructure are all subject to significant impacts from hazardous materials. Hazardous materials s often involve fire or explosions that can impact property and facilities, including roadways and bridges.

Any infrastructure in the area of the incident could be impacted by a hazardous materials incident. Gas lines, water lines, sewer lines, and communication lines can be interrupted or destroyed, depending on the nature of the event. If the event is significant

[3] Source: 2010 United States Census, Environmental Systems Research Institute's Community Analyst

enough, utilities in the area may need to be temporarily suspended or disconnected, which would impact multiple facilities and properties as shown in Table 14-2.

Table 14-2. Facilities located within a 1 Mile Buffer Radius of Major Highways & Railroads[4]

INFRASTRUCTURE SECTOR	NUMBER OF FACILITIES
Agriculture and Food	63
Banking and Finance	319
Chemical and Hazardous Materials Industry	621
Defense Industrial Base	n/a
Energy	63
Emergency Services	172
Information Technology	n/a
Communications	89
Postal and Shipping	43
Healthcare and Public Health	641
Transportation	20
Water	186
National Monuments and Icons	7
Commercial Facilities	1,841
Government Facilities	442
Dams	29
Nuclear Reactors, Materials, and Waste	87
Manufacturing	28

Environmental risks from hazardous materials incidents can range from nonexistent to catastrophic, depending on the nature of the release. For example, the Macdona (Texas) train derailment in 2004 did not result in any long-term environmental impacts in San Antonio, though areas around San Antonio were subject to monitoring and testing for a period after the incident. (Source: *Environmental Protection Agency's Emergency Response Review*) In a hazardous materials transportation incident, specialized containment,

[4] Source: San Antonio Office of Emergency Management

mitigation, and cleanup capabilities and procedures may be required to reduce environmental impacts.

By contrast, the 1986 Chernobyl nuclear reactor incident resulted in the permanent abandonment of several square miles, including an entire town. Impacts from the Chernobyl incident were felt on a global scale, and impacted the environment thousands of miles away from the incident site. Residual impacts remain to this day, and are not expected to diminish for decades.

Very little environmental testing or monitoring is completed after hazardous materials incidents, especially incidents in which there may be no impacts to monitor, because testing and monitoring can be expensive in terms of financial investments and staff resources. The inability to monitor and report on local environmental impacts is concerning to local hazardous materials officials.

Unless the incident causes physical damage to historical or cultural resources, the resources are unlikely to be impacted by a hazardous materials incident. Based on proximity, a resource could be impacted or have blocked access due to contamination concerns. Long-term lack of access, need for cleanup, or related negative publicity regarding the release could reduce ability of historic and cultural sites to attract tourists and generate income.

The risks to economic and financial sectors can be deeply felt and long-lasting. The depth and range of economic impacts will depend on the nature and severity of the incident. An incident that damages transportation infrastructure could have significant financial ramifications and could result in a significant impact to the local or regional economy. Cleanup costs, loss of access to facilities, and lost business or customers are all possible impacts after a hazardous materials incident.

For minor hazardous materials incidents, there is generally no impact to public confidence because most people are either not impacted or are unaware that the incident has even occurred. For larger incidents, the threat to public confidence is determined by how the public perceives the event is handles. Public perception will impact the public's behavior during the next incident.

Hazardous materials incidents often test the mechanisms and processes by which emergency management officials provide information, including evacuation orders, to the public. Misunderstood, confusing, conflicting messages, or delivery mechanisms that are ineffective, could have negative impacts to public confidence in emergency management staff and leadership.

The perception of incorrect, slow, or ineffective handling of an incident, particularly if that incident requires an evacuation of the public, can result in a less cooperative or successful evacuation during the next incident because the public may have less confidence in emergency management leadership. The public may blame local, state,

or federal governments for the event, if the cause of the event is viewed as a lack of responsible regulation or oversight, as occurred during the BP Deepwater Horizon oil spill incident in 2010. Without ongoing communication regarding hazardous materials risks and protective measures, the public may not perceive the government as aware and capable when an incident occurs.

SECTION 15: PIPELINE FAILURE

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

Hazard Description

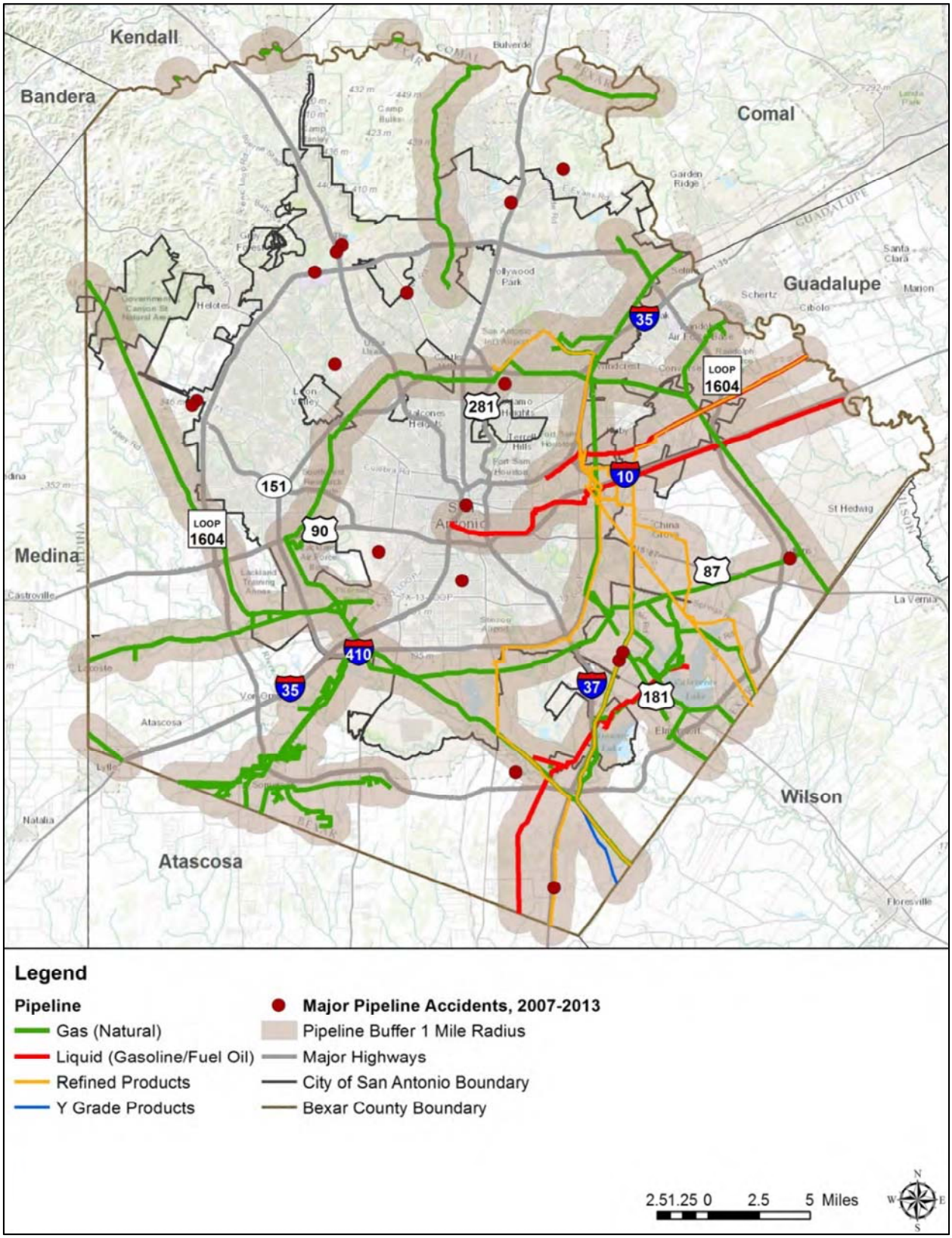
Energy pipeline breach or pipeline failure of an oil or natural gas pipeline is a serious hazard event. An estimated 2.4 million miles of pipelines in the United States carry hazardous materials. Natural gas pipelines transport natural gas and oil. Liquid petroleum pipelines transport crude oil and refined 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 15-1 shows the location of gas and oil energy pipelines and pipeline accidents in the City of San Antonio and Bexar County according to the Pipeline and Hazardous Materials Safety Administration and Railroad Commission of Texas.

Figure 15-1. Pipeline Location and Pipeline Accidents, 2007 – 2013



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.

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.

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 15-1 summarizes 18 "Major" historical pipeline events for Bexar County and the City of San Antonio. A Major pipeline event results from a cost or repair of $5,000 or greater and reported injuries or fatalities, or both.

Table 15-1. Historical Pipeline Accidents, 2007 – 2013[1]

INCIDENT DATE	OPERATOR	CITY	COST OR REPAIR	INJURED	FATALITIES	TYPE	FACILITY AFFECTED
4/11/2012	Nustar Logistics, L.P.	San Antonio	$50,001 or more	0	0	Liquid	Transmission

[1] Source: Pipeline and Hazardous Materials Safety Administration and Railroad Commission of Texas

INCIDENT DATE	OPERATOR	CITY	COST OR REPAIR	INJURED	FATALITIES	TYPE	FACILITY AFFECTED
8/23/2010	Enterprise Products Operating LLC	Adkins	$25,001-$50,000	0	0	Gas	Transmission
6/29/2009	CPS Energy	San Antonio	$25,001-$50,000	1	0	Gas	Distribution
9/28/2007	CPS Energy	San Antonio	$25,001-$50,000	0	0	Gas	Distribution
8/14/2013	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
2/26/2013	120784 – CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
5/5/2012	Enterprise Products Operating LLC	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
12/23/2011	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
12/16/2009	CPS Energy	Unknown	$5,001-$25,000	0	0	Gas	Distribution
11/17/2009	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
1/22/2009	Nustar Logistics, L.P.	Elmendorf	$5,001-$25,000	0	0	Liquid	Transmission
9/1/2008	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Unknown
7/1/2008	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Unknown
6/11/2008	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Unknown

INCIDENT DATE	OPERATOR	CITY	COST OR REPAIR	INJURED	FATALITIES	TYPE	FACILITY AFFECTED
6/5/2008	CPS Energy	San Antonio	$5,001-$25,000	0	0	Gas	Unknown
4/22/2008	Grey Forest Utilities	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
3/31/2008	Grey Forest Utilities	San Antonio	$5,001-$25,000	0	0	Gas	Distribution
9/28/2007	Grey Forest Utilities	San Antonio	$5,001-$25,000	0	0	Gas	Distribution

Probability of Future Events

According to the historical incident data, a pipeline incident for the City of San Antonio is likely, and an event can occur on average once every three 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. Pipeline breaches have the potential to cause multiple deaths and complete shutdown of facilities for 30 days or more.

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 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.

Assessment of Impacts

The risk to public health and safety during a pipeline failure event depends on a number of factors, including the type and amount of chemical(s) involved, location, weather conditions, time of day, and presence of an ignition source. The location of pipelines determines the potential number of people in proximity to the hazard and is a significant factor when determining the risk to public health and safety. It is possible that a release

of materials from a pipeline failure could involve a number of fatalities. It is likely that inhaled hazardous gases may result in respiratory problems, including burning sensations in the lungs, nose, and throat. A release of 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.

Depending on the nature and extent of a pipeline failure, the public could be required to either evacuate the area or shelter in place, which will interrupt normal routines. Table 15-2 summarizes demographics according to their location within a one mile buffer radius of pipelines identified earlier in Figure 15-1.

Table 15-2. Demographics for One Mile Buffer Radius of the Pipelines[2]

Population	38,815
Households	15,297
Housing Units	16,547
Businesses	3,151

Response personnel are also at risk from more concentrated or prolonged exposure to the agent involved in the event. Through response efforts, response personnel may respond and come in contact with hazardous substances before the nature of the hazard is determined. Response personnel also have a greater likelihood of impacts from secondary explosions or leaks.

Generally, pipeline failure events will interrupt operations and services within a limited area. The nature of the interruption will depend on the facilities in the impacted area. For example, if the event results in the temporary closure or evacuation of a hospital, this will also impact all hospitals in the area because area hospitals may be expected to assume the patient load for the now-inaccessible facility. However, if the event is near non-essential businesses, the operational or service interruption might not be as far-reaching. While the closure of businesses would result in negative impacts for those businesses, this scenario would not have the same community impacts as the first example.

Damage to roadways, railways, and physical infrastructure resulting from a pipeline failure event can impair normal operations and delivery of services.

During a pipeline failure event, the pressure in a pipeline can disrupt the soil above a break. Any facility or piece of infrastructure over or adjacent to a rupture could be damaged or destroyed. If gas ignites, it will set flammable objects near it on fire.

[2] Source: 2010 United States Census, Environmental Systems Research Institute's Community Analyst

Depending on environmental factors such as wind, proximity of vegetation or other fuels, and dryness of the environment, the fire could spread to other nearby structures damaging or destroying them. Table 15-3 summarizes critical facilities according to their location within a one mile buffer radius of the pipelines.

Table 15-3. Facilities located within a 1 Mile Buffer Radius of the Pipelines[3]

INFRASTRUCTURE SECTOR	NUMBER OF FACILITIES
Agriculture and Food	30
Banking and Finance	167
Chemical and Hazardous Materials Industry	404
Defense Industrial Base	n/a
Energy	51
Emergency Services	83
Information Technology	n/a
Communications	59
Postal and Shipping	23
Healthcare and Public Health	395
Transportation	12
Water	89
National Monuments and Icons	3
Commercial Facilities	972
Government Facilities	260
Dams	28
Nuclear Reactors, Materials, and Waste	58
Manufacturing	21

Any infrastructure in the area of the incident could be impacted by a pipeline failure event. Gas lines, water lines, sewer lines, and communication lines can be interrupted or destroyed, depending on the nature of the event. If the event is significant enough,

[3] Source: San Antonio Office of Emergency Management

utilities in the area may need to be temporarily suspended or disconnected, which would impact multiple facilities and properties.

Environmental risks from pipeline failure events can range from nonexistent to catastrophic, depending on the nature and extent of the release. Often minor environmental testing or monitoring is completed after a hazardous materials event, especially incidents in which there may be no impacts to monitor, because testing and monitoring can be expensive in terms of financial investments and staff resources. The inability to monitor and report on local environmental impacts is concerning to local hazardous materials officials.

A pipeline failure event can cause physical damage to historical or cultural resources in the San Antonio planning area, if there is a presence of an ignition source during a pipeline failure event. Based on proximity, a resource could be impacted or have blocked access due to contamination concerns. Long-term lack of access, need for cleanup, or related negative publicity regarding the release could reduce ability of historic and cultural sites to attract tourists and generate income.

The risks to local economic and financial sectors can be deeply felt and long-lasting. The depth and range of economic impacts will depend on the nature and severity of the event. Cleanup costs, loss of access to facilities, and lost business revenue are possible after a pipeline failure event.

For minor pipeline failure events, there is generally no impact to public confidence because most people are either not impacted or are unaware that the event has even occurred. For larger incidents, the threat to public confidence is determined by how the public perceives the event is handled. Public perception will impact the public's behavior during the next event.

Pipeline failure events often test the mechanisms and processes by which emergency management officials provide information, including evacuation orders, to the public. Misunderstood, confusing, conflicting messages, or delivery mechanisms that are ineffective, could have devastating impacts to public confidence in emergency management staff and leadership.

The perception of incorrect, slow, or ineffective handling of an incident, particularly if that incident requires an evacuation of the public, can result in a less cooperative or successful evacuation during the next event because the public may have less confidence in emergency management leadership. The public may blame local, state, or federal governments for the event, if the cause of the event is viewed as a lack of responsible regulation or oversight, as occurred during the BP Deepwater Horizon oil spill incident in 2010. Without ongoing communication regarding pipeline and protective measures, the public may not perceive the government as aware and capable when an event occurs.

SECTION 16: TERRORISM

Hazard Description 1
Location 2
Extent 2
Historical Occurrences 3
Probability of Future Events 4
Vulnerability and Impact 4
Assessment of Impacts 5

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. Bombings are the most frequently used terrorist method in the United States. A terrorist using a chemical or biological weapon is of particular concern to officials. Special training and equipment is 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 as they are extremely difficult to detect.

Chemical agents, kill or incapacitate people, destroy livestock, or 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, or nuclear hazards; energy, such as explosives, arson, and even 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 San Antonio planning area.

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

Extent

The Homeland Security Advisory System, issued by the U. S. Department of Homeland Security, is a color-coded terrorism warning system that identifies five threat levels. Terrorism Warning Threat Levels are described in Table 16-1.

Table 16-1. Terrorism Warning System Threat Levels[1]

Color	Threat Level[2]	Governmental actions to be taken
Green	Low: Low risk of attacks.	Requires "protective measures" such as regularly assessing facilities for weaknesses and finding ways to reduce them, and making sure State and local government employees are trained to handle terrorism situations.

[1] Department of Homeland Security
[2] Current threat levels can be found at: http://www.dhs.gov/xinfoshare/programs/Copy_of_press_release_0046.shtm.

Color	Threat Level[2]	Governmental actions to be taken
Blue	Guarded: General risk of attacks.	Requires government agencies to review and update emergency response procedures and communications systems, as well as provide the public with necessary information.
Yellow	Elevated: Significant risk of attacks.	Includes increasing surveillance of critical locations, coordinating emergency plans with nearby jurisdictions and implementing contingency and emergency response plans.
Orange	High: High risk of attacks.	Requires coordinating necessary security efforts with armed forces or law enforcement agencies, taking additional precautions at public events, preparing to work at an alternative site or with a dispersed workforce and restricting access to essential personnel.
Red	Severe: Severe risk of attacks.	Includes assigning emergency response personnel and setting up specially trained teams; monitoring, redirecting, or constraining transportation systems; closing public and government facilities; and increasing or redirecting personnel to address emergency needs.

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.

Historical Occurrences

Suspected terror plots have been thwarted in the City of San Antonio in recent years, including a break-in and a bomb scare at the Bexar County Courthouse on October 19, 2011. Salem al-Hazmi, a 9/11 terrorist on American Airlines flight 77, was reported to have resided and trained in San Antonio. Most recently, on September 18, 2012, the San

Antonio International Airport was evacuated over a bomb threat called from a parking garage. The San Antonio Regional Fusion Center and Intelligence Office has reported 483 potential terrorist threats to state and federal agencies since 2006. (Source: *San Antonio Office Emergency Management's Threat Hazard Identification and Risk Assessment, 2014*)

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.

In February 2010, after writing an anti-government, anti-big business, and anti-tax system rant, a computer engineer smashed a small aircraft into an office building in Austin, Texas, where nearly 200 employees of the Internal Revenue Service were starting their workday. The pilot and two building occupants were killed in the attack.

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 terrorism incident for the City of San Antonio is unlikely, with an event occurring on average once every ten years.

Vulnerability and Impact

There is no defined geographic boundary for a terrorist event. All of the population, buildings, critical facilities, infrastructure and lifelines and hazardous materials facilities are considered exposed to the hazards of terrorism and could potentially be affected.

There are no past local terrorist events. Therefore, all assets and facilities are potentially at risk to damages that may for the most part be secondary.

Terrorist events can have a "Major" severity of impact. They can cause injuries, illnesses, or both and result in permanent disability, complete shutdown of City area facilities for at least two weeks, and cause more than 25 percent of affected properties to be destroyed or suffer major damage.

Assessment of Impacts

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 San Antonio 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. Response personnel can be subjected to more long-term impacts resulting from prolonged exposure to chemicals or biological weapons.

Depending on the characteristics and location of the event, it is possible that operations and service delivery could be impacted by a terrorist attack. While the San Antonio Office of Emergency Management (SAOEM) has a protected facility from which to operate, the facility may not be accessible in the event of a terrorist attack near the facility. If the SAOEM office was inaccessible, then staff members would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the SAOEM and may suffer more interruptions as a result of damages from a terrorist attack. If hard or electronic files are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City, and could negatively impact its ability to respond to and recover from the terrorist event. Without a Continuity of Operations Plan (COOP) that takes into account department-specific issues, or regular exercise of that COOP, critical departments may not be able to function and provide necessary services.

Damage from a terrorist event can impact utility infrastructure, either directly or indirectly. This could result in a temporary loss of function for businesses in the planning area that rely on utilities for operation, even if those businesses were not directly impacted by the terrorist event. 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 planning area are at risk from damage or destruction from a terrorism event, including residential and commercial structures and their supporting utilities, vehicles and transportation infrastructure, and community buildings, such as hospitals, police stations, and schools. Roadways in or near

the terrorist event could be impacted because of damage or closure due to response or investigative operations.

When a terrorist attack occurs there are many potential environmental impacts due to the varied ways an event can occur. The environmental impacts associated with terrorism include, but are not limited to:

- 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 into the 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 City of San Antonio planning area is home to a large number of cultural and historic resources. Many of the historic neighborhoods may be at risk from a terrorist event because they are of a construction type and material that is more vulnerable to fire and explosions. Historic homes are generally exempt from modern building code requirements, which may require fire suppression equipment in the structure, and are often constructed close together. The city/county'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 terrorist event may be significant. A major attack, 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 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.

Public confidence in local government may be impacted by how response and recovery efforts resulting from the event are handled. A response demonstrating that the City, its leaders, and officials were prepared for the event, anticipated the magnitude, and understood what could happen, will boost the City's reputation and standing with residents. However, if the perception developed, correctly or incorrectly, that the response was slow, that needs or complaints of its residents were ignored, or that the leadership fails to anticipate the magnitude of the event, then public confidence can decline.

A terrorist attack that is responded to and handled with little damage to structures or infrastructure will enhance public perception. Visual images of the first responders can be a powerful tool to aid in the public trust and confidence regarding public safety.

SECTION 17: INFECTIOUS DISEASE

Hazard Description 1
Location 2
Extent 2
Historical Occurrences 4
Probability of Future Events 6
Vulnerability and Impact 7
Assessment of Impacts 7

Hazard Description

An infectious disease is as 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 1957 flu pandemic caused at least 70,000 deaths in the United States and one to two million deaths worldwide. 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 of all areas to disease because a denser population increases the risk of exposure to an infectious disease, allowing the disease too quickly and advancing the spread of infection.

The top 11 infectious diseases according to the World Health Organization (WHO) based upon number of deaths are presented in Table 17-1.

Table 17-1. Worldwide Mortality Due to Infectious Disease[1]

RANK	CAUSE OF DEATH	APPROXIMATE WORLDWIDE DEATHS IN 2008	PERCENTAGE OF ALL DEATHS WORLDWIDE
1	Lower Respiratory Infections	3.5 million	6.1%
2	Diarrheal diseases	2.5 million	4.3%
3	HIV/AIDS	1.8 million	3.1%
4	Tuberculosis (TB)	1.3 million	2.4%
5	Malaria	827,000	1.5%
6	Meningitis	340,000	0.6%
7	Pertussis	195,000	0.3%
8	Measles	155,000	0.3%
9	Hepatitis B	128,000	0.2%
10	Syphilis	100,000	0.2%
11	Tetanus	88,000	0.2%

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. 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.

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

[1] Source: World Health Organization

deaths might be 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 17-1.

The magnitude of a pandemic event is identified in terms of warning levels based on population. Figure 17-2 illustrates the various warning levels for pandemic. Dr. Margaret Chan, Director General of the WHO announced in June of 2009 that H1N1 had reached Phase 6, Pandemic.

Figure 17-1. Case-Fatality Rate for Severity

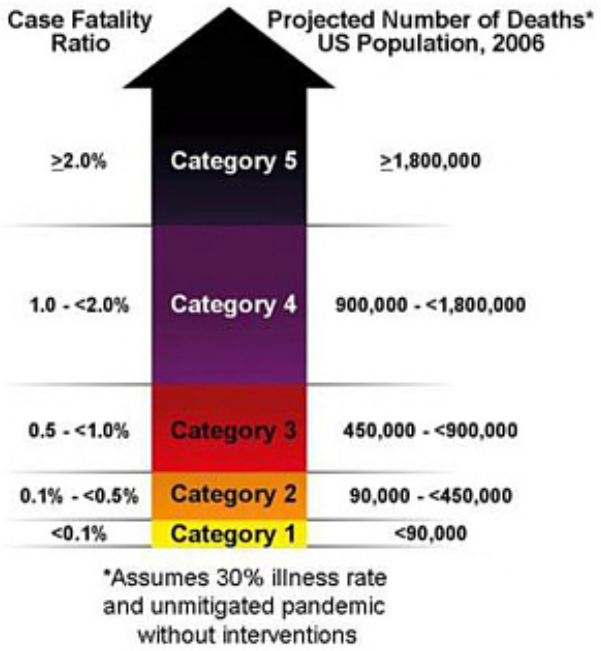
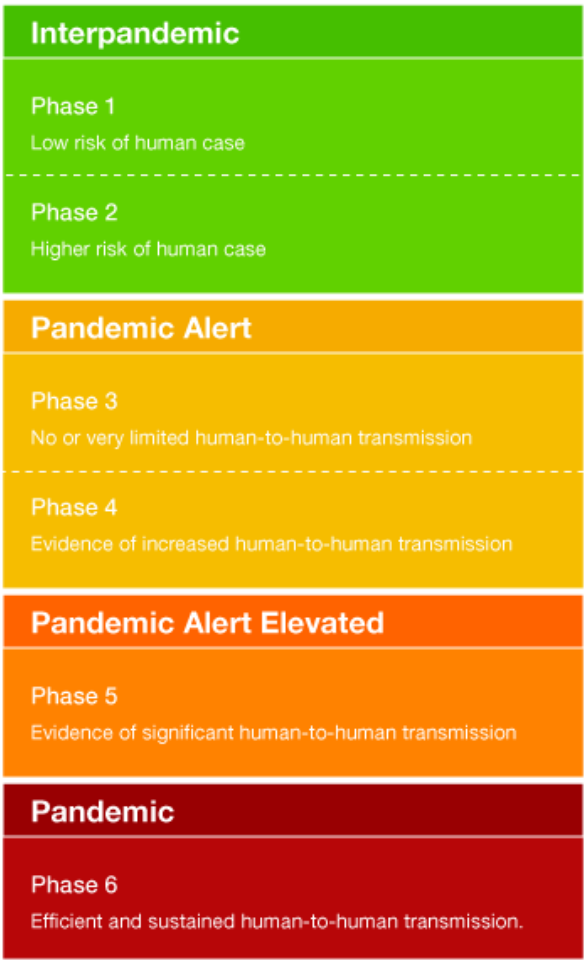


Figure 17-2. Risk levels for Pandemic (World Health Organization)



Historical Occurrences

The San Antonio Metropolitan Health District (SAMHD) has compiled a report on infectious disease from 2008-2012. The number of cases and rates are included in Table 17-2. 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, 1,115 cases of infectious disease are reported annually.

Table 17-2. Historical Infectious Disease for San Antonio and Bexar County, 2008 – 2012[2]

Infectious Disease	2008		2009		2010		2011		2012	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Campylobacteriosis	129	8.0	123	7.4	223	13.0	113	6.4	208	11.6
Cryptosporidiosis	40	2.5	0	0	4	0.2	16	0.9	11	0.6
Cyclosporiasis	0	0	0	0	0	0	1	0.1	12	0.7
Hepatitis A, acute	24	1.5	3	0.2	6	0.3	6	0.3	2	0.1
Hepatitis B, acute	101	6.2	83	5.0	78	4.5	13	0.7	6	0.3
Malaria	2	0.1	1	0.1	1	0.1	3	0.2	1	0.1
Measles (Rubeola)	0	0	0	0	0	0	0	0	0	0
Mumps	0	0	0	0	32	1.9	5	0.3	2	0.1
Neisseria Meningitidis	10	0.6	5	0.3	4	0.2	4	0.2	3	0.2
Pertussis	53	3.3	42	2.5	24	1.4	23	1.3	69	3.9
Salmonellosis	267	16.5	204	12.4	264	15.4	263	15.0	245	13.7
Shigellosis	314	19.4	239	14.5	97	5.7	200	11.4	263	14.7
Streptococcus	51	3.1	41	2.5	76	4.4	96	5.5	108	6.0
Tuberculosis	81	5.0	93	5.6	87	5.1	97	5.5	71	4.0
Varicella (Chicken Pox)	457	28.2	236	14.3	90	5.2	91	5.2	60	3.4

Occurrences of a biological event hazard are fairly common. Recently, there have been a number of *E. coli* and similar outbreaks traced to issues or deficiencies in the nation's food supply. In Texas, there have been several occurrences of biological hazards, as reported by the Center for Disease Control (CDC). In 2005, there were cases of dengue fever reported in South Texas, near the border with Mexico. In 2005, approximately 1,100 evacuees from Hurricanes Katrina and Rita were infected with norovirus in the Houston area. During the winter of 2009 and early spring of 2010, 429 cases of mumps were reported in the greater Houston area.

[2] Source: San Antonio Metropolitan Health District

In 2001, the CDC reported several cases of anthrax in both humans and cattle in South Texas and in the San Antonio and Bexar County area, including Bandera County, where one fatality occurred.

In the spring of 2012, Tuberculosis (TB) was detected at James Madison High School in San Antonio. Initially, two cases were confirmed, and a third case followed. By the time school released for the summer in June 2012, more than 400 students and almost 30 faculty members had been tested for TB and the majority of tests produced negative results (Source: *San Antonio Metropolitan Health District*). Early detection of TB and quick action on the part of the SAMHD resulted in a contained event rather than an epidemic.

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. As of September 27, 2009, more than 340,000 cases of H1N1 have been confirmed worldwide and approximately 4,100 deaths have been reported.[3]

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.[4]

Probability of Future Events

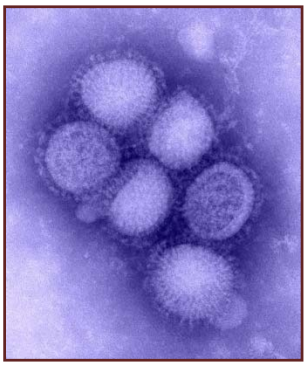
Epidemics and pandemics have occurred in human and animal populations for thousands of years. As humans began to gather and congregate in urban areas, the potential for pandemics and epidemics increased. As trade routes became established and contact with other cities became more frequent, the potential 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.

The probability of an infectious disease outbreak in the City of San Antonio planning area is likely and an event has the probability of occurring once every three years.

[3] World Health Organization

[4] 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.

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, and lost wages of patients. 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. For example, 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. With the H1N1 pandemic, most of the people affected have mild illness and do not require hospitalization. People at the highest risk for developing complications from H1N1 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, can experience a worsening of existing conditions if they contract the H1N1 virus.

The response costs to the public health sector for an outbreak, and the impact to health as a whole for the San Antonio planning area, could potentially be "Major." Injuries or illnesses that result in permanent disability could occur and City area facilities could be shut down for at least 2 weeks. Property damage could result from high absenteeism of persons responsible for property management.

Assessment of Impacts

Pandemics impact larger than normal segments of the population, and few sectors of the population are left untouched by infectious disease. The physical problems associated with the infectious disease may be short term or may lead to long-term physical maladies.

The impact of an infectious disease event will be measured by the number of fatalities, how the community is affected, and to what extent. If a large number of people get sick simultaneously, major social consequences will occur. Absenteeism in the workplace can have negative impacts on the overall functioning of society, particularly if it is prolonged.

The risks to public health and safety include first responders and others with increased exposure to the disease. Response personnel likely to experience the greatest impact

would be those with medical responsibilities, such as fire fighters, ambulance workers, and clinic and hospital personnel. Response personnel could be in frequent contact with those who are either sick or infected, and are prone to suffer proportionally higher impacts as a result.

Depending on the severity of the infectious disease event, there could be serious problems with continuity of operations and delivery of services. If City staff stay home due to illness, someone in their home is ill, or because they fear becoming ill, the ability of local government to maintain operations and deliver services could be seriously limited or compromised. A pandemic illness that impacts City staff could have significant negative impacts, particularly for departments that do not have or exercise a Continuity of Operations Plan (COOP). Without a COOP that takes into account department-specific issues, or regular exercise of that COOP, critical departments may not be able to function and provide necessary services.

A pandemic event may result in heightened stress for responders, health care providers, public health workers, individuals, and communities. A vital part of pandemic planning is the development of strategies and tactics to address these potential problems. Psychological health resources should be provided to ensure that special populations are identified prior to the event and that unique service and transportation needs are incorporated into the local pandemic influenza emergency management plan. Stress management support to those who are symptomatic, those who believe they are ill, and to staff who are dealing with the increased workloads and personal concerns will be required. The public will require information on how to recognize and cope with the short- and long-term risks of sustained stress during mass vaccinations, for those debilitated by an illness, and their caregivers (Source: *San Antonio Metropolitan Health District*).

An infectious disease hazard affects living beings, therefore the vulnerability of property to an infectious disease event is minimal. Pandemics are unlikely to directly result in physical damage to the built environment. However, there is the possibility of indirect damage resulting from staff absenteeism and lack of routine operations and maintenance. For example, the City's flood control system, though largely operational through a telemetry system, requires some hands-on maintenance. Increased absenteeism of maintenance staff could result in reduced maintenance operations, which could negatively impact the operation of the system.

Human infectious diseases do not normally pose a risk to the natural environment. Infectious diseases tend to be specific to humans, and therefore pose little threat to the natural environment or non-mammalian species. However, certain exceptions exist including the avian flu, which can affect both birds and humans. It is possible that other pathogens may affect more than one species, but those pathogens would likely be limited to specific species.

The historic and cultural resources of the area are generally immune to the effects of infectious disease events. However, historic and cultural resources attract significant numbers of tourists and visitors, increasing the potential for exposure and transmission of a variety of pathogens. The Alamo, Sea World, Six Flags, and Splashtown are all major tourist attractions. The Fiesta San Antonio cultural celebration, which lasts for 11 days and comprises more than 100 events, occurs in the early spring. These attractions and events draw large crowds. It would only take the presence of one infected person at a large event or attraction to cause the transmission of an infectious disease in the planning area and potentially damage the local tourism industry. A negative impact on local tourism could have serious economic ramifications for the community and for the businesses that operate or participate in these attractions and events.

Seasonal flu occurs annually and is estimated to cost the U.S. economy between $71 million and $167 million per year (Source: *World Health Organization*). Severe pandemics have been predicted to cause more than $700 billion in economic losses, and to result in a 5.5% decrease in U.S. Gross Domestic Product (GDP) (Source: *Federal Reserve Bank of St. Louis*).

Major infectious disease events and pandemics can be expected to have larger and deeper impacts to the local and national economy. If the disease is slow-progressing, particularly long-lasting, or has long-term residual effects, the impact to the economy could be extended.

If the normal movement of the epidemic within society needs to be curtailed, a process known as “social distancing,” then a greater impact to the local economy could occur. Social distancing can be accomplished by a number of means; two ways of increasing social distance activity restrictions are to cancel events and close buildings or to restrict access to certain sites or buildings. These measures are sometimes called "focused measures to increase social distance."

Depending on the situation, examples of cancellations and building closures might include: cancellation of public events, such as concerts, sports events, movies, plays; and closure of recreational facilities, such as community swimming pools, youth clubs, gymnasiums. While necessary to limit the spread of the pathogen, facility closures could have economic ramifications (Source: *GlobalSecurity.Org*).

Infectious disease events are complicated hazards. Accurate information and clear, concise explanation during an infectious disease event are critical when conveying messages to the public. When a communication to the public fails, it can result in a loss of credibility, and can result in a loss of public confidence in leadership.

Infectious disease events can undermine the public’s confidence in its government and leaders. Public dissatisfaction with government response will typically increase as the number of cases rise and public fear increases. Perceptions of inequality in medical care, particularly if those inequalities are based on socioeconomic status, ethnicity, age,

gender, or seniority, can lead to increased dissatisfaction with government and leadership, and may result in a weakening of social order or hostility towards those in leadership or medical roles. Required rationing of supplies or vaccinations should be conscientiously carried out to avoid the appearance of bias or impropriety. Decisions regarding vaccinations, guidance, and treatment should be explained clearly and consistently to the public. The SAMHD's Pandemic Flu Plan includes very specific guidance for communicating with the public, acknowledging the importance of communication with the public and providing the clearest possible information during pandemics.

There could be significant public resistance to a decision to quarantine those who are ill or exposed, to restrict travel, or to implement social distancing. Any decision to restrict individual movement must be accompanied by a major public relations campaign to assure the public that these actions are necessary. If decisions are perceived by the public as necessary for their protection, the public is more likely to comply with official instruction.

SECTION 18: MITIGATION STRATEGY

Mitigation Goals 1
Goal 1 1
Goal 2 2
Goal 3 2
Goal 4 2
Goal 5 3

Mitigation Goals

Based on the results of the risk and capability assessments, the Planning Team was able to develop and prioritize the mitigation strategy. At the Risk Assessment Workshop held August 11, 2014, and the Mitigation Workshop held September 8, 2014, Planning Team members refined the Plan's mitigation strategy. The following goals and objectives were identified by reviewing the information presented in the City of San Antonio and Bexar County Office of Emergency Management Hazard Identification, Risk Assessment (HIRA) and Consequence Analysis.

Goal 1

Protect public health and safety.

Objective 1.1

Partner with agencies serving vulnerable populations to minimize harm in the event of an emergency.

Objective 1.2

Promote disaster contingency planning and facility safety among institutions that provide essential services such as food, clothing, shelter and health care to vulnerable populations.

Objective 1.3

Educate individuals and communities about disaster preparedness and mitigation.

Objective 1.4

Improve disaster warning systems.

Objective 1.5

Strengthen local building code enforcement.

Objective 1.6

Train emergency responders.

Goal 2

Protect critical public facilities and infrastructure.

Objective 2.1

Implement mitigation programs that protect critical city facilities and services and promote reliability of lifeline systems to minimize impacts from hazards, maintain operations, and expedite recovery in an emergency.

Objective 2.2

Consider known hazards when siting new facilities and systems.

Objective 2.3

Create redundancies for critical networks such as water, sewer, digital data, power and communications.

Objective 2.4

Educate public officials, developers, realtors, contractors, building owners, and the public about hazard risks and building requirements.

Goal 3

Protect the environment.

Objective 3.1

Consider the secondary effects of disasters, such as hazardous waste and hazardous materials spills, when planning and developing mitigation projects.

Objective 3.2

Use environmentally and conservation friendly materials in mitigation projects whenever possible and economically feasible.

Goal 4

Increase public education and awareness.

Objective 4.1

Enhance understanding of local hazards and the risks they pose.

Objective 4.2

Educate the public on actions they can take to prevent or reduce the loss of life or property from all hazards and increase individual efforts to respond to potential hazards.

Objective 4.3

Publicize and encourage the adoption of appropriate hazard mitigation measures.

Goal 5

Encourage partnerships.

Objective 5.1

Partner with private sector, including small businesses, to promote structural and non-structural hazard mitigation as part of standard business practice.

Objective 5.2

Educate businesses about contingency planning citywide, targeting small businesses and those located in high risk areas.

Objective 5.3

Partner with private sector to promote employee education about disaster preparedness and practice conservation while at work and at home.

SECTION 19: MITIGATION ACTIONS

Summary 1
City of San Antonio 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 and human-caused hazards included in the Plan. Each of the actions in this section were prioritized based on FEMA's Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLEE) 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 STAPLEE 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.

Table 19-1.City of San Antonio Mitigation Action Matrix*

* FEMA does not review mitigation actions for human-caused hazards; therefore, they are not included in the comprehensive list of mitigation actions in Table 19-1.

CITY OF SAN ANTONIO: 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.					
HAZARDS	**Types of Action:**				
	LOCAL PLANS/ REGULATIONS	**STRUCTURAL/ INFRASTRUCTURE**	**NATURAL SYSTEM PROTECTION**	**EDUCATION & AWARENESS**	**EMERGENCY RESPONSE ACTIONS**
Dam Failure	XX	X		X	X
Drought	XX		X	X	
Extreme Wind	XXXX	XXXX		X	
Hurricane	XXXX	XXXX		X	
Extreme Heat		X		XX	
Flood	XXX	85+	X	XX	
Hail		XXXXX		X	
Tornado	XX	XXXX		X	
Wildfire	XXXXX	XXXX	XXXX	XXX	
Winter Storm	XX	XXX		XX	

City of San Antonio

		City of San Antonio – Action #1
	Proposed Action:	**Purchase radio communications equipment for the Fire Department.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase operational preparedness for wildfire events.
	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:	Reduce response time and loss of structures
Priority (High, Moderate, Low):	High
Estimated Cost:	$500,000
Potential Funding Sources:	HMGP
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Firewise, Fire Protection Plan, Emergency Operations/Response Plan

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #2
	Proposed Action:	**Implement program to remove dead and downed trees to decrease fire fuels, prevention of debris in case of hail or ice buildup during storms.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Natural landform protection and reduced risk of loss of property and life.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Winter Storm, Hail, Extreme Wind, Hurricane
Effect on New/Existing Buildings:	Reduce potential fire danger
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	HMGP, Texas Forest Service
Lead Agency/Department Responsible:	Parks & Recreation Department
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Fire Protection Plan, Firewise

COMMENTS
*** Street Tree inventory ranges from $3.50-$5.00 a tree; Tree storm report $4,000-$5,000 / with analysis $6,000-$7,500; Tree Canopy Study with ecosystem service benefits $50,000-$60,000
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #3
	Proposed Action:	**Install hail guards for Heating, Ventilation, and Air-Conditioning (HVAC) systems on critical facilities to protect against severe hail in excess of ½ inch diameter.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Protect HVAC systems to increase efficiency of units by minimizing debris damage, reduce electrical costs, and prevent overheating of units.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hail
Effect on New/Existing Buildings:	Decrease damage to critical facilities
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$500,000
Potential Funding Sources:	Grants
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	None

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #4
	Proposed Action:	**Conduct public education program and disseminate information to residents on how to mitigate their homes to extreme heat and protection associated with prolonged outdoor activities.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Provides education to the public on the dangers of extreme heat; reduces the risk to public health and welfare.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on New/Existing Buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$30,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	San Antonio Metropolitan Health District (SAMHD)
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #5
	Proposed Action:	**Insert information in residents' monthly utility bills for reducing water usage during drought conditions.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Conserve essential water supply.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought
Effect on New/Existing Buildings:	Educate residents on water conservation
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$30,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	San Antonio Water System (SAWS)
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Firewise Plan, Water/wastewater Utilities

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #6
	Proposed Action:	**Purchase generators for secondary emergency backup power. Generators will have enough power to enable full use of the primary pump stations that provide water to the City's critical facilities i.e., fire departments, fire hydrants, hospitals, medical offices, schools, universities, numerous high value commercial customers, large residential apartment complexes and homeowners.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Continue essential utility and electrical service to residents.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Flood, Winter Storm, Hail, Extreme Wind, Terrorism, Dam Failure, Hurricane, Extreme Heat
Effect on new/existing buildings:	Continue to provide essential services
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$875,000 per unit (purchase generators over several years as federal funding is available)
Potential Funding Sources:	PDM & HMGP
Lead Agency/Department Responsible:	San Antonio Water System (SAWS)
Implementation Schedule:	2015-2020 based on funding
Incorporation into Existing Plans:	Water Contamination Emergency Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #7
	Proposed Action:	**Install quick connect systems on all critical facilities with emergency generators.**
	BACKGROUND INFORMATION	
	Jurisdiction/Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Continue essential service operations in the event of power failure.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Tornado, Flood, Hail, Winter Storm, Dam Failure, Extreme Wind, Terrorism, Hurricane, Extreme Heat
Effect on New/Existing Buildings:	Supply power to critical structures
Priority (High, Moderate, Low):	High
Estimated Cost:	$100,000
Potential Funding Sources:	HMGP, Grants
Lead Agency/Department Responsible:	Office of Emergency Management
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #8
	Proposed Action:	**Install shutters on glass windows and doors to protect critical facility buildings during severe weather events.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Result *(Current Cost/Losses Avoided)***:**	Reduce damage to infrastructure during severe weather events, glass replacement costs, and injury to residents.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Wind, Tornado, Hail, Hurricane
Effect on new/existing buildings:	Protection of existing buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$750,000
Potential Funding Sources:	HMGP
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 4; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #9
	Proposed Action:	**Adopt and enforce the current International Wildland-Urban Interface (WUI) Code.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to residents and first responders, minimizes financial loss to residents and infrastructure.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on new/existing buildings:	Reduce risk to structures from hazards
Priority (High, Moderate, Low):	High
Estimated Cost:	Minimal
Potential Funding Sources:	Local
Lead Agency/Department Responsible:	Development Services Department, Fire Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Fire Protection Plan, Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #10
	Proposed Action:	**Develop and implement a Community Wildfire Protection Plan with local and state assistance.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to Citizens and First Responders; Allow for cooperative efforts from many entities; Minimize Cost of Recover.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$250,000
Potential Funding Sources:	Texas Forest Service
Lead Agency/Department Responsible:	Fire Department, Office of Sustainability
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Great opportunity for various agencies to work together, to minimize multiple risks, could incorporate other projects i.e. Firewise, waterway fuel reduction.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #11
	Proposed Action:	**Develop and implement a 'Dead and Down Fuels' Ordinance that requires residents and businesses to remove dead trees and brush from property.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk of hazards associated with dead trees and brush.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Extreme Wind, Hurricane
Effect on new/existing buildings:	Reduce risk to nearby structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$50,000 annually
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Development Services Department, Fire Department
Implementation Schedule:	2015-2019
Incorporation into Existing Plans:	Fire Protection Plan, Firewise

COMMENTS:
If property is over 5 acres any Dead and Down fuels within 30ft of property line must be removed.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 3; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 3; Legal = 4; Economically Sound = 5; and Environmentally Sound = 3

		City of San Antonio – Action #12
	Proposed Action:	**Join the Firewise Program and educate residents on reducing fire fuels in corporation with the Texas A&M Forest Service, and local community organizations.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Wildfire Risk Reduction; Drought reduction (Firewise Landscaping); Flood (when done in green belts and waterways).
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on new/existing buildings:	Reduce threat to wildfire and drought conditions
Priority (High, Moderate, Low):	High
Estimated Cost:	$100,000
Potential Funding Sources:	Texas Forest Service, local revenue
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Fire Protection Plan

COMMENTS:
Engage local Horticulture clubs, landscaper organizations.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #13
	Proposed Action:	**Work with State and City departments to reduce fuel on public and private lands, easements, and right of ways.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risks to citizens and public land; minimize damage, speed recovery and safety of responders.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire, Hazardous Materials, Pipeline Failure
Effect on new/existing buildings:	Reduce fuel threat, fire, explosion to structures
Priority (High, Moderate, Low):	High
Estimated Cost:	$500,000
Potential Funding Sources:	HMGP
Lead Agency/Department Responsible:	Cooperating agencies
Implementation Schedule:	2015-2019
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #14
	Proposed Action:	**Implement prescribed fire program to reduce fire fuel on natural waterways, aquifers, parkland areas, and San Antonio Water source.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Wildfire risk reduction and protect area waterways and water sources from runoff and pollutants resulting from wildfire.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on new/existing buildings:	Educate and reduce risk and threat to structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$1,000,000
Potential Funding Sources:	Local revenue, HMGP, other funding source(s)
Lead Agency/Department Responsible:	Fire Department, Office of Sustainability
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Would be a great plan and benefit for everyone, probably the most logical and cost of effective for overall benefit gained. Gives citizens to get used to and see the benefits of fire.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #15
	Proposed Action:	**Expand brush pickup program, frequency and locations to reduce amount and length of time fire fuels are present on City and private property.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce fire risk, increase first responder and community safety. Better access for first responders.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Wind, Wildfire, Winter Storm, Hurricane
Effect on new/existing buildings:	Reduce possible fires that threaten structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	HMGP, local revenue
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Firewise

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #16
	Proposed Action:	**Develop and implement agreements with railroads to develop a fuel reduction plan along the railways and right of ways.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduces risk to citizens, will keep railways open, reduces risk to first responders (access, being close to train); repair cost.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials
Effect on new/existing buildings:	Reduce exposure to structures/possible explosions
Priority (High, Moderate, Low):	High
Estimated Cost:	To be determined
Potential Funding Sources:	Railroad budget, local revenue
Lead Agency/Department Responsible:	Fire Department, Development Services Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
We make a lot of brush and grass fires that are caused by the Rail Cars, access is an issue. HazMat incidences will be assisted if right-of-ways are clean, access is easier.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #17
	Proposed Action:	**Identify shelters and safe refuge locations for public evacuation associated with disasters such as wildfire, hazardous materials, pipeline failure, terrorism, infectious disease.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	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 Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials, Pipeline Failure, Wildfire, Terrorism, Infectious Disease, Dam Failure
Effect on new/existing buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	Local revenue, grants
Lead Agency/Department Responsible:	Office of Emergency Management, Fire Department, Police Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #18
	Proposed Action:	**Conduct public education and awareness through social media to advertise shelter locations in the event of disasters such as wildland fires, hazardous materials release, pipeline failure, infectious disease, terrorism, dam failure.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	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 Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials, Pipeline Failure, Wildfire, Terrorism, Infectious Disease, Dam Failure
Effect on new/existing buildings:	None
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Office of Emergency Management, Fire Department, Police Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #19
	Proposed Action:	**Develop and implement an annual tree trimming program near public right-of-ways and utility lines to reduce falling limbs during severe weather events.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce cost of repairs; increase safety of citizens, utility workers.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Wind, Winter Storm, Flood, Tornado, Hail, Hurricane
Effect on new/existing buildings:	Reduce damage to nearby structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	HMGP, Local Utility Company, TCI
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Utility Services

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #20
	Proposed Action:	**Develop and implement annual program to identify and create fire breaks in public park areas and City-owned land to reduce fuels in the event of a fire.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce cost of repairs; life safety of citizens and first responders.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Wildfire
Effect on new/existing buildings:	Buffers around structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	Texas Forest Service
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Firewise

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #21
	Proposed Action:	**Conduct assessment of eligible flood reduction activities in preparation for applying for Community Rating System (CRS) program.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce flood insurance premiums for residents; remove flood-prone properties, promote higher regulatory standards to reduce loss of life and property damage in flood events.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Minimize flooding of structures in City
Priority (High, Moderate, Low):	High
Estimated Cost:	$100,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #22
	Proposed Action:	**Install automated systems at low-water crossings with high rate of vehicular access resulting in frequency of accidents and loss of life.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce potential loss of life from vehicular flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce loss of life during high water events
Priority (High, Moderate, Low):	High
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #23
	Proposed Action:	**Purchase open space in flood-prone areas to keep land free from construction in perpetuity.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce loss of life and property damage in flood-prone areas.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Natural Systems Protection

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce loss of life during high water events
Priority (High, Moderate, Low):	High
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Parks and Recreation Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #24
	Proposed Action:	**Install cooling stations at City-owned facilities to aid low income and elderly residents during extreme heat events.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce health risk, loss of life to a segment of population without air-conditioning.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	HMGP
Lead Agency/Department Responsible:	San Antonio Metropolitan Health District (SAMHD)
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #25
	Proposed Action:	**As part of Community Rating System (CRS), conduct public education through social media, City's website, brochures, and flyers to promote reduced flood insurance premiums and other program benefits.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce loss of life and property damage in flood-prone areas through purchase of flood insurance and reduce cost of flooding post-disaster through higher regulatory standards.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems 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:	To be determined
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Parks and Recreation Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #26
	Proposed Action:	**Update city building codes and San Antonio Property Maintenance codes every three years as required by new state building code amendments.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to residents by implementing updated building and maintenance codes.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Wind, Tornado, Hurricane
Effect on new/existing buildings:	Strengthen existing and new building designs
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Development Services Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 4; Economically Sound = 4; and Environmentally Sound = 4

		City of San Antonio – Action #27
	Proposed Action:	**Execute a Memorandum of Understanding between Solid Waste Management Department and Development Services Department to outline and coordinate efforts of debris removal on a quarterly basis.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to residents; reduce emergency response efforts during a severe weather event.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Wind, Tornado, Winter Storm, Dam Failure, Hurricane
Effect on new/existing buildings:	Reduce effects of debris on structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Development Services Department/Solid Waste Management Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #28
	Proposed Action:	**Upgrade drainage channels along the Union Pacific rail road tracks to reduce flooding to adjacent residential and commercial structures.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce intermediate flooding to residents living next to drainage channels. Reduce property damage, prevent soil erosion, reduces health risks to area.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flooding of adjacent structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$500,000
Potential Funding Sources:	HMGP, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department, Union Pacific
Implementation Schedule:	Upon Funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan, Drainage Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #29
	Proposed Action:	**Conduct a rooftop sight assessment plan of all flat roof buildings in the downtown business district to determine critical damage/necessary repairs to prevent roof collapse under current code.**
	BACKGROUND INFORMATION	
	Site and Location:	Downtown business district
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risks to businesses; reduce emergency response efforts during a severe weather event of damaged buildings or collapsing roofs.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Wind, Tornado, Winter Storm, Hail, Hurricane
Effect on new/existing buildings:	Retrofit and secure failing structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$35,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Development Services Department: Building Inspections and Damage Assessment Team
Implementation Schedule:	2015
Incorporation into Existing Plans:	Building Code and Regulations

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 3; Politically Acceptable = 4; Legal = 5; Economically Sound 2= ; and Environmentally Sound = 3

		City of San Antonio – Action #30
	Proposed Action:	**Adopt and implement smart growth initiatives that incorporate the adopted Hazard Mitigation Plan in long-term community development planning activities.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce future risk to residents and increase new and existing infrastructure resilience to severe weather events.

Smart Growth Initiative Action continued on next page

	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans/Structure and Infrastructure Projects Emergency managers and planners will annually develop a method to coordinate revisions and updates of the natural hazard mitigation and the City's Comprehensive Plan "Comp plan 2040". The result of this coordination process is to select mitigation strategies to determine how they can best be integrated into comprehensive plan updates that development regulations or link with other public or private efforts, such as open space preservation or other capital improvement projects. The assurance of integration of the natural hazard mitigation plan into the comprehensive planning process can help make certain that the appropriate hazard assessment information is considered during future land use and development planning. The Office of Sustainability is proposing to lead an annual assessment and update of the Hazard Mitigation Plan and the Comp plan 2040. The deliverables within the annual assessment will include but are not limited to: 1) A climate and vulnerability assessment – climate change *sensitivity analysis* addressing stormwater management, and road operations and maintenance to identify current and projected weather conditions. 2) Policy recommendations to enable the identification of parcels or areas to be designated as high risk. 3) Identification of related capital improvements or land acquisition projects to strengthen at-risk public facilities, such as fire and police stations, and utility systems, or to resist floods and geological hazards or incorporate interconnection service networks, such as roads, pipelines, and cables, and to allow more than one route to any point so that they are less vulnerable to local failures. Source: http://www.fema.gov/media-library-data/1388432170894-6f744a8afa8929171dc62d96da067b9a/FEMA-X-IntegratingLocalMitigation.pdf

Smart Growth Initiative Action continued on next page

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Wind, Wildfire, Winter Storm, Hurricane
Effect on new/existing buildings:	Increase new and existing infrastructure resilience to severe weather events
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$250,000 per year through December 2020
Potential Funding Sources:	Local revenue, HMGP, Regional and State Emergency Funding
Lead Agency/Department Responsible:	Office of Sustainability
Implementation Schedule:	December 2016 December 2017 December 2018 December 2019 December 2020
Incorporation into Existing Plans:	Comprehensive Plan 2040, Hazard Mitigation Plan, Infrastructure Management Plan, City of San Antonio Capital Improvements Program, Bond Program 2012-2017

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 3; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

		City of San Antonio – Action #31
	Proposed Action:	**Integrate fire services such as reporting suspicious activity and threat information into the Southwest Texas Fusion Center.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding suspicious activity reports, emerging threats and related information.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, DHS
Lead Agency/Department Responsible:	Fire Department, Southwest Texas Fusion Center
Implementation Schedule:	Upon Funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #32
	Proposed Action:	**Coordinate technology and communications equipment used by fire, police and first responders to be compatible and uniform.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding suspicious activity reports, emerging threats and related information.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, DHS
Lead Agency/Department Responsible:	Fire Department; Southwest Texas Fusion Center
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #33
	Proposed Action:	**Coordinate information/intelligence sharing and public safety information gleaned from first responders and departments upward through various government levels.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding suspicious activity reports, emerging threats and related information.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, DHS
Lead Agency/Department Responsible:	Fire Department; Southwest Texas Fusion Center
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #34
	Proposed Action:	**Form an all-man security team from fire and police trained in a uniform method to respond to terrorism acts and integrate into Fire Department Tech Services Division.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding suspicious activity reports, emerging threats and related information.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Terrorism
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, DHS
Lead Agency/Department Responsible:	Fire Department; Southwest Texas Fusion Center
Implementation Schedule:	Upon Funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #35
	Proposed Action:	**Conduct public education via social media, utility flyers, and other outreach methods to increase awareness of hazardous materials release and pipeline failure.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding threat of pipeline failure and hazardous materials release and related events.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials, Pipeline Failure
Effect on new/existing buildings:	Reduce possible explosions
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, Fire Department
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #36
	Proposed Action:	**Partner with pipeline companies, agencies and organizations to keep areas in the vicinity of oil and gas pipelines safe and secure, and report suspicious behavior or activity near pipelines.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to citizens regarding threat of pipeline failure and hazardous materials release and related events.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Hazardous Materials, Pipeline Failure
Effect on new/existing buildings:	Reduce possible explosions
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	HMGP, Fire Department
Lead Agency/Department Responsible:	Fire Department
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #37
	Proposed Action:	**Update City policy and plans for protecting City staff and residents from infectious disease.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce risk to all residents from seasonal influenza, virus, and rabies.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Infectious Disease
Effect on new/existing buildings:	None
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	Public Health Emergency Preparedness Grant
Lead Agency/Department Responsible:	San Antonio Metropolitan Health District (SAMHD)
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #38
	Proposed Action:	**Implement and conduct electronic vaccine record system for first responders.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Secure first line defense to reduce risk to first responders in an effort to expedite response to seasonal influenza, virus, and rabies.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Infectious Disease
Effect on new/existing buildings:	None
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	To be determined
Potential Funding Sources:	Public Health Emergency Preparedness Grant
Lead Agency/Department Responsible:	San Antonio Metropolitan Health District (SAMHD)
Implementation Schedule:	Upon funding
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

		City of San Antonio – Action #39
	Proposed Action:	**Acquire properties in flood prone areas with priority given to repetitive flood loss structures.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Remove flood prone properties; promote higher regulatory standards to reduce loss of life and property damage in flood events.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Minimize flooding of structures in City
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,000,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #40
	Proposed Action:	**Remove existing Mulberry St bridge and construct a new bridge that will allow a 100-year ultimate flood to pass below the roadway.**
	BACKGROUND INFORMATION	
	Site and Location:	Mulberry St bridge
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding and potential loss of life at low water crossing.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Minimize flooding of structures in City
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,590,354.55
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #41
Proposed Action:	**Replace existing culvert on with an upgraded multiple box culvert system (MBC) or bridge. Street reconstruction (including curbs and sidewalks as necessary) will be included. A concrete lined channel is also proposed.**
BACKGROUND INFORMATION	
Site and Location:	Sleepy Hollow St to Orsinger St
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding and potential loss of life at low water crossing.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Minimize flooding of structures in City
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,450,346.56
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Storm Water Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #42
	Proposed Action:	**Improve drainage to watershed SA-4 by installing cross drains, replacing existing metal grate, and add box culverts and other miscellaneous storm drain improvements.**
	BACKGROUND INFORMATION	
	Site and Location:	Mahncke Park
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding and potential loss of life at low water crossing.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Minimize flooding of structures in City
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,374,500
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #43
	Proposed Action:	**Construct multiple culvert crossing, reconstruct existing concrete lined channel from W. Martin St to the confluence of Bandera Branch Tributary to Apache Creek and at each crossing; include curbs and sidewalks.**
	BACKGROUND INFORMATION	
	Site and Location:	From the Apache Creek confluence (at NW 26th St) to W. Martin St
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Remove up to 25 homes from the FEMA SFHA
Priority (High, Moderate, Low):	High
Estimated Cost:	$1,119,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #44
	Proposed Action:	**Construct concrete lined channel with 100 ft. bottom width with 5:1 side slopes and reconstruct the culvert system upstream headwall.**
	BACKGROUND INFORMATION	
	Site and Location:	Village Crest Dr to Rittiman Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Remove up to 13 homes from the FEMA SFHA
Priority (High, Moderate, Low):	High
Estimated Cost:	$6,023,330
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #45
	Proposed Action:	**Construct a 60 ft. lateral structure, installation of 2,700 LF of 10'x10' single box culvert (SBC), reconstruction of the existing earthen channel to a 60 ft. bottom-width trapezoidal channel with 3:1 side slopes, and replace the existing culvert system at Ira Lee Rd with a two-span bridge. The storm sewer system will be jacked/bored to prevent traffic disruption.**
	BACKGROUND INFORMATION	
	Site and Location:	Salado Creek confluence to Harry Wurzbach Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Removes all structures from the floodplain east of Harry Wurzbach Rd
Priority (High, Moderate, Low):	High
Estimated Cost:	$6,081,300
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #46
	Proposed Action:	**Construct an underground drainage system utilizing 66" reinforced concrete pipe (RCP).**
	BACKGROUND INFORMATION	
	Site and Location:	Moursund Blvd to Six Mile Creek
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Alleviate home and street flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,710,090
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #47
	Proposed Action:	**Re-grading/channelization of the creek to improve flow characteristics. The project also includes the buy-out of several homes located in the floodplain.**
	BACKGROUND INFORMATION	
	Site and Location:	Bitters Rd to North Loop Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Alleviate home and street flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,700,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #48
Proposed Action:	**Expand 116,370 sq. ft. bridge under SW. Loop 410 and approximately 2,930 LF channel modification downstream from SW. Loop 410. This project also includes property buyout for necessary easement.**
BACKGROUND INFORMATION	
Site and Location:	SW. Loop 410 (east of Somerset Rd) and approx. 3,000 ft. downstream
Risk Reduction Benefit *(Current Cost/Losses Avoided)*:	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Eliminate low water crossing at SW. Loop 410
Priority (High, Moderate, Low):	High
Estimated Cost:	$65,931,219
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #49
	Proposed Action:	**Construct underground drainage 72" reinforced concrete pipe (RCP) to alleviate street flooding. Repair street including curbs and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Fredericksburg Rd to Williamsburg Pl
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce potential flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,862,736.93
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #50
	Proposed Action:	**Replace the concrete lined open channel between McCullough Ave and the confluence of the box culverts located approximately 800 ft. east of McCullough Ave. Reconstruct McCullough Ave from Barbara Dr to Sharon Dr with an underground storm sewer system with curb inlets to eliminate the low water crossing at Barbara Dr and McCullough Ave.**
	BACKGROUND INFORMATION	
	Site and Location:	McCollough Ave – Barbara Dr to Sharon Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce potential flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,586,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #51
	Proposed Action:	**Improve drainage and reconstruct necessary streets with curbs, sidewalks, and driveway approaches: Phase I will only address a portion of the described project. Barbara Dr drainage #73 Phase IIA – Channel modifications and improvements.**
	BACKGROUND INFORMATION	
	Site and Location:	Pinewood Ln (El Montan Ave to Dellwood Dr), Dellwood Dr (Pinewood Ln to Oblate Dr), Waring Dr (Springwood Ln to Barbara Dr), Barbara Dr (Oblate Dr to Skipper Dr), McCullough Ave (W. Rector to Linda Dr)
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce potential flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$21,967,009
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #52
	Proposed Action:	**Construct bridge crossing with +/- 6,300 LF of total channel grading upstream and downstream and excavating to eliminate a low water crossing. Street reconstruction includes driveway approaches, curbs, and sidewalks as required. A total of three lots will be required to buyout for drainage proposes.**
	BACKGROUND INFORMATION	
	Site and Location:	Dreamland Dr from railroad to 550 ft. west of railroad crossing; 1,600 LF both and 4,700 LF south of Dreamland Dr low water crossing
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,320,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #53
Proposed Action:	**Construct underground drainage improvements to both low water crossings #26 and #27 with street reconstruction including curbs, sidewalks and culverts. The project will also consist of channel drainage improvements and 5-10'x5' multiple box culverts (MBCs) at each crossing to eliminate the low water crossings.**
BACKGROUND INFORMATION	
Site and Location:	Lockhill Rd and White Bonnet St
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flooding
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,410,518
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #54
	Proposed Action:	**Construct drainage improvements and buyout properties in the floodplain.**
	BACKGROUND INFORMATION	
	Site and Location:	Andover Dr to Salado Creek
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,412,774
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #55
Proposed Action:	**Construct drainage improvements to provide all weather access. Replace existing multiple box culvert (MBCs) system with bridge structure. Improvements will require associated street reconstruction to include curbs, sidewalks, and driveway approaches be incorporated into the project.**
BACKGROUND INFORMATION	
Site and Location:	Pinn Rd, 1,500 ft. south of W. Commerce St
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,375,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #56
Proposed Action:	**Upgrade existing concrete channel to reduce the 1% floodplain and erosion. The project will consist of proposing concrete channel and channel excavation. The project will also consist of installing 9-10'x10' multiple box culverts (MBCs) and street reconstruction that will include driveways, curbs, and sidewalks.**
BACKGROUND INFORMATION	
Site and Location:	Loop 410 to Olmos Creek
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,465,528
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #57
	Proposed Action:	**Installation of underground system consisting of box culverts, Capital Improvement Program (CIP) Bond Project Phase I.**
	BACKGROUND INFORMATION	
	Site and Location:	Oak Glen Dr & Haskins Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$8,050,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

City of San Antonio – Action #58	
Proposed Action:	**Improve culvert crossing. Existing culvert causes storm water back up, which triggers flooding to local residents. Expand the existing channel, concrete line the channel, and replace the existing corrugated metal arch pipe with 5-12'X8' multiple box culverts (MBCs).**
BACKGROUND INFORMATION	
Site and Location:	Clyde Dent Dr to Leon Creek
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,076,296
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #59
	Proposed Action:	**Construct a drainage system and reconstruct the street to alleviate localized ponding.**
	BACKGROUND INFORMATION	
	Site and Location:	Fratt Rd, from Rittiman Rd to Eisenhauer Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$6,587,700
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #60
	Proposed Action:	**Construction of a drainage outfall to alleviate flooding problems in the area. The proposed system consists of 2-12'X8' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Outfall bounded by Frio City Rd and Hwy 90
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,798,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #61
	Proposed Action:	**Reconstruct underground drainage infrastructure and street reconstruction.**
	BACKGROUND INFORMATION	
	Site and Location:	Amity Rd from Roland Rd to Rigsby Ave
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,660,075.50
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #62
Proposed Action:	**Reconstruct underground drainage 6'x4' single box culvert (SBC). Associated street reconstruction to include curbs, sidewalks, and driveway approaches will be incorporated into the project.**
BACKGROUND INFORMATION	
Site and Location:	Ray Ellison Blvd from SW. Loop 410 to Valley Hi Dr
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,498,269
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #63
	Proposed Action:	**Install underground storm sewer system.**
	BACKGROUND INFORMATION	
	Site and Location:	Topperwein Rd from Nacogdoches Rd to Ridge Willow Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,336,800.84
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #64
Proposed Action:	**Major structure upgrade replacement to provide access across Leon Creek, requires significant channel grading with necessary street reconstruction with curbs and sidewalks.**
BACKGROUND INFORMATION	
Site and Location:	W. Commerce St from Pinn Rd to SW. Military Dr
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$14,020,627
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #65
	Proposed Action:	**Improve low water crossing to contain the 100-year ultimate flows. Includes channel improvements to Olmos Creek and necessary street reconstruction with curb and sidewalk.**
	BACKGROUND INFORMATION	
	Site and Location:	Vance Jackson Rd at Orsinger St low water crossing #36
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,524,121
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #66
	Proposed Action:	**Install underground drainage system utilizing 2-7'x3' multiple box culverts (MBCs) and an outfall to TxDOT channel. Necessary street reconstruction includes curbs, driveway approaches and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Marbach Rd from SW. Loop 410 to Horal Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,678,972.87
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #67
Proposed Action:	**Channelize sections of the Salado Creek. These improvements would require the removal of an estimated 500 trees and the pruning of an estimated 250 trees. These improvements would provide the capacity of the 10-year flood event.**
BACKGROUND INFORMATION	
Site and Location:	Salado Creek from J Street Park to Rigsby Ave
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,018,018.84
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #68
	Proposed Action:	**Install underground channel system consisting of 42" & 48" reinforced concrete pipe (RCP) and 2-8'x5' multiple box culverts (MBCs). The proposed channel will tie into an existing channel.**
	BACKGROUND INFORMATION	
	Site and Location:	Center Park Blvd from Remount Dr to Center Park Blvd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,243,565
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #69
	Proposed Action:	**Design and construct underground drainage system and earthen channel to divert drainage into the golf course and reconstruction to ensure proper drainage and include curbs and sidewalks.**
	BACKGROUND INFORMATION	
	Site and Location:	Pembroke Rd from Rochelle St to Abe Lincoln
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,543,466
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #70
	Proposed Action:	**Improve culvert crossings to provide an earthen channel that will convey the 1% annual chance future conditions floodplain.**
	BACKGROUND INFORMATION	
	Site and Location:	Mud Creek Tributary A drainage Improvements from Thousand Oaks Dr to Miss Ellie Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,016,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; The proposed channel was designed in HEC-RAS using the channel modification tool. The project will take multiple houses out of the 1% annual chance flood hazard area.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #71
	Proposed Action:	**Design and construct underground drainage and construct driveway culverts at all driveways to ensure proper drainage and include curbs and sidewalks.**
	BACKGROUND INFORMATION	
	Site and Location:	County View Ln from Rochelle St to Abe Lincoln
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,727,226.74
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #72
Proposed Action:	**Channelize and improve the low water crossing #21 and #22 with 5'x7' multiple box culverts (MBCs). A bypass system that will capture and convey the flow downstream is consisting of 2-10'x6' multiple box culverts (MBCs) and 5'X6' single box culvert (SBC). Knoll Creek Improvements Phase 1.**
BACKGROUND INFORMATION	
Site and Location:	Low water crossing #21 and #22, - From Jung Rd to Stahl Rd on Salado Creek Tributary F.
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,984,339
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #73
	Proposed Action:	**Replace existing low water crossing with an upgraded culvert 2-10'x10' multiple box culverts (MBCs) or bridge to eliminate a low water crossing #71 with some channel modifications upstream and downstream of the crossing.**
	BACKGROUND INFORMATION	
	Site and Location:	Low water crossing #71 Danville and Overbrook
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,000,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #74
	Proposed Action:	**Improve drainage and drainage ditch.**
	BACKGROUND INFORMATION	
	Site and Location:	Multi-phase project Zarzamora #83 B,C,D Phase II from W. Hutchins Pl to SW. Loop 410
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,000,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; This is the remaining phases of a multi-phase project "Zarzamora #83" from W. Hutchins Pl to SW. Loop 410. Complete street reconstruction with underground drainage and upgrading of existing earthen channel to alleviate street flooding. Total cost - $20,000,000; City Match - $4,000,000
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #75
	Proposed Action:	**Upgrade the existing box culvert system and storm sewer system with associated street repair and rehabilitation that will include curbs and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Pinn Rd from Orr Dr to Westlawn Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,818,336.34
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #76
	Proposed Action:	**Upgrade and replace the existing channel with an underground drainage system. The proposed system would consist of approximately 3,300 LF of 4-8'x4' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Thames Dr between Blanco Rd and San Pedro Ave
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,119,728.69
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; This project is expected to remove up to 15 homes from the floodplain. The capacity of that system must be verified prior to construction of this project. Bexar County has conducted multiple feasibility studies for that system (from El Montan Ave to the Olmos Basin Golf Course).
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #77
	Proposed Action:	**Install a reinforced-concrete open channel drainage system with associated at-grade drainage structures to alleviate localized street flooding.**
	BACKGROUND INFORMATION	
	Site and Location:	Normoyle Ditch
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$12,400,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #78
	Proposed Action:	**Construct underground drainage 7'x7' single box culvert (SBC) to alleviate street flooding.**
	BACKGROUND INFORMATION	
	Site and Location:	Freiling Dr from Wonder Pkwy to Vance Jackson Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,187,246
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #79
	Proposed Action:	**Construct earthen channel. Additionally, construction includes box culverts and a concrete channel.**
	BACKGROUND INFORMATION	
	Site and Location:	Shady Hollow Ln from northwest of Babcock Rd and NW. Loop 1604
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,181,560
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #80
Proposed Action:	**Upgrade low water crossing #24 to 10-7'x4' multiple box culverts (MBCs), and upgrade low water crossing #24.1 to 11-10'x6' multiple box culverts (MBCs). The improvements will require an upgrade to the earthen channel to a concrete line channel with a varying bottom ranging from 60 ft. to 100 ft.**
BACKGROUND INFORMATION	
Site and Location:	Lookout Rd and Judson Rd
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,910,592
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #81
	Proposed Action:	**Improve drainage system.**
	BACKGROUND INFORMATION	
	Site and Location:	Broadway St corridor - Phase V (Catalpa-Pershing drainage channel to Brackenridge Ave)
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,495,544
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #82
	Proposed Action:	**Install underground drainage system. The project will also reconstruct and modify/improve signalization as needed.**
	BACKGROUND INFORMATION	
	Site and Location:	Broadway Corridor Phase III- 1B; Burr Rd From Broadway St to N. New Braunfels Ave
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$1,174,900
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #83
	Proposed Action:	**Construct a regional storm water facility.**
	BACKGROUND INFORMATION	
	Site and Location:	East of Huebner Rd and Apple Green Rd, south of Eckhert Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$9,599,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #84
	Proposed Action:	**Construct an underground drainage system to alleviate street flooding. Underground drainage system includes installing 6'x4' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Braubach St from Roosevelt Ave to Six Mile Creek
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,115,764.24
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #85
Proposed Action:	**Construct a parallel storm sewer system and at-grade drainage structures to alleviate flooding of homes and streets. The proposed system consists of 10'x7' single box culvert (SBC), 10' inlets, and 24" & 30" laterals.**
BACKGROUND INFORMATION	
Site and Location:	Overbrook outfall; Evelyn Dr from Seeling Blvd and St Cloud to Rosemont Dr
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,154,961
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years The project includes reconstruction of all associated streets, curbs, sidewalks, and driveway approaches. This project requires that the Seeling Channel and Woodlawn Lake outfall be upgraded first.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #86
	Proposed Action:	**Construct a storm sewer system. System will consist of inlets with reinforced concrete pipe (RCP).**
	BACKGROUND INFORMATION	
	Site and Location:	Castle Cross from Midcrown Dr to Rittiman Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,700,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years. Street reconstruction including curbs and sidewalks and Concrete Riprap with rock riprap embedded will be required.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #87
	Proposed Action:	**Install an underground system which will continue in a box culvert. This will eliminate low water crossing #95.**
	BACKGROUND INFORMATION	
	Site and Location:	Northwood-Devonshire area drainage; Chevy Chase Dr to Eisenhauer Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,058,929
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #88
	Proposed Action:	**Construct additional culvert from outfall. Reconstruct streets, curbs & sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Olympia area streets and drainage from Alhambra to San Angelo
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,373,609
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #89
	Proposed Action:	**Conduct major channel improvements as well as three bridge/culvert crossings. Street reconstruction will be required as well.**
	BACKGROUND INFORMATION	
	Site and Location:	Diversey drainage from IH 10 E. just inside Loop 1604
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$13,922,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years. Additional ROW of 11,800 SF will be needed.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #90
Proposed Action:	**Install underground drainage system utilizing 3-9'x6' multiple box culverts (MBCs). Necessary street reconstruction includes sidewalks, curbs and driveway approaches.**
BACKGROUND INFORMATION	
Site and Location:	North San Antonio Hills subdivision; Misty Woods St & SH 151
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,567,272.42
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #91
	Proposed Action:	**Street and drainage reconstruction in order to alleviate runoff. The reconstruction of streets can include sidewalk, curbs, and approaches and inlets for the drainage improvements.**
	BACKGROUND INFORMATION	
	Site and Location:	Wilson from Woodlawn Ave to Waverly Ave
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$8,199,874.7
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #92
	Proposed Action:	**Construct drainage improvements. Drainage system/outfall and street reconstruction including curbs and sidewalks as required. Sheet flowing runoff runs over streets and through lows in private properties causing flooding and ponding.**
	BACKGROUND INFORMATION	
	Site and Location:	Mabelle Dr; Goforth Dr and N. Weidner Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,255,867.14
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #93
Proposed Action:	**Construct an underground drainage system within the right-of-way of Pickwell Dr to alleviate localized flooding at 115 Pickwell Dr. Reconstruction of Pickwell Dr, Gayle Ave, Banbridge Ave, Galway St, Tipperary Ave, Kilarney Dr, and Dublin Ave will be also be included along with curbs, sidewalks, and driveway approaches.**
BACKGROUND INFORMATION	
Site and Location:	Pickwell area drainage Improvement Phase C; Palfrey St to Dublin Ave
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$8,847,337
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #94
Proposed Action:	**Construct an underground drainage system comprising 2-10'x4' multiple box culverts (MBCs) to alleviate street flooding. The project requires reconstruction of Elmira St and the intersections of Euclid Ave, McCullough Ave, Erie Ave, and Atlanta St and Wilmington Ave.**
BACKGROUND INFORMATION	
Site and Location:	Elmira St from McCullough Ave to San Antonio River
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,104,468.52
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #95
	Proposed Action:	**Construct an underground drainage structure 4'x5' multiple box culverts (MBCs) to alleviate street flooding. The improvements would require associated drainage structures (culverts) and street reconstruction to include curbs, sidewalks, and driveway approaches.**
	BACKGROUND INFORMATION	
	Site and Location:	Jackson Keller Rd from San Pedro Ave to McCullough Ave
	Risk Reduction Benefit *(Current Cost/Losses Avoided)*:	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,036,610.20
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #96
	Proposed Action:	**Construct underground drainage system.**
	BACKGROUND INFORMATION	
	Site and Location:	Southwell Rd from Prue Rd to Huebner Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,080,032
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #97
Proposed Action:	**Construct underground drainage 10'x7' single box culvert (SBC) to alleviate flooding of homes. This project requires the Woodlawn Lake outfall be upgraded first.**
BACKGROUND INFORMATION	
Site and Location:	Seeling Drainage Improvements; Placid Dr to Zachry Dr
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$17,100,149
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #98
	Proposed Action:	**Install an underground drainage system along with street reconstruction curb, sidewalks, and driveway approaches.**
	BACKGROUND INFORMATION	
	Site and Location:	Five Palms Dr from Medina Base Rd to W. Military Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,935,700
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #99
	Proposed Action:	**Install an underground drainage system and street reconstruction. Also, an outfall to French Creek will be constructed.**
	BACKGROUND INFORMATION	
	Site and Location:	Heath Circle Dr from Coral Springs to Low Bid Ln
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$13,551,524.98
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #100
	Proposed Action:	**Install an underground drainage system along various streets. Along with associated at-grade drainage structures to alleviate localized street flooding with associated street repair and rehabilitation that will include curbs and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Wabash Storm Drainage; Fenfield Ave/W. Mayfield Blvd – Wabash St to New Laredo Hwy; Lovett Ave – Wabash St to New Laredo Hwy
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$13,685,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #101
	Proposed Action:	**Construct channel to contain storm water runoff within the Oakland Estates neighborhood, and utilized box culverts for street crossings. The project will help eliminate dangerous crossings.**
	BACKGROUND INFORMATION	
	Site and Location:	Southwell Rd From Verbena St to Encino Park Rd and Hollyhock Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,547,476
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #102
Proposed Action:	**Install an underground drainage system 36" reinforced concrete pipe (RCP) to alleviate street flooding. Reconstruction of street including curbs, driveway approaches and sidewalks as required.**
BACKGROUND INFORMATION	
Site and Location:	Cincinnati Ave from N. General McMullen Dr to Tulane Dr
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,125,803.77
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #103
	Proposed Action:	**Alleviate localized flooding with proposed drainage to help convey flows underground.**
	BACKGROUND INFORMATION	
	Site and Location:	Roland Rd Drainage Phase I, II, and III; Rigsby Ave to Family Tree Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$20,127,403
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #104
	Proposed Action:	**Upgrade and improve low water crossing and associated street reconstruction. Street reconstruction to include sidewalks, curbs and driveway approaches.**
	BACKGROUND INFORMATION	
	Site and Location:	Old Fredericksburg Rd, north of N. Loop 1604 W., from N. Loop 1604 W. and IH 10
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$7,791,882
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #105
	Proposed Action:	**Construct an earthen channel. The improvements also include adding multiply box culverts under Sligo St, Esma St, and San Juan Rd and limited street reconstruction.**
	BACKGROUND INFORMATION	
	Site and Location:	Brookside Outfall; Brookside Subdivision. From Lebanon St to an unnamed tributary to the San Antonio River west of Southton Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,738,107
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #106
Proposed Action:	**Improve drainage with 48" reinforced concrete pipe (RCP) & street reconstruction including curbs and sidewalks as required. Runoff sheet flow across streets into properties in whole neighborhood.**
BACKGROUND INFORMATION	
Site and Location:	Deerwood Dr from Rainbow Dr to Austin Hwy
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,003,464.05
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #107
	Proposed Action:	**Construct underground drainage system consisting of 24" to 60" reinforced concrete pipe (RCP), curb inlets, outfall structures, and boring beneath the railroad to the Airport Tributary.**
	BACKGROUND INFORMATION	
	Site and Location:	Empire St – Belfast Dr to Everest St; Ridgecrest Dr & W. Lawndale Dr – Everest St to Broadway St; Belfast Dr, Colton Dr, & Conway Dr – Empire St to Everest St; Mavis St – Belfast Dr to Conway Dr; Everest St – W. Lawndale Dr to Conway Dr; Janda Susan Rd & Lookover St - dead-end to Ridgecrest Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$9,385,100
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #108
Proposed Action:	**Improve channel for +/- 2,200 LF and +/- 3,000 LF of storm drain box culverts. The project limits will consist from an adjacent drainage channel to Hwy 90 to General Hudnell Dr, where runoff will be conveyed buy an additional 12'x8' box culvert +/- 3,000 LF will connect to an existing storm system.**
BACKGROUND INFORMATION	
Site and Location:	Hwy 90 to General Hudnell Dr to Frio City Rd
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$11,500,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #109
	Proposed Action:	**Expand 1,050 LF of existing channel and adding 1,655 LF of multiple box culverts (MBCs) to alleviate localized flooding. This project is created for drainage because the existing conveyance system does not have capacity.**
	BACKGROUND INFORMATION	
	Site and Location:	Channel runs north of Juniper St & underground system running down Gallant St to Sligo St
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,219,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #110
	Proposed Action:	**Install an underground drainage system utilizing 8'x5' single box culvert (SBC) to alleviate flooding of homes. Necessary street reconstruction includes curbs, driveway approaches, and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	W. Hildebrand Ave to W. Kings Hwy
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$23,878,250.92
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #111
	Proposed Action:	**Upgrade channel for floodplain reclamation and flow improvement in the area.**
	BACKGROUND INFORMATION	
	Site and Location:	Pershing Creek from Salado Creek to Fort Sam Houston
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,912,301
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #112
	Proposed Action:	**Install a large underground system that will capture the majority of the storm water before it gets to the grate inlet. The proposed system will tie into an existing TxDOT system, and increase the capacity of the existing system. The system ranges from 30" reinforced concrete pipe (RCP) to 4-7'x3' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Busby System Phase 2: Nacogdoches Rd to Lawndale Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,313,725
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; Localized flooding occurs near the intersection of N. New Braunfels Ave and NE. Loop 410 Access Rd. A single grate inlet near this intersection is supposed to capture over 650 cfs, but does not effectively collect storm water. This causes the storm water to back up into private property.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #113
	Proposed Action:	**Improve the drainage infrastructure to include installing 2-7'x3' multiple box culverts (MBCs). Necessary street reconstruction will include driveway approaches, curbs, and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Churchill Estates; Chloe Dr/Churchill Ave/Mimmie St
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,710,090
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #114
	Proposed Action:	**Install a large underground system that will capture the majority of the storm water before it gets to the grate inlet. The proposed system will tie into an existing TxDOT system, and increase the capacity of the existing system. The system ranges from 30" reinforced concrete pipe (RCP) to 4-7'x3' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Busby System Phase 1: Nacogdoches Rd to Lawndale Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,861,419
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; Localized flooding occurs near the intersection of N. New Braunfels Ave and NE. Loop 410 Access Rd. A single grate inlet near this intersection is supposed to capture over 650 cfs, but does not effectively collect storm water. This causes the storm water to back up into private property.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #115
	Proposed Action:	**Install a large underground system that will capture the majority of the storm water before it gets to the grate inlet. The proposed system will tie into an existing TxDOT system, and increase the capacity of the existing system. The system ranges from 30" reinforced concrete pipe (RCP) to 4-7'x3' multiple box culverts (MBCs).**
	BACKGROUND INFORMATION	
	Site and Location:	Busby System Phase 3: Nacogdoches Rd to Lawndale Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,118,162
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; Localized flooding occurs near the intersection of N. New Braunfels Ave and NE. Loop 410 Access Rd. A single grate inlet near this intersection is supposed to capture over 650 cfs, but does not effectively collect storm water. This causes the storm water to back up into private property.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #116
Proposed Action:	**Improve underground drainage 2-7'x3' multiple box culverts (MBCs) to one of three outfalls to the Hills & Dales neighborhood. Associated street reconstruction to include curbs, sidewalks, and driveway approaches be incorporated into the project.**
BACKGROUND INFORMATION	
Site and Location:	Shady Hollow Ln; Hills & Dales
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,111,316
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #117
Proposed Action:	**Reconstruct and upgrade of underground drainage, curbs, and sidewalks. May require at least a 7'x6' single box culvert (SBC) outfall existing channel and laterals on these streets to alleviate street flooding.**
BACKGROUND INFORMATION	
Site and Location:	Vestal Pl/Hutchins Pl/Langford Pl/Amber St
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,512,617.57
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #118
	Proposed Action:	**Construct a trapezoidal channel that connects to a storm water system. The trapezoidal channel will consist of a top width of 13 ft., bottom width of 4 ft. and side slopes of 3:1. The system will consist of eight 10ft curb inlets The system will tie into an existing system.**
	BACKGROUND INFORMATION	
	Site and Location:	Stringfellow St to Menlo Blvd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,805,945.96
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

	City of San Antonio – Action #119
Proposed Action:	**Construct channel to accept the flows from two culvert systems 1-48" and 2-36" corrugated metal pipes (CMP). The channel will be grass lined with exception of the upstream 100 ft. and downstream 100 ft., where it will be concrete riprap for erosion protection. Wing walls and energy dissipaters will also be required.**
BACKGROUND INFORMATION	
Site and Location:	Rockwell Outfall to Six Mile Creek; Railroad tract/Baetz Blvd to Six Mile Creek
Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,035,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #120
	Proposed Action:	**Construct an underground drainage system utilizing 9'x2' single box culvert (SBC) and street reconstruction to alleviate street flooding. Necessary street reconstruction includes driveway approaches, curbs, and sidewalks as required.**
	BACKGROUND INFORMATION	
	Site and Location:	Donore Pl and Tupelo Ln
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,075,856.69
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #121
	Proposed Action:	**Construct an underground drainage system and an 8'x6' multiple box culverts (MBCs) to alleviate street flooding.**
	BACKGROUND INFORMATION	
	Site and Location:	Wilma Jean Dr and Rockwell Blvd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,034,964
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #122
	Proposed Action:	**Construct and improve drainage ditch. Proposed improvements will rebuild S. Zarzamora St to a 5-lane section, 62 ft. travel lanes and two 5 ft. bike lanes for total 72 ft. pavement.**
	BACKGROUND INFORMATION	
	Site and Location:	S. Zarzamora St from W. Hutchins Pl to W. Villaret Blvd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$17,038,223.29
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years; This is a multi-phased project "Zarzamora #83." 9,276 ft. per streets.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #123
	Proposed Action:	**Upgrade channel at San Antonio River Spill at Broadway St. The upgraded channel will consist of removal and reconstruction of the current channel.**
	BACKGROUND INFORMATION	
	Site and Location:	San Antonio River near Broadway St and Carnahan St to Funston Pl
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$8,000,000
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #124
	Proposed Action:	**Install an underground drainage to improve local drainage. Street reconstruction includes driveway approaches, sidewalks and curbs.**
	BACKGROUND INFORMATION	
	Site and Location:	New Laredo Hwy between Pitluk Ave to Leon Creek
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$10,835,760.82
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #125
	Proposed Action:	**Drainage improvements of existing box culvert system on Westwood Village Creek, low water crossing #112.**
	BACKGROUND INFORMATION	
	Site and Location:	Near intersection of Westbriar and W. Military Dr
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$4,476,946
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #126
	Proposed Action:	**Construct a 7'x5' single box culvert (SBC) to alleviate street flooding.**
	BACKGROUND INFORMATION	
	Site and Location:	S. General McMullen Dr from Hwy 90 to Roselawn Rd
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$2,022,187.34
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #127
	Proposed Action:	**Upgrade underground drainage 2-7'x3' multiple box culverts (MBCs). Associated street reconstruction to include curbs, sidewalks, and driveway approaches are incorporated into the project.**
	BACKGROUND INFORMATION	
	Site and Location:	Shady Hollow Ln near northwest corner of Babcock Rd and N. Loop1604 W.
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,410,759
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #128
	Proposed Action:	**Construct underground drainage 9'x6' single box culvert (SBC) to alleviate flooding of yards and streets. Associated street reconstruction to include curbs, sidewalks, and driveway.**
	BACKGROUND INFORMATION	
	Site and Location:	S. San Ignacio Ave from W. Commerce St to Dartmouth St
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Increase flow and contain flood waters to reduce flooding.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood
Effect on new/existing buildings:	Reduce flood waters from backing up into area
Priority (High, Moderate, Low):	High
Estimated Cost:	$3,127,937.86
Potential Funding Sources:	HMGP, TWDB, local revenue
Lead Agency/Department Responsible:	Transportation & Capital Improvements (TCI) Department
Implementation Schedule:	2015
Incorporation into Existing Plans:	Flood Ordinance, Flood Management Plan, Stormwater Management Plan, Community Rating System (CRS)

COMMENTS:
County funded within next 10 years.
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #129
	Proposed Action:	**Advertise availability of cooling stations at City-owned facilities through City's website and other social media to aid low income and elderly residents during extreme heat events.**
	BACKGROUND INFORMATION	
	Site and Location:	Locations in City to be determined
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Reduce health risk, loss of life to a segment of population without air-conditioning.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Extreme Heat
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$5,000
Potential Funding Sources:	HMGP
Lead Agency/Department Responsible:	San Antonio Metropolitan Health District
Implementation Schedule:	2015
Incorporation into Existing Plans:	Emergency Operations/Response Plan

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 3; Administratively Possible = 4; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

		City of San Antonio – Action #130
	Proposed Action:	**Notify property owners of results of rooftop sight assessment plan of all flat roof buildings in the downtown business district to make necessary repairs to prevent roof collapse under current code.**
	BACKGROUND INFORMATION	
	Site and Location:	Downtown business district
	Risk Reduction Benefit *(Current Cost/Losses Avoided)*:	Reduce risks to businesses, reduce emergency response efforts during a severe weather event of damaged buildings or collapsing roofs.
	Type of Action: (*Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Education and Awareness

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Flood, Extreme Wind, Tornado, Winter Storm, Hail, Hurricane
Effect on new/existing buildings:	Retrofit and secure failing structures
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$35,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	Development Services Department: Building Inspections and Damage Assessment Team
Implementation Schedule:	2015
Incorporation into Existing Plans:	Building Code and Regulations

COMMENTS:
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 3; Politically Acceptable = 4; Legal = 5; Economically Sound 2= ; and Environmentally Sound = 3

		City of San Antonio – Action #131
	Proposed Action:	**Develop and implement an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling swimming pools, etc. during drought conditions.**
	BACKGROUND INFORMATION	
	Site and Location:	Throughout City
	Risk Reduction Benefit *(Current Cost/Losses Avoided)***:**	Conserve essential water supply.
	Type of Action: *(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)*	Local Plans and Regulations

MITIGATION ACTION DETAILS	
Hazard(s) Addressed:	Drought
Effect on New/Existing Buildings:	Water conservation measures during drought emergencies
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$30,000
Potential Funding Sources:	Local revenue
Lead Agency/Department Responsible:	San Antonio Water System (SAWS)
Implementation Schedule:	2015-2016
Incorporation into Existing Plans:	Firewise Plan, Water/wastewater Utilities

COMMENTS
Additional Considerations: The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

SECTION 20: PLAN MAINTENANCE

Plan Maintenance Procedures 1
Monitoring and Evaluation 1
Monitoring 2
Evaluation 2
Updating 3
Plan Amendments 3
Five Year Review 3
Incorporating the Plan into Other Planning Mechanisms 4
Continued Public Involvement 6

Plan Maintenance Procedures

The following is an explanation of how the City of San Antonio will implement the Hazard Mitigation Action Plan (Plan) and continue to evaluate and enhance the Plan over time. To ensure the Plan remains current and relevant, the following Plan Maintenance procedures will be addressed:

- Incorporation
- Monitoring and Evaluation
- Updating
- Continued Public Involvement

Monitoring and Evaluation

Periodic revisions of the Plan are required to ensure that goals, objectives, and mitigation actions are kept current. Revisions may be required to ensure the Plan is in compliance with federal and state statutes and regulations. This section outlines the procedures for completing Plan revisions, updates, and review. Table 20-1 indicates the department and title responsible for Plan monitoring, updating and review of the Plan.

Table 20-1. Team Members Responsible for Plan Monitoring, Updating and Review of the Plan

DEPARTMENT	TITLE
Office of Emergency Management	Emergency Management Coordinator
Office of Emergency Management	Assistant Emergency Management Coordinator(1)
Office of Emergency Management	Assistant Emergency Management Coordinator(2)
Office of Emergency Management	Special Projects Manager
Office of Emergency Management	Senior Management Analyst(1)
Office of Emergency Management	Senior Management Analyst(2)
Office of Emergency Management	Department Fiscal Administrator

Monitoring

Designated Executive Planning Team (Planning Team) members are responsible for monitoring, updating, and reviewing the Plan, as shown in Table 20-1. Individuals holding the title listed in Table 20-1 will be responsible for monitoring the Plan on an annual basis. Plan monitoring, includes reviewing mitigation actions submitted and coordinating with various City departments to determine if mitigation actions need to be re-evaluated and updated. The Planning Team will develop a brief report that identifies if changes to the Plan are needed, such as recommending an action for funding. A written summary of meeting notes will report the particulars involved in turning an action into a project.

Evaluation

As part of the evaluation process, the Executive 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 and identify any needed changes. The annual evaluation process will help to determine if any changes are necessary.

Updating

Plan Amendments

At any time, minor technical changes may be made to update the City of San Antonio Hazard Mitigation Plan. Material changes to mitigation actions or major changes in the overall direction of the Plan 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 TDEM.

In determining whether to recommend approval or denial of a Plan 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;
- New issues or needs that were not adequately addressed in the Plan; and
- Changes in information, data, or assumptions from those on which the Plan was based.

Five Year Review

The Plan will be thoroughly reviewed by the Executive Planning Team at the end of three 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, 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 Advisory Planning Team (Section 2, Table 2-2) meet to review the Plan at the end of three years because grant funds may be necessary for the development of a five-year update. Planning grant options in advance of the five-year Plan update deadline is recommended considering the timelines for grant cycles.

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 FEMA.

Incorporating the Plan into Other Planning Mechanisms

Upon formal adoption of the Plan, all Team members will work to integrate the hazard mitigation strategies into other planning mechanisms for the City. The Planning Team will review plans and policies on an annual basis, and analyze the need for amendments in light of the approved Plan. The Planning Team will ensure that future planning of capital improvement, disaster recovery, historic preservation, flood response plans, and other planning mechanisms will be consistent with the goals of the Plan.

The full Advisory Planning Team (Section 2, Table 2-2) will meet in person bi-annually, and more often if warranted, to ensure mitigation actions prioritized as high to moderate are tracked and monitored based on federal Disaster Declarations, Pre-Disaster Mitigation (PDM) funding cycles, and other non-federal funding sources. For Hazard Mitigation Grant Programs (HMGP), grant applications will be developed for submittal to TDEM and FEMA accordingly.

The potential funding sources listed for each identified mitigation action may be used when Planning Team members begin to seek funds to implement actions. An implementation time period, or a specific implementation date, has been assigned to each mitigation action as an incentive for completing each task and gauging whether actions are implemented in a timely manner.

Existing plans for the City will be reviewed by the Planning Team to optimize the incorporation of mitigation policies and actions. Table 20-2 indicates titles of persons for incorporating actions, method of incorporation, and approving authority. Table 20-3 identifies key planning mechanisms available and process of incorporation into current mitigation and planning efforts.

The Plan will be discussed at annual budget meetings to consider proposed funding sources for mitigation actions.

Table 20-2. Approving Authority, Team Members Responsible for Coordinating Incorporation of Planning Mechanisms into the Plan, Methods of Incorporation

POINTS OF CONTACT *(contact may vary based on 'Type' of Action to be Implemented)*	METHOD OF INCORPORATING MITIGATION ACTIONS INTO LOCAL PLANNING MECHANISMS
Mayor (approving authority for the Plan), Office of Emergency Management Staff	Annual budget review, Flood Damage Ordinance, Community Rating System, Emergency Operations Plan, Building Codes, Disaster Response and Recovery Plan, Master Drainage Plan, Storm Water Management Plan, National Flood Insurance Program (NFIP), Long-term Comprehensive Development Plan, Local Emergency Planning Committee, Fire Plan, Transportation and CIP Plan.

Table 20.3 - Process of Incorporation by Planning Mechanism

PLANNING MECHANISM	INCORPORATION OF PLAN
Grant Applications	The Plan will be consulted by Planning Team Members whenever grant funding is sought for mitigation projects. If a project is not in the Plan, an amendment may be necessary to include the action in the Plan.
Annual Budget Review	Various departments and key personnel that participated in the planning process will review the Plan and mitigation actions therein when conducting their annual budget review. Allowances will be made in accordance with grant applications sought or mitigation actions that will be undertaken according to the implementation schedule of the specific action.
Regulatory Plans	Currently, the City of San Antonio has regulatory plans in place, such as Emergency Management Plans, Continuity of Operations, Disaster Recovery Plans, Economic Development and Evacuation Plans. The Plan 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.

PLANNING MECHANISM	INCORPORATION OF PLAN
Capital Improvement Plans	The City of San Antonio 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 Plan, as limiting public spending in hazardous zones is one of the most effective long-term mitigation actions available to local governments.
Comprehensive Plans	The City of San Antonio has a Long-Term Comprehensive Development Plan in place. Since comprehensive plans involve developing a unified vision for a community, the mitigation vision and goals of the Plan will be reviewed in the development or revision of a Comprehensive Plan.
Floodplain Management and Fire Protection Plans	Floodplain Management Plans include preventative and corrective actions to address the flood hazard. Therefore, the actions for flooding, and information found in Section 7 of this plan discussing the people and property at risk to flood, will be reviewed and revised when the City of San Antonio updates their Management Plans or develop new plans.

Continued Public Involvement

Public input was an integral part of the preparation of this Plan and will continue to be essential for Plan updates. Changes or suggestions to improve or update the Plan will provide opportunities for additional public input.

The public can review the Plan on the City of San Antonio's website (http://saoemprepare.com/), where officials and the public are invited to provide ongoing feedback. The City of San Antonio will also provide an opportunity for feedback during the annual Citizens Preparedness Workshop. Additionally, copies of the Plan will be kept in the offices of the City.

The Planning Team may also designate voluntary citizens from the City, or willing stakeholder members that were involved in the Plan's development, to provide feedback on an annual basis. It is important that stakeholders and the 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 Executive Planning Team is responsible for notifying stakeholders and community members on an annual basis, and maintaining the Plan as a part of their job description. Media, including local newspaper and radio

stations, will be used to notify the public of any maintenance or periodic review activities. 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.

APPENDIX A: PLANNING TEAM

Planning Team Members 1
Stakeholders 3

Planning Team Members

The City of San Antonio Hazard Mitigation Action Plan or *the Plan,* was organized using a direct representative model. An Executive Planning Team from the City of San Antonio Office of Emergency Management, 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 area organizations and City departments that participated throughout the planning process. Table A-3 is comprised of members of a "Stakeholder Working Group" that met on a monthly basis to provide Plan input. The public were also invited to participate via e-mail and throughout the planning process. Public outreach efforts and meeting documentation is provided in Appendix E.

Table A-1. Executive Planning Team

DEPARTMENT	TITLE
Office of Emergency Management	Emergency Management Coordinator
Office of Emergency Management	Assistant Emergency Management Coordinator(1)
Office of Emergency Management	Assistant Emergency Management Coordinator(2)
Office of Emergency Management	Special Projects Manager
Office of Emergency Management	Senior Management Analyst(1)
Office of Emergency Management	Senior Management Analyst(2)
Office of Emergency Management	Department Fiscal Administrator

Table A-2. Advisory Planning Team

ORGANIZATION	TITLE
Alamo Area Council of Governments (AACOG)	Public Safety Planning Coordinator
Alamo Area Council of Governments (AACOG)	Public Safety Director
Alamo Colleges	Emergency Management Coordinator

ORGANIZATION	TITLE
CPS Energy	Assistant Chief System Operator
Federal Executive Board	Executive Director
Local Emergency Planning Committee (LEPC)	Emergency Management Coordinator
National Weather Service (NWS)	Coordinator
San Antonio Department of Planning and Community Development	Director
San Antonio Development Services – Field Services	Assistant Director
San Antonio Development Services – Land Development	Assistant Director
San Antonio Development Services – Plan Review	Assistant Director
San Antonio Economic Development Office	Assistant Director
San Antonio Economic Development Office	Director
San Antonio Fire Department (SAFD)	Senior Management Analyst
San Antonio Fire Department (SAFD)	Assistant Fire Chief
San Antonio Fire Department (SAFD) Hazmat	Assistant Chief
San Antonio Fire Department (SAFD) Hazmat	Battalion Chief
San Antonio Fire Department (SAFD) Hazmat	Fire Captain
San Antonio Fire Department (SAFD) Hazmat	HazMat Specialist
San Antonio Fire Department (SAFD) Wild-land Fire	Fire Captain
San Antonio Human Services	Senior Management Analyst
San Antonio International Airport	Operations Supervisor
San Antonio Metropolitan Health District (SAMHD)	Special Projects Manager
San Antonio Office of Emergency Management	Project Coordinator
San Antonio Office of Emergency Management	Battalion Chief
San Antonio Office of Emergency Management	Homeland Security Consultant
San Antonio Office of Sustainability	Chief Sustainability Officer

ORGANIZATION	TITLE
San Antonio Police Department	Police Captain
San Antonio Police Department (SAPD)	Coordinator
San Antonio River Authority (SARA)	Project Administrator
San Antonio River Authority (SARA)	Watershed Engineer
San Antonio River Authority (SARA)	Watershed Engineering Manager
San Antonio River Authority (SARA)	Project Manager
San Antonio River Authority (SARA)	Project Manager
San Antonio Voluntary Organizations Active in Disaster	Coordinator
San Antonio Water System (SAWS)	Assistant Engineer
San Antonio Water System (SAWS)	Chief Operating Officer
Southwest Texas Fusion Center – San Antonio Fire Department (SAFD)	Battalion Chief
Southwest Texas Fusion Center – San Antonio Police Department (SAFD)	Director
Southwest Texas Fusion Center – San Antonio Police Department (SAPD)	Police Captain
Southwest Texas Regional Advisory Council on Trauma	Executive Director
Texas Division of Emergency Management	District Coordinator
The University of Texas at San Antonio	Business Continuity/EMC
Transportation & Capital Improvements (TCI)	Assistant Director, Storm Water
Transportation & Capital Improvements (TCI)	Special Projects Manager
University Health System	Emergency Preparedness Manager
VIA Metropolitan Transit	Emergency Coordinator

Stakeholders

The following groups listed in Table A-3 represent a partial list of organizations invited to stakeholder meetings, public meetings and workshops throughout the planning process and include: non-profit organizations; private businesses; hospitals; and school districts. The following list of persons, by Title, were sent an email and/or contacted by phone requesting their input into the HMAP planning process, and an invitation to participate at each of the Stakeholder meetings. Many did attend and were integral to providing

comments and data for the Plan. For a list of attendance at meetings, please see Appendix E[1].

Table A-3. Stakeholder Working Group

ORGANIZATION	TITLE
American Red Cross	Assistant Director
American Red Cross	Local Program Coordinator
Angel Staffing	Director
Association of Contingency Planner – Alamo Chapter/Security Service Federal Credit Union	Planning Coordinator
AT&T	Regional Manager
Baptist Child and Family Services	Assistant Director
Bexar County Emergency Management	Emergency Management Coordinator
Bexar County Sheriff's Office	Sheriff
Bexar Metro 9-1-1 Network District	Coordinator
Brooks Development Authority	Operations Supervisor
Center for Health Care Services	Assistant Director
Chamber of Commerce	Executive Director
Christus Health System	Director
City of Live Oak	Emergency Manager
Community Emergency Response Teams	Emergency Management Coordinator
Department of State Health Services	Program Manager
Education Service Center, Region 20	Assistant Director
Family Endeavors	Assistant Director
Federal Bureau of Investigation	Regional Bureau Chief
Federal Executive Board	Manager
HAM Operators	Volunteer
Haven for Hope	Volunteer

[1] Information contained in Appendix E is exempt from public release under the Freedom of Information Act (FOIA).

ORGANIZATION	TITLE
HEB	Business Development
Joint Base San Antonio	Assistant Director
Port San Antonio	Port Chief
Port San Antonio	Program Coordinator
Randolph Brooks	Director of Programs
San Antonio Airport Fire (SAFD) – Airport	Fire Chief
San Antonio Airport Police (SAPD) – Airport	Police Chief
San Antonio Aviation Department	Aviation Administrator
San Antonio Food Bank	Director
San Antonio Library	Senior Librarian
San Antonio Metropolitan Health District	District Supervisor
San Antonio Solid Waste Management	Assistant Director
San Antonio Transportation & Capital Improvements (TCI)	Director
South Texas Blood and Tissue Center	Operations Manager
Southwest Texas Regional Advisory Council	Council President
St. Mary's University	Risk Manager
Texas A&M Forest Service	Biologist
Texas A&M University – San Antonio	Risk Manager
Texas Commission on Environmental Quality	Assistant Director
Texas Division of Emergency Management	Senior Manager
Transportation Security Administration	Chief Operating Officer
TxDOT	Transportation Engineer
United States Marshals Service	Regional Director
United States Postal Service	Program Coordinator
United States Secret Service	Regional Director
University Health System	Emergency Manager
University of Texas at San Antonio	Risk Manager/EMC

ORGANIZATION	TITLE
University of Texas Health Science Center at San Antonio	Emergency Management Coordinator
United Services Automobile Association	Program Administrator
VIA Metropolitan Transit	Supervisor

APPENDIX B: PUBLIC SURVEY

Overview 1
Public Survey Results 2

Overview

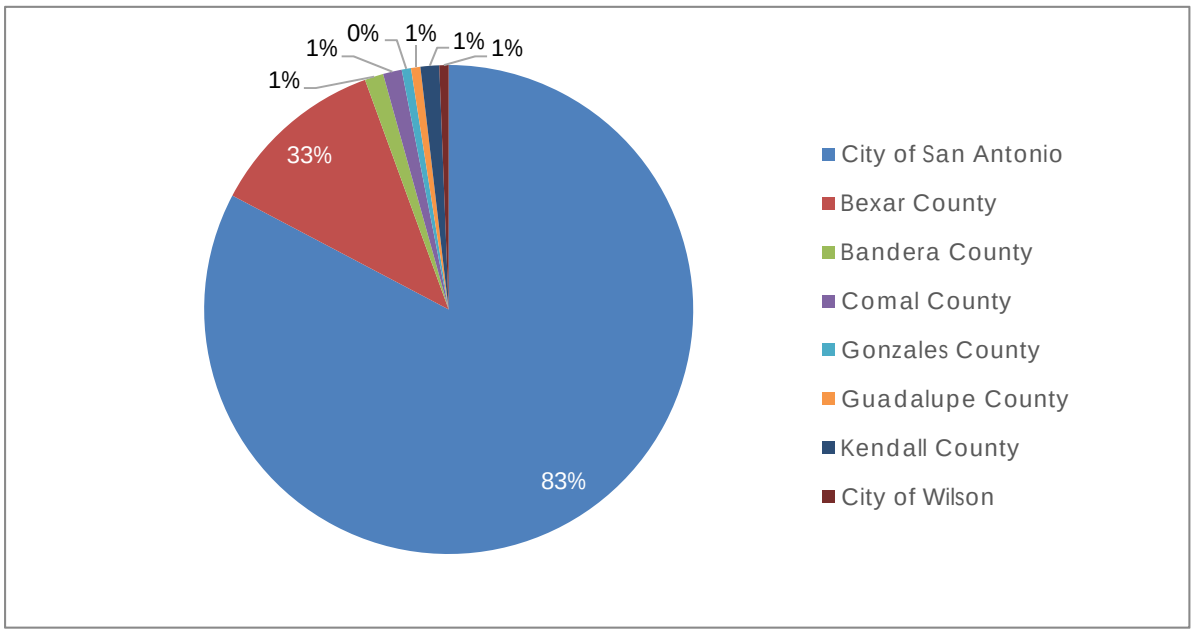
The City of San Antonio prepared public surveys requesting public opinion on a wide range of questions concerning natural hazards. The fifteen-question survey was made available on the City's website. This survey link was distributed at public meetings and stakeholder events throughout the planning process.

A total of 34 surveys were completed online, and an additional 130 surveys completed at City offices and public meetings, the results of which are analyzed in this Appendix. The purpose of the survey was to solicit public input during the planning process and help jurisdictions identify any potential actions or problem areas.

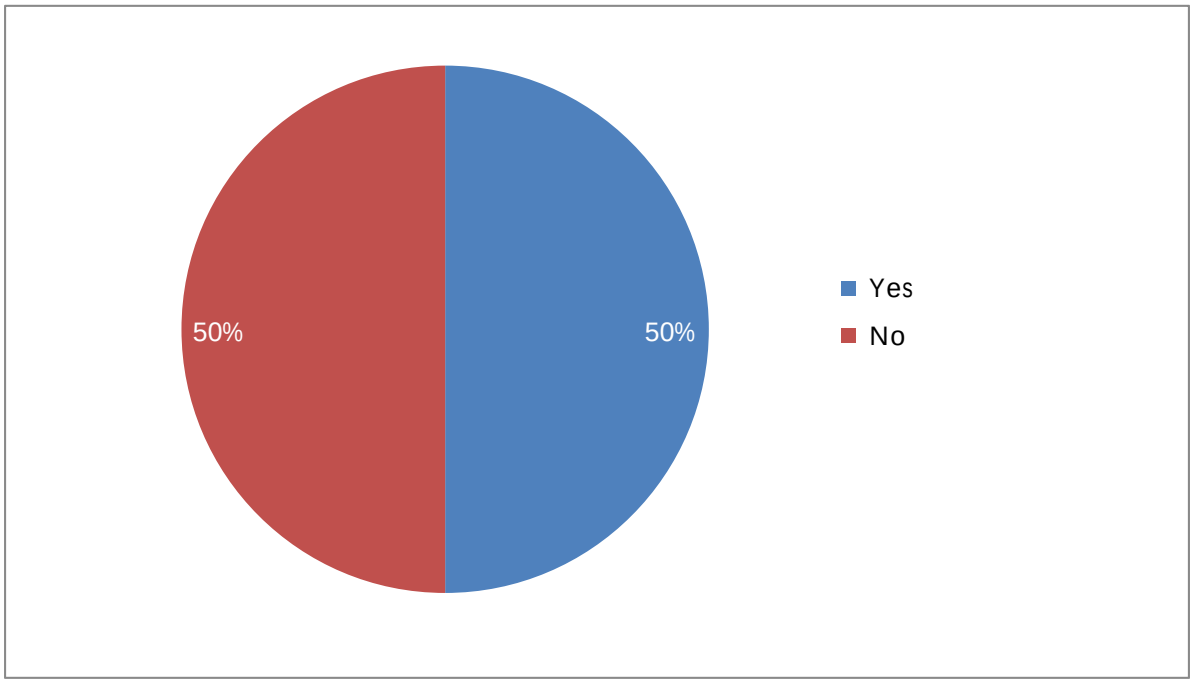
Survey results are depicted on the following pages, showing the percentage of responses for each answer. For questions that did not provide a multiple-choice answer, or that required an explanation, comments are summarized where similar.

Public Survey Results

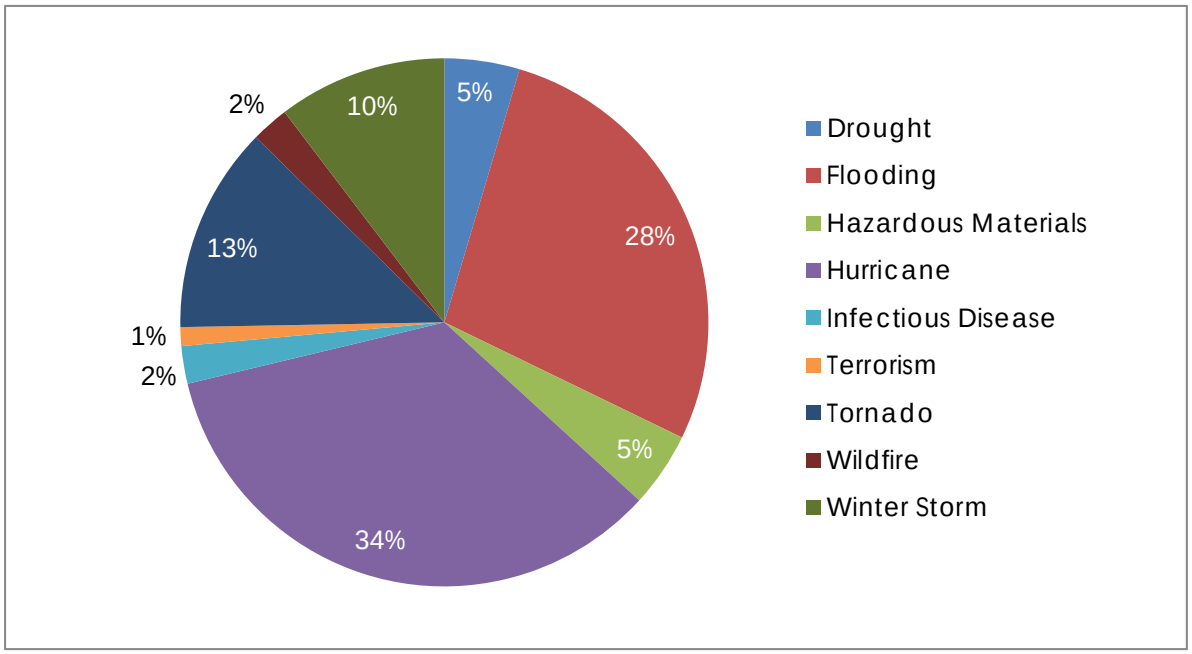
1. Please state the jurisdiction (city and community) where you reside.



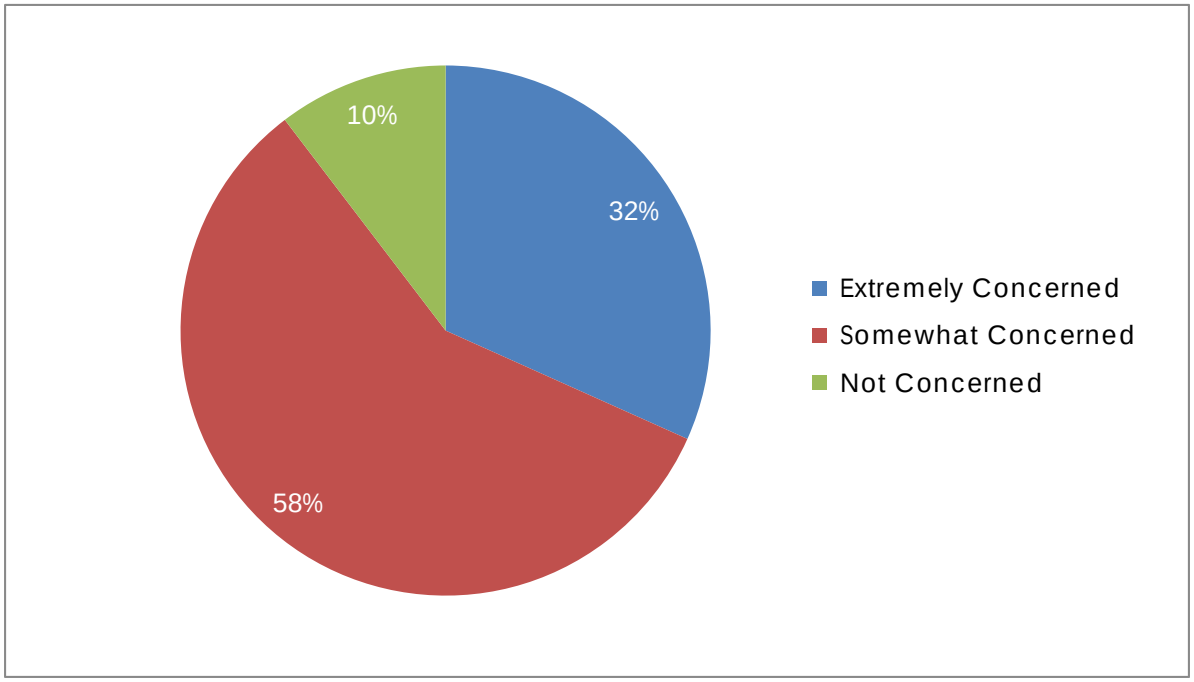
2. Have you ever experienced or been impacted by a disaster?



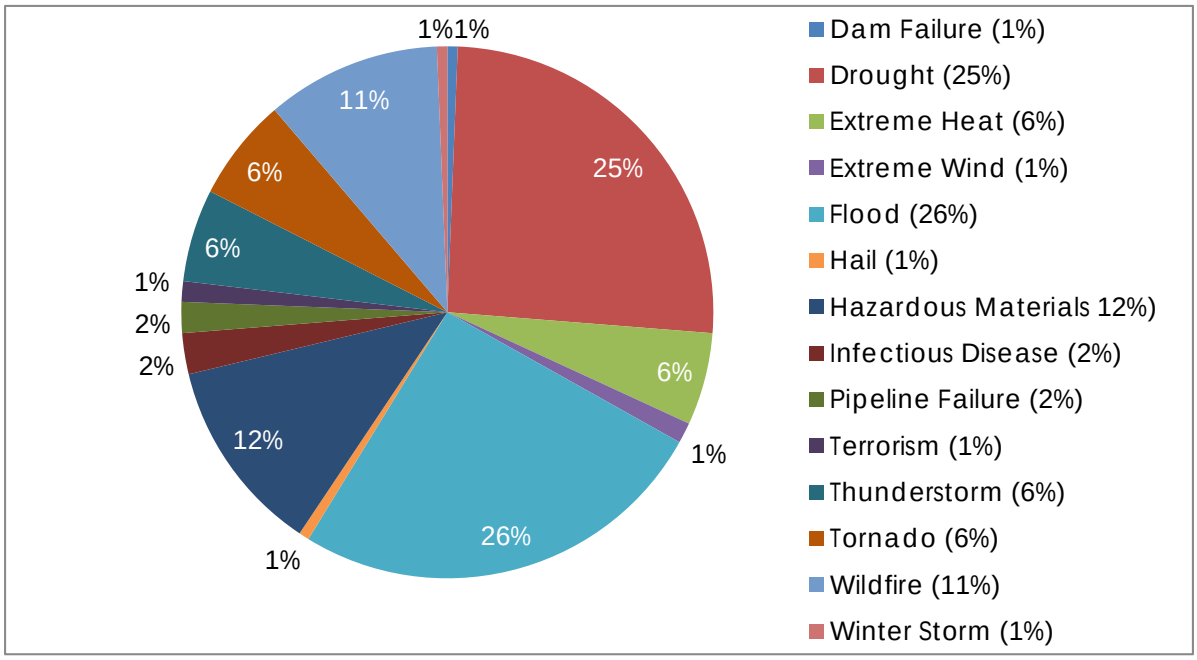
2. B. If "yes", please explain:



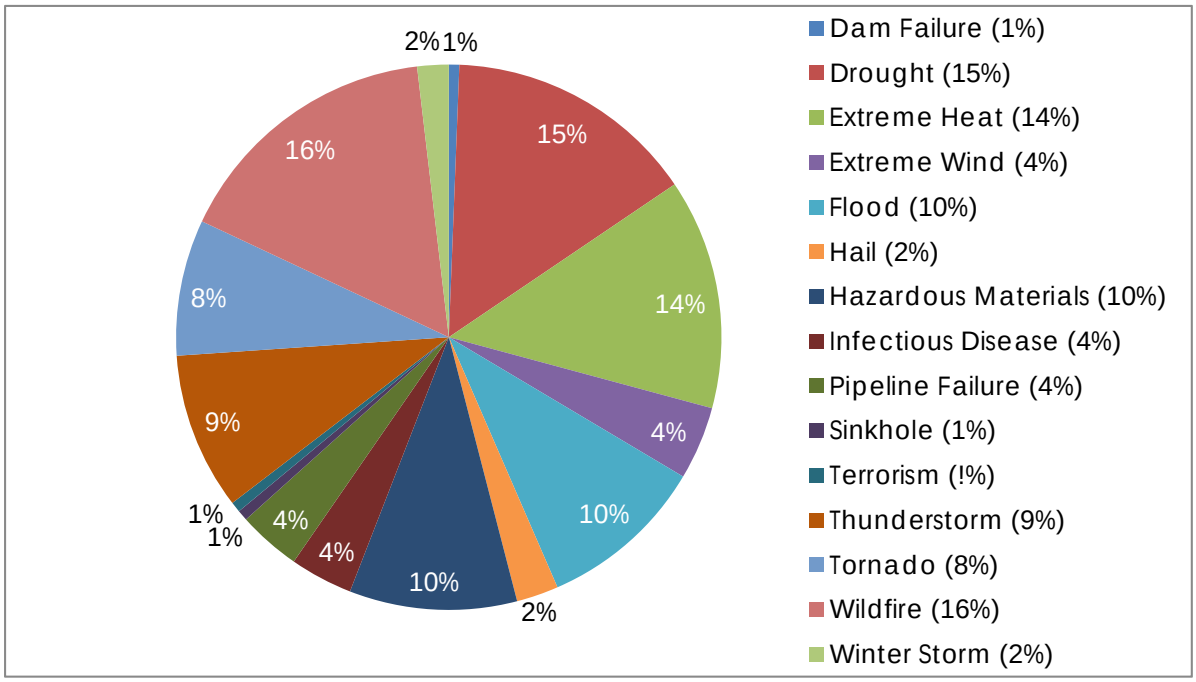
3. How concerned are you about the possibility of your community being impacted by a disaster?



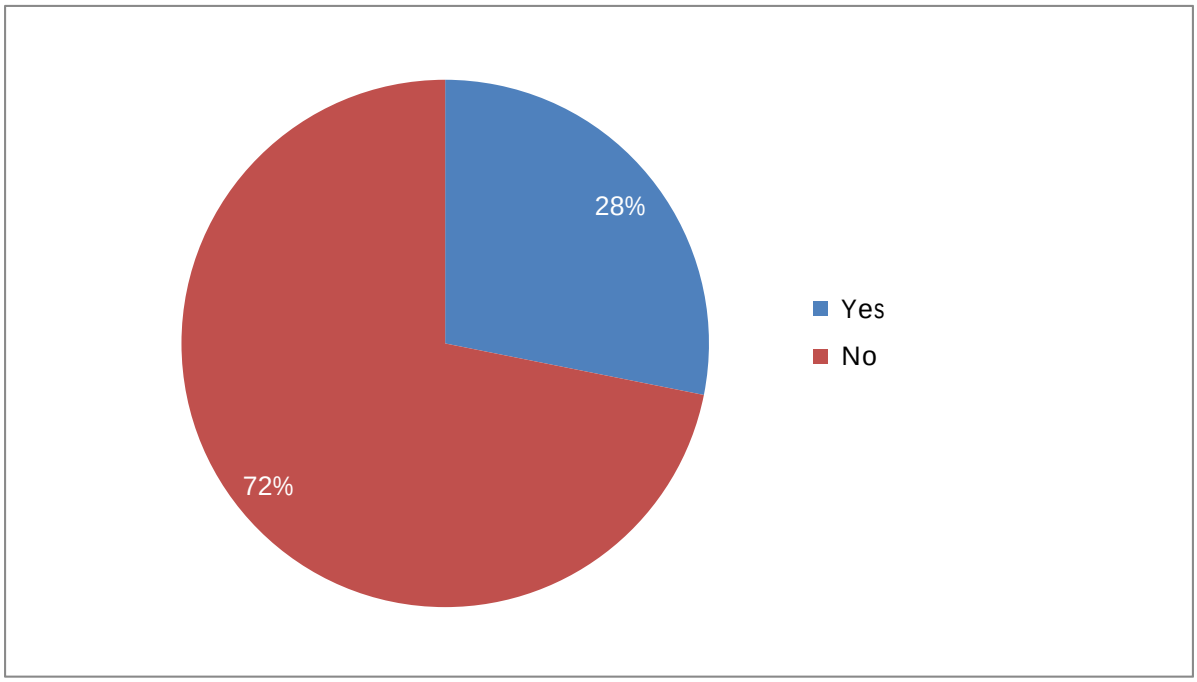
4. Please select the one hazard you think is the highest threat to your neighborhood:



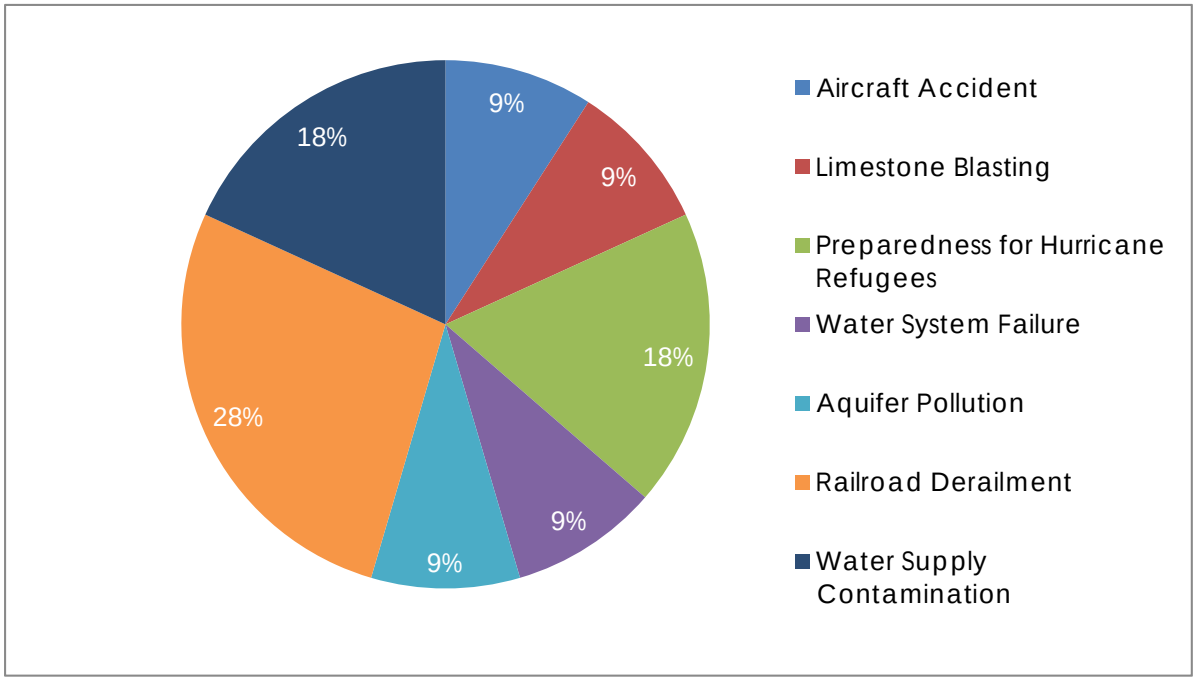
5. Please select the one hazard you think is the second highest threat to your neighborhood:



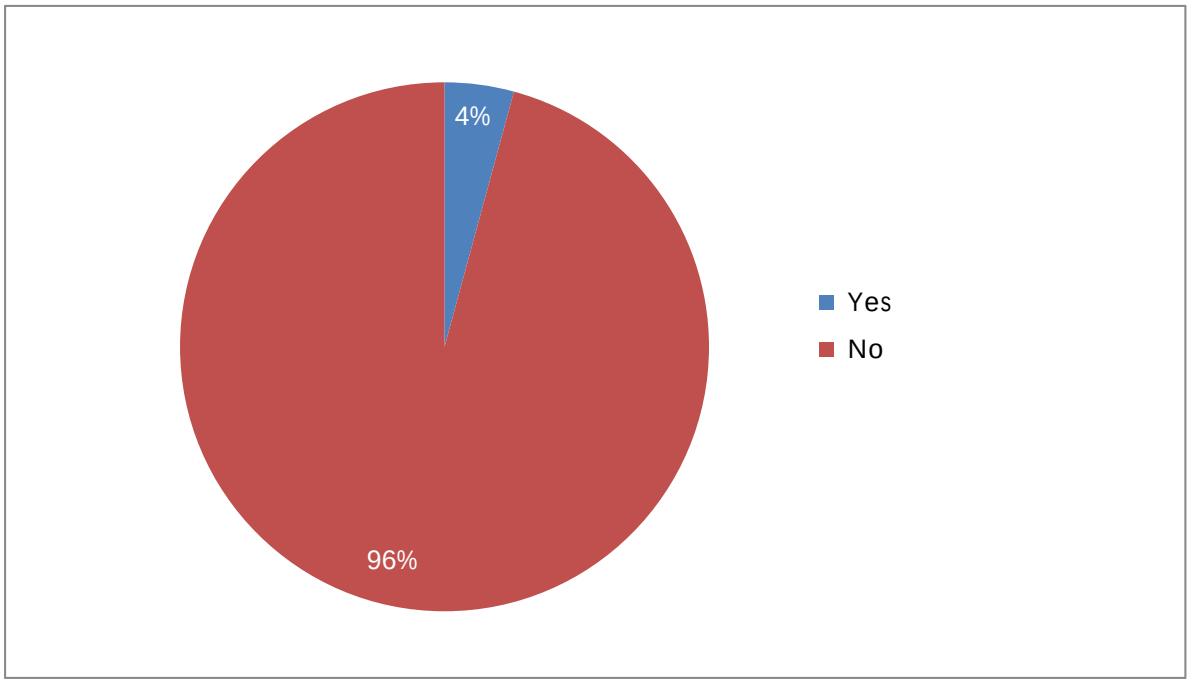
6. Are there hazards not listed above that you think is a wide-scale threat to your neighborhood?



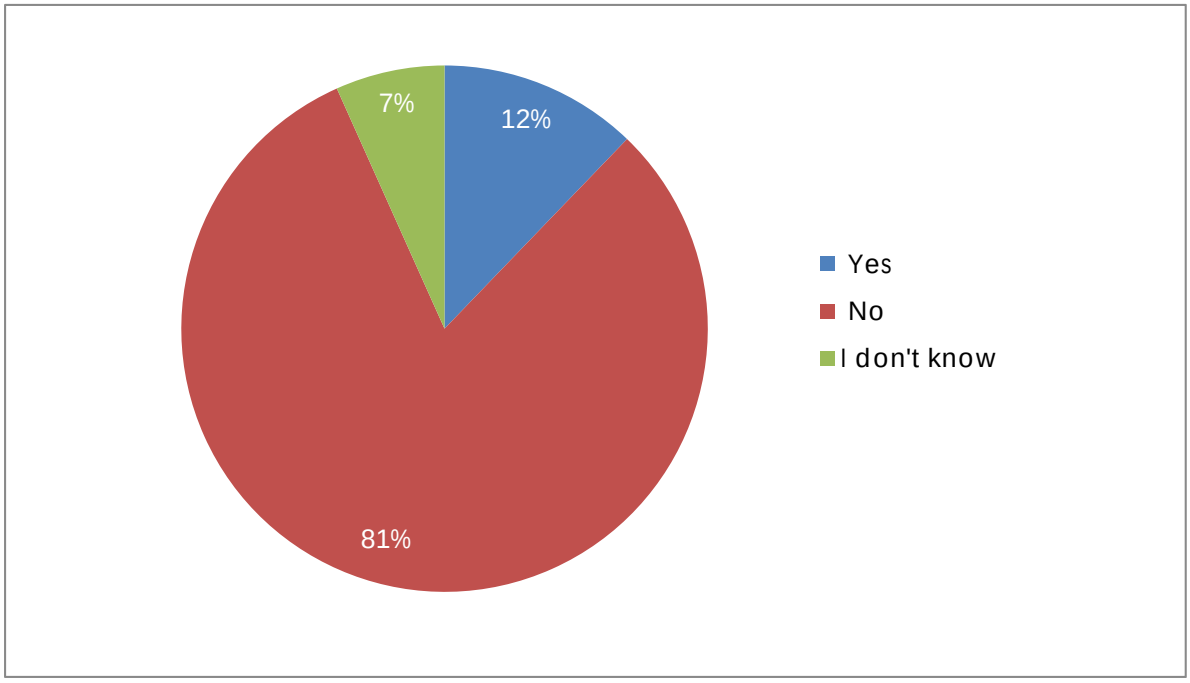
6. B. If "Yes," please explain.



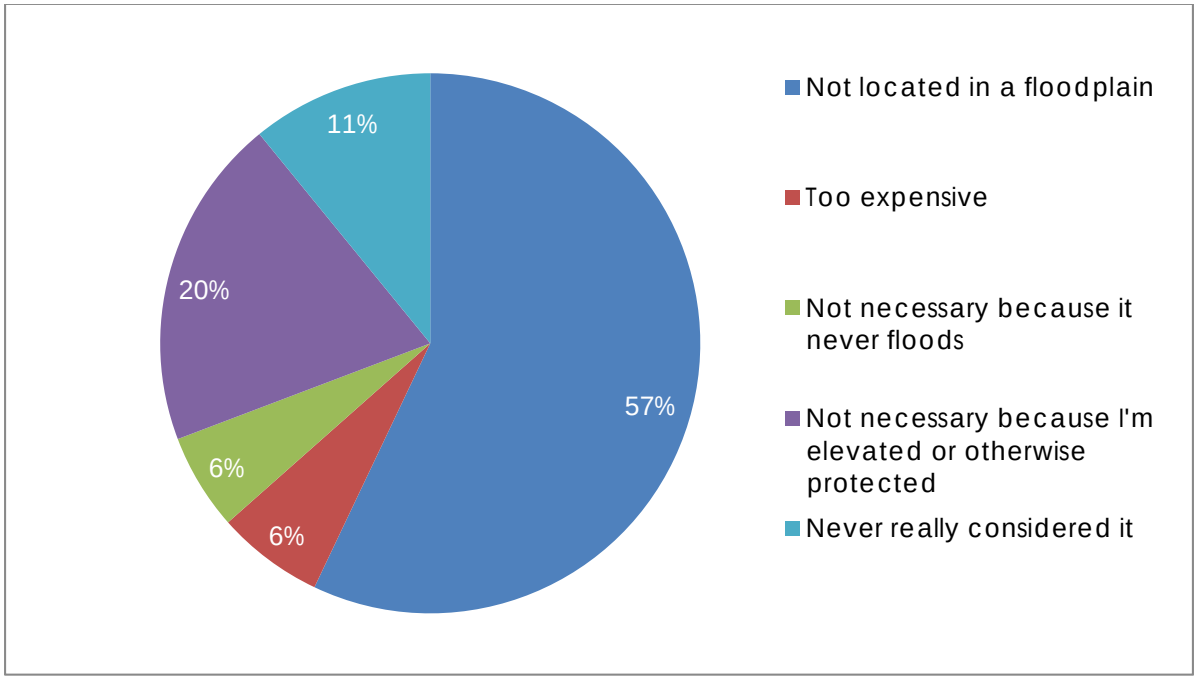
7. Is your home located in a floodplain?



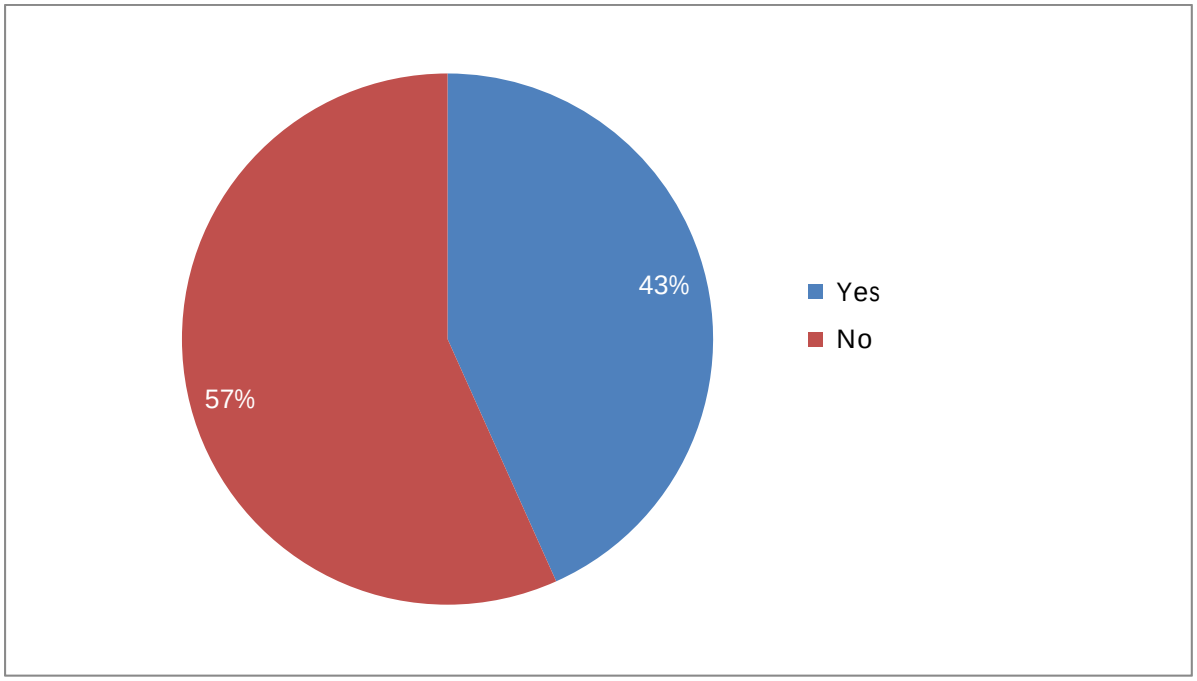
8. Do you have flood insurance?



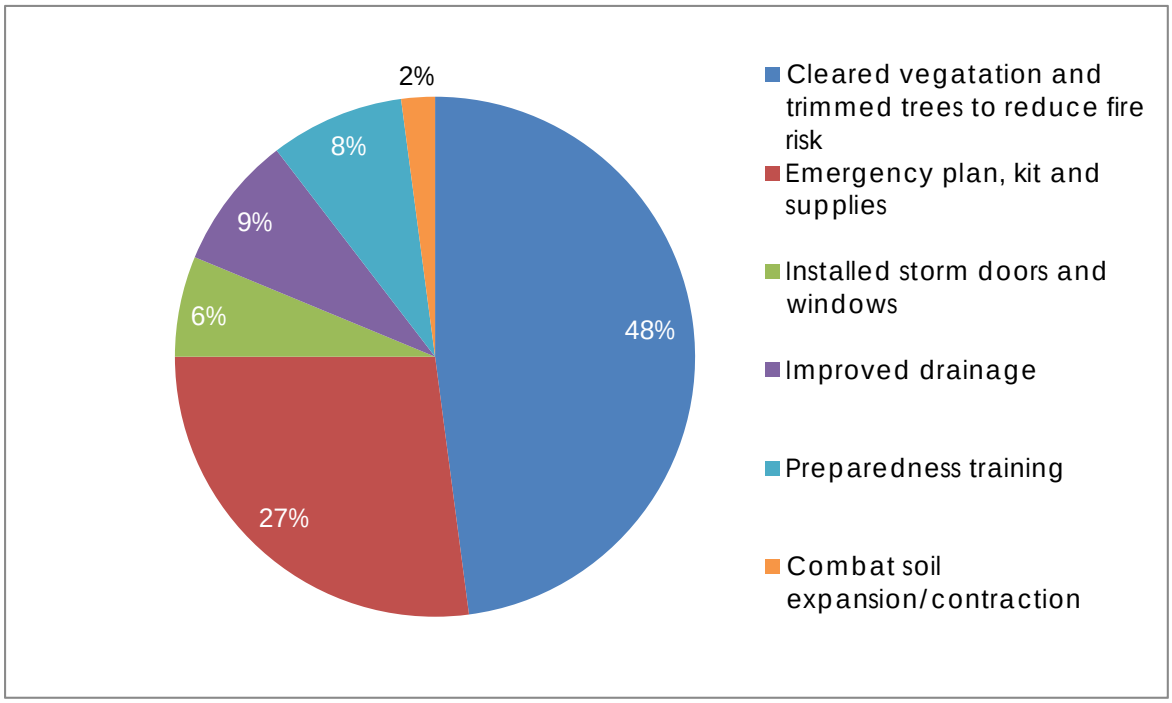
9. If you do not have flood insurance, why not?



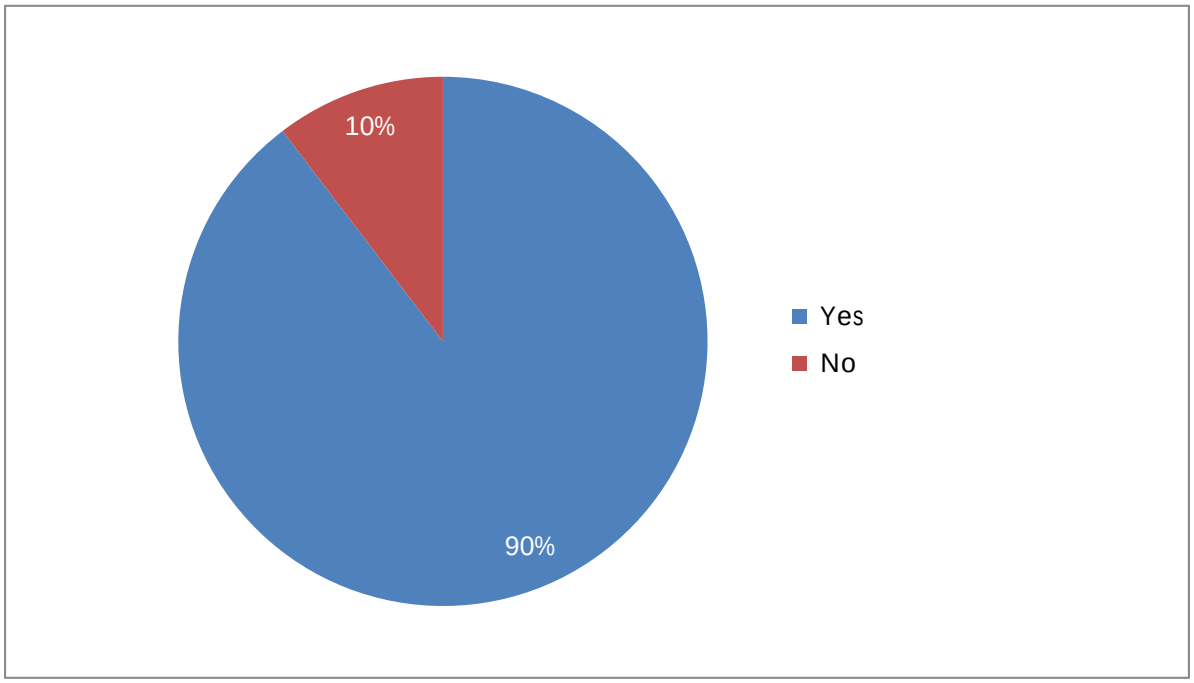
10. Have you taken any actions to make your home or neighborhood more resistant to hazards?



10. B. What have you done?

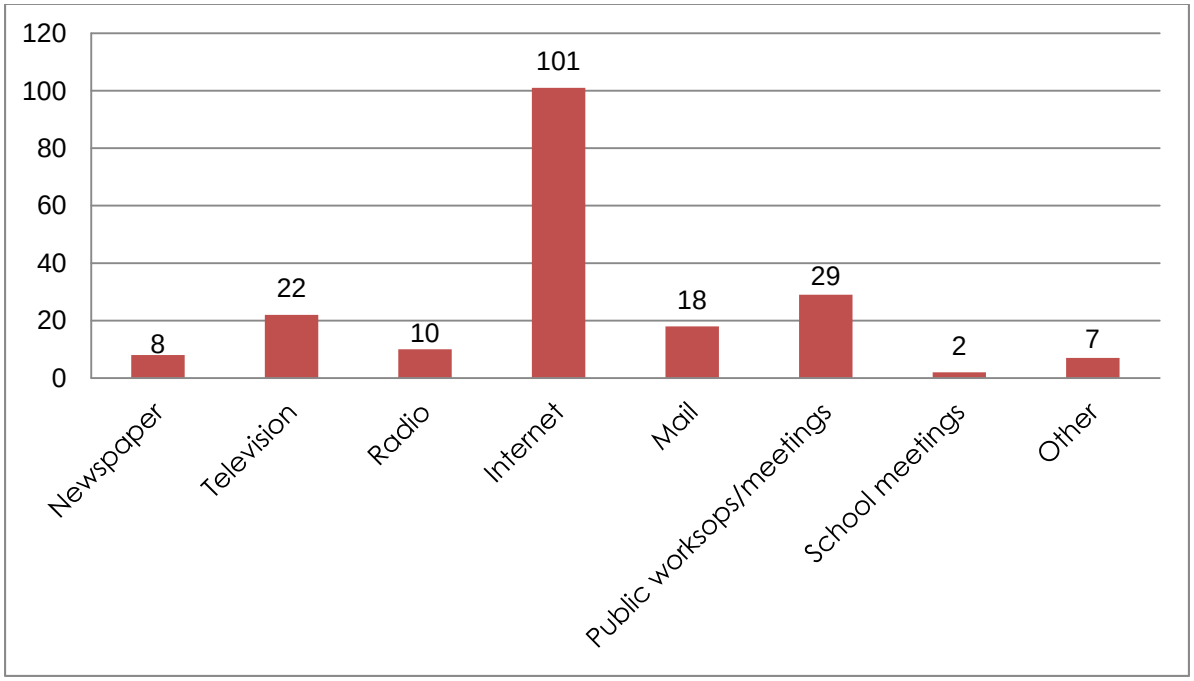


11. Are you interested in making your home or neighborhood more resistant to hazards?

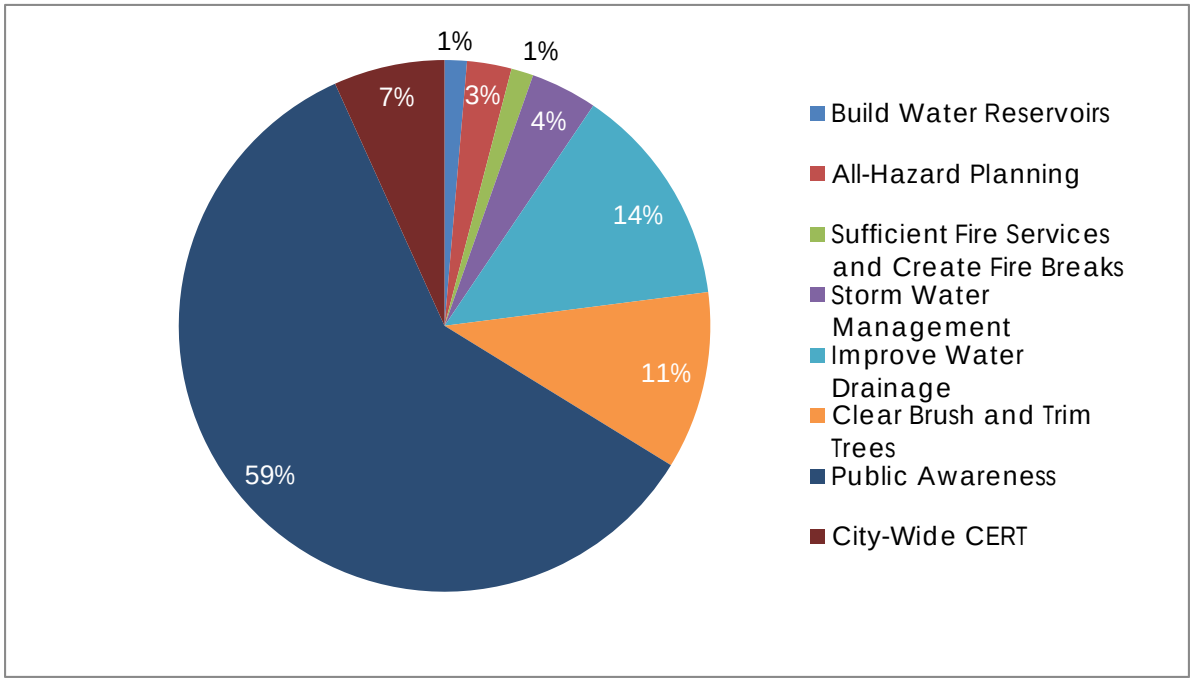


First Name	Last Name	Organization	How did you hear about CPW?

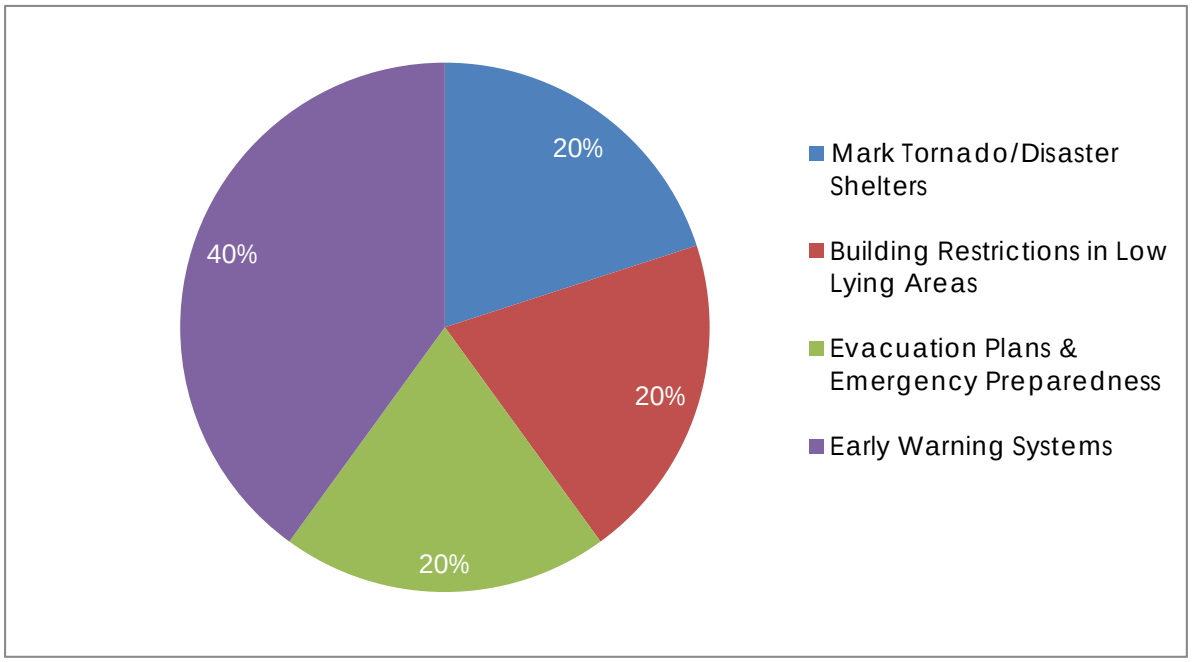
12. What is the most effective way for you to receive information about how to make your home and neighborhood more resistant to hazards?



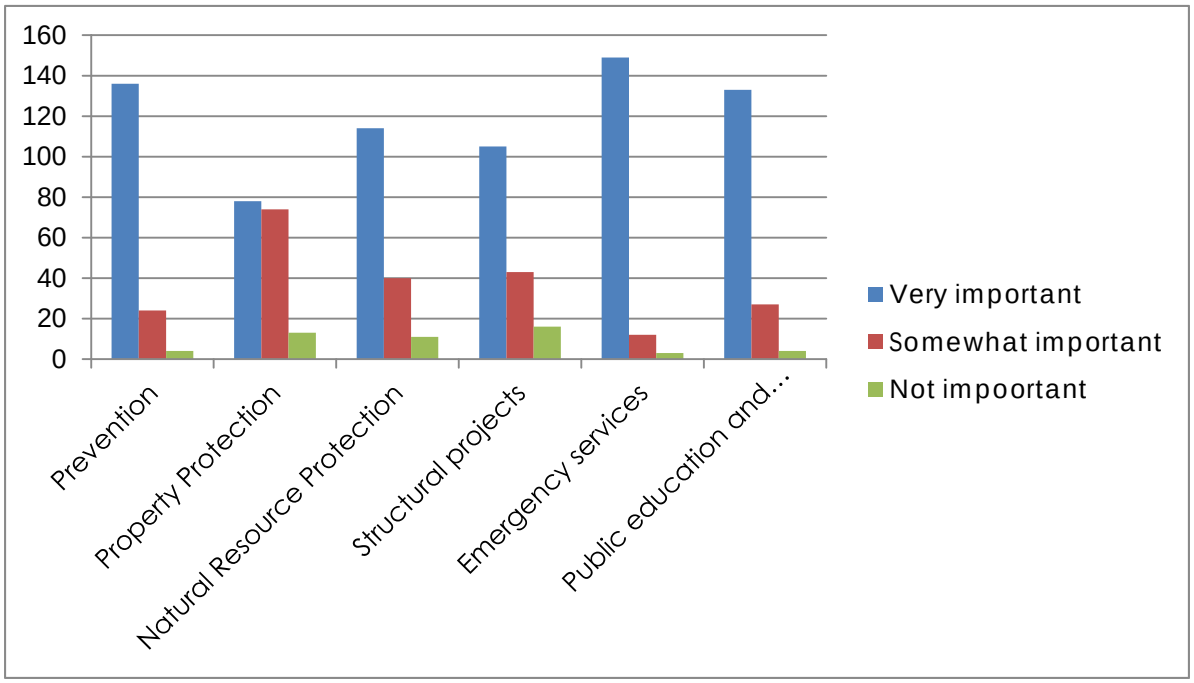
13. In your opinion, what are some steps your local government could take to reduce or eliminate the risk of future hazard damages in your neighborhood?



14. Are there any other issues regarding the reduction of risk and loss associated with hazards or disasters in the community that you think are important?



15. A number of community-wide activities can reduce our risk from hazards. In general, these activities fall into one of the following six broad categories. Please tell us how important you think each one is for your community to consider pursuing.



Prevention - Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning and zoning, building codes, open space preservation, and floodplain regulations.

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.

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.

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.

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.

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.

Appendix C: Critical Facilities

Overview 1

Overview

This Appendix is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

Appendix D: Dam Locations

Overview 1

Overview

This Appendix is **For Official Use Only (FOUO)** and may be exempt from public release

APPENDIX E: MEETING DOCUMENTATION

Background 1

Background

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APPENDIX F: CAPABILITY ASSESSMENT

Background 1
Community Capability Assessment 3
Expanding and Improving Capabilities 3

Background

The City of San Antonio's Advisory Planning Team completed a Capability Assessment survey at the beginning of the planning process. Beginning on Page 2, a completed Capability Assessment Checklist provides information on existing policies, plans and regulations in place for the City of San Antonio.

A community Capability Assessment is an integral component of the Hazard Mitigation Action Plan planning process. It is an invaluable tool in assessing a community's existing planning and regulatory capabilities to support implementation of mitigation strategy objectives.

Each community has a unique set of capabilities, including authorities, policies, programs, staff, funding, and other resources available to accomplish mitigation actions and reduce long-term vulnerability. By reviewing existing capabilities in each jurisdiction, the Planning Team can identify capabilities that currently reduce disaster losses, could reduce losses in the future, and could inadvertently increase risks in the community. The capability assessment is especially useful for multi-jurisdictional plans where local capability varies widely.

The City of San Antonio continuously assesses the impacts of current policies, ordinances, and plans for community safety from hazard risk due to growth. The City conducts their assessment through respective planning mechanisms, such as a Capital Improvements Program, Comprehensive Long-Term Development Plan, and Flood Protection Plan, and other planning strategies. The Capability Assessment was completed considering safe growth initiative to various sectors of the City including transportation, environmental management, and land use requirements.

Political capability is measured by the degree to which local political leadership is willing to enact policies and programs that further reduce hazard vulnerabilities in a community, even if met with opposition. The City of San Antonio has effectively initiated the following additional measures to reduce risk in their community

- Amended Texas Local Government Code Section 54.012 and 54.017 in 2013. By initiating this measure, the city will see a decrease in capital improvement projects needed to mitigate illegal fill violations.

- The San Antonio River Authority in developing Risk Maps. Together with the city's development of a Hazard Mitigation Plan, this initiative will further identify projects which are eligible for FEMA grant funding.
- The city currently participates in the National Flood Insurance Program (NFIP), and is working towards completing eligibility as a Community Rating System (CRS) community.
- Previous mitigation activities include digital FEMA FIRM's, and FEMA buyouts in 1998 and 2002 for over 300 properties.

In summary, the City of San Antonio, through development of a hazard mitigation plan, and other mitigation strategies outlined above to reduce risk to the community, is demonstrating their ability to implement and support mitigation strategy objectives identified in the Plan.

The City of San Antonio's annual budget will include timelines for implementing actions based on their funding capabilities, potential funding sources, and available HMA and other grant funding to turn an action into a project to achieve future mitigation. San Antonio has grant personnel that will develop grant applications through various funding mechanisms, including HMA grants, Texas Forest Service, Homeland Security, and other funding sources depending on the type of mitigation action. The capability assessment below outlines other programs by which to expand on funding capabilities and utilize available resources to achieve mitigation.

Community Capability Assessment

COMMUNITY CAPABILITY CHECKLIST	*City of San Antonio*
Plans	
Master or Comprehensive Land Use Plan	X
Capital Improvement Plan	X
Economic Development Plan	X
Storm Water Management Plan	X
Post-Disaster Recovery Plan	X
Open Space Plan	X
Master Drainage Plan	X
Comprehensive Emergency Management Plan	X
Emergency Response/Evacuation Plan	X
Flood Response Plan	X
Capital Improvements Plan	X
Floodplain Management Plan	X
Community Rating System (under development)	
Historic Preservation Plan	X
Continuity of Operations Plan	X
Hazard Mitigation Plan	X
Policies/Ordinance	
Building Codes	X
Zoning Ordinance/Land Use Restrictions	X
Subdivision Regulations	X
Watershed Ordinance	X
Storm Water Ordinance	X
Site Plan Review Requirements	X
Floodplain Ordinance	X
Fire Code	X

Expanding and Improving Capabilities

The purpose of the Capability Assessment is to assist the City of San Antonio identify gaps in planning, staff, and resourcing; and examine the potential to expand and improve capabilities. Options for improving capabilities include the following:

- Engaging Planning Team members with the authority to monitor the Plan 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) available through preparetexas.org.
- Reviewing current floodplain ordinances for opportunities to increase resiliency such as modifying permitting or building codes.
- Identifying partnerships where communities may form inter-local agreements or Memorandums of Understanding, to provide assistance and bolster existing resources; and solicit assistance from national sources such as FloodSmart (floodsmart.gov) and state sources such as the Texas Association of Counties.