Brazos County Hazard Mitigation

Mitigating Risk: Protecting Brazos County from All Hazards

2019-2024

Department of Emergency Management
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EXECUTIVE SUMMARY

PURPOSE AND PROCESS OF DEVELOPMENT

This updated document, "Mitigating Risk: Protecting Brazos County from All Hazards, 2019 – 2024," was prepared by the jurisdictions within Brazos County. The participating entities in the planning area of the Brazos County Hazard Mitigation Plan include Brazos County, the Cities of Bryan, College Station, Kurten, Wixon Valley and Texas A&M University. These will be referred to as "Brazos County and participating entities", "participating entities" or the "planning area".

This plan is a five-year blueprint for the future, aimed at making communities in Brazos County, to include all of the planning area; disaster resistant by reducing or eliminating the long-term risk of loss of life and property from the full range of natural disasters. It meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390); Section 44 of the Code of Federal Regulations, Part 201.6 and Part 206; and State of Texas Division of Emergency Management standards. An open public process was established to provide multiple opportunities for all sectors in Brazos County and participating entities to be involved in the planning process and provide input during its drafting stage.

HAZARDS FACING THE PLANNING AREA

The plan identifies and assesses the potential impact of nine natural hazards that threaten Brazos County and participating entities. Hazards were identified based on a review of historical records, national data sources, existing plans and reports, and discussions with local, regional, and national experts. The list of hazards that may threaten Brazos County and the participating entities are:

Floods

Droughts

Fires

Severe Winter Storms

Tornadoes

Hail

Thunderstorms

Dam failures

Excessive Heat

MITIGATION VISION

A vision statement, 6 goals, and 21 objectives were developed to guide the participating entities in the planning area in reducing or eliminating the long-term risk of loss of life and property from the full range of natural disasters. The mitigation vision for Brazos County and participating entities incorporates:

An informed citizenry aware of the risks they face and the measures that can be taken to protect their families, homes, workplaces, communities and livelihoods from the impact of disasters.

Local governments and regional entities that are capable of hazard-mitigation planning and project implementation, and of leveraging state, federal, and private resources for investments in mitigation.

Intergovernmental coordination and cooperation on mutual issues of concern related to floodplain management and hazard mitigation.

A commitment to locate buildings outside hazardous areas and to promote building methods that result in structures able to withstand the natural hazards that threaten them.

The integration of mitigation into routine budgetary decisions and planning for future growth and development in the planning area, making disaster resistance an integral part of the livability and sustainability of the county.

GOALS, OBJECTIVES AND ACTIONS

The overall goal of this plan is to reduce or eliminate the long-term risk of loss of life and property damage in Brazos County and participating entities from the full range of disasters. Individual goals are:

GOAL 1. Develop new, and upgrade existing capabilities for identifying the need for and implementing hazard mitigation activities.

GOAL 2. Generate support for and increase public awareness of the need for hazard mitigation.

GOAL 3. Increase awareness of public officials, community and business leaders of the need for hazard mitigation, and support actions to protect public health and safety.

GOAL 4. Promote resource-sharing and increase coordination and cooperation among governmental entities in conducting hazard mitigation activities.

GOAL 5. Mitigate damage to and losses of new and existing real property.

GOAL 6. Promote sustainable growth.

Twenty-one objectives in support of these goals are presented in Section 3.

Mitigation Actions

This plan sets forth mitigation actions and action plans to be carried out by Brazos County and the participating entities to reduce the risks to these hazards facing the planning area. Each action statement includes a description of the action, estimated costs, benefits, the responsible organization for implementing the action, an implementation schedule, priority, and potential funding sources. Some actions are directed at reducing the risk from a single hazard, such as flooding. Others pertain to multiple hazards or all nine hazards. The hazards differ in important ways, such as in their predictability, length of warning time, speed of onset, magnitude, scope, duration of impact, and the possibilities of secondary impacts.

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SECTION 1: PURPOSE AND ORGANIZATION OF THE PLAN

PURPOSE

The Brazos Valley Council of Governments (BVCOG) is made up of the seven-county Brazos Valley region that consists of Brazos, Burleson, Grimes, Leon, Madison, Robertson and Washington Counties, as well as incorporated cities and several unincorporated communities in those counties. Its boundaries are based on geographic features, economic market areas, labor markets, commuting patterns and media coverage areas. The BVCOG was established in 1966 and is charged by the Texas legislature with addressing regional issues and opportunities.

BVCOG's goal is to create and enhance partnerships among local governments, private businesses and service organizations to collaboratively plan for and maintain the highest quality of life in the Brazos Valley. The organization provides, in consultation with and through the cooperation of the local elected officials, housing, health, workforce, and senior services programs throughout the Brazos Valley. The council also administers the regional 9-1-1 plan, community and economic development programs, criminal justice planning and grants, Homeland Security planning and grants, and solid waste planning and grants.

Brazos County and participating entities developed the update to the comprehensive Hazard Mitigation Plan for planning area.

Entities participating in this Hazard Mitigation Action Plan include Brazos County, Texas A&M University, and the cities of Bryan, College Station, Wixon Valley, and Kurten.

Role of this Plan

This Hazard Mitigation Action Plan was prepared by the Hazard Mitigation Team, on behalf of the six participating entities. It is intended as a blueprint for future hazard mitigation, defined as "any sustained action taken to reduce or eliminate the long-term risk to human life and property from all hazards." The plan is designed to help build sustainable communities that, when confronted by natural disasters, will sustain fewer losses and recover more quickly. It is also intended to:

Minimize disruption to Brazos County communities following a disaster;

Streamline disaster recovery by articulating actions to be taken before a disaster strikes, to reduce or eliminate future damage;

Serve as a basis for future funding that may become available through grants and technical assistance programs offered by state or federal governments. The plan will enable Brazos County and participating entities to take advantage of rapidly developing mitigation grant opportunities as they arise; and ensure that Brazos County and participating entities maintain their eligibility for the full range of future federal disaster relief. Certain forms of federal mitigation assistance for projects will be available only to cities and counties that have a FEMA-approved hazard mitigation plan in place.

ORGANIZATION

The executive summary is at the beginning of the plan. Sections 1 and 2 of this plan address how it was prepared and who was involved in planning. Section 3 articulates the vision, mitigation goals, and objectives that guided the development of the plan. The goals are general guidelines that articulate a desired end state. They are expressed as policy statements of global visions. Objectives are specific, measurable, and define the strategies or implementation steps to attain the identified goals. Section 4 profiles the planning area's geography, population, land use and development trends in the planning area. Section 5 identifies the major natural hazards that have affected and may again affect planning area and describes the people and property at risk from these hazards.

Sections 6 through 14 discuss each of the natural hazards that affect the planning area. The plan addresses why each hazard is a threat and profiles each hazard in terms of its severity of impact, frequency of occurrence, hours of warning time, and existing warning systems. If the hazard has a geographic boundary, it is identified and mapped if possible. Data on the property and number of people at risk from each hazard are presented, along with the history of hazard events in Brazos County and participating entities.

Section 15 discusses previously implemented mitigation actions. These include federal projects such as the Federal Emergency Management Agency's Public Assistance projects, Hazard Mitigation Grant Program projects, and other federal mitigation projects; and the U.S. Army Corps of Engineers' (USACE) studies, plans, and projects. It also includes plans, studies and projects of the Texas Water Development Board, and local plans, ordinances, and inspection and permitting processes.

Section 16 contains actions to be undertaken by each participating entity to mitigate the hazards identified in Sections 6 to 14. Mitigation action plans describe each mitigation action, the hazard addressed, the estimated costs, benefits, organization responsible for overseeing implementation, implementation schedule, objectives the action is designed to achieve, priority, and potential funding sources. Section 17 discusses plan maintenance procedures, including how the plan is to implemented, maintained and evaluated, and how the public will continue to be involved.

Appendix A defines acronyms used in this plan. Appendix B reports the results of a web-based hazard survey to elicit information from the public on issues of concern about hazard mitigation. Appendix C identifies members of the local hazard mitigation team who updated this plan. Appendix D identifies the critical facilities in the planning area. Appendix E will contain the resolutions adopted by jurisdictional authorities when the plan is approved and the resolutions are adopted.

SECTION 2: THE PLANNING PROCESS

PREPARATION OF THE PLAN

This document was prepared by the Hazard Mitigation Team, in coordination with Brazos County and the participating entities. It was developed in accordance with the provisions of the Disaster Mitigation Act of 2000 (Public Law 106-390), the Pre-Disaster Mitigation Grant Program, Federal Regulations (44 CFR 206), and the planning standards adopted by the Texas Division of Emergency Management. The hazard mitigation planning process for Brazos County and participating entities was started in January 2016 and a draft was completed for submission to the State in March 2018.

Entity Participation

This updated plan covers Brazos County, Cities Bryan, College Station, Kurten, Wixon Valley and Texas A&M University. The entities all participated during the update process. Each entity contributed during the update process by:

Forming a new local Hazard Mitigation Team (HMT) with representatives from their jurisdiction, including numerous local Emergency Management Coordinators.

Attended kick-off meetings, mitigation workshops and public meetings.

Reviewed and analyzed the existing plan and updated each section, as necessary.

Provided an updated risk assessment for their jurisdiction.

Discussed the status of previous action items and provided new mitigation actions.

Devised a way to keep the plan maintained from 2019-2024.

Open Public Process

An open public process was established to give Brazos County and the participating entities an opportunity to become involved in the planning process and make their views known. Neighboring jurisdictions, federal and state agencies, businesses, Texas A&M University, non-profit organizations and the public participated in the process.

Each participating entity, established a Hazard Mitigation Team composed of broad-based representatives of cities and the county. A list of team members is provided at Appendix C. The Hazard Mitigation Team members from each jurisdiction participated actively throughout the planning process. They attended a kick-off workshop in the county, attended additional mitigation workshops in the county, updated mitigation actions and devised a way to keep the plan current from 2019-2024. Non-participating jurisdictions were notified about the planning effort and invited to participate. They were given the opportunity to attend a kick-off meeting, public meetings and the mitigation workshops and to fill out the Hazard Mitigation Survey Form.

A mitigation workshop was held November 2nd and 4th, 2015, and a kick-off meeting was held in Brazos Community Operations Center (CEOC) on July 28, 2016. A stakeholders meeting was held December 11, 2017. County commissioners, mayors, city council members, academia, elected officials, city managers, floodplain managers, emergency management coordinators, fire marshals, police chiefs, sheriffs, county engineers, building officials and inspectors, and other interested officials were invited to the kick-off meeting and subsequent workshops.

At the workshop, TDEM provided a briefing on the FEMA hazard mitigation planning requirements and the respective roles and responsibilities of the local jurisdictions. An opportunity was provided for Brazos County and participating entities officials to discuss how they would like to approach the planning process throughout the county.

A public meeting was held November 8, 2018 to inform the public about the planning process and solicit their ideas and recommendations. A second public meeting for Brazos County and participating entities will be held after FEMA's review of the draft plan.

A Hazard Survey was developed to solicit opinions from the public about hazards of concern. The Hazard Surveys were distributed to the public during public outreach opportunities, via jurisdictional websites, local media partners, and social media. The survey provided a mechanism to gain input from agencies, businesses, academia, non-profit organizations, and other interested parties. A total of 653 responses were received. The responses are summarized in Appendix B.

Identify Hazards

Profiles of hazards were prepared to show their severity of impact, frequency of occurrence, seasonal patterns, warning time, cascading potential, and applicable warning systems.

Assess Risks

The characteristics and potential consequences of each hazard were assessed to determine how much of the planning area could be affected and the potential effects on local assets.

An inventory was taken of "at risk" populations, buildings, infrastructure and lifelines, and commercial facilities in the planning area classified as "critical" or "special" or housing hazardous materials. A list of critical facilities is provided in Appendix D.

The Hazard Identification and Risk Assessment sections were revised continually throughout the update process to ensure completeness. Nine hazards that have the potential or probability to affect Brazos County and participating entities were identified based on a review of historical records, national data sources, existing plans and reports, and discussions with local, regional, state, federal and national experts.

Develop Mitigation Strategies

Based on a review of the vision statement, goals, and priorities of the previous plan with the local elected officials and the Hazard Mitigation Team, it was determined that the vision statement, goals, and objectives are still relevant and should remain the same. These goals and

objectives will reduce or eliminate the long-term risk to life and property from hazards. The goals are general guidelines that articulate a desired end state. They are expressed as policy statements of global visions. Objectives are specific, measurable, and define the strategies or implementation steps necessary to attain the identified goals. The vision statement, goals, and objectives are presented in Section 3 of this plan.

Hazard Mitigation Team (HMT) members reviewed various documents, reports and plans, including Capital Improvement Plans for Bryan and College Station, Brazos County Emergency Operations Plans, Building Codes and Floodplain Maps. Additionally, a hazard survey was circulated throughout the county through city and county websites. Citizens were asked to rank hazards and propose mitigation projects based on their observations. Some surveys were returned to the Emergency Operations Center for review and discussion by the Hazard Mitigation Team.

In addition, local floodplain ordinances from participating jurisdictions were studied and the HMT discussed whether local floodplain management could be strengthened in an effort to improve mitigation. The HMT discussed if safety would be improved with the addition of freeboard requirements for building permits. Freeboard is defined as the additional amount of height above a flood elevation at which a structures' lowest floor must be elevated to. The HMT also reviewed local building codes to determine if stronger ordinances would help strengthen new buildings from some hazards, such as tornadoes. Section 15 and the hazard-specific sections of the plan summarize the findings from the studies, plans, reports and technical information. Other sources of the information included the Federal Emergency Management Agency, USACE, the Insurance Services Office, the U.S. Fire Administration, the National Oceanic and Atmospheric Administration, the Texas Water Development Board, the Texas Commission on Environmental Quality, the State Comptroller, the Texas State Data Center, and the Texas Division of Emergency Management. Section 15 and the hazard-specific sections of the plan summarize the findings from the studies, plans, reports and technical information.

An inclusive and structured process was used to develop and prioritize mitigation actions for this Hazard Mitigation Plan. It included the following steps:

A vision statement, mitigation goals and objectives were formulated to reduce or eliminate the long-term risk to human life and property from each hazard.

Mitigation team members considered the benefits that would result from the mitigation actions versus the cost of those projects. For those actions in which the benefits could be quantified, an economic evaluation was one factor that helped team member's select one mitigation action from among many competing ones. Cost-effectiveness of actions was considered as each team member developed their final list of mitigation actions. Economic considerations were part of the community's analysis of the comprehensive range of specific mitigation actions and projects being considered.

Each participating entity did a review of benefits and costs for the mitigation actions/projects. The review of benefits and costs considered: 1) how many people will be affected; 2) what size of an area will be affected; and 3) which critical facilities will be affected. Then, the following questions were answered:

Are costs reasonable compared with the size of the problem and probable benefits?

Does the project make sense for the overall community?

Each mitigation action/project was ranked based on the following criteria:

Does this project address multiple goals and objectives outlined in this plan?

Does this project impact a large percentage of the population or involve multiple participating entities?

Will project result in life safety and/or property protection?

Does the project address multiple hazards?

Is funding available?

Is the project cost effective (future benefits exceed cost)?

Each criteria was given a score between 0 to 4 and the overall mitigation action/project score was a summation of criteria scores. Each mitigation action/project was categorized as low (0 – 8), medium (9 – 16), or high (17 – 24) based on its overall score.

Participants received a briefing on the risk assessment results and identified any unique hazards for the entity's planning area that varied from those hazards affecting the planning area as a whole. Participants discussed potential mitigation actions to identify any that might be relevant to the risks they face in jurisdiction and to solicit ideas.

Implement the Plan and Monitor Progress

A formal process was established at the workshops to ensure that the plan is implemented and remains an active and relevant document. Plan maintenance is addressed in Section 17.

PUBLIC INVOLVEMENT

Because public involvement is critical to the success of hazard-mitigation planning, public input was sought in several ways. Public input was solicited during the drafting stage, upon development of the draft, and prior to adoption of the plan. The public also was given the opportunity to provide comments, input into the planning process, and discuss other issues of concern to the entire planning area.

A public meeting was held at the CEOC November 8, 2018 to inform the public about the planning process and solicit their ideas and recommendations. Announcements of the public meeting were distributed to the media and civic organizations, as well as being posted to Facebook, Twitter, jurisdictional websites, and displayed in public places. Members of the general public, residents, local businesses, community leaders, educators, representatives of neighboring jurisdictions and private and non-profit groups were invited to attend and participate. A second public meeting for Brazos County and participating entities will be held after FEMA's review of the draft plan.

The county-wide public meetings provided an opportunity for the public to give input in the planning process during the drafting stage. The public was also provided an opportunity to comment on the draft plan prior to its submission to the Texas Division of Emergency Management and FEMA.

A Hazard Survey was made available to the public and was distributed at the public meetings. The survey sought information from citizens about hazards that have affected them and recommendations for action to reduce future risks. A total of 653 responses were received. The survey results provided an important source of information for use in formulating mitigation actions. Survey results appear in Appendix B.

Finally, the draft of this plan was made available on the Brazos County Department of Emergency Management website (www.bcdem.org/plans) for public review and comment. Each participating jurisdiction made a copy of the plan available for public inspection and review and formally solicited public review and comment prior to their governing bodies' adoption of the plan. A copy of each resolution adopting the plan will be in Appendix E after the participating jurisdictions each adopt the plan.

PARTNERS IN PLANNING

Hazard Mitigation Teams

The Hazard Mitigation Team (HMT), which had a central role throughout the planning process, was composed of local officials throughout Brazos County and participating entities. For a complete list of the HMT, see Appendix C.

The local Hazard Mitigation Team (HMT) was comprised of various members of the communities and local government with wide-ranging expertise. In addition to Emergency Managers, membership included Floodplain Administrators, Risk Managers, Public Works Supervisors, Code Enforcement Agents, Public Health Officers and Urban/Regional Planners. Mitigation projects were discussed and weighted, then considered for inclusion in the Mitigation Action Plan. Members attended planning meetings as well as public meetings to discuss hazards in the planning area.

The HMT was chaired by the Emergency Management Coordinator for Brazos County. Representatives were invited from the participating entities by the Emergency Management Coordinators for each entity, to meet in a central location to discuss the mitigation plan and the update process. Talking points, slide shows and hand-out materials were provided during the meetings. Discussions were held on mitigation planning, the update process, and what hazards impact each of the participating entities. The HMT discussed which new hazards, if any, should be included in the plan and if any hazards should be removed from the plan. Mitigation actions for the 2012-2017 update needed to be reviewed and updates given on each action. The HMT then discussed ideas for new mitigation projects which will need to be included in the updated plan.

The HMT laid the groundwork for the plan, examined risk in county jurisdictions, sought the participation of stakeholders and the public, and articulated the mitigation actions and action plans presented in the document. The team, in short, served as the primary vehicle through which to share information, invite active participation, and coordinate the plan's development, implementation, and maintenance within participating jurisdictions.

Federal and state agencies guidance and data were utilized in the planning process. These included the Federal Emergency Management Agency of the Department of Homeland Security, the USACE, the Texas Division of Emergency Management, the Texas Water Development Board, the Texas Department of Transportation, and the Texas A&M Forest Service. Weather event data were provided by the National Weather Service and the National Oceanic and Atmospheric Association (NOAA). The Mitigation Section of the Texas Department of Emergency Management reviewed the plan and provided input and guidance, which assisted the team in developing the plan.

Hazard mitigation team members assessed their capabilities, examined previous mitigation efforts, and developed mitigation actions. Throughout the process, they reached out to police and fire departments, emergency medical services, code enforcement entities, floodplain managers, neighboring jurisdictions, local businesses, community leaders, educators and other private and non-profit organizations to inform them of the planning process and seek their views.

Updated Plan Participation

This Hazard Mitigation Action Plan was created in 2005 and updated in 2012. This 2019 update covers Brazos County and the participating entities.

As part of the update process, a local Hazard Mitigation Team (HMT) was formed and tasked with reviewing and updating each section of the plan, as necessary.

The process by which the HMT undertook to determine whether a section warranted an update began with the HMT reviewing the 2012 version of the plan. Local team members were then tasked to review and analyze the information that pertained to their local planning area. The HMT would then determine if that data needed to be updated based on whether it contained outdated information or, in the case of mitigation actions, had already been accomplished. Likewise, sections of the 2012 plan that did not warrant an update were not revised in this 2019 version.

The following is a summary of the sections that were updated by the Hazard Mitigation Team:

The Executive Summary and Section 1: *Purpose and Organization of the Plan* was updated to reflect changes in the plans development. In keeping with the 2012 Version, this update reflects a continuing focus on Brazos County and participating entities.

Section 2: *The Planning Process* was updated to reflect the local planning process undertaken by Brazos County and participating entities. This includes the formation of the local Hazard Mitigation Team to review and analyze each section of the plan.

Section 3: *Mitigation Vision, Goals, and Objectives* were not revised by the Hazard Mitigation Team (HMT). The HMT discussed the vision, goals, and objectives of the original version of the plan and felt they were still valid. The team voted to keep the vision, goals and objectives the same for this version of the plan.

Section 4: *Brazos County Planning Area at a Glance* reflects a focus on the planning area.

Section 5: *Hazards the Planning Area Faces and What's at Risk* reflects a focus on Brazos County and the participating entities.

Sections 6-14 contain the risk assessment for each of the nine hazards listed in the plan and was revised as necessary to reflect any changes to the risks that can affect the planning area. The HMT discussed the hazards listed in the original plan and decided not to include the chapter on hurricanes. The hazards the participating entities experience during hurricanes is covered in the chapters for flood, tornadoes, hail, and thunderstorms. The chapter on thunderstorms includes information on windstorms and lightning hazards. The team then discussed the man-made hazards listed in the plan and voted again to eliminate the four (4) man-made hazards of energy pipeline failures, hazardous materials incidents, nuclear power plant accidents and terrorism. These four man-made hazards were eliminated because they are difficult to mitigate with the available federal mitigation funds, and because they are not required by Section 44 of the Code of Federal Regulations, Part 201.6(c)(2)(i), which requires a risk assessment for all natural hazards that can affect the participating entities.

Section 15: *Previous Mitigation Actions* discusses mitigation actions supported by federal and state agencies, and local programs relating to building and fire codes and floodplain management ordinances. This section was revised to reflect any updated building and fire codes, and floodplain ordinances that were re-adopted since the original version of the plan.

Section 16: *Mitigation Actions* contains actions to be undertaken by each of the participating entities to mitigate the hazards identified in Sections 6 through 14. This section was reviewed and analyzed by the HMT to review previous actions, identify any previous actions items from the original plan that could be deferred to this updated plan, and to include new action items to help achieve the vision, goals and objectives listed in Section 3.

Section 17: *Plan Implementation and Maintenance Procedures* discusses the plan maintenance procedures and was revised to reflect how Brazos County and the participating entities will maintain, update and evaluate the plan during the next five years.

SECTION 3: MITIGATION VISION, GOALS, AND OBJECTIVES

VISION

The mitigation vision for the planning area is:

Intergovernmental coordination and cooperation on mutual issues of concern related to hazard mitigation and disaster preparedness;

Local governments and regional entities with high levels of capability for hazard mitigation planning and project implementation, leveraging state, federal and private resources for investments in mitigation;

An informed citizenry aware of the risks they face and the measures that can be taken to protect their families, homes, workplaces, communities and livelihoods from the impact of disasters;

Build structures outside of hazardous areas and ensure built to withstand the natural hazards that threaten them;

Communities integrating hazard mitigation concerns into routine planning and budgetary decisions and plans for future growth and development; with disaster resistance an integral part of the livability and sustainability of the region.

GOALS AND OBJECTIVES

Overall Goal: To reduce or eliminate the long-term risk of loss of life and property damage in the planning area from the full range of natural disasters.

The following mitigation goals and objectives, from the previous version of this plan, were re-evaluated by the Hazard Mitigation Team in 2012 and determined to remain valid and effective.

GOAL 1. Build the capability for carrying out hazard mitigation activities.

Objective 1.1 Encourage education and training for personnel involved in hazard mitigation to develop high levels of expertise.

Objective 1.2 Ensure, to the extent feasible, adequate levels of staffing for hazard mitigation activities.

Objective 1.3 Create and foster partnerships to help communities reduce their exposure to hazards.

Objective 1.4 Focus on identifying and obtaining federal, state, and private-sector funds available for hazard mitigation.

Objective 1.5 Upgrade operational systems and facilities that support hazard mitigation.

GOAL 2. Heighten public awareness and support for hazard mitigation.

Objective 2.1 Ensure that communication between disaster personnel and the public in advance of and during hazard events is adequate in content and coverage.

Objective 2.2 Inform area citizens about the full range of natural and man-made hazards they face, and the need for guarding against injury and loss of life caused by those hazards.

Objective 2.3 Devise programs to educate the public about how to prevent or reduce the loss of life or property from all hazards, including specific actions that can be taken.

GOAL 3. Increase awareness of public officials, community and business leaders of the need for hazard mitigation, and support actions to protect public health and safety.

Objective 3.1 Encourage the adoption of appropriate hazard mitigation measures by local governments, businesses, institutions, and individuals, and communicate information about specific, effective actions they can take.

Objective 3.2 Ensure that communication among disaster personnel and public officials in advance of and during hazard events is adequate in content and coverage.

Objective 3.3 Focus on protecting particularly vulnerable areas during hazard events (e.g., hospitals, nuclear reactors, areas crossed by fuel transmission lines).

GOAL 4. Promote resource-sharing and increase coordination and cooperation among governmental entities in conducting hazard-mitigation activities.

Objective 4.1 Improve and expand communication and coordination within and among federal, state, and local governments and the Brazos Valley Council of Governments in mitigating hazards.

Objective 4.2 Identify and map critical facilities and take action to ensure that critical facilities and services can continue to operate in disaster situations.

Objective 4.3 Create hazard-specific and general hazard-mitigation partnerships among Brazos Valley counties, cities, the Brazos Valley Council of Governments and other stakeholders.

GOAL 5. Mitigate damage to and losses of new and existing real property.

Objective 5.1 Protect public infrastructure and private buildings from known hazards.

Objective 5.2 Support methods, codes, and ordinances that reduce threats to existing and new development and ensure that citizens are not unnecessarily exposed to potential hazards.

Objective 5.3 Reduce repetitive losses to the NFIP.

Objective 5.4 Protect against financial losses caused by hazard events through liberal application of insurance coverage.

GOAL 6. Promote sustainable growth.

Objective 6.1 Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

Objective 6.2 Incorporate hazard mitigation into long-range planning, budgeting and development activities.

Objective 6.3 Prevent creation of future hazards to life and property.

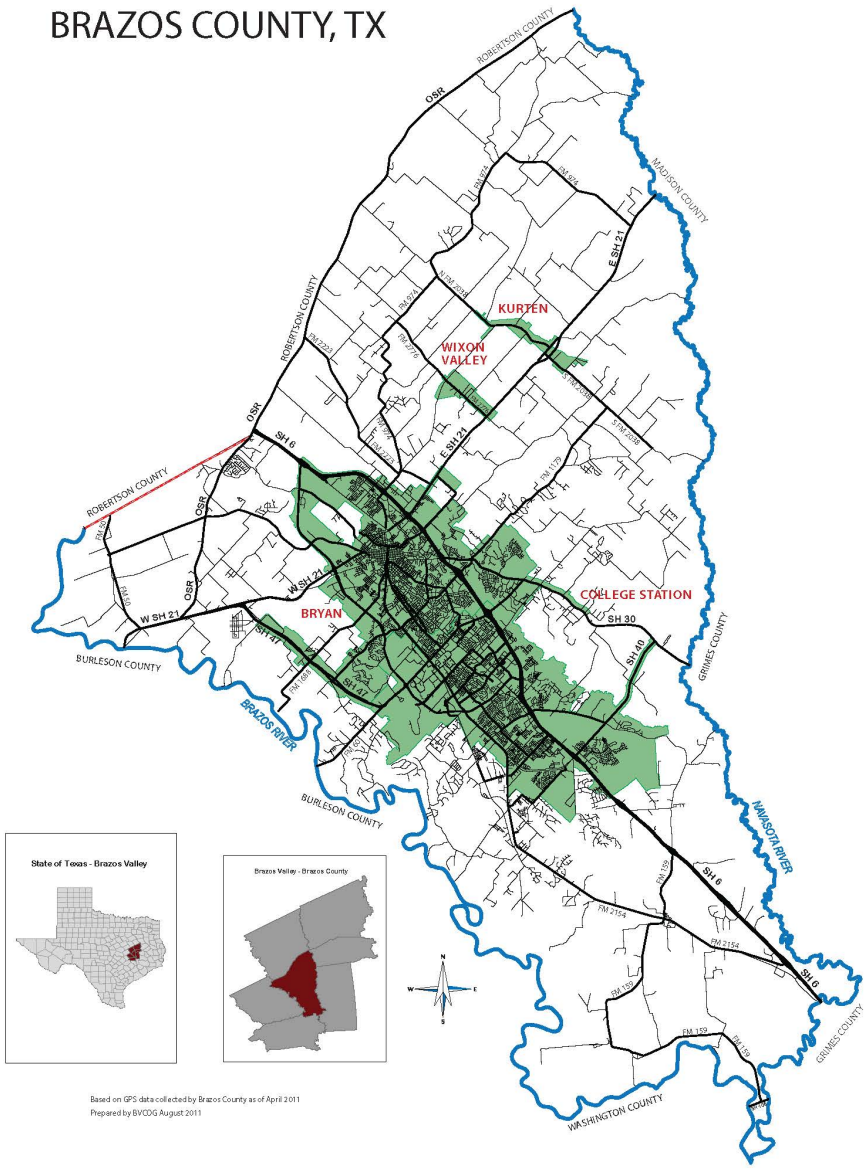
SECTION 4: BRAZOS COUNTY PLANNING AREA AT A GLANCE

GEOGRAPHY

The planning area claims 588 square miles of southeast central Texas between the Navasota River and the Brazos River for which it was named. Brazos County includes four incorporated cities: Bryan, College Station, Kurten, and Wixon Valley. Rolling prairie and woodlands that rise 200 to 350 feet above sea level characterize the county. Businesses throughout the county are involved in higher education, defense electronics, research, medical, agriculture, and varied manufacturing. Information is included in this section about the population and demographics of the county, as well as information about businesses in the county (higher education, agriculture, minerals, housing, economic development, and tourism).

Figure 4-1. Brazos County in the Brazos Valley Region

Figure 4-2. Planning area



POPULATION

The population of Brazos County and participating entities in 2010 was 194,851 people. It is now currently estimated to be 209,896, with the largest cities in the planning area being College Station (93,857) and Bryan (80,552).

Table 4-1. Demographics of planning area

General Demographics		
	Totals	**Percent**
Total Population	209,896	
Male	106,391	50.69%
Female	103,505	49.31%
White Only	155,512	74.09%
Black/African American	22,208	10.58%
American Indian/Alaskan Native	874	0.42%
Asian	12,608	6.01%
Native Hawaiian/Pacific Islander	71	0.03%
Other Race	12,507	5.96%
Two or More Races	6,116	2.91%

Figure 4-3. Gender Composition of Planning area

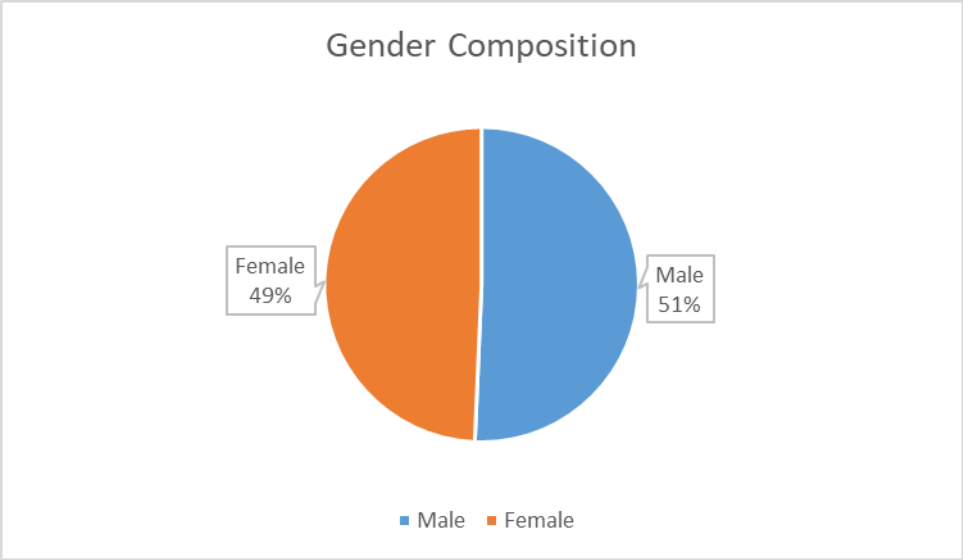
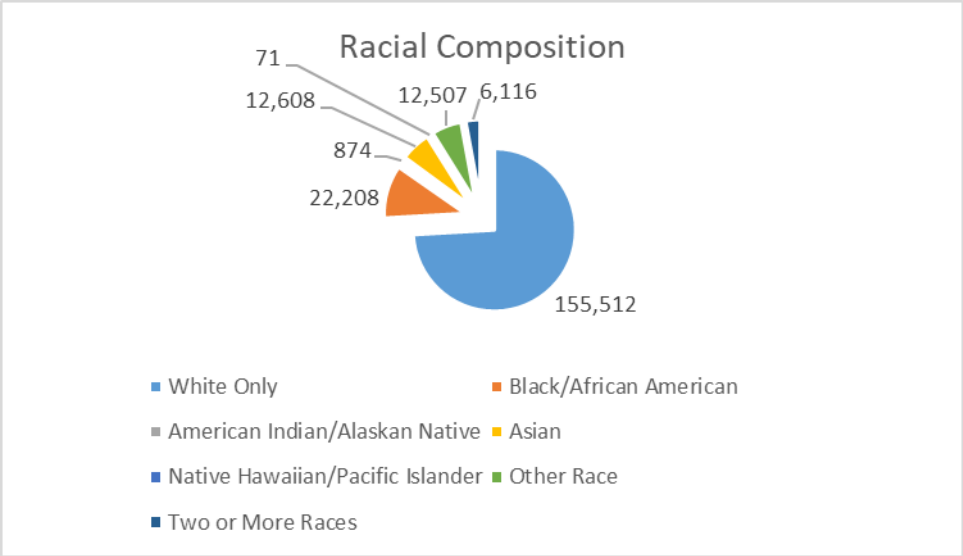


Figure 4-4. Racial Composition of Planning area



HIGHER EDUCATION

Texas A&M University, located in College Station, was the state's first public institution of higher education. It was opened on Oct. 4, 1876 as the Agricultural and Mechanical College of Texas. The school owes its origin to the Morrill Act of 1862, which established the nation's land-grant college system. The initials "A" and "M" are a link to the university's past; they no longer represent any specific words as the school's curriculum has grown to include not only agriculture and engineering, but architecture, business, education, geosciences, liberal arts, medicine, science, and veterinary medicine. The university's enrollment includes 66,425 students.

Blinn College is a two-year institution with its main campus in Brenham. It is the oldest county owned junior college in Texas and began in Washington County. Blinn College serves a 13 county service area and also has campuses in Bryan and Schulenburg in Fayette County.

Table 4-2. Higher Education Institutions

Institution	Location	Enrollment Fall 2016	Number of Faculty
Texas A&M University	College Station	66,425	3,995*
Blinn College	Bryan**	12,338	~750

**Faculty includes professors, associate professors, assistant professors, other faculty, and teaching assistants.*
Source: Texas A&M University

***Main campus in Brenham (Washington County)*

LAND USE

The U.S. Department of Agriculture conducts a census of agricultural uses of land. The 1,412 farms in the planning area averaged about 212 acres in size. Of this about 62,733 acres of the total farmland, were devoted to harvested crops. Of the harvested cropland, about 5,563 acres were irrigated.

Table 4-3. Agricultural Land Use in Brazos County, 2012

County	Number of Farms	Ave. Size of Farm (acres)	Harvested Cropland (acres)	Irrigated Land (acres)
Brazos	1,412	212	62,733	5,563

Source: US Department of Agriculture, Census of Agriculture

Farms in the area covered by the planning area produce a wide variety of agricultural products with cattle being the most common.

Table 4-4. Agricultural Products in Brazos County

County	Agricultural Products	Annual Value
Brazos	Cattle, poultry, cotton, hay, horses and horticulture.	$95 million

Source: Texas Almanac

In terms of minerals, oil is produced in each of the seven counties making up the BVCOG. Table 4-4 lists the chief minerals found in the planning area.

Table 4-5. Minerals in Brazos County

County	Minerals
Brazos	Sand, gravel, lignite, gas, oil

DEVELOPMENT TRENDS

Although building of new structures will continue throughout the planning area, primary focus of construction will be the Bryan/College Station Metropolitan Statistical Area (MSA) which includes all of planning area and which accounts for about 57 percent of the population in the BVCOG region. Pressure on the housing stock is greater in Brazos County and participating

entities, than in the other counties because of the very high percentage of housing units that are occupied.

Table 4-6. Housing Units in Brazos County, as of 2016

County	Total Housing Units	Percent of Housing Units Occupied
Brazos	83,504	91 %

Source: U.S. Census

The primary impetus for development is, of course, population growth. The Texas State Data Center projects continued moderate growth for the Bryan/College Station MSA, 8.6 percent between 2002 and 2010 and 10.9 percent between 2010 and 2020. However, the Texas Water Development Board forecasts a much steeper climb in population, 24.7 percent and 14.2 percent over the same two periods. If the Water Board's numbers are closer to what actually occurs, residential development will pose an especially difficult challenge for the two adjoining cities. Since the previous plan approval, the population within Brazos County has increased by approximately 7% and the number housing units have increased by nearly 30%. There has also been an increase in commercial structures and roadways to support the growing population. While the completion of some mitigation actions from the previous plan have reduced the vulnerability for each jurisdiction, such continued growth will put pressure on using land in high hazard areas in each jurisdiction. Thus, such growth may increase the vulnerability within each jurisdiction.

Local governments are also working to develop the economic potential of the area and bring high quality jobs to the MSA. They are working hard to develop commercial research opportunities. Table 4-8 contains the name, telephone number and e-mail address of the economic development organization for Brazos County.

Table 4-7. Number and Value by Property Type in Planning Area, as of 2016

	Residential		Rental		Commercial		Industrial	
	Number	Value ($1,000)	Number	Value ($1,000)	Number	Value ($1,000)	Number	Value ($1,000)
Bryan	18,653	$2,682,007	1,2722	$778,219	1,804	$1,957,137	81	$120,778
College Station	19,909	$4,564,110	1,947	$2,183,466	994	$2,532,657	5	$36,052
Kurten	112	$9,642	0	0	10	$3,979	0	0
Wixon Valley	59	$8,007	0	0	22	$8,067	0	0
Unincorporated	45,516	$8,961,868	3,280	$2,975,321	3,238	$4,688,558	119	$201,834

Source: Brazos County Appraisal District

Table 4-8. Regional Economic Development Organization

County	Organization Name	Telephone Number	E-Mail Address
Brazos	Brazos Valley Economic Development Corp*	979-260-1755	mprochaska@researchvalley.org

**website: www.researchvalley.org*

Although all of the communities in the planning area are projected to grow in population, the cities of Bryan/College Station are the only metropolitan areas in the planning area and hence will face the most severe development challenges and thus pressure will increase to build in areas that are hazard-prone. Several of the smaller towns and communities will, however, deal with similar problems of maintaining the quality of life during periods of growth and paying for new schools, roads, and other types of infrastructure.

As part of the five-year plan update, depending upon resource availability, a review will be undertaken of development trends in each jurisdiction and vulnerability. Also as part of the five-year plan update, depending upon resource availability, a review will be undertaken for each hazard of the type and number of existing and future buildings, infrastructure and critical facilities within each hazard area, and an estimate will be undertaken of the vulnerability of critical facilities and infrastructure in terms of potential dollar losses from each hazard. Also depending upon resource availability, land uses and development trends will also be re-examined, including the types of development occurring, location, expected intensity, and pace by land use for each jurisdiction. This will help complete and improve future vulnerability assessment efforts. Based on the analysis, a summary of vulnerability will be provided for the participating entities.

COMMUNITIES DESIGNATED FOR SPECIAL CONSIDERATION

The State of Texas requires that hazard mitigation plans identify any Small and Impoverished Communities in the planning area. These communities may receive special consideration in some federal and state grant programs.

According to the established criteria, Small and Impoverished Communities 1) have a population less than 3,000 and are not a remote area within the corporate boundaries of a larger city and 2) are economically disadvantaged, with residents having an average per capita annual income not exceeding 80 percent of the national per capita income and a local unemployment rate that exceeds by one percentage point or more the most recently reported national unemployment rate.

At this time, there are no small and impoverished communities within the planning area.

SECTION 5: HAZARDS THE PLANNING AREA FACES AND WHAT'S AT RISK

RISK ASSESSMENT METHODOLOGIES

A risk assessment evaluated the probability of occurrence of a hazard event and the potential associated losses in Brazos County and participating entities. The resulting loss estimates are a starting point from which to evaluate mitigation measures if a real hazard event occurs. The loss estimates also are intended to support mitigation decision-making. It is important to note, however, that loss estimates calculated during the risk assessment used available data and methodologies and are approximate. The estimates should be used to understand relative risks from hazards and potential losses and are not intended to predict precise results. Uncertainties are inherent in any loss-estimation methodology and arise, in part, from incomplete scientific knowledge about natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications (such as incomplete or outdated inventory, demographic, or economic parameter data) that are necessarily used during a comprehensive analysis. These data can result in a range of uncertainty in loss estimates, perhaps at a factor of two or more. In addition, a variety of previous studies and reports were reviewed for additional risk data.

PEOPLE AND PROPERTY AT RISK

Hazard identification consists of defining the study area in terms of scale and coverage and collecting and compiling a list of prevalent hazards in the planning area to help narrow the focus of the analysis.

Figure 5-1 below shows the extent of the planning area, as well as the population density distribution at the county level (based on Census 2010). Table 5-1 provides the types of critical facilities. Figure 5-2 is a map of critical facilities in the planning area. Detailed lists of critical facilities, identified by county, can be found in Appendix D.

Figure 5-1. Population Density Distribution Map for the Planning Area

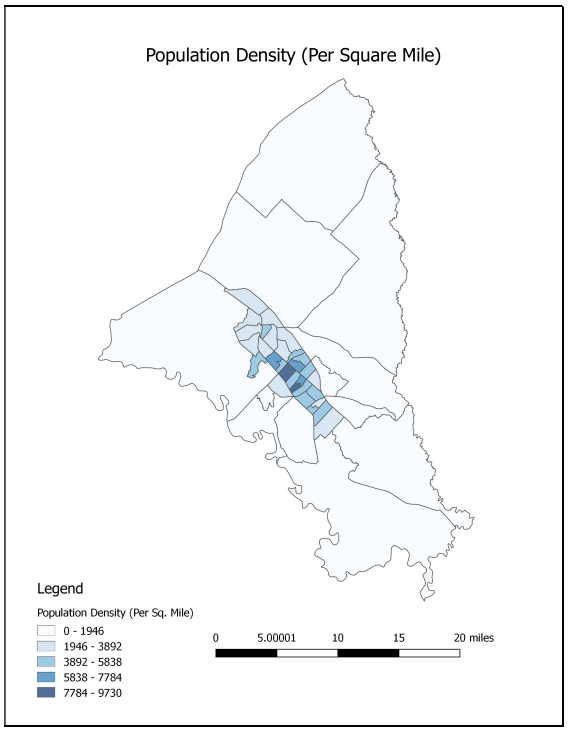


Table 5-1. Social Vulnerability Indicators for the Planning Area

Social Vulnerability Indicators		
	Totals	**Percent**
Under 5	13,235	6.31%
65 and Over	17,225	8.21%
Non-White	48,268	23.00%
Persons in Poverty[1]	52,652	26.98%
Persons over 25: Less than High School[2]	15,385	14.36%
Single Parent Households with Children[3]	11,551	15.24%
Vacant Housing Units[4]	5,408	6.48%
Mobile Homes, RVs, Boats, Etc[4]	7,707	9.23%

[1] Persons in poverty is based on persons whose income-to-poverty threshold ration is 0.99 and below. The percentage is based on the total population for whom poverty status has been determined.
[2] The percentage of persons with less than a high school education is based on the total population of persons over the age of 25.
[3] Single parent households with children are the total households with only a male or female parent. The percentage is based on the total number of households.
[4] The percentage of vacant housing units and mobile homes/recreational vehicles/boats/etc. are based on the total housing units.

The maps that follow are representative of the geographical locations that have populations with higher vulnerabilities. For instance, educating all county residents about multiple ways into and out of their residence. This is particularly important when Brazos County and the entire planning area experiences heavy rain incidents with localized flooding.

Figure 5-2. Social Vulnerability Map for the Planning Area

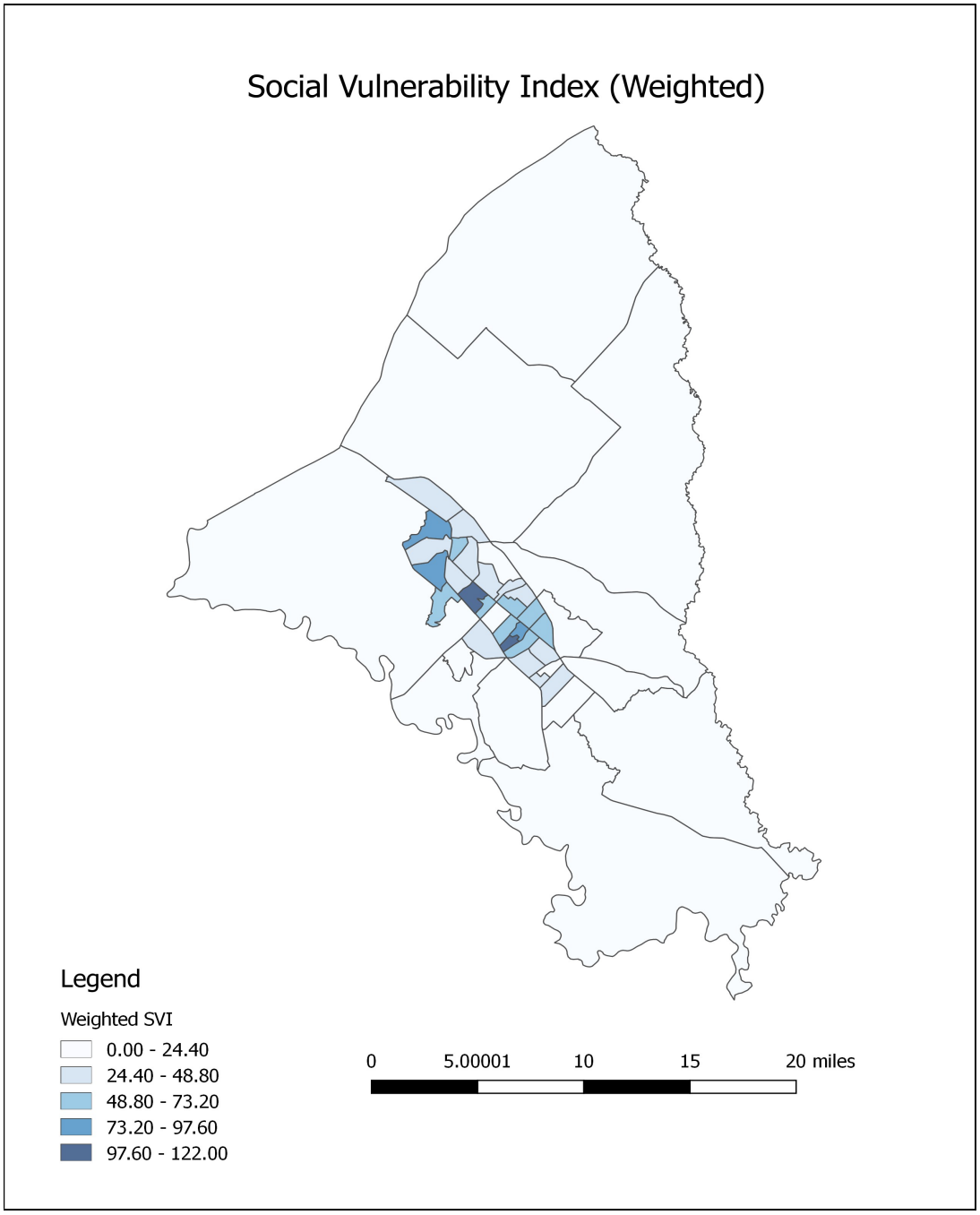


Figure 5-3. Total Population Map for the Planning Area

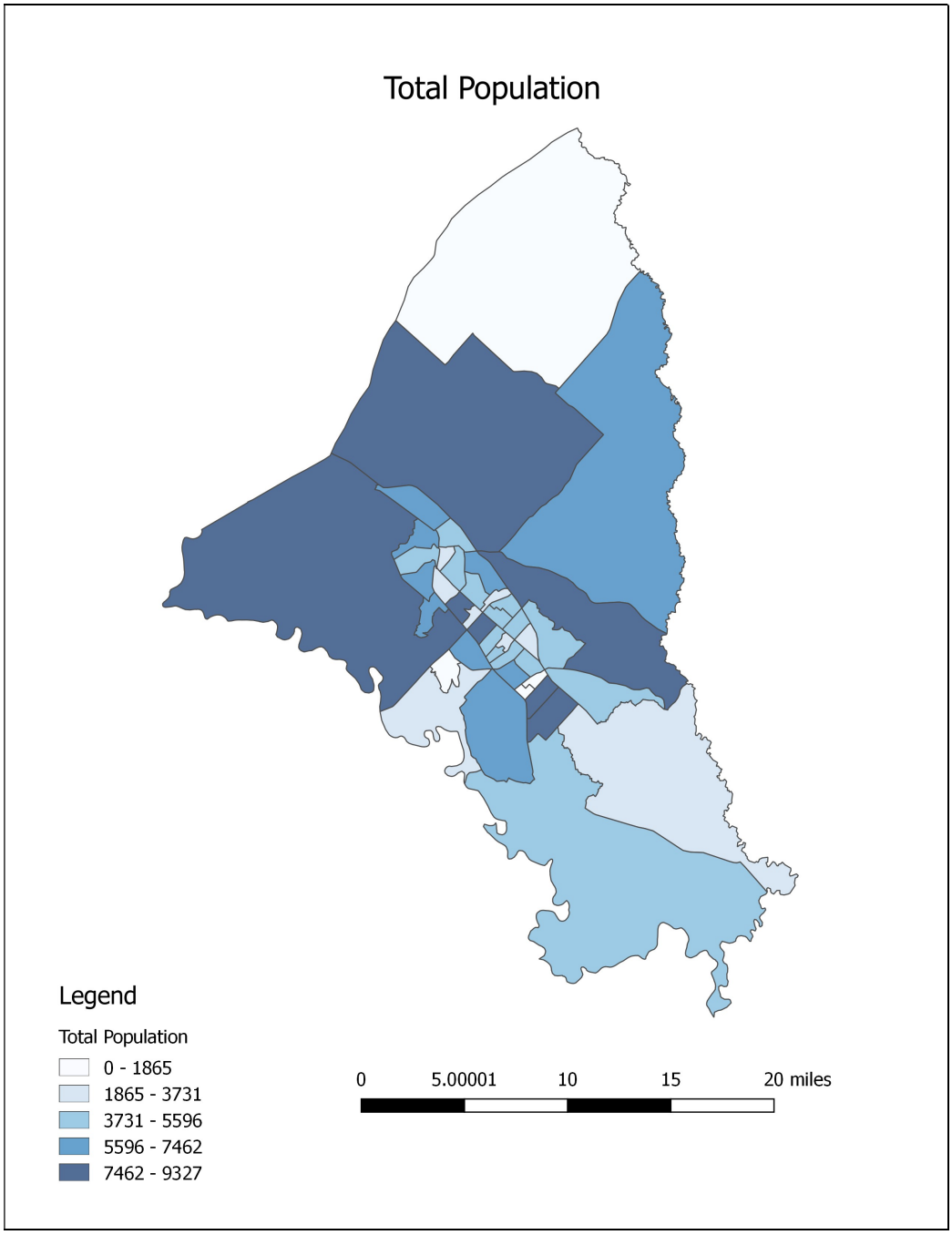


Figure 5-4. Population 65 and Over Map for the Planning Area

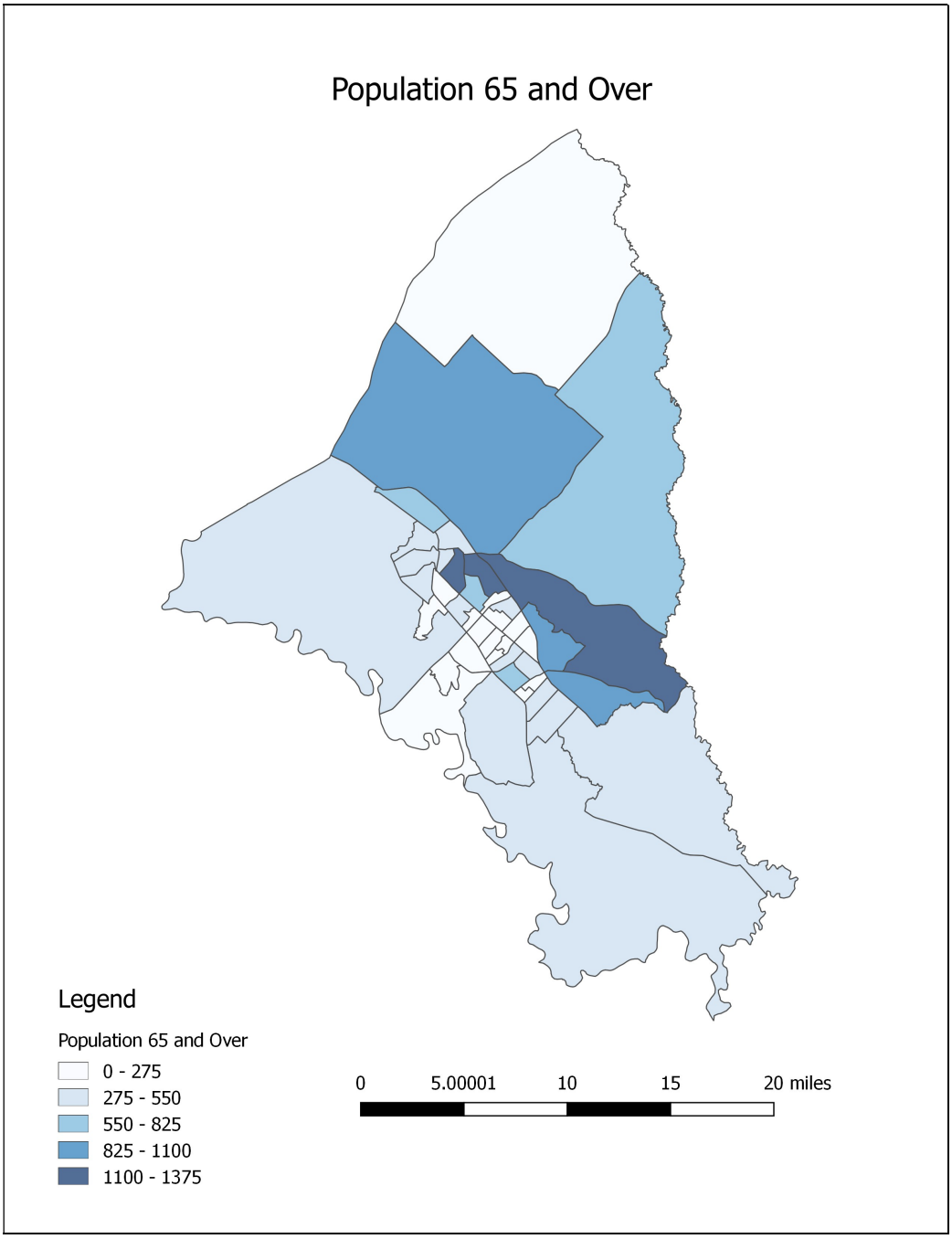


Figure 5-5. Population of Persons in Poverty Map for the Planning Area

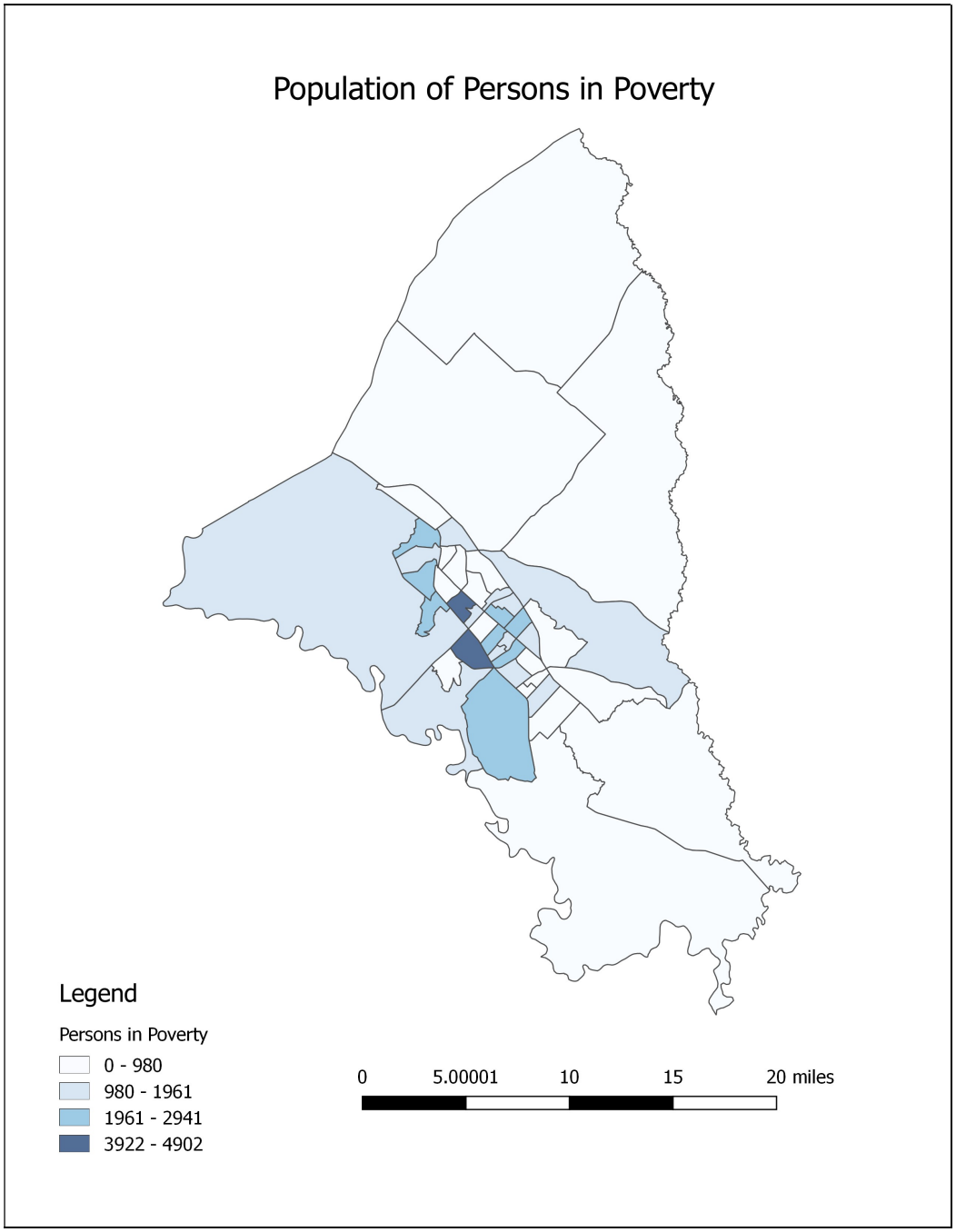


Figure 5-5. Persons Living in Mobile or Other Homes Map for the Planning Area

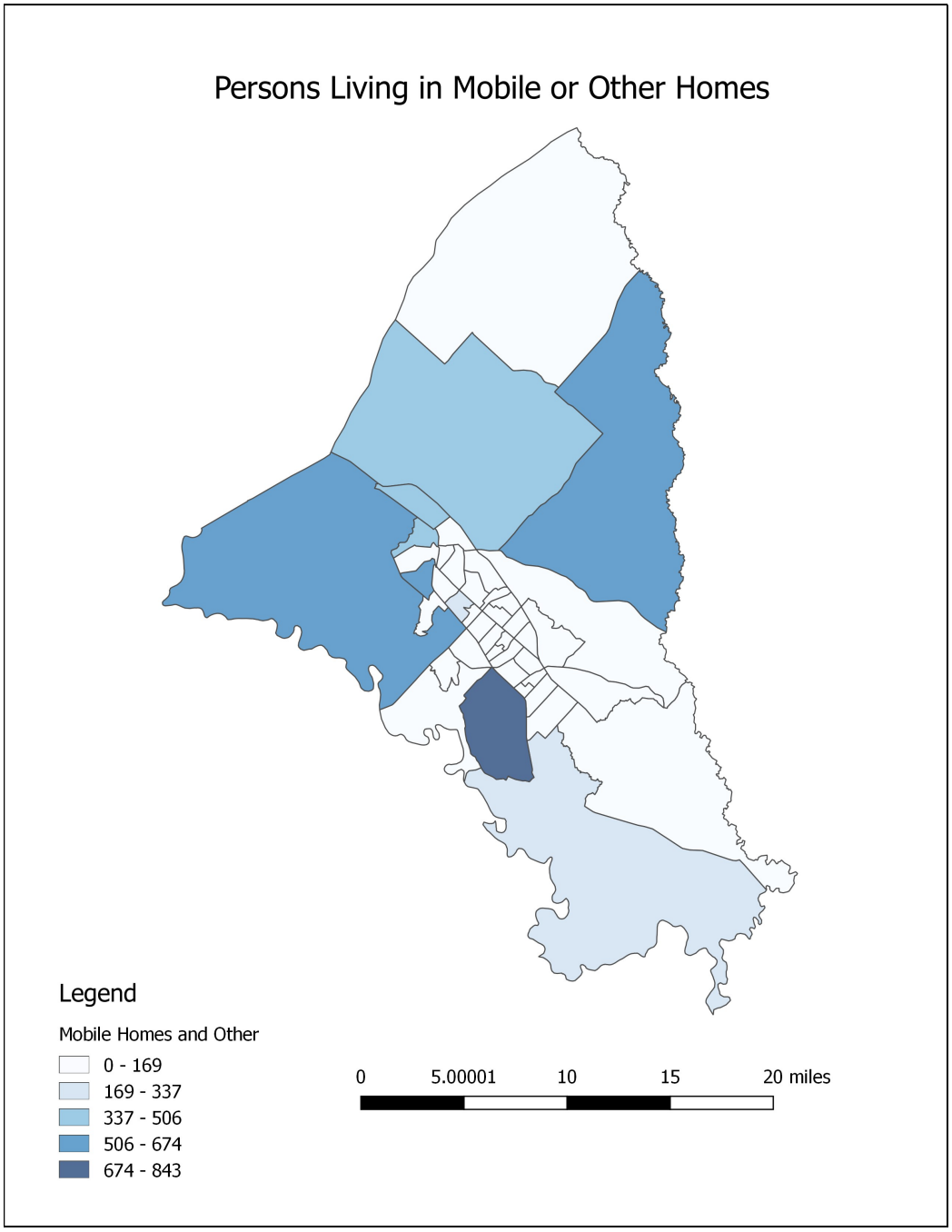


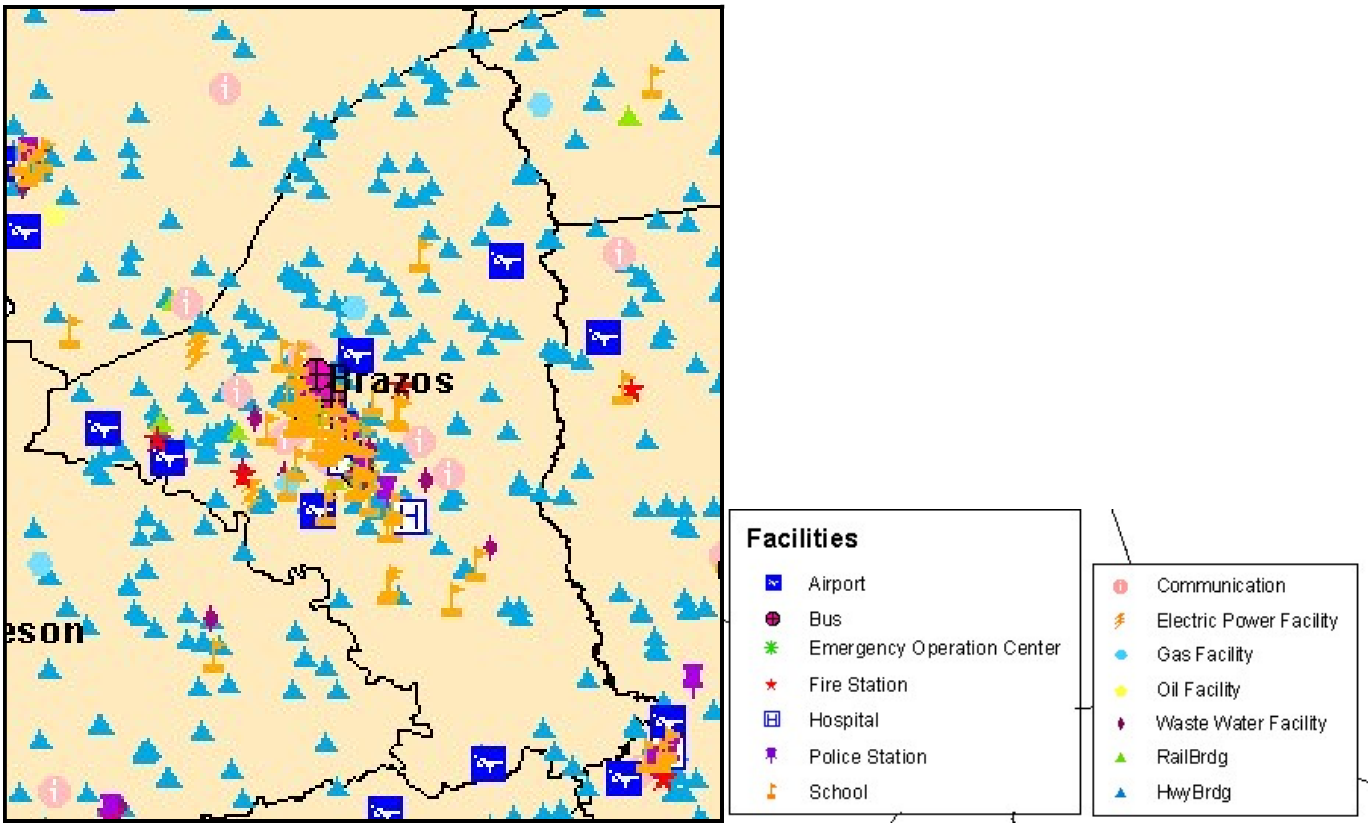
Table 5-2. Critical Facilities by Type in the Planning Area

Jurisdiction	Infrastructure and Lifelines			
	Oil Pipe (km)	Gas Pipe (km)	Highway (km)	Railroad (km)
Brazos	375.9	1,819.9	216.4	113.2

	Brazos County	Bryan	College Station	Texas A&M University	Wixon Valley
Airport		1		1	
Bus		2		1	
City Hall		1	1		1
Communication		6	1	1	
Courthouse	1				
Electric		1	1	2	
Emergency		1		1	
Fire Station	12	5	6		
Highway	6		2		
Medical		2	3	1	
Police Station	1	2	1	1	
School	1	32	16		
Wastewater		3	2	2	

	Multiple Jurisdictions
Highway	14
Railway Bridge	2

Figure 5-6. Critical Facilities Distribution Map for the Planning Area



HAZARDS OF CONCERN

Based on input such as historical data, public perception, and technical requirements, the following hazards (listed alphabetically) were considered for analysis:

Dam failures

Drought

Excessive Heat

Fires

Floods

Hail

Severe Winter Storms

Thunderstorms

Tornados

Historical Disaster Declarations

Of the 1,037 major disaster declarations in the 50 states, the District of Columbia, and nine U.S. territories between 1972 and 2010, the State of Texas, at 84, claims the highest number of presidential disaster declarations for any state or territory. Presidential disaster declarations and Small Business Administration declarations for Brazos County and participating entities are identified in Table 5-3. Since 1965, there have been five Presidential Disaster and five Small Business Administration Declarations for Brazos County and the participating entities.

Table 5-3. Disaster Declarations in the Planning Area

County	Year	Disaster Number	Primary Incident Type	Presidential Declaration	SBA Declaration
Brazos	1991	930 DR	Flood	Yes	Yes
Brazos	1994	1041 DR	Flood	Yes	Yes
Brazos	2005	1606 DR	Hurricane	Yes	Yes
Brazos	2008	1791 DR	Hurricane	Yes	Yes
Brazos	2016	4272 DR	Flood/Tornado	Yes	Yes

Economic and Social Losses

Risk (vulnerability) assessments are presented, whenever possible, in terms of annualized losses. The annualized data are useful for three reasons:

Contribution of potential losses from all future disasters is accounted for with this approach.

Results in this form from different hazards are readily comparable and, hence, easier to rank.

For purposes of evaluating mitigation alternatives, use of annualized losses is the most objective approach.

Annualized losses for hazards where the parametric approach is used are computed in a three-step process:

Compute / estimate losses for a number of scenario events with different return periods (e.g., 10-year, 100-year, 200-year, 500-year)

Approximate the probability versus loss curve through curve fitting

Calculate the area under the fitted curve to obtain annualized losses.

Computations of loss predictions from the other hazards that used a statistical approach are based primarily on observed historical losses.

Impact on Critical and Essential Facilities

Hazard mitigation plans often focus on critical facilities vulnerable to hazards simply because it is usually most cost-effective to mitigate the assets that are the most important to the community. These could be facilities critical to emergency operations, or ones that house important government functions or vulnerable populations, or ones simply deemed important to the community for their economic or cultural value. Consequently, these facilities are considered high-priority when evaluating structures for the purpose of increasing their disaster resistance.

Critical and essential facilities include:

Facilities critical to normal and emergency response operations in the planning area (fire stations, police stations, and the EOC)

Infrastructure and facilities critical to community survivability or continuity of community services (transportation facilities; post offices; radio station and other communication facilities; electrical transmission and distribution; water and wastewater treatment),

Facilities needed to assist vulnerable populations during and after a disaster (schools, hospitals, residential care facilities), and

Facilities in which key government functions take place (sheriff's office, county courthouse, town halls).

In general, for most of the hazards addressed in this study, the potential for significant damage exists primarily at critical facilities located in flood-prone areas. Critical facilities that happen to be in the tornado path or nearby energy pipelines where incidents could occur also may sustain considerable damage.

HAZARD RANKING

Based on the priority risk index in Table 5-4 below, the hazards in the planning area are:

Floods

Thunderstorms

Drought

Urban and Wildland Fire

Dam Failure – except Wixon Valley and Kurten

Hail

Excessive Heat

Winter Storm

Tornado

UNIQUE HAZARDS

This plan is a multi-jurisdictional plan developed to address common risks faced by Brazos County and the participating entities. Members of the Hazard Mitigation Team conducted an assessment of risks their entity faces in comparison to the other communities in the planning area.

CONCLUSIONS

Tables 5-4 and 5-5 on the following page provides an overall summary of the planning area's vulnerability to hazards. Table 5-4 provides the definitions utilized in the priority risk index (PRI). Table 5-5 provides the ratings of the priority risk index. The PRI as a function of probability, special extent, impact, duration of incident, and warning time. For each participating entity, each hazard was given a rating of *1 to 4 (with 1 being the lowest)* within each area.

Section 201.6(c)(2)(iii) of FEMA regulations indicate that for multi-jurisdictional plans, the risk assessment must assess each participating entity's risks where they vary from the risks facing the entire planning area. These ratings were developed based on the best acceptable data and will be updated during the five-year plan review and update process.

Table 5-4. Definitions for the Priority Risk Index

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 100% annual probability	3	
	Highly Likely	100% annual probability	4	
Impact (Impact is subdivided into 3 categories: social impact, property impact, and CIKR impact)	Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more	4	
Spatial extent	Negligible	Less than 1% of area affected	1	20%
	Small	Between 1 and 10% of area affected	2	
	Moderate	Between 10 and 50% of area affected	3	
	Large	Between 50 and 100% of area affected	4	
Warning Time	More than 24 hours	Self-explanatory	1	10%
	12 to 24 hours	Self-explanatory	2	
	6 to 24 hours	Self-explanatory	3	

	Less than 6 hours	Self-explanatory	4	
Duration	Less than 6 hours	Self-explanatory	1	10%
	Less than 24 hours	Self-explanatory	2	
	Less than one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

Source: Brazos County Hazard Mitigation Team (adapted from North Caroline Emergency Management Division)

Table 5-5. Priority Risk Index by Planning Entity

	PROBABILITY	EXTENT	IMPACT					DURATION	WARNING TIME	PRI
			Social Impact		Property Impact	CIKR Impact		Incident Exposure		
	Probability	Spatial Extent	Historical Human	Possible Human	Extent of Damage	Duration of Shutdown	Average Impact	Duration of Exposure	Warning Time	Priority Risk Index
Weights	0.3	0.2					0.3	0.1	0.1	
Brazos County	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	3	2	4	4	2	3.00	3	3	3
Drought	3	4	1	1	2	1	1.25	4	1	2.575
Urban and Wildland Fires	4	1	1	1	2	1	1.25	1	4	2.275
Winter Storms	1	4	2	1	1	1	1.25	2	3	1.975
Tornados	1	2	1	3	3	3	2.50	1	4	1.95
Hail	3	2	1	1	2	1	1.25	1	4	2.175
Thunderstorms	4	3	1	1	2	1	1.25	2	3	2.675
Dam Failure	1	2	1	4	4	4	3.25	3	3	2.275
Excessive Heat	1	4	2	2	1	1	1.50	4	1	2.05
City of Bryan	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	3	2	4	4	2	3.00	3	3	3
Drought	3	4	1	1	2	1	1.25	4	1	2.575
Urban and Wildland Fires	4	1	1	1	2	1	1.25	1	4	2.275
Winter Storms	1	4	2	1	1	1	1.25	2	3	1.975
Tornados	1	2	1	3	3	3	2.50	1	4	1.95
Hail	3	2	1	1	2	1	1.25	1	4	2.175
Thunderstorms	4	3	1	1	2	1	1.25	2	3	2.675
Dam Failure	1	2	1	4	4	4	3.25	3	3	2.275
Excessive Heat	1	4	2	2	1	1	1.50	4	1	2.05
City of College Station	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	3	2	4	4	2	3.00	3	3	3
Drought	3	4	1	1	2	1	1.25	4	1	2.575
Urban and Wildland Fires	4	1	1	1	2	1	1.25	1	4	2.275
Winter Storms	1	4	2	1	1	1	1.25	2	3	1.975
Tornados	1	2	1	3	3	3	2.50	1	4	1.95
Hail	3	2	1	1	2	1	1.25	1	4	2.175
Thunderstorms	4	3	1	1	2	1	1.25	2	3	2.675
Dam Failure	1	2	1	4	4	4	3.25	3	3	2.275
Excessive Heat	1	4	2	2	1	1	1.50	4	1	2.05
City of Kurten	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	3	2	4	4	2	3.00	3	3	3
Drought	3	4	1	1	2	1	1.25	4	1	2.575
Urban and Wildland Fires	4	1	1	1	2	1	1.25	1	4	2.275
Winter Storms	1	4	2	1	1	1	1.25	2	3	1.975
Tornados	1	2	1	3	3	3	2.50	1	4	1.95
Hail	3	2	1	1	2	1	1.25	1	4	2.175
Thunderstorms	4	3	1	1	2	1	1.25	2	3	2.675
Dam Failure	0	0	0	0	0	0	0.00	0	0	0
Excessive Heat	1	4	2	2	1	1	1.50	4	1	2.05
City of Wixon Valley	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	3	2	4	4	2	3.00	3	3	3
Drought	3	4	1	1	2	1	1.25	4	1	2.575
Urban and Wildland Fires	4	1	1	1	2	1	1.25	1	4	2.275
Winter Storms	1	4	2	1	1	1	1.25	2	3	1.975
Tornados	1	2	1	3	3	3	2.50	1	4	1.95
Hail	3	2	1	1	2	1	1.25	1	4	2.175
Thunderstorms	4	3	1	1	2	1	1.25	2	3	2.675
Dam Failure	0	0	0	0	0	0	0.00	0	0	0
Excessive Heat	1	4	2	2	1	1	1.50	4	1	2.05
TAMU	P1: Prob	S1: Extent	H1: Extent	H2: Number	Pr1: Extent	CI1: Shutdown	Severity	D1: Duration	W1: Warning	PRI
Flood	3	1	1	4	4	4	3.25	2	2	2.475
Drought	1	4	1	1	1	1	1.00	4	1	1.9
Urban and Wildland Fires	2	1	1	1	1	1	1.00	1	1	1.3
Winter Storms	1	4	1	1	1	1	1.00	2	1	1.7
Tornados	1	3	1	3	3	3	2.50	2	4	2.25
Hail	2	3	1	1	1	1	1.00	1	3	1.9
Thunderstorms	3	4	1	1	1	1	1.00	1	3	2.4
Dam Failure	1	1	1	4	4	4	3.25	1	1	1.675
Excessive Heat	1	4	1	1	1	1	1.00	4	1	1.9

The hazard-event profiles relevant to Brazos County and the participating entities reveal historic hazard trends and provide a reference point for understanding the potential effects of future hazard events. A review of historic data helps to evaluate hazard-event profiles and answer questions: How often may a particular disaster occur? Who and where are most likely to be affected? How bad can it get?

Sections 6 through 14 of this plan contain reviews of the historical frequency of occurrence and/or loss and damage estimates, by hazard, in the planning area.

Each section discusses why the hazard is a threat, profiles the hazard, identifies areas at risk to hazards that have distinct geographic boundaries, identifies the people and property at risk, and summarizes the history of hazard events and potential damages and losses.

The results of this study are useful in at least three ways:

Improving our understanding of the risk associated with the natural hazards in the planning area through better understanding of the complexities and dynamics of risk, how levels of risk can be measured and compared, and the myriad factors that influence risk. An understanding of these relationships is critical in making balanced and informed decisions on managing the risk.

Providing a baseline for policy development and comparison of mitigation alternatives. The data used for this analysis present a current picture of risk in the planning area. Updating this risk "snapshot" with future data will enable comparison of the changes in risk with time. Baselines of this type can support the objective analysis of policy and program options for risk reduction in the region.

Comparing the risk among the natural hazards addressed. The ability to quantify the risk to all these hazards relative to one another helps in a balanced, multi-hazard approach to risk management at each level of governing authority. This ranking provides a systematic framework to compare and prioritize the very disparate natural hazards that are present in the planning area. This final step in the risk assessment provides the necessary information for the Mitigation Planning Committee to craft a mitigation strategy to focus resources on only those hazards that pose the most threat to the region.

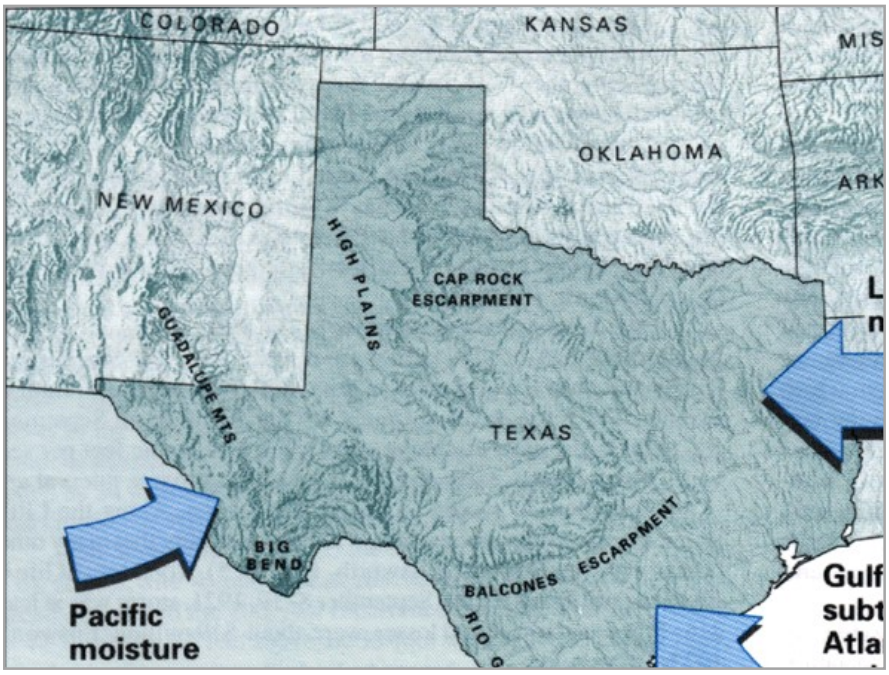
WHY FLOODS ARE A THREAT

Unique Geographic and Atmospheric Conditions

Texas, according to American Hazardscapes: The Regionalization of Hazards and Disasters published by the National Academy Press, consistently outranks other states in deaths and damage from floods. This is due to the location and size of the state. Texas is second in casualties and damages from hurricanes and tropical storms.

The state's vulnerability is the result of several factors: miles of Gulf of Mexico coastline; proximity to the Pacific Ocean off the west coast of Mexico; geographical location near the Rocky Mountains of Colorado and Arizona; the high-altitude jet stream; and nearness to the unique West Texas "dry line," a shifting, invisible atmospheric separation of dry desert air from the moist Gulf air. These factors create a breeding ground for the big storms of spring and fall that spawn tornadoes and suck up Gulf or Pacific moisture that feed the heavy rains that cause flash flooding. All these geographic factors cause Texas to experience extensive, annual storms. Figure 6-1 shows the state's vulnerability to damaging storms. Flooding takes many forms in the planning area.

Figure 6-1. Texas Sources of Moisture



Flash Flooding

Most flash flooding is caused by slow-moving thunderstorms, by thunderstorms repeatedly moving over the same area, or by heavy rains from hurricanes and tropical storms. Flash floods can occur within a few minutes or after hours of excessive rainfall. Often there is no warning that flash floods are coming.

Flash flooding can pose a deadly danger to residents of the planning area. A number of roads run through low-lying areas that are prone to sudden and frequent flooding during heavy rains. Motorists often attempt to drive through barricaded or flooded roadways. It takes only 18-to-24-inches of water moving across a roadway to carry away most vehicles. Floating cars easily get swept downstream, making rescues difficult and dangerous.

Riverine Flooding

Riverine flooding is natural and inevitable. It is the overbank flooding of rivers and streams, typically resulting from large-scale weather systems that generate prolonged rainfall over a wide geographic area. 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.

Urban Flooding

Urban flooding occurs as land is converted from fields or woodlands to roads, buildings and parking lots and when the natural land loses its ability to absorb rainfall. Urbanization changes the natural hydrologic systems of a basin, increasing runoff two to six times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while highway underpasses and underground parking garages can become death traps as they fill with water.

HAZARD PROFILE

Major flooding and flash flooding events can have a substantial severity of impact to the Brazos County and the participating entities. They can cause multiple deaths, completely shut down facilities for thirty days or more, and cause more than fifty percent of affected properties to be destroyed or suffer major damage.

The frequency of occurrence of flooding in the planning area is likely.

The extent of flooding in Brazos County and participating entities, can be water depths from between one and four feet deep in structures located in the identified flood hazard area.

Brazos County and participating entities have infrastructure and critical facilities that are vulnerable to floods. There are also residential structures that are vulnerable to flooding, and mitigation actions regarding those structures are addressed in Section 16 of this plan.

Flooding occurs in seasonal patterns. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come together during the transition from summer to winter, most thunderstorms and resulting flooding occur during the spring (April, May and June) and fall (October, November, and December).

HISTORY OF FLOODING

Flood events in the planning area reported to the National Weather Service are listed in Table 6-1.

Table 6-1. Reported Flood Events, January 1, 1994, to September 1, 2017

Type	Location	Date	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
Flash flooding	Brazos	10/16/1994	0	0	$5.0M	$50K
Flash flooding/ flood	Brazos	12/15/1994	0	0	50K	5K
Flash flood	Bryan/ College Station	09/21/1995	0	0	5K	0
Flash flood	Countywide	02/20/1997	0	0	5K	0
Flash flood	North Portion	10/13/1997	0	0	5K	0
Flash flood	College Station	01/06/1998	0	0	5K	0
Flash flood	College Station	10/17/1998	0	0	5K	0
Flooding, riverine	County	10/17/1998	1	0	0	0
Flash flood	College Station	10/18/1998	0	0	2K	0
Flash flood	Countywide	10/18/1998	0	0	15K	0
Flooding, riverine	County	11/12/1998	0	0	0	0
Flash flood	Countywide	11/02/2000	0	0	1.0M	0
Flash flood	Countywide	11/03/2000	0	0	25K	0
Flash flood	Countywide	11/03/2000	0	0	25K	0
Flash flood	Countywide	11/03/2000	0	0	1.0M	0

Flash flood	Countywide	09/09/2001	0	0	50K	0
Flash flood	Bryan	07/14/2002	0	0	20K	0
Flash flood	Countywide	11/04/2002	0	0	95K	0
Flash flood	Countywide	02/20/2003	0	0	8K	0
Flash flood	Bryan	05/13/2004	0	0	250K	0
Flash flood	College Station	06/15/2004	0	0	55K	0
Flash flood	Bryan	06/30/2004	0	0	15K	0
Flash flood	Countywide	11/22/2004	0	0	0	0
Flash flood	Bryan	05/01/2007	0	0	130K	0
Flash flood	Countywide	12/15/2007	0	0	5K	0
Flash flood	Bryan	04/25/2009	0	0	1K	0
Flash flood	Bryan	06/09/2010	0	0	1K	0
Flash flood	College Station	06/09/2010	0	0	0	0
Flash flood	College Station	06/09/2010	0	0	0	0
Flash flood	College Station	06/09/2010	0	0	0	0
Flash flood	College Station	06/09/2010	0	0	0	0
Flash flood	College Station	02/03/2012	0	0	100K	0
Flash flood	Bryan (Edge)	02/03/2012	0	0	2K	2K
Flash flood	Bryan	05/09/2013	0	0	10K	0
Flash flood	College Station	09/28/2013	0	0	0	0
Flash flood	Bryan	06/25/2014	0	0	0	0
Flash flood	College Station	07/17/2014	0	0	50K	0
Flash flood	Bryan	09/12/2014	0	0	3K	0
Flash flood	Bryan	05/25/2015	0	0	5K	0
Flash flood	Bryan	10/24/2015	0	0	0	0
Flash flood	College Station	12/27/2015	0	0	0	0

Flash flood	County Wide	05/26/2016	0	0	100K	0
Flood	County Wide	08/24/2017-08/28/2017	0	0	TBD	0

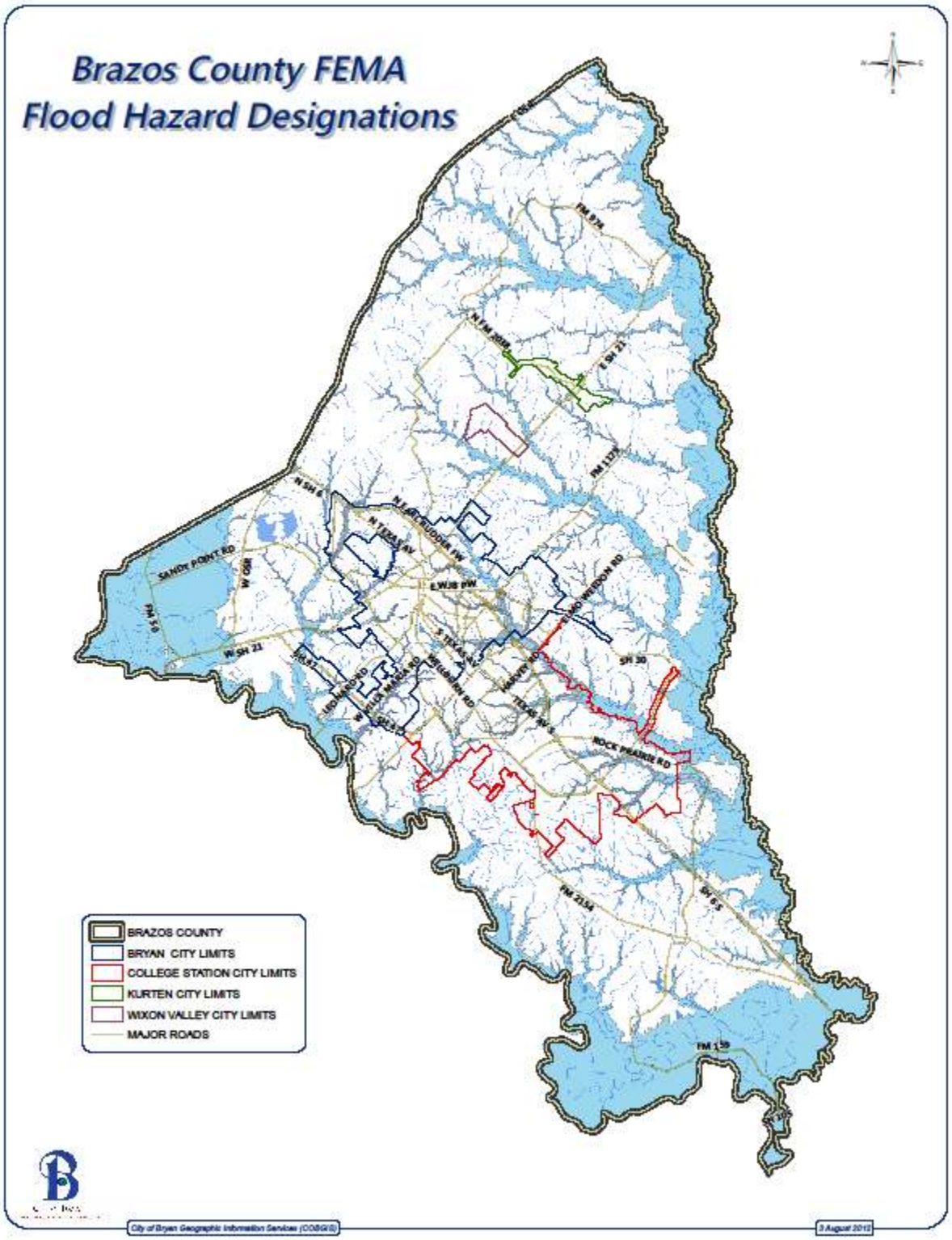
LOCATION OF HAZARDOUS AREAS

Flood-hazard areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with communities; floodplain topographic surveys; and hydrological and hydraulic analyses. FEMA's Flood Insurance Rate Maps (FIRMs) identify areas subject to flood hazard. These include Special Flood Hazard Areas, which are defined as areas that will be inundated by a flood event having a one-percent chance of being equaled or exceeded in any given year. The one-percent-annual-chance flood is also referred to as the base flood or 100-year flood. Moderate flood-hazard areas are also shown on the FIRM, and are the areas between the limits of the base flood and the two-tenths of a percent-annual-chance (or 500-year) flood.

The location of flood hazard areas for Brazos County and participating entities are shown in Figure 6-2. Flooding is primarily located along the Brazos River on the west side of the county and along the Navasota River on the east side of the county. Depths of flood waters can range from one to four feet deep along the Brazos River and one to three feet deep along the Navasota River.

Figure 6-2 on the following page depicts the flood zones throughout the planning area, where there is potential for damage to property and loss of life.

Figure 6-2. Riverine Flooding Potential for the Planning Area



NFIP PROGRAM PARTICIPATION

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the ravages of flooding.

According to FEMA, jurisdictions participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary.

Brazos County, cities of Bryan, College Station, and Wixon Valley are currently the jurisdictions within the county that participate in the NFIP. It should be noted that Wixon Valley participates in the NFIP but has no floodplain within the city limits. There is no floodplain within the city limits of Kurten that would require participation in the NFIP. However, the City of Kurten has identified the desire to participate in the NFIP as one of their projects to mitigate for flooding.

These jurisdictions maintain their continued NFIP compliance in several ways, including:

Requiring all new development in the identified flood hazard area to be permitted

Requiring revisions to existing structures in the identified flood hazard area to be permitted

Requiring Elevation Certificates to be submitted as part of the permitting process

Persons looking to purchase flood prone property are being advised of the flood hazard area through credited hazard disclosure measures

Continued preservation of open space in the floodplain

Acquisition of existing structures from the floodplain

Keeping track of building improvements and repairs to structures located in the identified flood hazard area

Continued enforcement of stream dumping regulations

The cities of Bryan, College Station, and Wixon Valley participate in the NFIP's Community Rating System (CRS). This voluntary incentive program recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Additional activities are verified annually and community success is translated into ratings which equal policy holder discounts.

For more information regarding the floodplain management ordinance of each community, see Section 15.

Table 6-2. National Flood Insurance Program, Policies and Losses for the Planning Area (as of (5/31/2018)

Community	Policies in Effect	Total Coverage in Thousands	Total Losses	Dollars Paid, Historical
Brazos County	236	$68,635	34	$1,155,567
Bryan	673	$168,691	280	$4,406,382
College Station	641	$202,581	185	$1,082,188

PEOPLE AND PROPERTY AT RISK

To assess flood risk, flood areas were modeled for 100-year and 500-year events. Flood depth was estimated at the pixel level for affected areas, along with proportion of the area affected within the census block. Table 6-3 shows the estimated buildings and people at risk to flooding.

Because detailed information was not available to calculate potential losses due to flood, it is assumed that in a worst-case-scenario event, all exposed areas would be impacted and the exposed values would equal the potential losses.

Table 6-3. Potential Wet Exposure for 100-Year Flood (Riverine Flooding)

	Residential		Rental		Commercial		Industrial	
	Number of Parcels	Value ($1,000)	Number of Parcels	Value ($1,000)	Number of Parcels	Value ($1,000)	Number of Parcels	Value ($1,000)
Bryan	1192	$204,781	104	$96,394	179	$445,253	14	$40,561
College Station	564	$189,914	78	$530,835	108	$506,456	2	$29,990
Kurten	0	0	0	0	0	0	0	0
Wixon Valley	0	0	0	0	0	0	0	0
Unincorporated	520	$127,312	4	$2,443	56	$78,095	6	$2,541
Brazos County - TOTAL	2276	$522,006	186	$629,672	343	$1,029,804	22	$95,956

Market Value: $3,494,789,179

Land Value: $1,585,952,326

Improvement Value: $1,908,836,853

Potential Damages and Losses

To estimate annualized losses due to flood, the exposed values were multiplied by the probability of the occurrence of a 100-year flood event (1 percent) to calculate the estimated annualized losses. Annualized losses by county are shown in Table 6-4. Potential impacts to critical facilities and infrastructure are provided in Table 6-5. Repetitive losses are provided in Table 6-6.

Table 6-4. Potential Annualized Losses (Riverine Flooding)

Planning Entity	Total Exposure ($1,000)	Annualized Loss (Residential)	Annualized Loss (Commercial)	Annualized Loss (Industrial)	Total Annualized Loss	Annualized Loss Percentage Ratio
Brazos County	$210,391	$69,920.00	$249,728.86	$303,325.74	$622,974.60	0.30%
City of Bryan	$786,989	$431,794.18	$284,055.76	$224,273.04	$940,122.98	0.12%
City of College Station	$1,257,195	$77,627.34	$43,801.11	$19,002.26	$140,430.71	0.01%

Table 6-5. Critical Facilities and Infrastructure Potentially Damaged, Brazos County

County	Critical Facilities and Infrastructure		
	Total Number	Number Inside the 100-year Floodplain	Percentage Susceptible to Flooding
Brazos	298	129	43.29

Repetitive Losses

Brazos County has four (4) structures on FEMA's Repetitive Loss (RL) list and no Severe Repetitive Loss (SRL) structures.

The City of Bryan has twenty-eight (28) structures on FEMA's RL list and seven (7) structures on the SRL list.

The City of College Station has four (4) structures on FEMA's RL list and one (1) structure on the SRL list.

Forty-one (41) structures are residential, and three (3) are commercial. They are primarily constructed of brick and mortar on concrete slab foundations.

None of the other participating entities within this plan have either RL or SRL structures listed by FEMA.

WHY DROUGHT IS A THREAT

According to the Texas Parks and Wildlife Department, "Drought is one of the most complex, and least understood, of all natural hazards, affecting more people than do other natural hazards, but differing from them in important ways. Unlike earthquakes, hurricanes and tornadoes, drought unfolds at an almost imperceptible pace with beginning and ending times that are difficult to determine, and with effects that often are spread over vast regions. 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 regimes, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 7-1 shows the drought classification definitions.

Table 7-1. Drought Classification Definitions

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.

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

Over time, droughts can have very damaging effects on crops, municipal water supplies, recreational uses, and wildlife. If droughts extend over a number of years, the direct and indirect economic impact can be significant.

Droughts can affect a large area and range in size from a couple of counties to several states. Their impact on wildlife and area farming is enormous. Droughts can kill crops, grazing land, edible plants and even in severe cases, trees. The historic Texas drought of 2011 led to a record $5.2 billion in agricultural losses, making it the most costly drought on record, according to Texas AgriLife Extension Service economists. The $5.2 billion in losses exceeds the previous

record of $4.1 billion during the 2006 drought. Additionally dying vegetation also serves as a prime ignition source for wildland fires.

The following is a list of economic drought losses from 1998 through 2011 compiled by AgriLife Extension economists:

2011– $5.2 billion

2009 – $3.6 billion

2008 – $1.4 billion

2006 – $4.1 billion

2002 – $316 million

2000 – $1.1 billion

1999 – $223 million

1998 – $2.4 billion

A heat wave combined with a drought is a very dangerous situation. Although drought can occur in any season, when extreme heat combines with drought conditions, the result can be a community disaster.

Droughts occur regularly in Texas and are a normal condition. They can vary greatly, however, in their intensity and duration. On average, a yearlong drought takes place somewhere in Texas once every 3 years and a major drought every 20 years. Major droughts can last for years. In 2011, the planning area experienced a severe drought event.

HAZARD PROFILE

The potential severity of impact of droughts is substantial, especially taking into consideration the economic losses that may result.

The frequency of occurrence of drought in the planning area is likely.

The planning area has critical facilities or infrastructure that are vulnerable to drought. The participating entities in this plan all have back-up water supply systems in place to provide water to commercial and residential structures should a drought affect the water supply system. Most residences in the planning area rely on water from underground wells. Livestock and agriculture losses could occur in the county during periods of drought. Additionally, drought increases the risk of wildfires due to lack of soil and plant moisture. The risk of wildfires is address in the subsequent section.

Droughts are slow onset hazards. Warning time for drought is long, since drought events take place over long periods of time. Drought warnings are issued by the state Drought Preparedness Council, as directed by H.B. 2660, based upon input from NOAA, the Office of the State Climatologist, the U.S. Geological Service, the Texas Water Development Board, Texas

Commission on Environmental Quality, and the Texas Agricultural Statistics Service. Warnings utilize five "levels of concern" and take into account assessments of climatology, agriculture, and water availability for each of 10 climatic regions of the state.

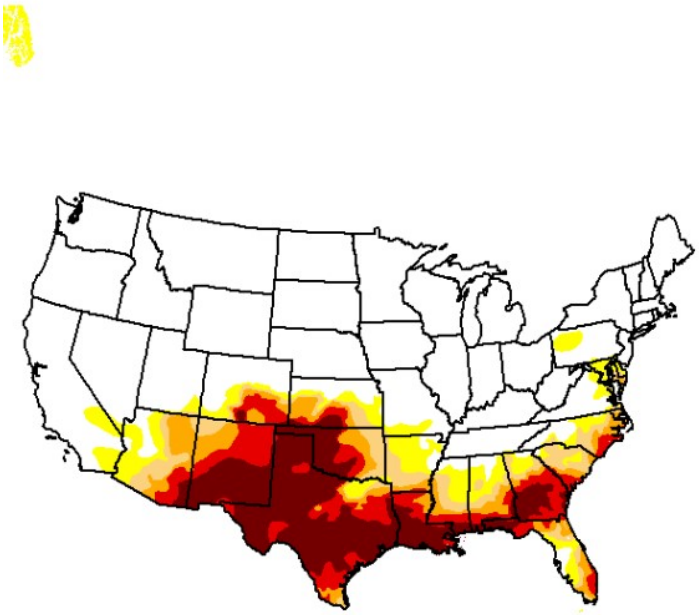
According to the Palmer Drought Index, shown in Table 7.2 on the next page, the extent of droughts can range from minor or moderate to extreme or exceptional. The maximum extent of drought that can affect the planning area would be exceptional, as shown in Figure 7.1. This occurred during the summer and fall of 2011. The minimum extent of drought that can affect Brazos County and the participating entities would be moderate, as shown in Figure 7.2. This occurred during the spring of 2017 after some much needed rain.

Table 7-2. Palmer Drought Index

Drought Severity	Return Period (years)	Description of Possible Impacts	Drought M
			Standardized Precipitation Index (SPI)
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-1.3 to -1.5
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-1.6 to -1.9

Figure 7-1. Extent of Drought for the United States during 2011

U.S. Drought Monitor
CONUS



July 12, 2011
(Released Thursday, Jul. 14, 2011)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	64.33	35.67	28.70	23.69	18.67	11.96
Last Week 7/5/2011	62.63	37.37	29.28	23.58	18.62	11.77
3 Months Ago 4/12/2011	62.57	37.43	28.49	18.31	9.00	0.93
Start of Calendar Year 1/4/2011	60.50	39.50	21.74	8.50	2.60	0.00
Start of Water Year 9/28/2010	60.05	39.95	13.16	3.09	0.30	0.00
One Year Ago 7/13/2010	74.84	25.16	7.83	1.33	0.25	0.00

Intensity:

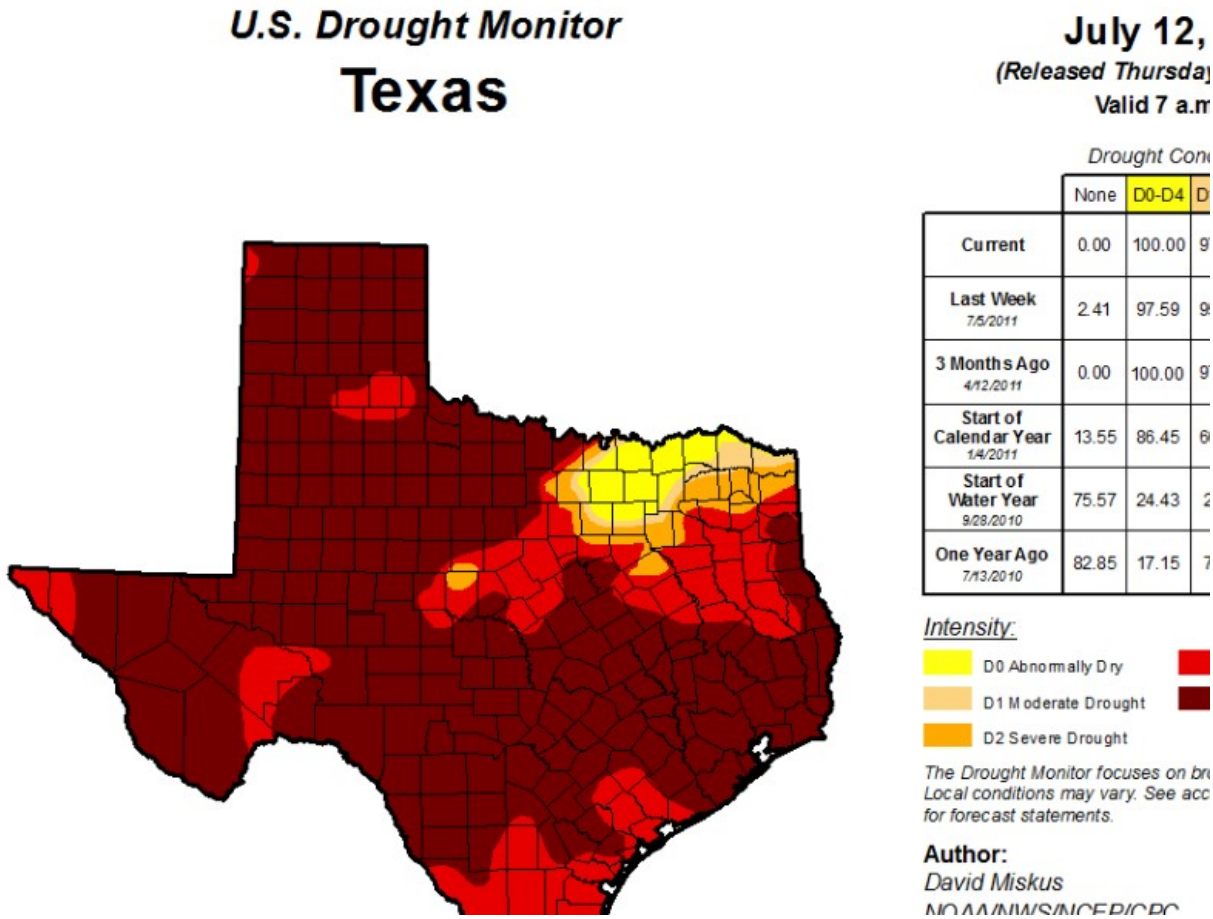
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author(s):
David Miskus
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/

Figure 7-2. Extent of Drought Specific to the State of Texas during 2011



HISTORY OF DROUGHT

The data collected for this hazard is from the National Weather Service and provides estimates of historical losses for property and crop damages (see Table 7-3).

Table 7-3. Exposure to Droughts in the Planning Area as Reported to the National Weather Service, 01/01/1996 to 11/30/2017

Date	Death	Injury	Property Damage	Crop Damage	Notes
4/1/1996	0	0	0	0	Entire county affected
5/1/1996	0	0	0	0	Entire county affected
6/1/1996	0	0	0	0	Entire county affected
5/1/1998	0	0	0	0	Entire county affected
6/1/1998	0	0	0	0	Entire county affected
7/1/1998	0	0	0	0	Entire county affected
8/1/1998	0	0	23.0M	167.9M	Entire county affected No data to separate damages within area
8/1/2000	0	0	0	0	Entire county affected
9/1/2000	0	0	0	102.3M	Entire county affected No data to separate damages within area
7/1/2011	0	0	0	TBD	Entire county affected
8/1/2011	0	0	0	TBD	Entire county affected

People and Property at Risk

Droughts have the potential to impact large geographical areas, thus all the agricultural property, population, and built environment are considered exposed to the hazard and could potentially be impacted. In the planning area, drought does not have specific location.

Drought has the ability to adversely affect agriculture such as reduced crop productivity as well as harm to livestock through reduced water levels, additional stress, and reduced forage. Economic impacts to agriculture can be found in "Potential Damages and Losses" below.

Vulnerable populations due to drought are the elderly (ages 65 and above) and the young (ages 5 and below) as well as populations living at or below poverty level. The elderly are more vulnerable to drought possibly due to underlying health conditions as well as to possible limited access to potable water.

Through the reduction of soil moisture, drought can impact the built environment through the shrinking of soils. This could affect building foundations, bridge construction, and dam construction.

Potential Damages and Losses

In order to analyze the risk of Brazos County and participating entities to drought and estimate potential losses, 100 years of statistical data from the University of Nebraska was used (this data was developed by the University based on Palmer Drought and Crop Severity Indices) as well as 1997 USDA agriculture data. A drought event frequency-impact was then developed to determine a drought impact profile on non-irrigated agriculture products and estimate potential losses due to drought in the area. Table 7-4 shows annualized expected exposure for the planning area.

Table 7-4. Annualized Expected Agricultural Product Market Value Exposed to Drought in the Planning Area in 2017

County	Annualized Expected Exposure ($1000)
Brazos	24,856.7

SECTION 8: URBAN AND WILDLAND FIRES

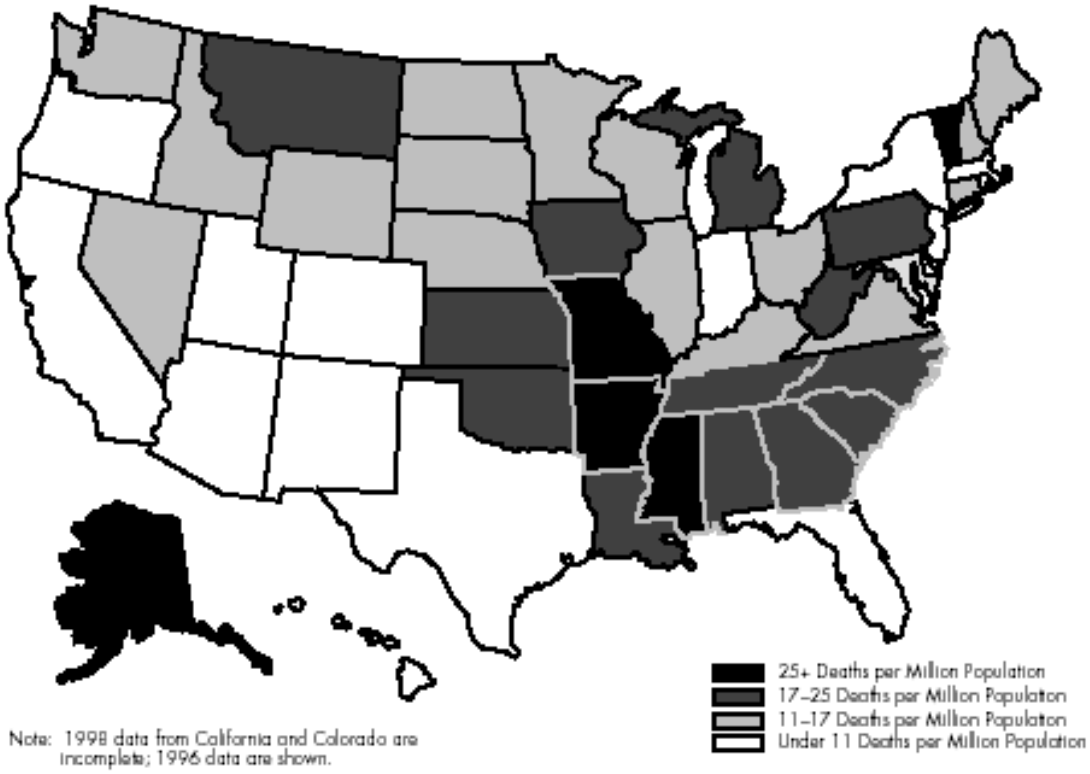
WHY URBAN AND WILDLAND FIRES ARE A THREAT

The fire problem in the United States on a per capita basis is one of the worst in the industrial world. Thousands of Americans die each year from fire, tens of thousands of people are injured, and property losses reach billions of dollars. To put these figures in context, the annual losses from floods, tornadoes, earthquakes and other natural disasters combined in the United States average just a fraction of the losses from fire.

According to the National Fire Data Center of the U.S. Fire Administration, recent trends show a decline in the numbers of fires, deaths, injuries, and dollar loss to property. However, despite these encouraging trends, an average of over 3,000 deaths and 16,000 injuries to civilians, and over 85 firefighter deaths occurred annually over the 10–year period from 2005-2015. The fire death rate, by state, is shown in Figure 8-1.

This plan addresses both wildland fires and major urban fires. For purposes of this plan, major wildland fire events are those that were greater than or equal to two-alarm fires. Major urban fires are defined as those structure fires that were greater than or equal to three-alarm fires.

Figure 8-1. Fire Death Rate by State



Major Urban Fires

The leading causes of fires nationally are arson, open flames, and cooking. Urban fires cause most fire deaths and injuries. The leading causes of fire deaths are smoking, arson, and heating. Between 70 and 80 percent of deaths result from residential fires. People under age 5 and over age 55 have a much higher death rate than the average population. These two age groups account for more than one-third of all deaths nationally.

Wildland Fires

A wildland fire is any fire occurring on grassland, forest, or prairie, regardless of ignition source, damages, or benefits. According to the National Fire Plan, 2000, the wildland fire risk is now considered by authorities as "the most significant fire service problem of the century."

The National Fire Plan was issued by the U.S. Departments of Agriculture and Interior. It defines the urban/wildland interface as "the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels." The interface problem has grown dramatically over the last twenty years, spawned by increases in population, urban expansion, land-management decisions that place neighborhoods adjacent to wildland preserves, parks, and greenbelts, and the ever-present desire to intermingle with nature. The marriage between humans and their property and wildland areas has significantly increased human exposure to wildfires.

More and more people are building their homes in woodland settings in or near forests, rural areas, or remote mountain sites. Many of these homes are nestled along ridgelines, cliff-edges, and other classic fire-interface hazard zones. There, homeowners enjoy the beauty of the environment but they also face the very real danger of wildfire.

Years of fire suppression have significantly disturbed natural fire occurrences—nature's renewal process. The result has been the gradual accumulation of understory and canopy fuels to levels of density that can feed high-energy, intense wildfires and further increase the hazards from and exposure to interface problems.

Multiple devastating interface-area fires over the past several years have demonstrated the disastrous potential inherent in the interface.

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

Three different classes of wildfires exist. A "surface fire" is the most common type and burns along the floor of a forest, moving slowly and killing or damaging trees. A "ground fire" is usually started by lightning and burns on or below the forest floor in the humus layer down to the mineral soil. "Crown fires" spread rapidly by wind and move quickly by jumping along the tops of trees.

Humans start about 90 percent of wildfires (cigarettes thrown from cars, burning of refuse, etc.); lightning starts the other 10 percent.

Hazard Profile

The extent of both urban and wildland fires in the planning area is major; fires can completely shut down facilities for at least two weeks and cause more than 25 percent of affected properties to be destroyed or incur major damage.

The frequency of occurrence of urban and wildland fire events in the planning area is likely.

Winter is the peak period for major urban fires and fire deaths. The wildland fire risk varies considerably by month.

Warning time for urban and wildland fire events is minimal or none.

History of Wildfire in the Planning Area

Table 8-1 shows the number of voluntarily reported incidents by Precinct in Brazos County and participating entities during 2005 through 2017. It is likely that more fire incidents occurred during this timeframe that were not reported. Reporting is voluntary and thus not consistent.

Table 8-1. Wildland Fire Incidents and Losses in the Planning Area, 2005-2017 (over 25 acres)

Fire Dept. Name	Date	Type	Acres	Cause	Agencies Responding
Brazos County Pct. 4 VFD	10/6/2005	Wildfire	320	Debris burning	8
Brazos County Pct. 4 VFD	12/3/2005	Wildfire	375	Equipment use	6
Brazos Co. Dist. 2 VFD	12/24/2005	Wildfire	300	Miscellaneous	5
Brazos County Pct. 3 VFD	12/24/2005	Wildfire	500	Miscellaneous	7
Brazos Co. Dist. 2 VFD	1/3/2006	Wildfire	500	Incendiary	7
Brazos Co. Dist. 2 VFD	1/7/2006	Wildfire	300	Incendiary	7
Brazos Co. Dist. 2 VFD	2/27/2006	Wildfire	40	Debris burning	2
Brazos County Pct. 3 VFD	2/27/2006	Wildfire	30	Debris burning	2
Brazos Co. Dist. 2 VFD	3/31/2006	Wildfire	30	Debris burning	2
Brazos County Pct. 3 VFD	9/2/2006	Wildfire	148	Miscellaneous	3
South Brazos County FD	7/11/2008	Wildfire	25	Miscellaneous	5
Brazos County Pct. 3 VFD	7/11/2008	Wildfire	50	Debris burning	5
Brazos County Pct. 3 VFD	11/5/2008	Wildfire	25	Debris burning	6

Brazos County Pct. 3 VFD	12/7/2008	Wildfire	50	Debris burning	3
Brazos County Pct. 3 VFD	1/7/2009	Wildfire	35	Debris burning	3
Brazos County Pct. 3 VFD	1/21/2009	Wildfire	40	Debris burning	4
Brazos County Pct. 3 VFD	1/31/2009	Wildfire	145	Debris burning	3
Brazos County District 2 VFD	5/9/2011	Wildfire	100	Unknown	8
Brazos County District 2 VFD	11/04/2017	Wildfire	40	Debris burning	5

LOCATION OF HAZARDOUS AREAS

There is no defined geographic hazard boundary for urban and wildland fires in the planning area. Due to the recent droughts of 2009 and 2011, along with the excessive heat of the summer months during those years, most people, buildings, critical facilities, infrastructure and lifelines are considered exposed to the urban and wildland fire hazard and could potentially affect the planning area.

Figure 8-2 on the following page shows wildfire risk locations across Brazos County and the participating entities, as determined by the Texas Forest Service. The map represents the cumulative weights of (1) the risks associated with fuel complexes, (2) the risks associated with population, and (3) the weighted factors of population growth. These combined variables determine the following risk categories:

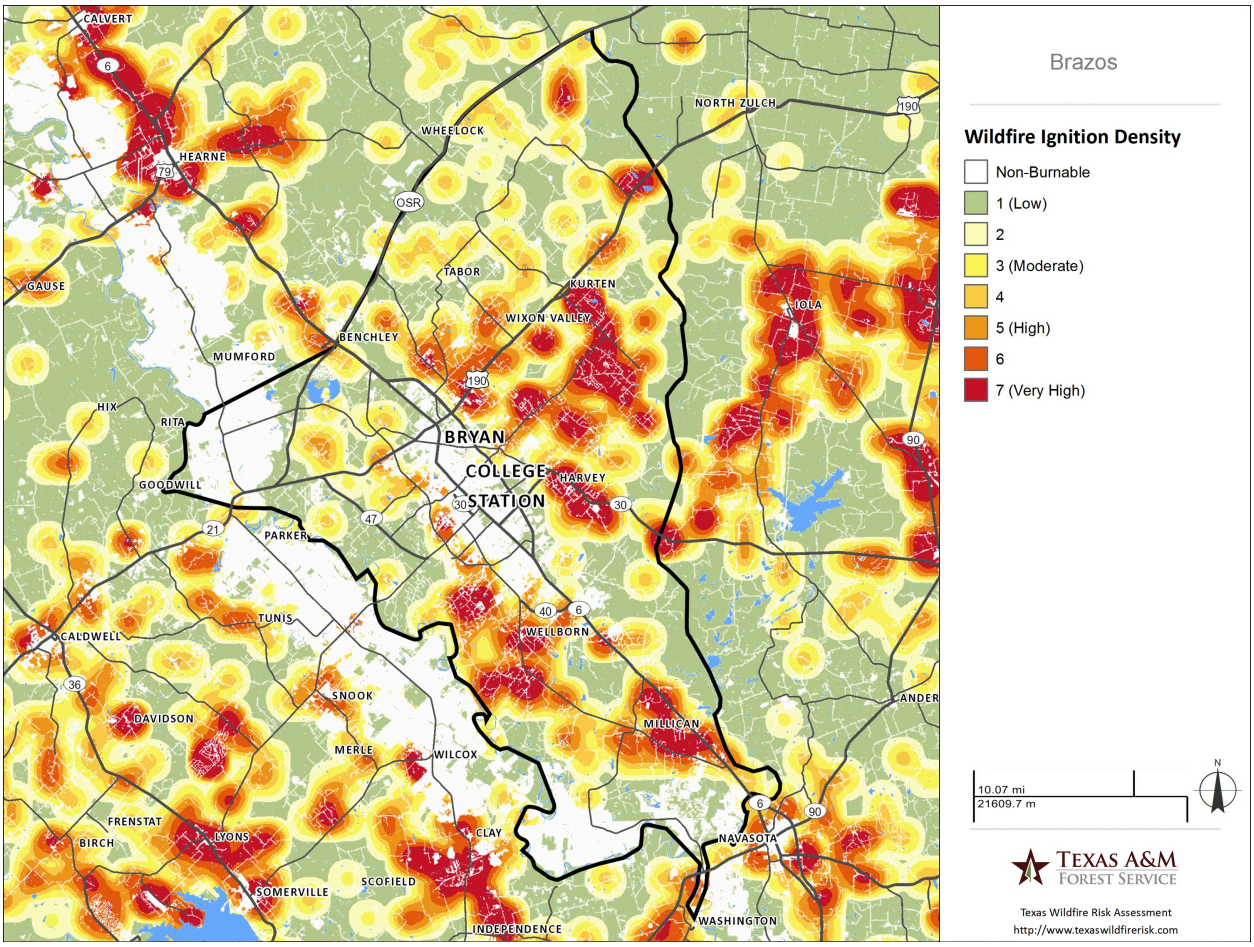
Low risk: Areas are primarily those that have little population or population densities that are not located near or in a hazardous fuel complex.

Moderate risk: Areas that may have a high population but are located near or in a moderate- or low-hazard fuel complex. Also, areas that have a low population but have significant growth located near or in a high-hazard fuel complex are included in this category.

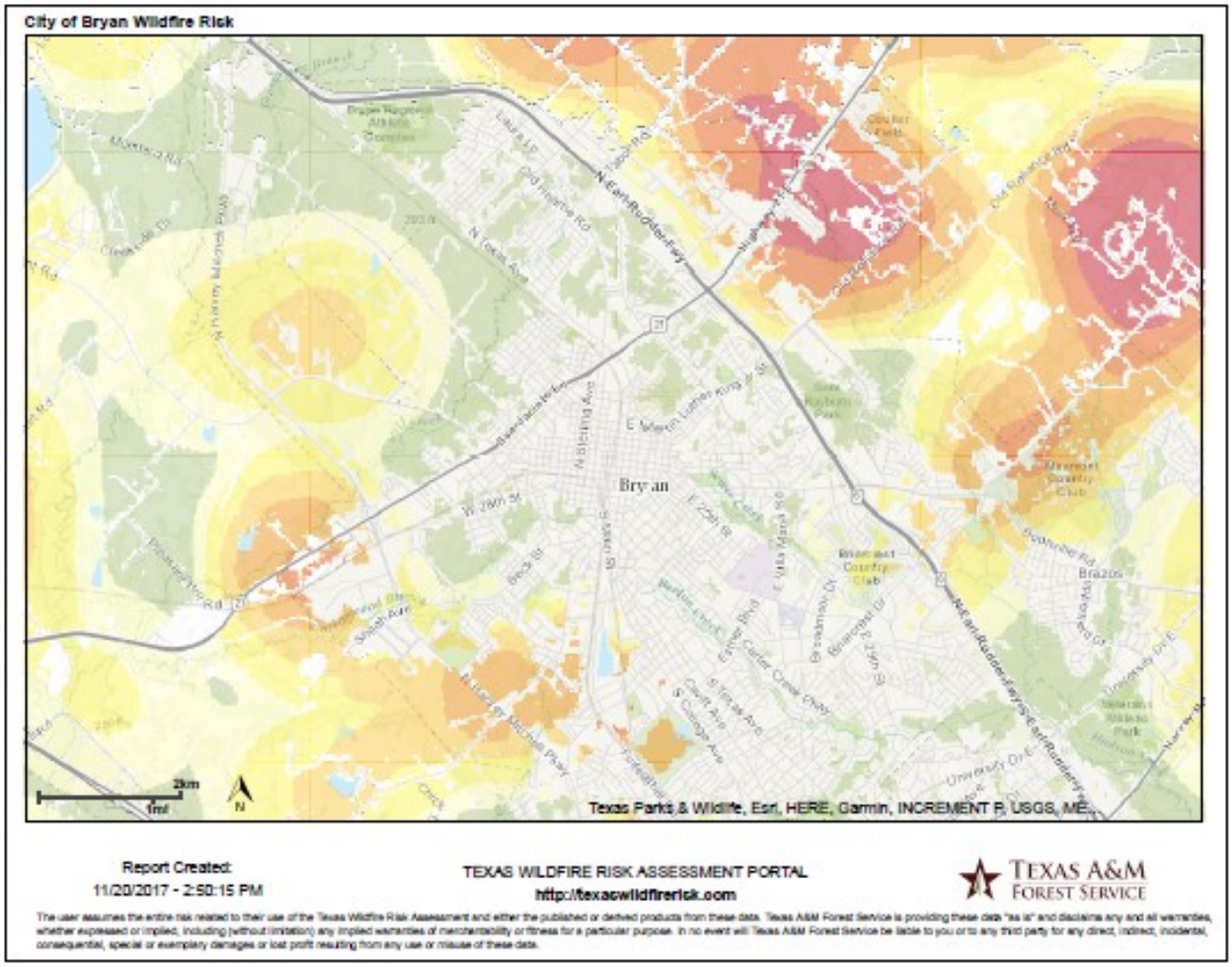
High risk: Areas that have a moderate population and a high growth rate and are located near or in a high- or moderate-hazard fuel complex.

Very High risk: Areas that have high population numbers and moderate-to-high growth rates and are located near or in a high-hazard fuel complex area.

Figure 8-2. Areas at Risk to Wildfire in the Planning Area

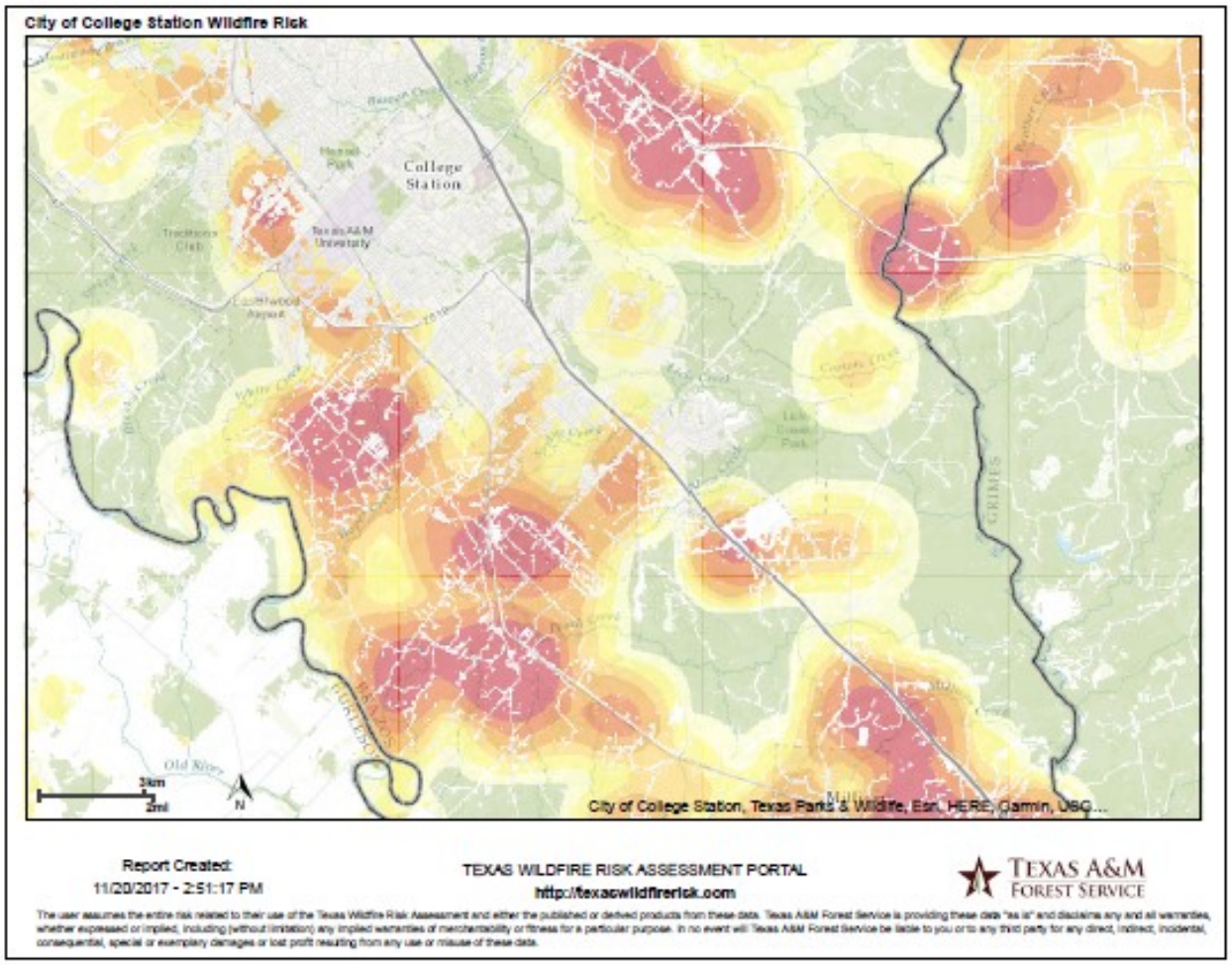


From *Texas Wildfire Risk Assessment Summary Report* for Brazos County (11/13/2017)



Wildfire Ignition Density

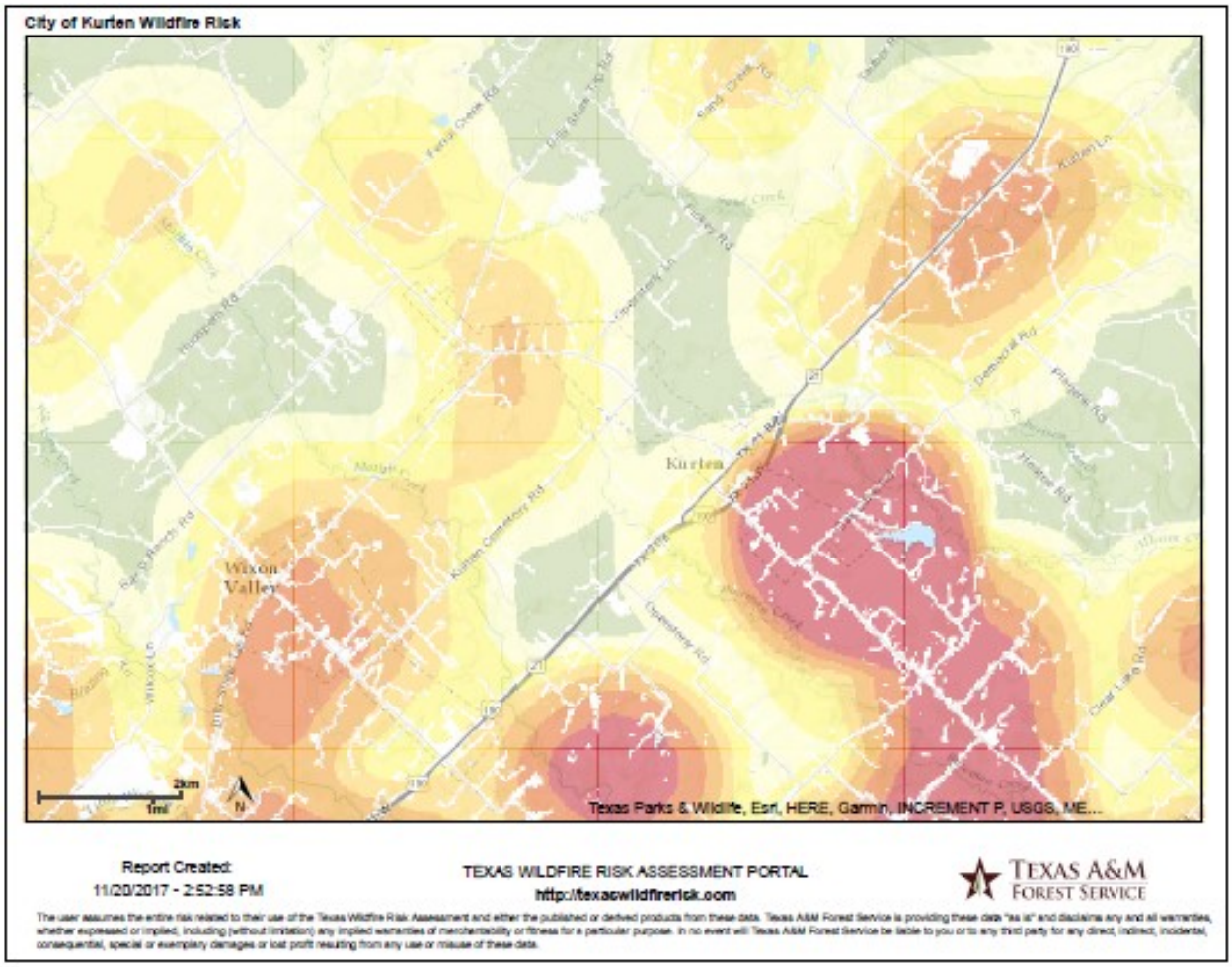
- 1 (Low)
- 2
- 3 (Moderate)
- 4
- 5 (High)
- 6
- 7 (Very High)



The majority of Texas A&M University campus is within the City of College Station; however, some portions are in the City of Bryan. Regardless, Texas A&M University falls under the category of "low" when considering the risk of wildfire.

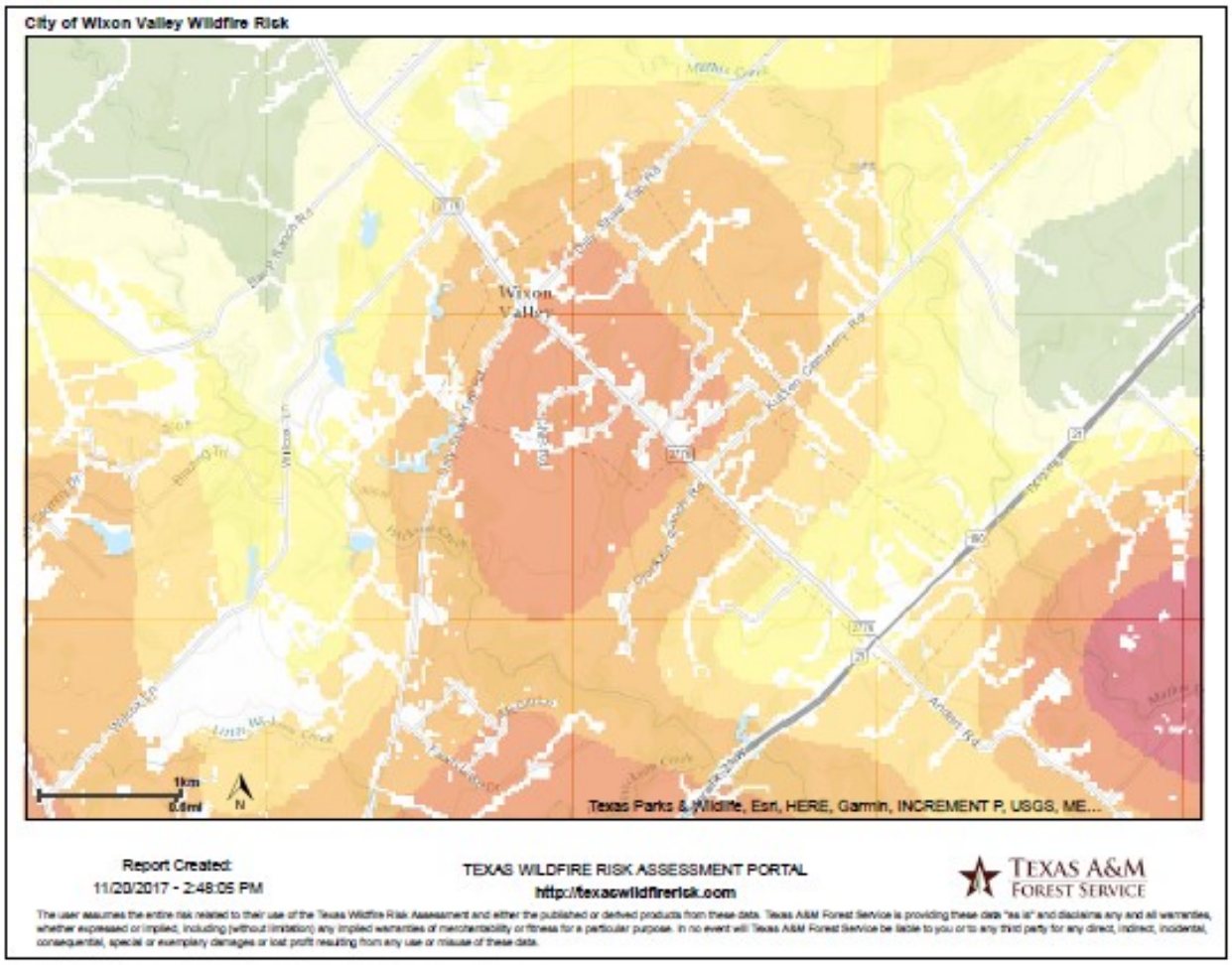
Wildfire Ignition Density

- 1 (Low)
- 2
- 3 (Moderate)
- 4
- 5 (High)
- 6
- 7 (Very High)



Wildfire Ignition Density

- 1 (Low)
- 2
- 3 (Moderate)
- 4
- 5 (High)
- 6
- 7 (Very High)



Wildfire Ignition Density

- 1 (Low)
- 2
- 3 (Moderate)
- 4
- 5 (High)
- 6
- 7 (Very High)

This overall hazard rating by the Texas Forest Service is descriptive and not predictive, based on wide-ranging parameters. In most cases, the interface risk in a county will change based on the distribution of hazardous wildland fuels and population and growth within the county. Keeping this in mind, counties that have an overall low-hazard rating may have isolated areas within the county that are at high risk, just as counties identified as high risk may have isolated areas within the county that are at low risk.

A major component of the risk assessment was the relation of population and urban development to hazardous wildland fuels. To achieve a rating, the fuels model map for Texas was categorized in to fuel complexes that represented low, moderate and high hazard fuels. This correlation was developed under the direction of Karen Allender and the UWI division of the Texas Forest Service. Fuels were grouped by NFDRS and Anderson Fuel Model ratings and the resulting descriptors of low to high hazard were assigned. These descriptors were based on the fuel complexes potential for spread rates, heat output (BTUs) and duration of output, difficulty of control and potential for fire movement in the canopy of the vegetation. Fuels that had the highest potential for crowning, difficulty in control and heat output for duration posed the most hazards.

Any structure is exposed to the urban fire risk. The wildland fire risk is a function of the following:

the climate (patterns over time);

fuel complexes (vegetation);

topography (slope, aspect and elevation);

human factors (structures and infrastructure).

History of Fire

Table 8-2 shows the number of voluntarily reported incidents and the total dollar losses by Brazos County and the participating entities. It is likely that more fire incidents occurred during this timeframe that were not reported. Reporting is voluntary and thus not consistent.

Table 8-2. Urban Fire Incidents and Losses in the Planning Area, 1989-2017

County	Incidents	Total Dollar Loss ($)
Brazos	4,272	14,570,651

People and Property at Risk

The urban fire hazard can occur throughout the entire planning area. Historically most urban fires have been in residential facilities. Table 8-3 below shows the total number of residential facilities by participating entity.

Table 8-3. Total Number of Residential Facilities by Participating Entity

Participating Entity	Number of Residential Facilities
City of Bryan	19,925
City of College Station	21,856

City of Kurten	112
City of Wixon Valley	59
Texas A&M University	~40
Unincorporated Brazos County	48,796

For a breakdown of residential types per entity, refer to Chapter/Section 5.

The potential for wildland fires will be limited to the rural areas of the planning area. These areas are identified in Table 8-4 below:

Table 8-4. Total Number of Facilities by Participating Entity

	Area (Sq Mi)	Residential (Structures)	Commercial/Industrial (Number of Facilities)	Critical Infrastructure
Kurten	4.60	112	10	Post Office/VFD/Church
Unincorporated	490.49	48,796	3,357	BISD Campus off Mumford/VFDs/Churches/ Post Offices
Wixon Valley	1.81	59	22	City Hall, Industrial Complex

POTENTIAL DAMAGES AND LOSSES

Table 8-3 shows potential annualized losses for Brazos County and the participating entities due to urban fire, which were calculated using the statistical risk assessment methodology. The general steps used in the statistical risk assessment methodology are; to compile data from local and national sources, clean up the data by removing duplication, identify patterns in frequency and vulnerability, extrapolate the statistical patterns, and produce meaningful results with the development of annualized loss estimates.

Table 8-5. Potential Annualized Losses to Urban Fire in the Planning Area

County	Annualized Expected Property Losses ($)
Brazos	1,553,605

SECTION 9: WINTER STORMS

WHY WINTER STORMS ARE A THREAT

A severe winter storm event includes a storm with snow, ice or freezing rain—all of which can cause significant problems for area residents. Winter storms that threaten Texas usually start out as powerful cold fronts that push south from central Canada.

Most of the precipitation seen in the planning area from severe winter storms takes the form of ice or sleet. Freezing rain occurs when rain developing in a relatively warm (above freezing) layer of air falls through a layer of air that is below freezing (25-32° F). The rain is "supercooled" as it falls through the cold layer near the surface of the earth. When the supercooled but still liquid raindrops strike the ground or an object already below freezing, they freeze on contact. The resulting coating of ice is commonly known as glaze.

A heavy accumulation of ice can topple power and telephone lines, television towers, and trees. Highways become impossible to travel on, and even stepping outdoors can be extremely risky. The severity of an ice storm and the amount of damage caused by the storm depends on the amount of rain and thus the amount of icing taking place, the strength of the wind, and whether or not the storm strikes an urban or rural area. Urban areas tend to suffer more damage than rural areas because of the concentration of utilities and transportation systems (aircraft, trains, buses, trucks, and cars), all of which may be affected to a great degree by the icing.

HAZARD PROFILE

The severity of impact of winter storms is generally minor. Winter storms can cause injuries and completely shut down facilities for more than one week, and cause more than ten percent of affected properties to be destroyed or suffer major damage.

The extent of winter storms on the planning area can extend from something as minor as winter weather advisory's or as major as freezing temperatures with sleet, snow and wind chill. The maximum extent of winter storms for Brazos County and participating entities include low temperatures below 32 degrees, freezing rain and sleet, and/or snow amounts up to 6-10 inches.

The frequency of occurrence of winter storms in the planning area is unlikely.

Warning time for winter storms is generally six to twelve hours.

Table 10.1 shows the definitions for winter weather alerts.

Table 9-1. Winter Weather Alerts

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.

HISTORY OF SEVERE WINTER STORMS

Winter storm events that have occurred in the Planning Area from 1997 to 2017 are presented in Table 9-2, along with reported injuries, deaths and damages.

Table 9-2. Severe Winter Storms for the Planning Area, 1997–2017

Type	Location	Date	Deaths	Injuries	Property Damage	Crop Damage
Winter storm (ice)	County	01/12/1997	0	0	0	0
Winter Storm	County	12/23/1998	0	0	75K	0
Winter storm (ice)	County	12/13/2000	0	0	1.0M	0
Ice Storm	County	12/07/2005	1	2	70K	0
Ice Storm	County	1/16/2007	0	0	1K	0K
Ice Storm	County	2/04/2011	0	0	0K	0K
Winter Storm	County	2/04/2011	0	0	0K	0K
Winter Weather (Ice)	County	12/07/2013	0	0	0	0
Winter Weather (Ice)	County	01/28/2014	0	0	0	0
Winter Weather (Ice)	County	01/28/2014	0	0	0	0
Winter Weather (Ice)	County	02/06/2014	0	0	50K	0
Winter Weather (Ice)	County	03/02/2014	0	0	0	0
Winter Storm	County	03/03/2014	0	0	0	0
Heavy Snow	County	12/07/2017	0	0	0	0

PEOPLE AND PROPERTY AT RISK

Winter storms usually impact large geographical areas; thus, all the population, buildings, critical facilities, infrastructure and lifelines, and hazardous materials facilities in the Planning Area are considered exposed to the hazard and could potentially be impacted.

Winter storms impact large geographical areas of the planning area, thus the entire population, buildings, identified critical infrastructure, lifelines, and hazardous materials facilities are considered exposed to the hazard and could potentially be impacted. In the planning area, winter storms do not have a specific location. However, all participating entities are at risk and could be affected by this hazard. It is understood, however, that there are populations throughout the planning area that are more vulnerable than others. Information is provided in Chapter 5 – Hazards the Region Faces and What's at Risk on the different populations found within the planning area. In analyzing the relative risks from hazards, potential losses and ability

to recover from losses, it is understood that the more vulnerable populations are those that are in the lower socio-economic levels.

POTENTIAL DAMAGES AND LOSSES

Table 9-3 presents annualized expected property losses due to winter storms in Brazos County and participating entities, which were calculated using the statistical risk assessment methodology. The general steps used in the statistical risk assessment methodology are; to compile data from local and national sources, clean up the data by removing duplication, identify patterns in frequency and vulnerability, extrapolate the statistical patterns, and produce meaningful results with the development of annualized loss estimates.

Table 9-3. Potential Annualized Losses due to Winter Storms in the Planning Area

County	Annualized Expected Property Losses ($)
Brazos	66,249

WHY TORNADOES ARE A THREAT

Tornadoes are unquestionably the most violent storms on the planet. A tornado is a violently 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.

The most powerful tornadoes are spawned by "super-cell thunderstorms." These storms are affected by horizontal wind shears (winds moving in different directions at different altitudes) that 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 10-1. Enhanced Fujita Tornado Scale implemented February 1, 2007

EF-Scale Number	Intensity	Wind Speed (mph)	Type of Damage Done
EF0	Gale tornado	65-85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
EF1	Moderate tornado	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	Significant tornado	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 tornado	136-165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	Devastating tornado	166-200	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	Incredible tornado	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 100 meters; trees debarked; steel reinforced concrete badly damaged.

The planning area is affected by frequent severe weather and thunderstorms. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come

together during the transition from summer to winter, most thunderstorms occur during the spring and fall months. Severe thunderstorms can produce tornadoes, high winds, and hail—any of which can cause extensive property damage and loss of life.

Tornadoes occasionally accompany tropical storms and hurricanes that move over land. Tornadoes are the most common to the right and ahead of the path of the storm center as it comes ashore.

Tornadoes vary in terms of duration, wind speed and the toll that they take, as shown in Table 10-2.

Table 10-2. Variations Among Tornadoes

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

HAZARD PROFILE

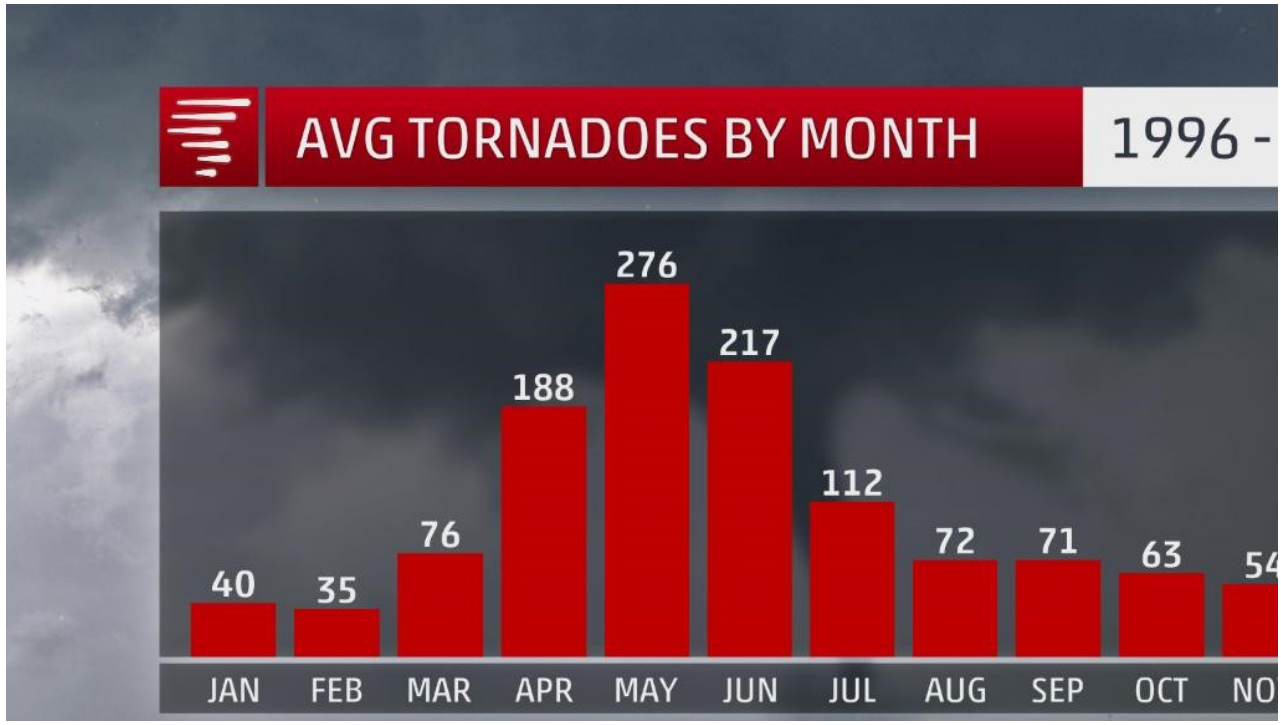
The impact of tornadoes can be substantial. They can cause multiple deaths, completely shut down facilities for thirty days or more, and cause more than fifty percent of affected properties to be destroyed or suffer major damage.

The maximum extent of tornadoes that can affect Brazos County and the participating entities is an EF5, which according to the Enhanced Fujita Scale, would be an incredibly strong tornado with winds speeds over 200 miles per hour.

While the frequency of occurrence of tornadoes in the planning area is less than 1% per year, millions of dollars of damage has occurred within the planning area.

Seasonal patterns are relevant to tornadoes. Thunderstorms form when warm, moist air collides with cooler, drier air. Since these masses tend to come together during the transition from summer to winter, most thunderstorms and resulting tornadoes occur during the spring (March, April, May and June) and, at a lesser intensity, during the fall (September, October, and November). Warning time for tornadoes is minimal.

Figure 10-1. Occurrence of Texas Tornadoes, by Month



HISTORY OF TORNADOES

Historical evidence, as reflected in Table 10-3, shows that most of the planning area is vulnerable to tornado activity. There is no defined hazard boundary for tornadoes.

Since the Enhanced Fujita Scale was not implemented until 2007, the original Fujita Scale is included here to help understand the History of Tornado Events scale in Table 10-3.

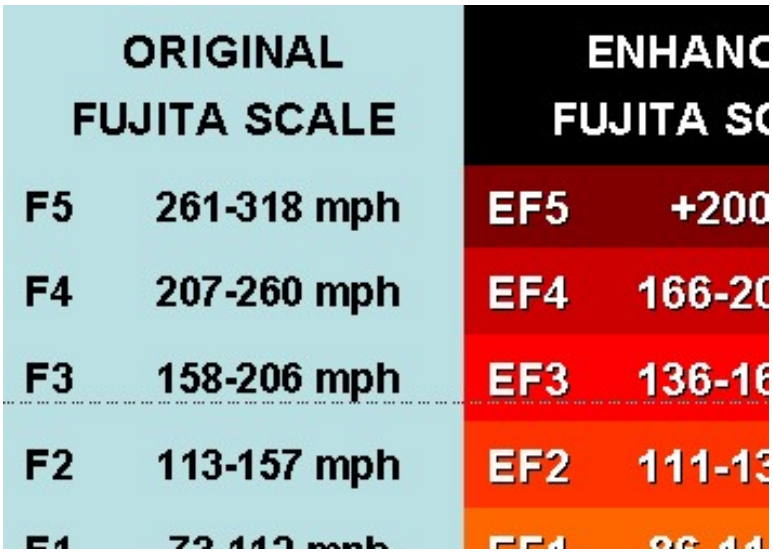


Table 10-3 identifies reported tornado events in the planning area, and Table 10-4 gives the total number of tornadoes in the Planning Area.

Table 10-3. History of Tornado Events in the Planning Area as Reported to the National Weather Service, 01/01/1950 to 08/26/2017

Type	Date	Time	Magnitude	Death	Injury	Property Damage	Crop Damage
Tornado	12/2/1953	1530	F2	0	0	25K	0
Tornado	4/30/1954	0730	F2	0	0	0K	0
Tornado	4/5/1956	1515	F3	0	0	250K	0
Tornado	3/31/1957	1610	F0	0	0	3K	0
Tornado	5/20/1960	0615	F0	0	0	0K	0
Tornado	5/17/1965	1456	F0	0	0	0K	0
Tornado	2/10/1981	0245	F1	0	1	25K	0

Tornado	11/19/1983	0910	F2	0	0	2.5M	0
Tornado	4/27/1990	1758	F0	0	0	0K	0
Tornado	5/13/1994	1525	F0	0	0	0	0
Tornado	5/18/1995	0230	F0	0	0	60K	0
Tornado	5/18/1995	0230	F0	0	0	60K	0
Tornado	1/21/1998	1644	F0	0	0	35K	0
Tornado	10/17/1998	1540	F1	0	0	20K	0
Tornado	10/12/2001	1150	F1	0	0	60K	0
Tornado	12/23/2002	1120	F0	0	0	5K	0
Tornado	6/13/2003	1500	F0	0	0	1K	0
Tornado	10/5/2003	1705	F1	0	1	750K	0
Tornado	10/5/2003	1730	F0	0	0	3K	0
Tornado	2/24/2004	2110	F0	0	0	25K	0
Tornado	3/17/2004	0040	F0	0	0	3K	0
Tornado	5/13/2004	0545	F1	0	0	515K	0
Tornado	12/29/2006	1523	F1	0	3	2.8M	0K
Tornado	4/28/2009	1441	F0	0	0	0K	0K
Tornado	05/26/2016	1130	EF1	0	0	7M	0K
Tornado	08/26/2017	0705	EF0	0	0	0M	0K

Table 10-4. Overall Historical Impact of Tornadoes in the Planning Area

County	Number of events	Maximum EF-Scale
Brazos	26	EF3

People and Property at Risk

Tornadoes can occur throughout the entire planning area. Because it cannot be predicted where a tornado will touch down, almost all of the buildings and facilities in the Planning Area are considered to be vulnerable to tornadoes. Greater losses would be expected in areas where there is substandard housing. Infrastructure such as power poles and lines could be downed during a strong tornado. Critical facilities within the Planning Area that have back-up generators could continue to operate. It is understood, however, that there are populations throughout the planning area that are more vulnerable than others. Information is provided in Chapter 5 – Hazards the Region Faces and What's at Risk on the different populations found within the planning area. In analyzing relative risks from tornadoes, potential losses and the ability to recover from losses, it is understood that the more vulnerable populations are those that are in the lower socio-economic levels. They are more likely to suffer greater losses due to damages to substandard housing. They may also lack resources, such as insurance, to recover from losses.

Of note, mobile and manufactured homes are especially vulnerable to tornadoes. There are a total of 5,255 mobile or manufactured homes within the entire planning area, as of 2016 (2016 5-year ACS survey).

Potential Damages and Losses

Table 10-5 shows potential annualized expected property losses for the Planning Area, which were calculated using the statistical risk assessment methodology. The general steps used in the statistical risk assessment methodology are; to compile data from local and national sources, determine the average exposed value based on likely tornado intensity and path area, and calculate annualized loss estimates.

Table 10-5. Potential Annualized Losses from Tornadoes in the Planning Area

Jurisdiction	Exposed Value	Annualized Loss	Annualized Loss Percentage
Bryan	$5,538,141,000.00	$3,488,846.54	0.06%
College Station	$9,316,285,000.00	$6,628,623.26	0.07%
Kurten	$13,621,000.00	$35,994.79	0.26%
Wixon Valley	$16,074,000.00	$107,952.79	0.67%
Unincorporated	$16,827,581,000.00	$420,384.81	0.00%

WHY HAILSTORMS ARE A THREAT

Large hail results in nearly $1 billion in damage annually to property and crops in the United States. Hail is made up of spherical balls of ice. It is a product of thunderstorms or intense showers. It is generally white and translucent, consisting of liquid or snow particles encased with layers of ice. Hail is formed within the high tops of a well-organized thunderstorm. An updraft will sometimes throw rain droplets high up into the tops of a cloud, where the temperature is well below freezing. The droplet freezes, then falls and can become caught in another updraft. This time, a second coating of ice is added, making the hail stone larger. This cycle continues until the hailstone is too heavy to be lifted again and falls to the ground as hail. The stronger the updraft, the longer the hail develops and the bigger the hailstone is when it falls.

Hail is not to be confused with sleet, which consists of frozen raindrops that fall during winter storms. Hail can be smaller than a pea or as large as a softball and can be very destructive to plants, cars, homes, buildings and crops.

The development and maturation of hailstones are very complex processes. Numerous factors impact the size of the hailstone including updraft strength, storm scale wind profile, height of the freezing level, and the mean temperature and relative humidity of downdraft air. The complexities of hail formation and sub-cloud processes make utilizing Doppler radar data to forecast the occurrence of large hail difficult. Verification of hail events is also important, but is a cumbersome process due to the limited temporal and spatial distribution of the event.

Large hailstones fall at speeds faster than 100 mph. Large falling balls of ice can be very dangerous. Large hail can do significant damage to automobiles, windows, roofs, crops and animals. When caught in a hailstorm, it is important to seek shelter immediately. Pets and livestock are particularly vulnerable to hail, and should be brought into a shelter.

HAZARD PROFILE

Hailstorms are generally localized and their impact is considered limited since the injuries they cause are generally treatable with first aid, they shut down critical facilities and services for 24 hours or less, and less than ten percent of affected properties are destroyed or suffer major damage.

Hail events in the planning area are likely. Most hailstorms occur during the spring (March, April and May) and the fall, during the month of September.

Warning time for a hailstorm is generally minimal to no warning. The National Weather Service classifies a storm as severe if hail of ¾ of an inch in diameter (approximately the size of a penny) or greater is imminent based on radar intensities or observed by a spotter or other people.

The extent of hail in the Planning Area can range from ¾ of an inch up to 1.75 inches. The frequency of occurrence of hail in planning area is approximately 2 incidents per year.

HISTORY OF HAILSTORMS

Table 11-1 shows the historical hail events that hit the planning area. Historical hail events with hailstone size one inch or greater are listed in Table 12-1 below. Table 12-2 aggregates historical hail events by jurisdiction.

Table 11-1. Overall Historical Hail Impact for Brazos County (National Climatic Data Center), 2005-2017

Location or County	Date	Time	Type	Magnitude	Death	Injury	Property Damage	Crop Damage
Bryan	3/19/2005	5:50 PM	Hail	1.75 in.	0	0	30K	0
Bryan	3/19/2005	6:02 PM	Hail	1.75 in.	0	0	30K	0
College Station	3/19/2005	6:02 PM	Hail	0.75 in.	0	0	4K	0
College Station	3/19/2005	6:08 PM	Hail	0.88 in.	0	0	5K	0
College Station	3/19/2005	6:25 PM	Hail	1.75 in.	0	0	30K	0
College Station	3/19/2005	6:35 PM	Hail	1.75 in.	0	0	30K	0
Bryan	4/5/2005	8:45 PM	Hail	0.75 in.	0	0	6K	0
College Station	10/31/2005	3:05 PM	Hail	0.75 in.	0	0	2K	0
College Station	4/25/2006	11:30 PM	Hail	1.75 in.	0	0	20K	0
Bryan	5/1/2007	16:06 PM	Hail	0.88 in.	0	0	0K	0K
Bryan Coulter Airport	4/4/2008	8:03 AM	Hail	1.00 in.	0	0	1K	0K
Bryan Coulter Airport	4/4/2008	8:29 AM	Hail	1.25 in.	0	0	1K	0K
College Station	7/19/2009	17:55 PM	Hail	1.75 in.	0	0	5K	0K

College Station	7/19/2009	17:57 PM	Hail	0.75 in.	0	0	0K	0K
College Station	7/20/2009	18:25 PM	Hail	1.00 in.	0	0	0K	0K
College Station	8/12/2009	16:15 PM	Hail	0.88 in.	0	0	0K	0K
College Station	4/07/2010	16:58 PM	Hail	0.75 in.	0	0	0K	0K
College Station	2/03/2012	19:15	Hail	1.00 in	0	0	5K	0K
College Station	2/03/2012	19:35	Hail	2.25 in	0	0	30K	0K
College Station	12/09/2012	18:30	Hail	.75 in	0	0	0K	0K
College Station	05/09/2013	16:48	Hail	1.00 in	0	0	0K	0K
Millican	05/09/2014	19:50	Hail	1.00 in	0	0	0K	0K
Bryan	04/16/2015	16:09	Hail	1.50 in	0	0	0K	0K
Bryan	04/19/2015	14:40	Hail	.88 in	0	0	0K	0K
Bryan	04/19/2015	15:02	Hail	1.00 in	0	0	0K	0K
Bryan	03/27/2017	01:20	Hail	1.25 in	0	0	0K	0K

Table 11-2. Overall Historical Hail Impact by County (National Climatic Data Center)

County	Number of Events	Maximum Diameter (inches)
Brazos	26	1.75

People and Property at Risk

Hail may impact large geographical areas of the planning area, thus the entire population, buildings, identified critical infrastructure, lifelines, and hazardous materials facilities are considered exposed to the hazard and could potentially be impacted. In the planning area, hail does not have a specific location. However, all participating entities are at risk and could be affected by this hazard. It is understood, however, that there are populations throughout the planning area that are more vulnerable than others. Information is provided in Chapter 5 – Hazards the Region Faces and What's at Risk on the different populations found within the

planning area. In analyzing the relative risks from hazards, potential losses and ability to recover from losses, it is understood that the more vulnerable populations are those that are in the lower socio-economic levels.

POTENTIAL DAMAGES AND LOSSES

To estimate losses due to hail, PBS&J used NOAA historical hail loss data to develop a hail stochastic model. In this model:

Losses were scaled to account for inflation;

Average historic hail damageability was used to generate losses for historical hail events where losses were not reported;

Expected annualized losses were calculated through a non-linear regression of historical data; and

Probabilistic losses were scaled to account for would-be losses where no exposure/instrument was present at the time of the event.

Table 11-3 shows potential annualized losses in the Planning Area.

Table 11-3. Overall Historical Hail Impact for the Planning Area (National Climatic Data Center)

County	Annualized Expected Property Damage ($)
Brazos	281, 565

SECTION 12: THUNDERSTORMS

WHY THUNDERSTORMS ARE A THREAT

A thunderstorm is defined as a storm of heavy rain accompanied by lightning, thunder, wind, and sometimes hail.

Damaging winds are often called "straight-line" winds to differentiate the damage they cause from tornado damage. Strong thunderstorm winds can come from a number of different processes. Most thunderstorm winds that cause damage at the ground are a result of outflow generated by a thunderstorm downdraft. Damaging winds are classified as those exceeding 50-60 mph.

Damage from severe thunderstorm winds account for half of all severe reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles.

Since most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft, anyone living in thunderstorm-prone areas of the world is at risk for experiencing this hazard.

People living in mobile homes are especially at risk for injury and death. Even anchored mobile homes can be seriously damaged when winds gust over 80 mph.

Lightning is a massive electrostatic discharge between electrically charged regions within clouds, or between a cloud and the Earth's surface.

Thunderstorms occasionally accompany tropical storms and hurricanes that move over land which may produce damaging winds and dangerous lightning.

HAZARD PROFILE

Thunderstorms are generally localized events. The severity of impact of thunderstorms is considered to be limited since they generally result in injuries treatable with first aid, shut down critical facilities and services for 24 hours or less, and less than ten percent of affected properties are destroyed or suffer major damage.

Most thunderstorms occur during the spring (March, April and May) and the fall, during the month of September.

Warning time for thunderstorms is generally minimal to no warning.

The maximum extent of thunderstorm winds in the planning area can reach 78 knots. Some minor localized flooding may also occur if the thunderstorms bring substantial rain amounts.

The frequency of occurrence of thunderstorms in the planning area is between 1 and 2 per year.

HISTORY OF THUNDERSTORMS

Table 12-1 gives aggregated historical thunderstorm information for the planning area. Historical thunderstorm events are detailed in Table 13-2. It is important to note that only thunderstorms that have been reported are recorded in these tables. It is likely that a higher number of occurrences have not been reported.

Table 12-1. Thunderstorms in Brazos County, 2000-2017
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

County	Number of Events
Brazos	23

Table 12-2. Thunderstorms in Brazos County, 2000-2017

Type	Location or County	Date	Time	Magnitude	Death	Injury	Property Damage	Crop Damage
Thunderstorm Winds	Brazos	02/10/2009	2325	52 kts.	0	0	8K	0
Thunderstorm Winds	Kurten	03/31/2009	0445	50 kts.	0	0	3K	0
Thunderstorm Winds	Bryan	05/03/2009	0454	55 kts.	0	0	2K	0
Thunderstorm Winds	Kurten	05/03/2009	0454	55 kts.	0	0	2K	0
Thunderstorm Winds	Bryan	05/03/2009	0500	55 kts.	0	0	5K	0
Thunderstorm Winds	College Station	07/19/2009	1800	56 kts.	0	0	1K	0
Thunderstorm Winds	Bryan	02/01/2011	0440	52 kts.	0	0	5K	0
Thunderstorm Winds	Bryan	05/12/2001	1030	58 kts	0	0	0	0

Thunderstorm Winds	Kurten	06/06/2011	1735	52 kts	0	0	1K	0
Thunderstorm Winds	Bryan	08/24/2011	1829	52 kts	0	0	0	0
Thunderstorm Winds	Bryan	01/09/2012	0412	52 kts	0	0	3K	0
Thunderstorm Winds	Bryan	01/25/2012	0715	50 kts	0	0	6K	0
Thunderstorm Winds	College Station	01/25/2012	0724	55 kts	0	0	15K	0
Thunderstorm Winds	Bryan	02/03/2012	1938	65 kts	0	0	5K	0
Thunderstorm Winds	Bryan	08/07/2012	1645	50 kts	0	0	0	0
Thunderstorm Wind	College Station	10/13/2013	0158	52 kts	0	0	15K	0
Thunderstorm Wind	Bryan	05/23/2015	2230	55 kts	0	0	0	0
Thunderstorm Winds	Bryan	08/25/2015	1115	55 kts	0	0	0	0
Thunderstorm Winds	College Station	08/25/2015	1128	59 kts	0	0	0	0
Thunderstorm Winds	Bryan	04/27/2016	0136	60 kts	0	0	0	0
Thunderstorm Winds	College Station	04/27/2016	0140	60 kts	0	0	0	0
Thunderstorm Wind	Edge	01/02/2017	0635	52 kts	0	0	0	0
Thunderstorm Wind	Smetana	03/27/2017	0120	51 kts	0	0	0	1K
Thunderstorm Wind	Millican	05/21/2017	0008	60kts	0	0	0	0
Thunderstorm Wind	Bryan	05/28/52017	1853	53kts	0	0	0	0

Thunderstorm Wind	Smetana	05/28/2017	1853	52kts	0	0	0	0

Table 12-3. Lightning in Brazos County, 2000-2017

Type	Location or County	Date	Time	Magnitude	Death	Injury	Property Damage	Crop Damage
Lightning	Bryan	7/8/2009	1515		0	2	0	0
Lightning	College Station	5/15/2010	445		0	0	2000	0
Lightning	College Station	6/9/2010	855		0	0	5000	0
Lightning	College Station	5/12/2011	1030		0	0	5000	0
Lightning	Wellborn	5/12/2011	1400		0	0	5000	0
Lightning	Bryan	5/27/2014	2305		0	0	35000	0
Lightning	College Station	4/11/2017	1030		0	0	300	0

PEOPLE AND PROPERTY AT RISK

Thunderstorms impact large geographical areas of the planning area, thus the entire population, buildings, identified critical infrastructure, lifelines, and hazardous materials facilities are considered exposed to the hazard and could potentially be impacted. In the planning area, thunderstorms do not have a specific location. However, all participating entities are at risk and could be affected by this hazard. It is understood, however, that there are populations throughout the planning area that are more vulnerable than others. Information is provided in Chapter 5 – Hazards the Region Faces and What's at Risk on the different populations found within the planning area. In analyzing the relative risks from hazards, potential losses and ability to recover from losses, it is understood that the more vulnerable populations are those that are in the lower socio-economic levels.

SECTION 13: DAM FAILURE

WHY DAM FAILURE IS A THREAT

Dams are water storage, control, or diversion barriers that impound water upstream in reservoirs. Dams provide many benefits and are an important part of our public works infrastructure. They are built for a variety of reasons, including maintenance of lake levels, flood control, power production, and water supply.

Although dams have many benefits, the risk that a dam could fail still exists. Dams can pose a risk to communities if not designed, operated and maintained properly. Dam failure is a collapse or breach in the structure. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage 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 flows;

Internal erosion caused by embankment or foundation leakage or piping;

Improper maintenance, including failure to remove trees, repair internal problems, or maintain gates, valves, and other operational components;

Improper design, such as 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;

Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, leading to structural failure.

The nation's infrastructure of dams is aging. Old age and neglect can intensify vulnerability to these same influences. Furthermore, the terrorist attacks of September 11, 2001, have brought an increased focus on infrastructure protection nationwide, including the safety of dams.

Dam failures may result in the quick release of all the water in the lake. 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 great property damage downstream of the dam.

HAZARD PROFILE

The frequency of occurrence of a major dam failure in the planning area is a highly unlikely event. If a major dam should fail, however, the severity of impact could be substantial. It could

cause multiple deaths, completely shut down facilities for thirty days or more, and cause more than fifty percent of affected properties to be destroyed or severely damaged.

The extent of a major dam failure in our planning area is that several thousand gallons of water could be released at a sudden and unexpected rate. Over 2,000 people could be affected, 700 buildings could be flooded and several million dollars in damages could occur.

A flooding-related dam failure would most likely occur in months when floods are most likely -- during the spring (April, May and June) and fall (October, November, and December). Warning time for dam failure, or the potential speed of onset, varies with the causes but is estimated to be three to six hours.

There are about 80,000 dams in the United States today. Catastrophic dam failures have occurred frequently throughout the past century. Between 1918 and 1958, 33 major dam failures in the United States caused 1,680 deaths—an average of 42 deaths a year. According to information from damsafety.org and damfailures.org, there were sixty-six major dam failures worldwide from 1959 - 2018. There have been 3 dam failures in the planning area – Leisure Lake in 2009, Bryan Utilities Lake in 2016, and Clifty Creek Lake (spillway breech) in 2017.

PEOPLE AND PROPERTY AT RISK

High-hazard-potential dams are those at which failure or misoperation would probably cause loss of human life. Significant-hazard-potential dams are those at which failure or misoperation probably would not result in loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, or other significant damage. Significant-hazard-potential dams often are located in predominantly rural or agricultural areas but could be located in populated areas having significant infrastructure. Low-hazard-potential dams are those at which failure or misoperation probably would not result in loss of human life but might cause limited economic and/or environmental losses. Losses would be limited mainly to the owner's property.

Table 13-1. Dam Failure Hazard-Potential Classifications, FEMA

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, and Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Some local damages
High	Probable. One or more expected	Yes (but not necessary for this classification)

Low hazard dams pose no threat to the communities participating in this plan, and thus, will not be profiled further. Significant hazard dams do pose some threat to property damage and high hazard dams, pose a threat to human life as well as property damage for the participating entities and are profiled in this plan.

LOCATION OF HAZARDOUS AREAS

Figure 13-1 shows the location of dams in planning area. Detailed maps of dam failure inundation areas are not currently available for all dams. This is noted as a data deficiency and a hydrology study to address this data deficiency is included for Brazos County in the list of mitigation projects for 2019-2024. It is assumed that dam breaks happen most likely at the time of maximum capacity of the lake and that the location of the released water would inundate a downstream quarter-circle buffer proportional to the maximum capacity of the dam to represent the maximum impact area.

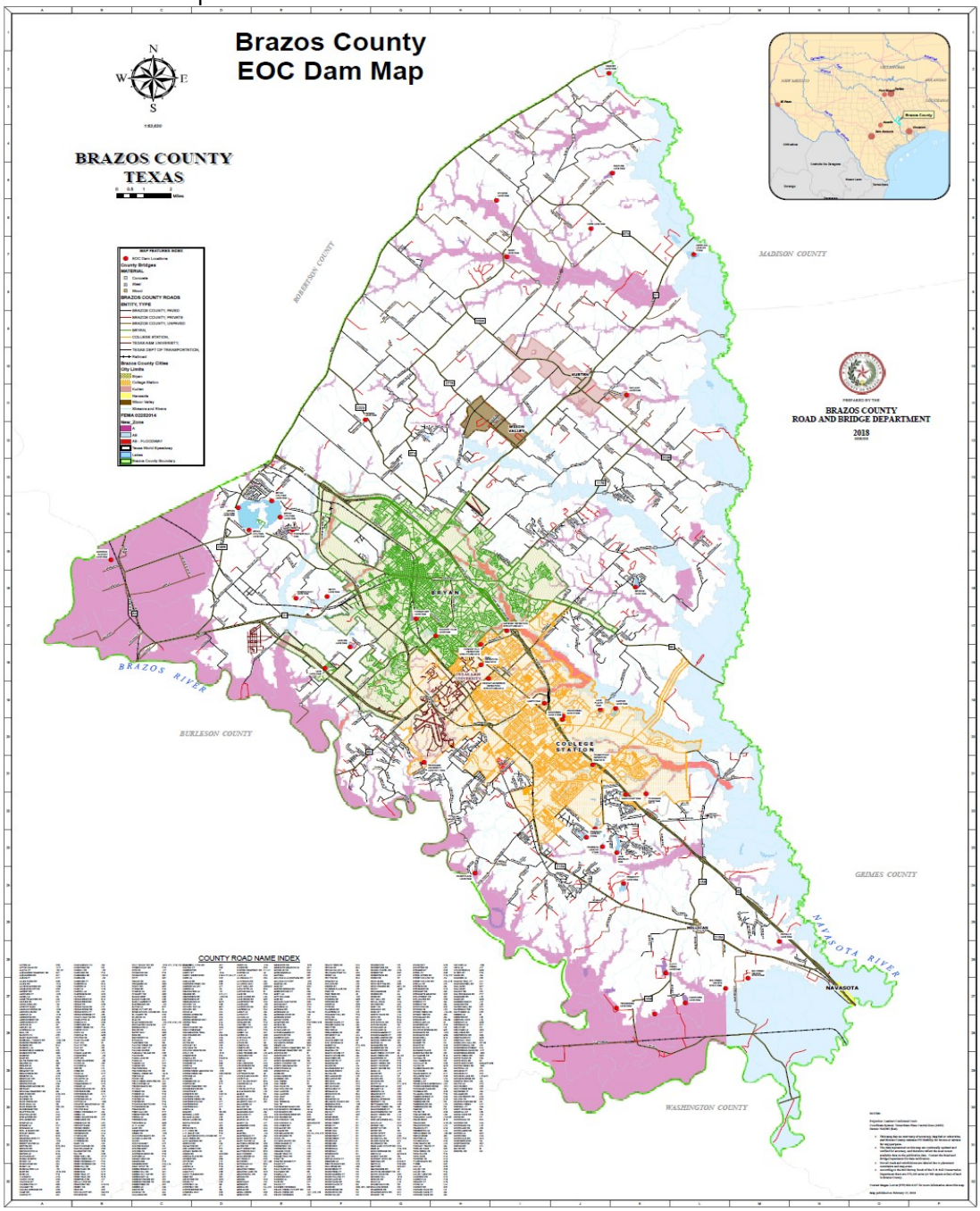


Table 13-2. Summary Status of Dams in Brazos County

County	High	Significant	Low	Undetermined	Total
Brazos	7	5	26	0	38

Legislation was passed on September of 2013 allowed for some dams to be designated as exempt if they met all of the following five criteria:

Privately owned

Less than 500 acre foot maximum capacity

Located in a county with population of less than 350,000 (per 2010 census)

Located outside the city limits

Low or significant hazard rating

While owners are still required to do maintenance on those dams, TCEQ is not required to do the every 5 year inspection on those dams. For those dams that are non-exempt (see Table 13-3), the owners must continue the maintenance of the dams, schedule inspections every 5 years with TCEQ, and if they are high and significant hazard dams, they must also produce an emergency action plan. As part of the emergency action plan, the owners need to do a tabletop exercise every five years and submit an annual update or a letter stating there were no updates necessary.

Table 13-3. High and Significant/Exempt and Non-ExemptDams in Brazos County

Dam Name	Exemption Status	Latitude/Longitude	Dam Height (Ft.)	Maximum Storage (acre feet)	Normal Storage (acre feet)	Has Available Data
BRYAN UTILITIES LAKE DAM	Non-Exempt	30.710067 / -96.453721	59	20763	13647	Data Deficient
CARTER LAKE DAM	Non-Exempt	30.594992 / -96.248677	32	2196	481	Data Deficient
COUNTRY CLUB LAKE DAM	Non-Exempt	30.639827 / -96.358982	10	128	42	Yes

CSISD AT ANDERSON ST DETENTION STRUCTURE NO 3	Non-Exempt	30.613940 / -96.327372	11.7	9	0	Data Deficient
FIN-FEATHER LAKE DAM	Non-Exempt	30.649868 / -96.371041	16.1	300	156	Data Deficient
LAKE ARAPAHO DAM	Non-Exempt	30.510553 / -96.250460	37	924	436	Data Deficient
LEISURE LAKE DAM	Non-Exempt	30.633847 / -96.411916	25	322	175	Data Deficient
NANTUCKET DAM	Non-Exempt	30.543651 / -96.243367	20	428	140	Data Deficient
OAKLAND LAKE DAM	Non-Exempt	30.776483 / -96.235630	32	550	272	Data Deficient
TAMU DETENTION DAM NO 8	Non-Exempt	30.621050 / -96.333642	8.2	140	0	Yes
THOUSAND OAKS DAM NO 11	Non-Exempt	30.544471 / -96.231595	22	120	58	Data Deficient
TERRY LAKE	Exempt	30.6211 / -96.334	17.5	21	18	Data Deficient

POTENTIAL DAMAGES AND LOSSES

Tables 13-4 & 5 show the risk to people and buildings of failure of Country Club Lake (Figure 13-2) and TAMU Detention Dam #8 (Figure 13-3), respectively. It was assumed that dam breaks happen most likely at the time of maximum capacity and that a downstream quarter-circle buffer proportional to the maximum capacity of dams represents the maximum impact area.

Figure 13-2. Country Club Lake

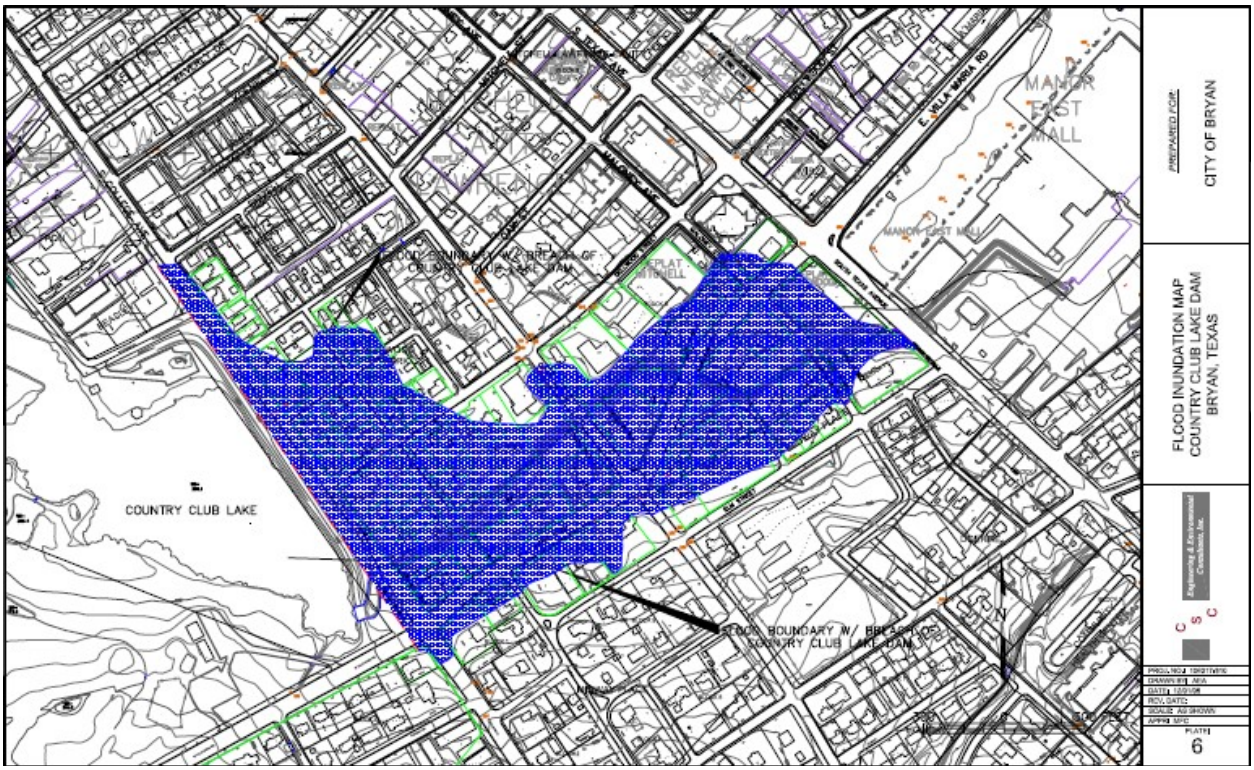


Table 13-4. Exposure of People and Buildings to Country Club Lake

	Parcels	Value	Structures	Value	Population
Residential	54	$4,904,587	44	$4,624,447	~180
Commercial	40	$12,358,400	36	$12,211,670	

Additionally, Villa Maria and College Avenue are highly trafficked roadways. So, there could be numerous motorists within the inundation area depending on the time of day.

Figure 13-3. TAMU Detention Dam #8

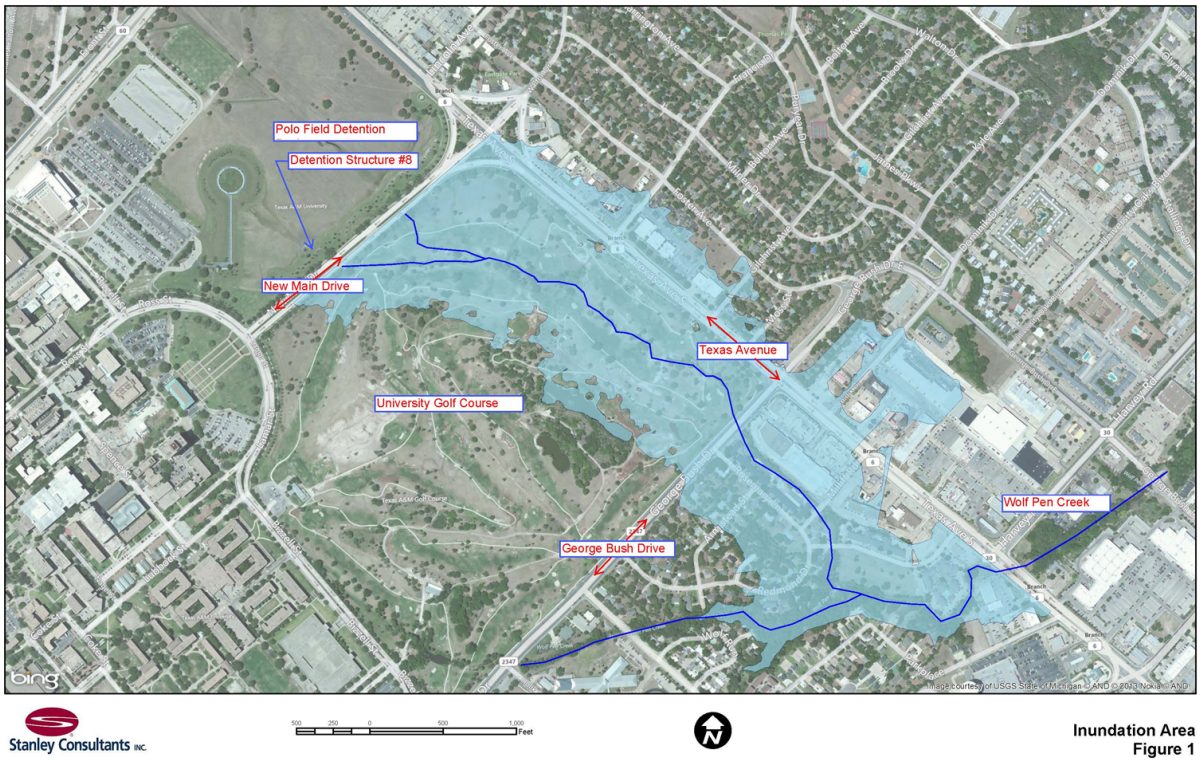


Table 13-5. Exposure of People and Buildings toTAMU Detention Dam #8

	Parcels	Value	Structures	Value	Population
Residential	73	$20,926,630	66	$19,451,270	769
Commercial	19	$48,037,109	18	$44,322,719	
Rural Land – not defined	1	$1,020,000			

Additionally, Texas Avenue and George Bush Drive are highly trafficked roadways. So, there could be numerous motorists within the inundation area depending on the time of day.

Vulnerabilities and impacts can not be determined for the other dams due to data deficiencies.

WHY EXCESSIVE HEAT IS A THREAT

Texas is known for its long hot summers. These conditions can pose problems for those not accustomed to the climate or who are outside for prolonged periods of time. Excessive heat is defined as temperatures that hover 10 degrees or more above the high average temperature for a particular region and last for several weeks.

Excessive heat can pose a threat even to individuals and communities that are accustomed to high temperatures. Heat disorders can occur when victims are overexposed to heat or have over-exercised for their age and physical condition. Heat kills by pushing the body beyond its limits. Under normal conditions an internal thermostat produces perspiration that evaporates and cools the body. In excessive heat and high humidity, however, evaporation is slowed, and the body must work extra hard to maintain a normal temperature.

Excessive heat kills more people nationally than any other natural disaster. According to the Center for Climatic Research at the University of Delaware, an average of 1,500 American city dwellers die every year from the effects of excessive heat. Elderly residents, young children, those who are overweight, and people suffering from serious illnesses are especially prone to heat-related problems. Excessive heat disorders include sunburn, heat cramps, heat exhaustion, and heat stroke. Heat stroke is a severe medical emergency.

Table 14-1. Urban Heat Deaths

City	Duration of heat wave	Heat-related deaths	% Increase in deaths over norm
Chicago	7 days in 1995	739	147
New York	7 days in 1972	891	62
Los Angeles	9 days in 1955	946	122
Kansas City	1 month in 1980	236	65
St. Louis	1 month in 1980	308	57

HAZARD PROFILE

Excessive heat waves usually come on subtly, raising summer temperatures higher than normal, leaving casualties in their wake. Excessive heat can have a major impact, causing multiple

deaths, but sparing property. With excessive heat, there is little physical destruction, although roads can buckle, trains derail, and livestock die.

The frequency of occurrence of excessive heat in the Planning Area is likely. There are seasonal patterns to excessive heat waves, with an event most likely to occur in the summer months. Warning time is long with a slow speed of onset.

Excessive heat can also cause utility outages due to an increased demand for electricity. Utility outages can severely cripple a city's ability to provide services. Facilities can become inoperable and have to be closed without power or water.

Local warning systems that may be utilized for excessive heat events include local television and radio stations and the Internet.

History of Excessive Heat in the Planning Area

There have been no reported excessive heat events in the planning area from 01/01/1950 to present.

Source: https://www.ncdc.noaa.gov

Location of Hazardous Areas

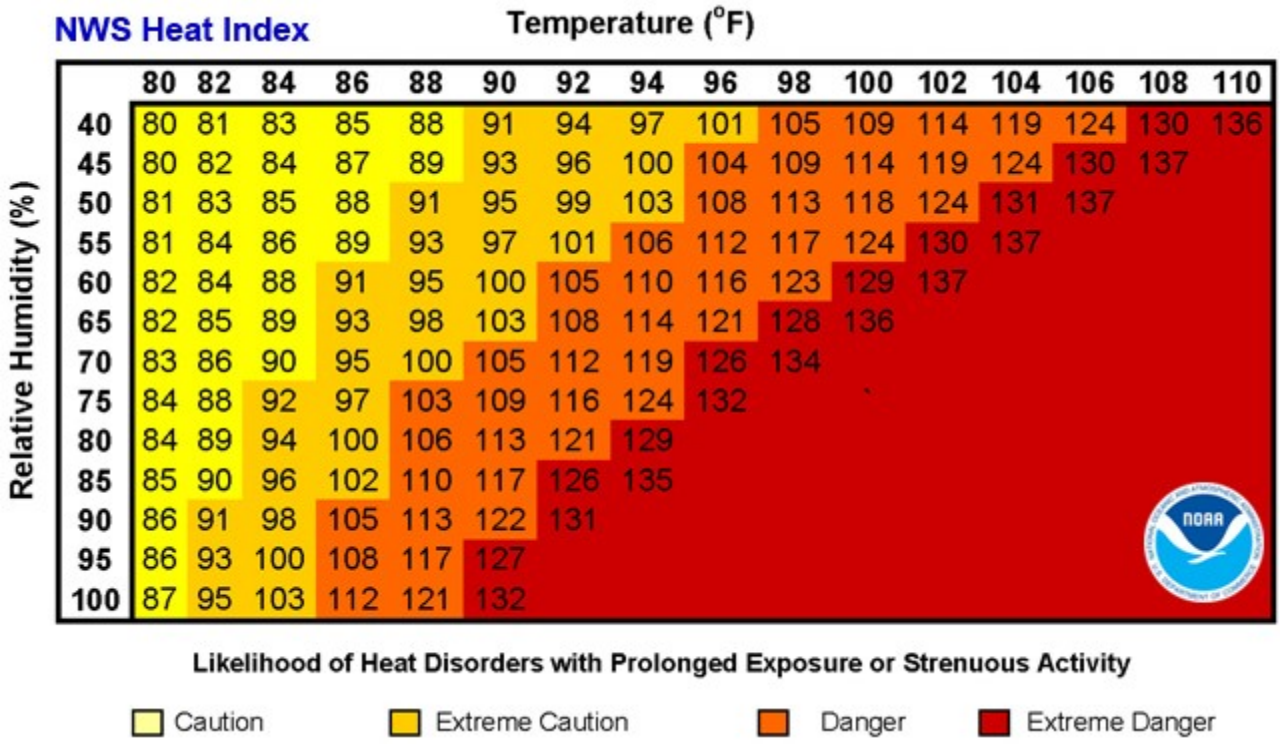
The entire planning area is subject to excessive heat.

People and Property at Risk

The entire population of the planning area is at risk from excessive heat, but those at highest risk are the poor, the elderly, those who live alone, and those who lack access to transportation and air-conditioning. People living in urban areas may be at greater risk from the effects of a prolonged heat wave than people living in rural regions. An increased health problem can occur when stagnant atmospheric conditions trap pollutants in urban areas, thus adding contaminants to excessively hot temperatures. Excessive heat generally affects people rather than property.

The extent of excessive heat in the planning area can be temperatures above 100 degrees for several days or weeks in a row. During the summer of 2011, temperatures above 100 degrees were recorded for over 30 days in the planning area.

Based on the Heat Index Chart, the extent of excessive heat in Brazos County can be placed in the Danger Range when the conditions are present of high temperatures and high relative humidity.



Source: https://www.weather.gov/safety/heat-index

POTENTIAL DAMAGES AND LOSSES

Potential dollar loss estimates for excessive heat are not available. The potential impact of excessive heat on Brazos County is the possible deaths of the poor, the elderly, those who live alone, and those who lack access to transportation and air conditioning.

SECTION 15: PREVIOUS MITIGATION ACTIONS

FEDERAL EMERGENCY MANAGEMENT AGENCY PROGRAMS

The effectiveness of previously implemented hazard mitigation measures was examined as part of the hazard mitigation planning process. The effectiveness of each previously implemented mitigation program was evaluated based on its effect on overall risk to life and property, ease of implementation and political and community support.

A total of five Presidential and five Small Business Administration Disaster Declarations have been issued since 1965 for Brazos County and participating entities, paving the way for assistance by the Federal Emergency Management Agency and other federal agencies. FEMA's Individual Assistance Program helps disaster victims to secure temporary housing, low-interest loans, unemployment assistance, and legal aid; makes grants to low-income individuals; conducts crisis counseling; and assists victims with income tax, Social Security, and veteran's benefits issues.

"Public Assistance" is aid to state or local governments and certain private non-profit entities to pay part of the approved costs (generally 75 percent) of rebuilding a community's damaged infrastructure. Public assistance may include debris removal; emergency protective measures; repair, replacement, or restoration of damaged public property; loans needed by communities to restore essential government functions; and grants for public schools.

Through the Hazard Mitigation Grant Program (HMGP), FEMA has financially helped the state to permanently reduce or eliminate future damages and losses due to natural hazards. HMGP funds promote safer building practices that improve existing structures and supporting infrastructure. The HMGP currently provides post-disaster funds, which can be used anywhere in the state, equal to 7.5 percent of obligations for individual and public assistance. Grants are for planning and projects, including acquisition of real property, relocation and demolition of structures, seismic retrofitting, strengthening of existing structures, initial implementation of vegetative management programs, elevation of residential structures, elevation or dry flood-proofing of non-residential structures, and other activities that bring a structure into compliance with the floodplain management requirements of the National Flood Insurance Program. A review of the state's HMGP records reveals no hazard mitigation projects conducted within the BVCOG jurisdictions. There were also no Project Impact, Pre-Disaster Mitigation, or Hurricane Property Protection Mitigation Projects.

PREVIOUS PLANNING EFFORTS

All participating entities in the planning area have performed numerous planning activities. As shown in Table 15-1, Brazos County has received Emergency Management Performance Grants (EMPG) from FEMA. These grants are intended to help develop comprehensive, all-hazards emergency management and improve local capabilities for emergency planning, preparedness, mitigation, response, and recovery. Assistance includes grant funding covering 13 key

functional areas, including laws and authorities; hazard identification and risk assessment; hazard management; resource management; planning; direction, control, and coordination; communications and warning; operations and procedures; logistics and facilities; training; exercises; public education and information; and finance and administration.

The previous hazard mitigation action plans have been utilized in the updating of our Interjurisdictional Emergency Management Plan and associated annexes, the threat and risk assessment (THIRA), drainage and stormwater plans, and flood mitigation plans.

Brazos County and participating entities have undertaken previous planning efforts that have complemented the region-wide planning conducted during the development of this Hazard Mitigation Action Plan. These other related planning efforts include development of hazard analyses, Annex P, comprehensive plans, capital improvement plans, drainage and stormwater plans, long-range growth plans and flood mitigation plans. Table 15-1 details these previous planning efforts.

Table 15-1. Previous Planning Efforts for Brazos County and participating entities

Participating Entities	Received EM Grant Funds? Y(es), N(o)	Planning Documents Completed for State Department of Emergency Management		Other Planning Efforts Undertaken (list)
		Basic Plan	Annexes*	
All participating entities are covered under one plan (Brazos County, City of College Station, City of Bryan, City of Kurten, City of Wixon Valley, Texas A&M University)	Y	Y	All	

* Annexes

Annex A	Warning	Annex F	Firefighting
Annex B	Communications	Annex G	Law Enforcement
Annex C	Shelter and Mass Care	Annex H	Health and Medical Services
Annex D	Radiological Protection	Annex I	Public Information
Annex E	Evacuation	Annex J	Recovery

Annex K	Public Works and Engineering
Annex L	Utilities
Annex M	Resource Management
Annex N	Direction and Control
Annex O	Human Services
Annex P	Hazard Mitigation
Annex Q	Hazardous Materials and Oil Spill Response
Annex R	Search and Rescue
Annex S	Transportation
Annex T	Donations Management
Annex U	Legal
Annex V	Terrorist Incident Response

Texas A&M University is largely located within College Station city limits within Brazos County, Texas. Because Texas A&M University is a state entity, it is subject to code regulations that are required by the State of Texas. The university has staff that includes emergency management, police, environmental health & safety, facilities, and engineers that meet regularly to discuss safety, security, and mitigation action items for current and future buildings. In the event of an opportunity to apply for a hazard mitigation grant key people from each department would be assigned, creating a team to manage the hazard mitigation project. The assigned department, in conjunction with emergency management, would be the lead department on each respective hazard mitigation projects. Texas A&M University would consult with the City of College Station and/or Brazos County if beneficial or if necessary.

The planning team reviewed existing regulatory capabilities and opportunities for establishing new capabilities and enhancing existing ones. All jurisdicitons can improve their capabilities by: budgeting for mitigation actions and support, passing policies and procedures to implement mitigation actions, adopting and implementing stricter building regulations, approving the hiring and training of staff for mitigation activities, and approving mitigation action updates and additions to existing plans as new needs are recognized.

BUILDING AND FIRE CODES

Building codes are laws, ordinances, or government regulations that set forth standards and requirements for the construction, maintenance, operation, occupancy, use, or appearance of buildings, premises, and dwelling units. Building codes are an effective way to ensure that development is built to withstand natural hazards. Building codes apply primarily to new construction.

Adherence to existing building codes and standards is essential to maintain public safety and promote an effective local mitigation program—so much so that the insurance industry has moved to rate communities according to their ability to enforce the building code and by the qualifications and training of their staff.

There are four principal types of building codes, promulgated by various code organizations:

Uniform Building Code, promulgated by the International Conference of Building officials (ICBO),

National Building Code, promulgated by the Building Officials and Code Administrators International, Inc. (BOCA),

Standard Building Code, promulgated by the Southern Building Code Congress, International (SBCCI), and

International Building Codes, promulgated by the International Code Council (ICC).

The building codes are periodically reviewed by the respective organizations and revised, as appropriate, when new requirements and materials are introduced. In the past, local governments have adopted these codes either in their entirety or as amended to adapt them to their local conditions. Legislation passed by the Texas Legislature in 2001, however, now requires communities to adopt the International Building Code.

Table 15-2 shows the effective date of each jurisdiction's building code, the name of the code, the type of code on which it is based, and whether any amendments have been made.

Table 15-2. Building Codes

Jurisdiction	Current Building Code							
	Effective Date	Name	Type					Amend-ments made (Y /N)
			UBC	NBC	SBC	IBC	Other	
Brazos County	September 2009	2003 International Residential Code and 2002 National Electrical Code						N
City of College Station	December 2009	International Building Codes				X		Y
City of Bryan	October 2010 and June 2011	International Building Codes				X		Y

FIRE CODES

Fire codes are laws, ordinances, or government regulations that set forth standards and requirements for the construction, maintenance, operation, occupancy, use, or appearance of buildings, premises, and dwelling units in order to prevent damage and loss of life from fire hazards.

There are three principal types of fire codes, promulgated by various code organizations. They are:

Uniform Fire Code (UFC), published by the International Fire Code Institute,

International Fire Code (IFC), published by the International Code Council, and

Standard Fire Code (SFC), published by the SBCC.

The fire codes are periodically reviewed and revised by the relevant organizations, as appropriate, when new requirements and materials are introduced. Local governments have adopted these codes either in their entirety or amended them as appropriate to their local conditions.

Table 15-3 shows the effective date of each jurisdiction's fire code, the name of the code, the type of code on which it is based, and whether any amendments have been made.

Table 15-3. Fire Codes for Brazos County and Participating Entities

Jurisdiction	Current Fire Code					
	Effective Date	Name	Type			
			UFC	IFC	SFC	Other
Brazos County	N/A					
City of College Station	December 2009	International Fire Code		X		
City of Bryan	November 9, 2010	International Fire Code		X		

INSPECTION AND PERMITTING PROCESSES

Adherence to existing building and fire codes and standards is essential to maintaining public safety and promoting an effective local mitigation program. New buildings can fail in a disaster if builders or inspectors do not adequately observe the code. Studies of the damage caused by Hurricane Andrew in 1992 attributed one-quarter of the storm's total damages to "shoddy workmanship and poor enforcement of building codes."

Well-trained inspectors are more likely to recognize building practices that are suspect with regard to hazard resilience than are poorly trained or untrained inspectors. Training is critical to the inspection and permitting process.

Table 15-4 shows the number of building inspectors and their average years of experience in each jurisdiction and, of those, the number certified. It also shows the number of building starts and inspections conducted in the last twelve months.

Table 15-4. Building Inspections and Permitting

Jurisdiction	Number of:				
	Building Inspectors (FTEs)	Inspectors Certified	Yrs. Experience (Average)	Building Starts (last 12 months)	Inspections (last 12 months)
Brazos County	N/A				
College Station	6	6	5	782	11,067
Bryan	5	5	11	700	17,094

A vigorous fire inspection process and well-trained inspectors are critical to saving lives and property from fire hazards. It also gives the number certified and number having received the Texas State Certification course.

Building Code Effectiveness Grading Schedules and Fire Ratings

The Insurance Services Office maintains Building Code Effectiveness Grading (BCEG) ratings and Public Protection Classification (PPC) ratings. The latter gauge the capacity of the local fire department to respond if flames engulf a property. PPC ratings are recorded for each individual street address in Texas.

There are 10 classes of ratings in BCEG schedule. Class 1 is the best rating, i.e., strongest program of building code enforcement, and 10 is the lowest rating. The date identified is the date of the rating by ISO. This rating applies to all structures built after that date and can lead to lower insurance rates.

Table 15-5. Community Mitigation Classifications

Community	PPC Fire Grading Classification	BCEGS (Building Code Effectiveness Grading Schedule) for Personal Property (Single Family Dwelling)	BCEGS (Building Code Effectiveness Grading Schedule) for Commercial Property	Date of Rating
Bryan	2	03	03	2017
College Station	3	04	04	2002

Floodplain Management Ordinances

Table 15-6 below describes the floodplain management ordinances currently in use in the planning area, while Table 15-7 provides information regarding floodplain administration. This includes the number of: people on the administrator's staff; certified managers; inspections in the past month; and variances.

Table 15-6. Floodplain Management Ordinances in Brazos County

Jurisdiction	Current Flood Ordinance	
	Effective Date	Description
Brazos County	May 2012	Each newly built or installed structure requires permit; structures not in floodplain receive exemption; structures in floodplain must be at least one foot above BFE and have special septic system; enforced by spot inspections.
College Station	November 2009	All work in or near floodplains is required to obtain a Drainage Development Permit. Applications are reviewed for effects to surrounding areas, as well as meeting requirements for publicly maintained drainage facilities.
Bryan	November 2010	All work in or near floodplains is required to obtain a Drainage Development Permit. Applications are reviewed for effects to surrounding areas, as well as meeting requirements for publicly maintained drainage facilities.
Wixon Valley	May 2012	Each newly built or installed structure in a floodplain requires a permit; structures not in a floodplain receive an exemption; structures in a floodplain must be at or above BFE.

Table 15-7. Jurisdictional Floodplain Administration Process

Jurisdiction	Number of:				
	Floodplain administration professional staff	Certified floodplain managers	Average years of experience of professional staff	Inspections in last twelve months	Floodplain variances in last twelve months
Brazos County	3	3	15	Not Applicable	0
College Station	2	2	10	40	0
Bryan	3	7	15	144	0
Wixon Valley	1	0	0	Not Applicable	0

FEMA Community Assistance Program Involvement

The Federal Emergency Management Agency's Community Assistance Program (CAP) is a product-oriented financial assistance program directly related to the flood loss reduction

objectives of the NFIP. States and communities that are participating in the NFIP are eligible for this assistance. The CAP is intended to identify, prevent, and resolve floodplain management issues in participating communities before they develop into problems requiring enforcement action. The program involves Community Assistance Contacts (CACs) and Community Assistance Visits (CAVs). During CACs and CAVs, officials discuss current local ordinances, the number of floodplain insurance policies in the community, floodplain administration, permitting, and annexation issues. Table 15-8 shows the dates of CACs and CAVs according to FEMA records.

Table 15-8. Community Assistance Contacts and Community Assistance Visits from FEMA, 2004 - 2018

Jurisdiction	CAC	CAV
Brazos County	05/14/2018 12/03/2015 11/03/2014 06/27/2012 02/20/2012 07/07/2008 05/22/2007 05/02/2007 02/20/2004	None
Bryan	07/15/2014 02/22/2012 08/09/2011 07/09/2008 06/22/2006 5/14/2004	11/18/2013
College Station	10/27/2014 02/20/2012 07/09/2008 07/11/2006	07/27/2016 08/18/2008
Wixon Valley	11/03/2014 02/22/2012 07/07/2008	None
Kurten	02/20/2012 07/07/2008	None

Previous Action Items

The following items submitted from the previous 2012 plan have been addressed.

Projects - 2012 -2017			
Jurisdiction	**Mitigation Action 2012 - 2017**	**Completed?**	**If not, why not?**
Brazos County	Enhance the County's ring-down notification system and increase public education in the role of 2-1-1.	Project is on-going	A new emergency notification system (ENS) was implemented in 2017 with plans to further upgrade the system in 2018.
Brazos County	Enhance Emergency Alert System (EAS) and expand capability to other counties in the region to activate EAS.	Project is was not completed and will not be carried forward	Work on the project was ceased due to lack of technical expertise and loss of institutional knowledge need to expand the system into other counties in the region.
Brazos County	Place NOAA weather radios in existing critical facilities such as churches, schools, and high population buildings.	Project is not complete	Lack of funding

Brazos County	Increase public awareness of flood hazards, as related to continued NFIP compliance. Many NWS campaigns, such as "Turn around, don't drown" have increased awareness of these dangers. On the local level, we will broadcast public awareness spots on local government channels and local network television if funds are available. Also, the Floodplain Administrator's Office distributes public awareness material to the public on a limited basis.	Project is on-going	Project is on-going
Brazos County	Purchase generators to power existing emergency communications. Two BVWACS tower sites do not have back-up generators but do currently have battery back-up power systems. We plan for all sites to eventually have a generator.	Project is not complete	Lack of funding
Brazos County	Back-up power generators for existing critical facilities. Assess and install "quick-connect for emergency generator hook-ups at critical facilities. The EOC and the Courthouse Administration Building now have (partial) back-up power generators and the County has purchased (4) large generators for use at critical facilities as needed.	Project is on-going	Purchase and installation of generator for the Brazos Center planned for 2018.

Brazos County	Eliminate burning of hazardous materials and/or non-hazardous materials.	Project is on-going	Brazos County Sheriff's Office has created a position for an environmental enforcement. This individual works to educate the citizens about how to handle hazardous materials and the laws that dictate guidelines for outdoor burning.
Brazos County	Identify possible funding for the purchase of thermal energy scanners, floating pumps, and eight new electronic defibrillators. Some VFDs have been equipped with thermal scanners and all have been equipped with electronic defibrillators.	Not completed using hazard mitigation funds.	The VFDs were able to purchase this equipment either with money own budgets or by using Texas A&M Forest Service grants.
Brazos County	Partner with Texas Forest Service (TFS) and their Firewise program to develop public awareness information and Public Service Announcements about fire risks and steps that homeowners can take to protect themselves and their existing homes against fire, including wildfires.	Project is on-going	

Brazos County	Create a data layer of FEMA repetitive loss claims for our web GIS. This will help the County prioritize the purchase of existing repetitive loss properties throughout the County, and possibly prevent new structures from being built in the flood hazard area.	Project is on-going	
Brazos County	Provide "fan drives" for people in the County who do not have the means to keep themselves cool.	Project not completed.	Utilize 2-1-1 to provide information regarding availability of fans through local non-for- profits for individuals that need them and provide information on places for individuals to go if they need to escape the heat.
Brazos County	Determine the flood inundation areas for Bryan Utilities Lake and acquire structures located in the identified hazard area.	Project not completed.	Lack of funding.
Brazos Valley COG	Stand-by Electric Generator for the existing COG Building.	Yes; action completed. Generator has been in service for over four years and tested on a routine bases.	

Brazos Valley COG	Purchase and install new individual safe rooms throughout the County.	Yes; action completed. BVCOG managed a regional Individual Safe Room grant. The grant closed December 6, 2014. Only 36 citizens took advantage of the grant.	
City of Bryan	Implement a new Records Management System for the Fire and Police Departments.	Fire Department completed, Police Department on-going	
City of Bryan	Improve EOC software so that all governmental agencies can communicate better.	On-going	
City of Bryan	Create a map showing low water crossings in the City of Bryan. The results of the flood mapping will be used to determine which low water crossings should be eliminated first with the building of a bridge with 404 Mitigation Funds.	Mapping completed (although continuously updated). Results used to prioritize bridge replacements	
City of Bryan	Improve new shelter capabilities.	On-going	

City of Bryan	Provide "cooling center" for people in the City who do not have the means to keep themselves cool during periods of excessive heat.	On-going, continually working with College Station and Brazos County utilizing GIS to coordinate "shelters" that could be used in times of excessive heat	
City of Bryan	Purchase NOAA Radios.	No	The advent of technology has made weather radios more accessible to a wide range of residents. No funding at this time
City of Bryan	Obtain updated low level aerial photography and topographic mapping within the city limits and ETJ.	Completed, on-going	
City of Bryan	Perform detailed studies of areas prone to flooding to determine the most cost effective means to reduce potential loss. The flood studies will be used to prevent new buildings from being built in the flood hazard area, and studies will be used to determine which existing Repetitive Loss properties should be purchased first.	Completed, on-going	

City of Bryan	Purchase or elevate existing properties subject to repetitive loss or severe repetitive floodplain losses.	On-going, received HMGP grant to purchase 4 (with 1 alternate) SRL properties	
City of Bryan	Replace drainage culverts identified in Stormwater Master Plan to improve their efficiency. This will also have a positive effect on new buildings.	Completed, on-going	
City of Bryan	As related to continued compliance with the NFIP, install paired rain and stream gauge units with the major watersheds of the City of Bryan to better calibrate rainfall and flooding projections. This will result in more accurate Base Flood Elevations (BFE), which in turn will allow for new buildings to be built higher above the floodplain.	No	Annual maintenance too costly. Water Services installed rain gauges to monitor infiltration/inflows, data is being used to monitor/calibrate hydrologic and hydraulic models.
City of Bryan	This Project was listed under City of College Station. These dams are not in City of College Station - this project should be on City of Bryan's list. Determine the flood inundation areas for Country Club Lake and Finfeather Lake and acquire structures located in the identified hazard area.	Partially completed, emergency action plan has been completed for Country Club Lake	Finfeather Lake will be removed since it is not in the City's control. Acquisition of structures located in the hazard area is unlikely to occur.
City of College Station	Offer tree pruning education classes to the public to reduce debris caused by limbs failing due to excessive snow or ice.	Project is on-going	

City of College Station	Increase public awareness of the effects of hail and mitigation activities that can lessen damage.	Project is on-going	
City of College Station	Purchase existing flood-prone properties to remove structures subject to chronic flooding and to facilitate stream restoration project in the Wolf Pen Creek basin.	Project is not complete	Funding is not available to purchase the property or properties and the/one of the owners is unwilling to sell.
City of College Station	Mitigate existing structures with Repetitive Loss flood insurance claims by either elevating them above the base flood elevation, or purchase and demolish them to remove them from the floodplain.	Project is not complete	Funding is not available
City of College Station	Purchase existing flood-prone properties, remove structures subject to chronic flooding, and construct a regional flood control/detention pond project in the Bee Creek basin.	Project is 90% complete	1 homeowner is unwilling to sell
City of College Station	Educate and purchase NOAA weather radios for the citizens of College Station.	Project is complete	
City of College Station	Maintain/enhance public education programs regarding fire dangers for identified risk areas and population groups. Enhance fire hydrant maintenance program. Provide adequate/required-staffing levels. Provide optimum resource distribution.	Project is complete	

City of College Station	Improve outdated Emergency Operations Center technological capabilities for monitoring, recording, and responding to disasters.	Project is complete	
City of College Station	Implement a water conservation program.	Project is complete	
City of College Station	Create a hurricane hazard information center to better inform the public. Continue to recruit and certify shelter facilities.	Project is on-going	
City of Kurten	Public education and awareness about floods, droughts, excessive heat, and tornadoes	Project is on-going	
City of Kurten	To buyout, relocate or elevate any existing repetitive loss flood properties located within the floodplain.	No such properties known to exist in the city limits	
City of Kurten	Purchase and install a generator on the existing City of Kurten Municipal Building.	Project not completed	No funding
City of Wixon Valley	Public education and awareness about floods, droughts, excessive heat, and tornadoes	Project is on-going	
City of Wixon Valley	To buyout, relocate or elevate any existing repetitive loss flood properties located within the floodplain.	No such properties known to exist in the city limits	
City of Wixon Valley	Purchase and install a generator on the existing City of Wixon Valley Municipal Building.	Project is on-going	

NEW PROJECTS 2019-2024

Jurisdictions	All participating entities (Brazos County; Cities of Bryan, College Station, Kurten, and Wixon Valley; and TAMU)
Action:	Develop an annual public workshop or expo for all residents to educate them on all the hazards, NFIP, and develop methods to mitigate damage to personal properties from all the hazards. Additionally, educate residents about the need for and creation of preparedness kits.
Hazard	Flood, Drought, Wildfire, Winter Storm, Tornadoes, Hail, Thunderstorms, Dam Failure and Excessive Heat
Priority	High
Estimated Cost	$2,000
Responsible Organization	All participating entities
Target Completion Date	2019
Funding Sources	General funds and corporate donations

Jurisdictions	All participating entities (Brazos County; Cities of Bryan, College Station, Kurten, and Wixon Valley; and TAMU)
Action:	Purchase generators for critical facilities
Hazard	Flood, Drought, Wildfire, Winter Storm, Tornadoes, Hail, Thunderstorms, Dam Failure and Excessive Heat
Priority	High
Estimated Cost	Up to $150,000 per generator
Responsible Organization	All participating entities
Target Completion Date	2023
Funding Sources	Grant and General Funds

Jurisdictions	All participating entities (Brazos County; Cities of College Station, Kurten, and Wixon Valley; and TAMU)
Action:	Build, renovate, rehabilitate or convert a building or buildings for use as emergency shelters for individuals and families.
Hazard	Flood, Wildfire, Winter Storm, Tornadoes, Hail, Thunderstorms, Dam Failure and Excessive Heat
Priority	Medium
Estimated Cost	$1million
Responsible Organization	Brazos County
Target Completion Date	2021
Funding Sources	Grant monies and general funds

Jurisdictions	Brazos County
Action:	Do a hydrology study of the watersheds that exist in Brazos County that contribute to flooding during heavy rain incidents
Hazard	Flood
Priority	Medium
Estimated Cost	$25,000
Responsible Organization	Brazos County
Target Completion Date	2023
Funding Sources	Grant monies and general funds

Jurisdictions	City of Bryan
Action:	Create 2D “rain on mesh” model to better identify flooding hazards outside of riverine areas (local flooding hazards)
Hazard	Flood
Priority	Medium
Estimated Cost	$100k
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	Drainage and general funds

Jurisdictions	City of Bryan
Action:	Create a map showing low water crossings in the City of Bryan. The results of the flood mapping will be used to prioritize low water crossing replacements/improvements
Hazard	Flood
Priority	High
Estimated Cost	$10k
Responsible Organization	City of Bryan
Target Completion Date	2020
Funding Sources	Drainage and general funds

Jurisdictions	City of Bryan
Action:	Perform detailed studies of areas prone to flooding to determine the most cost effective means to reduce potential loss. The flood studies will be used to prevent new buildings from being built in the flood hazard area.
Hazard	Flood
Priority	Medium
Estimated Cost	$250k
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	Drainage and general funds

Jurisdictions	City of Bryan
Action:	Purchase or elevate existing properties subject to repetitive loss or severe repetitive losses
Hazard	Flood
Priority	Medium
Estimated Cost	$7M
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	Drainage and general funds

Jurisdictions	City of Bryan
Action:	Replace drainage culverts identified in the Stormwater Master Plan to improve efficiency.
Hazard	Flood
Priority	Medium
Estimated Cost	$5M
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	Drainage and general funds

Jurisdictions	City of College Station
Action:	Continue to enforce building codes and STP's
Hazard	Flood
Priority	High
Estimated Cost	$6k
Responsible Organization	City of College Station
Target Completion Date	2020
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Improve flood risk assessment
Hazard	Flood
Priority	Medium
Estimated Cost	$50k
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	General funds

Jurisdictions	Texas A&M University
Action:	Design and construct detention ponds to control runoff of rainwater from Texas A&M University property.
Hazard	Flood
Priority	Medium
Estimated Cost	$12M
Responsible Organization	Texas A&M University
Target Completion Date	2023
Funding Sources	Grand and local funds

Jurisdictions	City of Kurten
Action:	Join the National Flood Insurance Program so residents can be eligible for flood insurance
Hazard	Flood
Priority	High
Estimated Cost	N/A
Responsible Organization	City of Kurten
Target Completion Date	High
Funding Sources	N/A

Jurisdictions	City of Wixon Valley
Action:	Include space for a Shelter in the new City Hall
Hazard	Flood
Priority	High
Estimated Cost	$3M
Responsible Organization	City of Wixon Valley
Target Completion Date	2023
Funding Sources	Grant and general funds

Jurisdictions	All participating entities (Brazos County; Cities of Bryan, College Station, Kurten, and Wixon Valley; and TAMU)
Action:	Create a series of PSA's/outreach for topics such as Burn Bans, foundation watering how to's, water conservation in times of drought
Hazard	Drought
Priority	High
Estimated Cost	$1k
Responsible Organization	All participating entities
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Aquifer storage & recovery (ASR)
Hazard	Drought
Priority	High
Estimated Cost	$24M
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	SWIFT

Jurisdictions	City of College Station
Action:	Monitor water supply
Hazard	Drought
Priority	Medium
Estimated Cost	$5k
Responsible Organization	City of College Station
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Educate residents on water saving techniques
Hazard	Drought
Priority	Medium
Estimated Cost	$5k
Responsible Organization	City of College Station
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	Texas A&M University
Action:	Incorporate drought tolerant practices into landscaping of current and new open spaces to reduce dependence on irrigation
Hazard	Drought
Priority	Medium
Estimated Cost	$500k
Responsible Organization	Texas A&M University
Target Completion Date	2021
Funding Sources	Grant and local funds

Jurisdictions	Brazos County, Cities of Kurten and Wixon Valley
Action:	Develop wildfire plan for the unincorporated areas of Brazos County, to include cities of Kurten and Wixon Valley
Hazard	Urban & Wildfires
Priority	High
Estimated Cost	$1k
Responsible Organization	Brazos County, Cities of Kurten and Wixon Valley
Target Completion Date	2020
Funding Sources	Grant

Jurisdictions	City of Bryan
Action:	Obtain updated low level aerial photography and topographic maps within the city limits and ETJ. Imagery can be used to delineate areas susceptible to urban/wildland fire hazards
Hazard	Urban & Wildfires
Priority	High
Estimated Cost	$250k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Update/maintain wildfire plan
Hazard	Urban & Wildfires
Priority	High
Estimated Cost	$5k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	Grant funds

Jurisdictions	City of Bryan
Action:	Work with Red Cross to initiate a smoke alarm program.
Hazard	Urban & Wildfires
Priority	High
Estimated Cost	$2k
Responsible Organization	City of Bryan
Target Completion Date	2020
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Map and assess vulnerability to wildfire
Hazard	Urban & Wildfires
Priority	Medium
Estimated Cost	$5k
Responsible Organization	City of College Station
Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	City of College Station
Action:	Increase wildfire risk awareness
Hazard	Urban & Wildfires
Priority	Medium
Estimated Cost	$3k
Responsible Organization	City of College Station
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	Texas A&M University
Action:	Continue to enhance and improve the fire inspection program
Hazard	Urban & Wildfires
Priority	Medium
Estimated Cost	$45k
Responsible Organization	Texas A&M University
Target Completion Date	2022
Funding Sources	General funds

Jurisdictions	City of Wixon Valley
Action:	Purchase and install flag pole and burn ban warning flags.
Hazard	Urban & Wildfires
Priority	High
Estimated Cost	$1,500
Responsible Organization	City of Wixon Valley
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Wixon Valley
Action:	Install/expand City of Wixon Valley hydrant coverage.
Hazard	Urban & Wildfires
Priority	Medium
Estimated Cost	$15k
Responsible Organization	City of Wixon Valley
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Create an SOP for winter storm events including roadway safety, power outages, etc.
Hazard	Winter Storm
Priority	High
Estimated Cost	$10k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Maintain weather condition information on the city's website, including closures, safety tips, etc.
Hazard	Winter Storm
Priority	High
Estimated Cost	$50k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Conduct winter weather risk awareness activities.
Hazard	Winter Storm
Priority	Medium
Estimated Cost	$1k
Responsible Organization	City of College Station
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Assist vulnerable populations
Hazard	Winter Storm
Priority	Medium
Estimated Cost	$1k
Responsible Organization	City of College Station
Target Completion Date	2020
Funding Sources	General funds

Jurisdictions	Texas A&M University
Action:	Planning for and maintaining adequate road/sidewalk and debris clearing capabilities
Hazard	Winter Storm
Priority	Medium
Estimated Cost	$10k
Responsible Organization	Texas A&M University
Target Completion Date	2023
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Maintain hazardous weather condition information on the city's website and PSA's, including closures, safety tips, etc.
Hazard	Tornado
Priority	High
Estimated Cost	$50k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Create PSA's, procedures to provide residents regarding cleanup/permit requirements after events, and choosing contractors
Hazard	Tornado
Priority	High
Estimated Cost	$10k
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General funds

Jurisdictions	City of College Station
Action:	Encourage construction of safety rooms
Hazard	Tornado
Priority	Medium
Estimated Cost	$1k
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	Grant and general funds

Jurisdictions	City of College Station
Action:	Conduct tornado awareness activities
Hazard	Tornado
Priority	Medium
Estimated Cost	$1k
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	General funds

Jurisdictions	Texas A&M University
Action:	Enhance building emergency plans to include “areas of refuge”
Hazard	Tornado, hailstorms, thunderstorms (to include lightning and wind storms)
Priority	Medium
Estimated Cost	$45,500
Responsible Organization	Texas A&M University
Target Completion Date	2021
Funding Sources	General funds

Jurisdictions	City of Bryan
Action:	Maintain hazardous weather condition information on the city's website and PSA's, including closures, safety tips, etc.
Hazard	Hail Storms
Priority	High
Estimated Cost	$50,000
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	City of Bryan
Action:	Create PSA's, procedures to provide to residents regarding cleanup/permit requirements after events, and choosing contractors
Hazard	Hail Storms
Priority	High
Estimated Cost	Less than $10,000
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	City of College Station
Action:	Locate safe rooms to minimize damage
Hazard	Hail Storms
Priority	Medium
Estimated Cost	$1,000
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	General Funds

Jurisdictions	City of College Station
Action:	Increase hail awareness
Hazard	Hail Storms
Priority	Medium
Estimated Cost	$1,000
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	General Funds

Jurisdictions	City of Kurten
Action:	Create mailouts and/or social media messages that provide information to residents regarding the use of weather radios, teach residents about the dangers of lightning and safety precautions to take when severe weather and lightning threatens
Hazard	Hail Storms
Priority	High
Estimated Cost	$250
Responsible Organization	City of Kurten
Target Completion Date	2020
Funding Sources	General Funds

Jurisdictions	City of Bryan
Action:	Maintain hazardous weather condition information on the city's website and PSA's, including closures, safety tips, etc.
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	High
Estimated Cost	$50,000
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	City of Bryan
Action:	Install lightning detectors in areas where there may be significant numbers of residents congregating outside (pools, parks, etc.)
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	High
Estimated Cost	$150,000
Responsible Organization	City of Bryan
Target Completion Date	2023
Funding Sources	Grants

Jurisdictions	City of Bryan
Action:	Create/maintain tree trimming program (BTU)
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	High
Estimated Cost	$2 million
Responsible Organization	City of Bryan
Target Completion Date	2019
Funding Sources	Enterprise Funds

Jurisdictions	City of College Station
Action:	Conduct lightning awareness programs.
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	Medium
Estimated Cost	$1,000
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	Grants

Jurisdictions	City of College Station
Action:	Create and mail lightning safety brochures with COCS water bills.
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	Medium
Estimated Cost	$2,500
Responsible Organization	City of College Station
Target Completion	2021

Date	
Funding Sources	General Funds

Jurisdictions	City of Kurten
Action:	Create mailouts and/or social media messages that provide information to residents regarding the use of weather radios, teach residents about the dangers of thunderstorms and safety precautions to take when severe weather threatens.
Hazard	Thunderstorms (to include lightning and wind storms)
Benefits	
Priority	High
Estimated Cost	$250
Responsible Organization	City of Kurten
Target Completion Date	2020
Funding Sources	General Funds

Jurisdictions	City of Wixon Valley
Action:	Install surge & strike reduction rods/system in the new City Hall.
Hazard	Thunderstorms (to include lightning and wind storms)
Priority	High
Estimated Cost	$10,000
Responsible Organization	City of Wixon Valley
Target Completion Date	2023
Funding Sources	General and Grant Funds

Jurisdictions	Brazos County, Bryan, College Station
Action:	Conduct hydrology studies to identify the extent for each dam on the list for

	which there is no current information. The extent will be stated in the form of water depth in the inundation area for each dam. This project is to address data deficiencies identified in Section 13
Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	$50,000
Responsible Organization	Brazos County
Target Completion Date	2021
Funding Sources	Grant monies

Jurisdictions	City of Bryan
Action:	Maintain/update Emergency Action Plans for Country Club Lake and Lake Bryan
Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	$100,000
Responsible Organization	City of Bryan
Target Completion Date	2020
Funding Sources	Drainage/General Funds

Jurisdictions	City of Bryan
Action:	Update development regulations within the hazard areas identified with the EAP's.
Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	Less than $10,000
Responsible Organization	City of Bryan
Target Completion Date	2020
Funding Sources	General Funds

Jurisdictions	City of College Station
Action:	Conduct a study estimating economic consequences for dam failure scenarios.

Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	$40,000
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	Grants Funds

Jurisdictions	City of College Station
Action:	Conduct a study estimating loss of life for dam sector for dam failure scenarios.
Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	$40,000
Responsible Organization	City of College Station
Target Completion Date	2021
Funding Sources	Grants Funds

Jurisdictions	Texas A&M University
Action:	Enhance routine dam maintenance to include vegetation evaluation and removal (as appropriate) annually.
Hazard	Dam Failure (and levee failure)
Priority	Medium
Estimated Cost	$10,000
Responsible Organization	Texas A&M University
Target Completion Date	2021
Funding Sources	General Funds

Jurisdictions	All participating entities (Brazos County, Cities of Bryan, College Station, Kurten, Wixon Valley, and TAMU)
Action:	Provide information to the public on where they can go to stay cool during periods of excessive heat
Hazard	Excessive Heat
Priority	High
Estimated Cost	$1,500
Responsible Organization	All participating entities

Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	All participating entities (Brazos County, Cities of Bryan, College Station, Kurten, Wixon Valley, and TAMU)
Action:	Educate vulnerable populations about sources of fans and sources of programs that can assist citizens having trouble paying utility bills.
Hazard	Excessive Heat
Priority	High
Estimated Cost	$1,500
Responsible Organization	All participating entities
Target Completion Date	2019
Funding Sources	General Funds

Jurisdictions	City of Bryan
Action:	Study and quantify possible urban heat island effects in Bryan and subsequently assess a possible need for a mitigation program.
Hazard	Excessive Heat
Priority	Low
Estimated Cost	$200,000
Responsible Organization	All participating entities
Target Completion Date	2023
Funding Sources	Grants and General Funds

SECTION 17: PLAN IMPLEMENTATION AND MAINTENANCE PROCEDURES

IMPLEMENTATION

This section discusses how this Hazard Mitigation Plan will be implemented by Brazos County and the participating entities listed in this plan. 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.

Brazos County and participating entities will be responsible for implementing its own mitigation action plans contained in Section 17. Each action has been assigned to a specific person or local government office that is responsible for implementing it. The governing bodies of each participating jurisdiction have adopted the mitigation action plan for their jurisdictions. Copies of the governing body resolutions are contained in Appendix E.

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 or a specific implementation date also has been assigned to each action as an incentive for seeing the action through to completion and to gauge whether actions are timely implemented.

Participating jurisdictions will integrate implementation of their mitigation action plans with other, existing planning mechanisms such as capital improvement plans, long range growth plans, master stormwater and drainage plans, and regional planning efforts. Jurisdictions will ensure that the actions contained in the mitigation action plans are reflected in these other planning efforts. These other planning efforts will be used to advance the mitigation strategies of the jurisdictions.

Each participating entity will conduct periodic reviews of their comprehensive and land use plans and policies and analyze the need for any amendments in light of the approved hazard mitigation plan. Participating entities will ensure that comprehensive or capital improvement planning in the future will also be integrated into this hazard mitigation plan to reduce the long-term risk to life and property from all hazards. Within one year of formal adoption of the hazard mitigation plan, existing planning mechanisms will be reviewed by each participating entities and incorporated into the plan, as necessary. The process to be used to integrate any plans into this mitigation plan will be for the local jurisdictions to amend their portion of the mitigation plan by including any action items from other planning mechanisms that are relevant to mitigation. Likewise, any mitigation actions that are relevant to comprehensive planning will be incorporated from the mitigation plan into those comprehensive plans.

Upon formal adoption of the plan, hazard mitigation team members from each jurisdiction will review all comprehensive land use plans, capital improvement plans, transportation plans, and any building codes to guide and control development. The hazard mitigation team members will work to integrate the hazard mitigation strategies into these other plans and codes. Each jurisdiction will conduct periodic reviews of their comprehensive and land use plans and policies

and analyze the need for any amendments in light of the approved hazard mitigation plan. Participating jurisdictions will ensure that capital improvement planning in the future will also contribute to the goals of this hazard mitigation plan to reduce the long-term risk to life and property from all hazards. Within one year of formal adoption of the hazard mitigation plan, existing planning mechanisms will be reviewed by each jurisdiction.

EVALUATION AND ENHANCEMENT

Periodic revisions and updates of the plan are required to ensure that the goals, objectives, and mitigation action plans for the Brazos County and participating entities are kept current. More importantly, revisions may be necessary to ensure that the plan is in full compliance with federal regulations and state statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

Monitoring and Five-Year Plan Review and Update

The Brazos County Hazard Mitigation Plan will be monitored and evaluated for any updates, input and planning for the next revision due in the year 2024. Brazos County Emergency Management and City of Bryan Emergency Management will coordinate the monitoring and maintenance of the 2019 through 2024 plan, including all four elements and serve as the plan contacts. The Brazos County Hazard Mitigation Team (BCHMT) will be notified of the status of the plan upon approval. On the third Thursday in April of 2020 and 2021, a request for updates will be sent to the BCHMT along with any updates that have been added to the plan during the last three years. This will be followed up with a meeting two weeks later to review the planning process and review the plan. The plan contacts will work with the TDEM Hazard Mitigation Section Staff to keep up to date on requirements and will attend any appropriate training needed. January of 2022, the plan contacts will arrange and hold a Hazard Mitigation Team Meeting and continue the process to evaluate, update and submit the new HMP as required for approval through the State of Texas and FEMA. This will allow plenty of time for proper involvement from the HMPT, all stakeholders and the public as outlined in our plan and sufficient time to have the plan revised and approved before the expiration date occurs in 2024.

Hazard mitigation team members from each jurisdiction (see Appendix C) are responsible for continual monitoring those components of the hazard mitigation plan that pertains to their entity on an annual basis. As part of the monitoring process, team members will assess any changes in risk; determine whether implementation of mitigation actions is on schedule or if there are any implementation problems, such as technical, political, legal or coordination issues; and reflect changes in land development or programs that affect mitigation priorities or actions.

This mitigation action plan will be formally reviewed and updated every five years to determine whether significant changes may have occurred in Brazos County and participating entities that could affect the plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and revisions to federal or state legislation are examples of changes that may affect the currency of the plan. Criteria to be included in the evaluation will include, at a minimum:

- The goals and objectives address current and expected conditions;
- The nature, magnitude, and/or type of risks has changed;
- The current resources are appropriate for implementing the plan;
- There are implementation problems, such as technical, political, legal, or coordination issues with other agencies;
- The outcomes have occurred as expected; and,
- The agencies and other partners participated as originally proposed.

The review also will give community officials an opportunity to evaluate successful actions and to explore the possibility of documenting losses avoided because of actions taken. The plan also will need to be revised to reflect lessons learned following a disaster declaration or to address specific circumstances arising from changing conditions surrounding disaster events.

As part of the plan review process, participating jurisdictions will be asked to review each goal and objective to determine their continued relevance; review the risk assessment portion of the plan to determine if the information should be updated or modified; report on the status of each of their mitigation actions; report on which implementation processes worked well, any difficulties encountered, how coordination efforts are proceeding, and which mitigation actions should be revised; and evaluate the effectiveness of their mitigation action plans and recommend changes or amendments.

As part of the five-year plan update, depending upon resource availability, a review will be undertaken of development trends in each jurisdiction and vulnerability. Also as part of the five-year plan update, depending upon resource availability, a review will be undertaken for each hazard of the type and number of existing and future buildings, infrastructure and critical facilities within each hazard area, and an estimate will be undertaken of the vulnerability of critical facilities and infrastructure in terms of potential dollar losses from each hazard. Also depending upon resource availability, land uses and development trends will also be re-examined, including the types of development occurring, location, expected intensity, and pace by land use for each jurisdiction. This will help complete and improve future vulnerability assessment efforts. Based on the analysis, a summary of vulnerability will be provided for participating jurisdictions below the county level.

Plan Amendments and Updates

At any time, minor technical changes may be made to the plan to keep it up to date. However, any changes to the 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 participating jurisdictions.

After initial adoption, any amendment to the mitigation action plan contained in Section 18 must also be approved by the governing body of the participating city or county for inclusion in an amended plan.

At the end of the comment period, the proposed amendment and all comments will be forwarded to the governing body of the proposing jurisdiction for consideration. If no comments are received from the reviewing parties within the specified review period, this will also be noted. The governing body will then review the proposed amendment and comments received, and vote to accept, reject, or amend the proposed change. The public will have an opportunity to provide input during the governing body meeting at which the request is considered. Upon ratification, the amendment will be included in the plan and forwarded to the Texas Division of Emergency Management.

In determining whether to recommend approval or denial of a plan amendment request, the following factors will be considered:

- 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;
- Changes in information, data, or assumptions from those on which the plan was based.

CONTINUED PUBLIC INVOLVEMENT

Public input was an integral part of the preparation of this plan and will continue to be essential as the plan grows and changes. As with any officially adopted plan or ordinance, a significant change to this plan shall require an opportunity for the public to make its views known.

This Hazard Mitigation Action Plan will be posted continuously on the website of the Brazos County Department of Emergency Management, where the public is invited to provide ongoing feedback. The public will be notified that the plan is available on the website and social media through the participating entities. For more information, contact the CEOC at 979-821-1000.

APPENDIX A: ACRONYMS

AL	Annualized Loss
ALR	Annualized Loss Ratio
BCEG	Building Code Effectiveness Grading
BCEGS	Building Code Effectiveness Grading Schedule
BOCA	Building Officials and Code Administrators
BTU	British Thermal Unit
BVCOG	Brazos Valley Council of Governments
CAC	Community Assistance Contact
CAP	Community Assistance Program
CAV	Community Assistance Visit
CDBG	Community Development Block Grant
CERT	Community Emergency Response Team
CFS	Cubic feet per second
CHER-CAP	Comprehensive Hazardous Materials Emergency Response – Capability Assessment Program
CHEMTREC	Chemical Transportation Emergency Center
COG	Council of Governments
COOP	Continuity of Operations Plan
COPS	Community Oriented Police Services
CTP	Cooperating Technical Partner
DEM	Texas Division of Emergency Management
DFIRM	Digital Flood Insurance Rate Map
DOD	Department of Defense
EAS	Emergency Alert System

EM	Emergency Management
EMP	Emergency Management Plan
EMPG	Emergency Management Performance Grants
EMS	Emergency Medical Services
EO	Emergency Operations
EOC	Emergency Operations Center
EP	Exceeding Probability
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
GIS	Geographic Information System
HAZUS	Federal Emergency Management Agency's Hazards U.S.
HMT	Hazard Mitigation Team
IFC	International Fire Code
ISO	International Organization for Standardization
NFDS	National Fire Danger Rating System
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
PPC	Public Protection Classification
SFC	Standard Fire Code
TEEX	Texas Engineering Extension Service
UFC	Uniform Fire Code
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture

APPENDIX B: PUBLIC SURVEY RESULTS (2017)

Introduction:

The public survey collects information from the citizens of Brazos County and the participating entities on their knowledge of local natural hazards. One goal of the survey is to gauge impacts to the citizens of the planning area from previous natural disasters. Another purpose of this survey is to provide information *to* the citizens about local hazards and convey strategies to reduce loss of life and property from future disasters. The Federal Emergency Management Agency (FEMA) requires community involvement in the creation of a hazard mitigation plan to:

- Increase education and awareness around threats, hazards, and vulnerabilities;
- Build partnerships for risk reduction involving government, organizations, businesses, and the public;
- Identify long-term, broadly-supported strategies for risk reduction;
- Align risk reduction with other state, tribal, or community objectives;
- Identify implementation approaches that focus resources on the greatest risks and vulnerabilities; and
- Communicate priorities to potential sources of funding.

The '*Public Survey for the Brazos County and Participating Entities Hazard Mitigation Plan Update – 2017*' (Community Survey) was designed for citizens to share their opinions and participate in the mitigation planning process. Responses to the Community Survey give emergency managers, hazard mitigation planning committee members, and elected officials a snap shot of information about the survey respondents and their concerns as well as provide an opportunity to compare this information to Brazos County and participating entities as a whole. Community involvement in the Brazos County Hazard Mitigation Plan Update is a requirement for a FEMA approved-hazard mitigation plan. A FEMA-approved hazard mitigation plan enables Brazos County and participating entities to receive certain types of non-emergency disaster assistance. This funding is used to complete hazard mitigation projects to reduce the loss of life and property and reduce the impacts of disasters within the planning area.

Information to be collected:

The Community Survey includes questions to gather information on public perception of hazard risks within the Brazos County and participating entities. Other questions in the survey aim to identify previous citizen experiences from disaster impacts. Brazos County and participating entities officials requested that a particular focus be given to floods and flooding hazards. Officials also requested information on how citizens receive warnings regarding severe weather events. In regard to these requests, the survey included questions directed at collecting these types of data from the respondents. Basic information, such as the respondent's zip code and simple demographics, was collected to help officials better understand who was received the survey. Officials will then better understand which populations are underrepresented or missing from the survey responses. As a result, future distribution channels and methods of data collection will have an opportunity for improvement and encourage a greater and more diverse sample of the population of the planning area.

Development of the survey instrument:

In order to develop the survey instrument, several activities were undertaken. First, examples of past hazard mitigation survey instruments were collected from a variety of sources including Galveston, Texas, San Leandro, California, and Fort Bend County, Texas.

Once the initial draft was developed the survey was distributed to emergency managers and other city and county officials for review and comments. Two separate meetings were held with emergency managers and officials to review the survey and make revisions. Concern with the difference between perceived risk by the public and the actual risk to the public was expressed by the survey developers therefore, questions to help understand this paradigm were created and included in the survey. The thought behind this was, for example, to identify respondents that might not perceive flooding as a risk yet they reside in a flood zone. Consequently, these findings would be used to target areas within the County where officials will provide public education on actual local risks and deliver information about achievable mitigation strategies aimed to help reduce the loss of life and property from future disasters. Questions were designed to help guide the respondent in giving comprehensive answers yet stay within measurable bounds. This was done in an effort to help quantify the various responses and later visualize the percentages of the answers given. By providing charts and graphs depicting survey responses, officials and the public will have the opportunity to quickly assess where they stand on perceived risks and recognize what actual risks exist within the County. The visuals also aid in identifying areas within the County where public outreach will be directed and where additional mitigation strategies need to be applied.

The survey as distributed to the public follows on the next 11 pages.

Public Survey for the Brazos County Hazard Mitigation Plan Update - 2017

1. The Purpose of This Survey

Brazos County is working to become less vulnerable to natural disasters, and your participation in this planning process is important to us!

Our County, along with local jurisdictions and other partners (including but not limited to the cities of Bryan, College Station, Kurten, Wixon Valley and Texas A&M University), are working to prepare an update to our current Hazard Mitigation Plan. This plan identifies and assesses our community's natural hazard risks and develops strategies and actions to minimize or manage those risks.

Having an established Hazard Mitigation Plan is important to citizens in that it helps to reduce flood insurance rates, reduces damage/loss to personal property and creates the ability to apply for recovery funds should a Federal Disaster Declaration be issued.

The following survey will help you share your opinions and participate in our mitigation planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that should help lessen the impacts of future hazard events.

The anticipated draft of our Hazard Mitigation Plan Update is expected Fall 2016 and is due for finalization by FEMA in November 2017.

Public Survey for the Brazos County Hazard Mitigation Plan Update - 2017

2. As we update our Brazos County Hazard Mitigation Plan, we need to hear from you!

There are two easy ways you can help:

1. Take this survey! (Please submit by August 30, 2016). Your answers will help our Hazard Mitigation Planning Committee determine our community's concerns and questions about the plan and guide discussion during the revision process.

2. Attend the public meetings! At least one to two public meetings will be held during the process (there will be a page at the end of the survey for you to provide your contact information to receive updates!). These meetings will provide you with an opportunity to learn more about the hazard mitigation plan, ask questions, and make comments.

Thank you for your participation and input! Please encourage your neighbors to also participate!

*****One survey per household, please*****

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Public Survey for the Brazos County Hazard Mitigation Plan Update - 2017

3. Brazos County Hazard Mitigation Plan Update Questions:

Please answer the following questions based on where you live.

1. How concerned are you about your area being impacted by a natural disaster? (Click for more information, then choose one answer)

- ◯ Extremely concerned
- ◯ Somewhat concerned
- ◯ Not concerned

2. Have you ever experienced a natural disaster? (Click for more information, then choose one answer)

- ◯ Yes
- ◯ No

3

3. Which of the following natural hazard(s) have you experienced while living in Brazos County that have resulted in structural damage, personal displacement, loss of utility services for more than 24 hours, or other issues? (Choose all that apply)

- [ ] Flood
- [ ] Winter Storm
- [ ] Tornado
- [ ] Urban/Wildfire
- [ ] Hurricane
- [ ] Dam Failure
- [ ] Windstorm/Thunderstorm
- [ ] Lightning
- [ ] Hail
- [ ] Drought
- [ ] Excessive/Extreme Heat
- [ ] Expansive Soils

Other (please specify)

* 4. Do you rent or own the place where you live? (Choose one)

- ◯ Own (Includes holding a mortgage)
- ◯ Rent
- ◯ Other (please specify)

4

5. Please select the housing type that best describes your dwelling. (Choose one)

- ◯ Single-family home
- ◯ Duplex
- ◯ Apartment
- ◯ Condominium or Townhome
- ◯ Manufactured Home (modular)
- ◯ Mobile Home or Trailer

Other (please specify)

6. Is your home in a floodplain? Floodplains are areas that are vulnerable to flooding and are identified by the Federal Emergency Management Agency (FEMA) through the National Flood Insurance Program (NFIP). Click HERE to go the the FEMA Flood Map website. (Please choose one answer)

- ◯ Yes, my home is located in a floodplain.
- ◯ No, my home is not located in a floodplain.
- ◯ I am unsure if my home is located in a floodplain.

7. Do you have flood insurance? Flood insurance is not included in a standard home owner's insurance policy/renter's insurance policy and must be purchased separately. (Choose one)

- ◯ Yes, I have flood insurance.
- ◯ No, I do not have flood insurance.
- ◯ I am not sure if I have flood insurance.

Flood Insurance is available to the residents of our county. Please click HERE for more information on the FEMA National Flood Insurance Program.

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8. If you do not have flood insurance, why? (Choose all that apply)

- [ ] I am not located in a floodplain.
- [ ] Flood insurance is too expensive.
- [ ] Flood insurance is not necessary because it does not flood in my area.
- [ ] Flood insurance is not necessary because my home is elevated or otherwise protected.
- [ ] My mortgage did not require flood insurance.
- [ ] I have never really considered flood insurance.

Other (please specify)

9. Please indicate how concerned you are that your neighborhood would be impacted by these natural hazards.

	Extremely Concerned	Somewhat Concerned	Not Concerned
Flood	○	○	○
Winter Storm	○	○	○
Tornado	○	○	○
Urban/Wildfire	○	○	○
Hurricane	○	○	○
Dam Failure	○	○	○
Windstorm/Thunderstorm	○	○	○
Lightning	○	○	○
Hail	○	○	○
Drought	○	○	○
Excessive/Extreme Heat	○	○	○
Expansive Soils	○	○	○

10. Natural hazards can have significant impacts, but planning for these impacts can help to reduce them. The following statements will help determine citizen priorities regarding planning for natural hazards. Thinking about the community as a whole, how important are the following priorities? (Choose one per row)

	Very Important	Somewhat Important	Not Very Important
Protecting private property	○	○	○
Protecting critical facilities (i.e. Hospitals, Fire Stations, etc.)	○	○	○
Protecting "Life-lines" (i.e. Utilities such as water, electric, natural gas, etc.)	○	○	○
Protecting critical infrastructure (i.e. Bridges, Transportation Routes, etc.)	○	○	○
Preventing development in hazard prone areas	○	○	○
Protecting natural features like wetlands and streams that can reduce flooding	○	○	○
Protecting cultural and historical landmarks	○	○	○
Strengthening emergency response services	○	○	○
Enhancing public education on natural hazards that can impact our area	○	○	○
Signage to identify flood-prone areas within our community	○	○	○

11. Disasters occur at different times of the day. Are you aware of local school, business or religious organization emergency plans? (Choose one)

- ○ Yes, I am familiar with these emergency plans.
- ○ I am somewhat aware of these emergency plans.
- ○ I am not familiar with other emergency plans.

12. Families may want to have household plans for a variety of events. Which of the following has your family planned for? (Choose all that apply)

- [ ] Flood
- [ ] Winter Storm
- [ ] Tornado
- [ ] Urban/Wildfire
- [ ] Hurricane
- [ ] Dam Failure
- [ ] Windstorm/Thunderstorm
- [ ] Lightning
- [ ] Hail
- [ ] Drought
- [ ] Excessive/Extreme Heat
- [ ] Expansive Soils

Please click HERE to find out more about how to help your family plan for a variety of events.

Our county has the Brazos County Emergency Notification System. If you do not subscribe to this service, please follow this link to enter your information to receive emergency notifications.

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13. How do you receive warnings regarding severe weather events? (Please choose all that apply)

- [ ] Television
- [ ] Radio
- [ ] Brazos County Emergency Notification System
- [ ] Texas A&M's Code Maroon Notification System
- [ ] NOAA Weather Radio
- [ ] Cell Phone Services / Apps
- [ ] Social Media (Facebook, Twitter, etc.)
- [ ] Cable TC System Alerts

Other (please specify)

14. What would be the most effective way for you to receive information about how to make your home and neighborhood more aware and better prepared for natural hazards? (Please check all that apply)

- [ ] Local Newspaper
- [ ] Television or Local Town Cable Channel
- [ ] Radio
- [ ] Information on Utility Bills
- [ ] Direct Mailings
- [ ] Email
- [ ] County/City/Town Website
- [ ] County/City/Town Meetings
- [ ] School Meetings and/or Messages
- [ ] Information at Local Library
- [ ] Roadside Message Boards
- [ ] Emergency Notification System (Phone or Text Message)
- [ ] Social Media (Facebook, Twitter, etc.)

Here are a few questions to answer about yourself and your household.

9

15. What is your zip code?

16. With which do you identify as?

- ◯ Male
- ◯ Female

17. What is the highest level of education completed by any household member?

- ◯ No High School Diploma
- ◯ High School Diploma
- ◯ Some College
- ◯ Trade-Specific Certificate / Associate Degree
- ◯ Bachelor Degree
- ◯ Master Degree or Higher

18. Including yourself, please indicate the number of people in each age range that live in your household.

12 and under	
13 - 18	
19 - 64	
65 and over	

19. What is the current marital status of the head of household?

- ◯ Single
- ◯ Married/Domestic Partnership
- ◯ Separated/Divorced
- ◯ Widowed

20. Considering all the members of your household what is the highest number of years any member has been a resident of Brazos County?

21. Please choose which best describes your race.

- ◯ White
- ◯ Black
- ◯ Asian
- ◯ Other (please specify)

22. Are you of Hispanic origin? (Note: Hispanic origin can be viewed as the heritage, nationality, lineage, or country of birth of the person or the person's parents or ancestors before arriving in the United States. People who identify as Hispanic, Latino, or Spanish may be any race - US Census)

- ◯ Yes
- ◯ No

THANK YOU FOR YOUR PARTICIPATION! The survey may be submitted anonymously. However, if you would like to receive information regarding upcoming public meetings for the Brazos County Hazard Mitigation Plan Update, please provide your name and contact information.

23. Your Contact Information: (Optional)

Name:

Address:

Phone:

Email:

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How the Survey was conducted:

Survey Distribution

The Community Survey was distributed to the citizens of Brazos County and participating entities through a variety of means including paper copies distributed at public meetings and events, in public locations such as libraries and City Halls, and digitally through an online form available by hyperlink located on publically-accessible websites. This hyperlink to the online survey was also sent via email to Brazos County employees and employees of the City of Bryan and the City of College Station. The table below indicates the form of distribution used throughout the planning area.

	County-wide	Brazos County	City of Bryan	City of College Station	Texas A&M University
Paper Copies at Public Locations	x				
Paper Copies at Public Meetings	x				
Paper Copies at Public Events	x				
Digital Copy via Website		x	x	x	x
Digital Copy via Email	x	x	x	x	

A digital copy of the survey was available by following the hyperlink - https://www.surveymonkey.com/r/BCHMPUpdate from either an email sent to a city or county employee or by visiting one of the websites listed below:

- brazosceoc.org
- www.cstx.gov
- www.bryantx.gov
- www.tamu.edu

Survey Data Entry

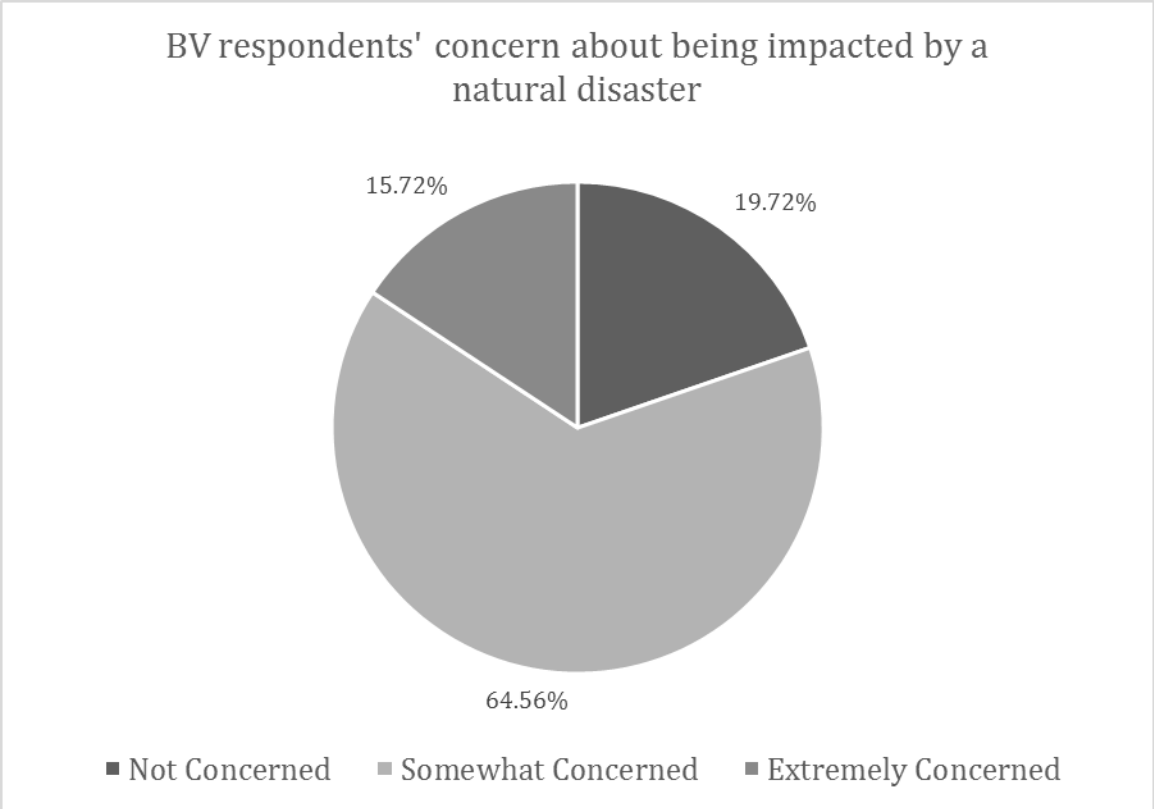
Responses to the survey submitted via digital means (hyperlinks available on websites and through email) were captured and recorded through the SurveyMonkey website (www.surveymonkey.com). Responses to the survey submitted via printed means were entered into the digital format of the survey and added to the SurveyMonkey website totals. By the closing date of the survey there were a total of 653 responses (digital and print combined) which were recorded and saved for analysis.

Survey results for questions 1 through 15 are detailed on the following pages.

Community Survey Results:

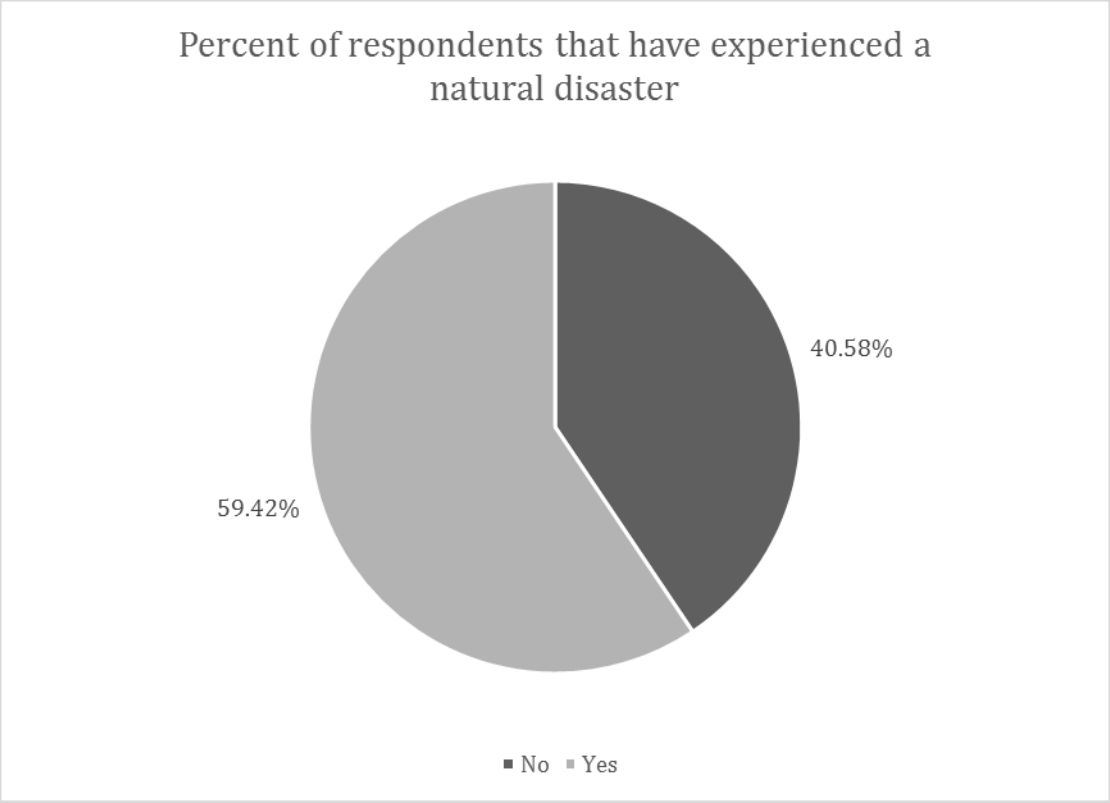
1. **How concerned are you about your area being impacted by a natural disaster?**

Concern about being affected by a natural disaster?	**Frequency**	**Percent**	**Cumulative**
Not Concerned	128	19.72%	19.72%
Somewhat Concerned	419	64.56%	84.28%
Extremely Concerned	102	15.72%	100.00%
Total	649	100.00%	



2. **Have you ever experienced a natural disaster?**

Have you ever experienced a natural disaster?	Frequency	Percent	Cumulative
No	265	40.58%	40.58%
Yes	388	59.42%	100.00%
Total	653	100.00%	



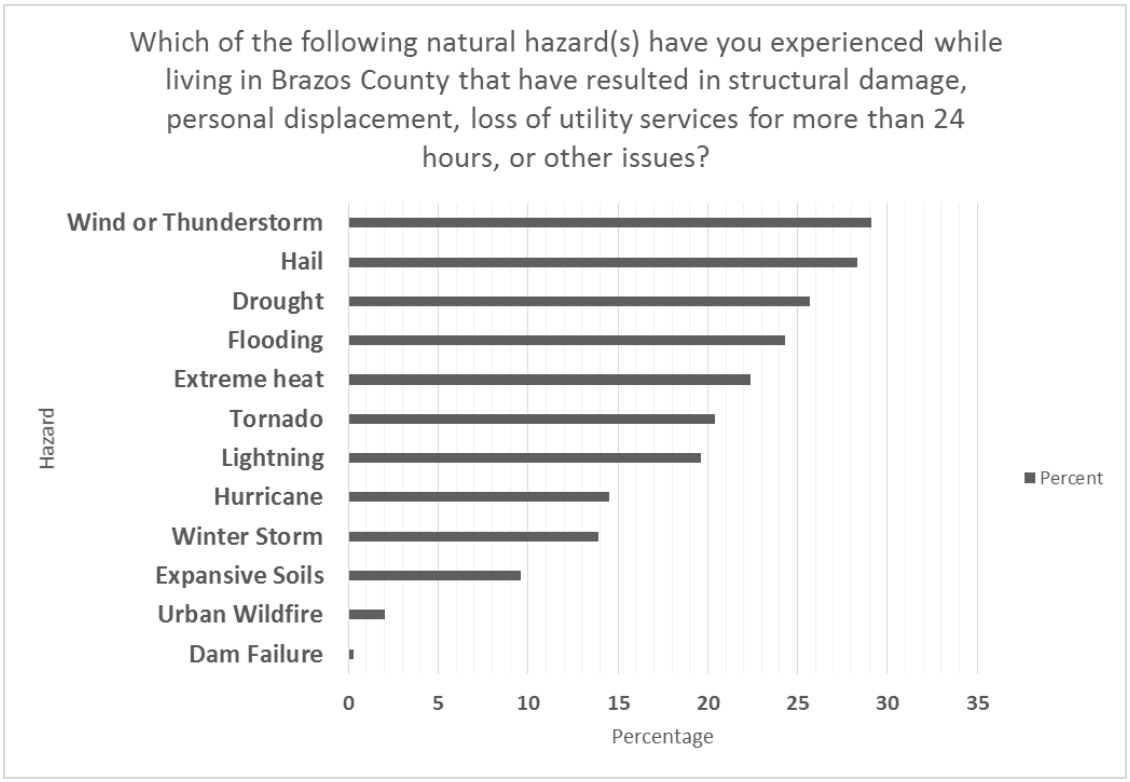
3. **Which of the following natural hazard(s) have you experienced while living in Brazos County that have resulted in structural damage, personal displacement, loss of utility services for more than 24 hours, or other issues?**

Respondents were asked to indicate which of the following natural hazards they have "experienced" – with quite detail examples of experience, to frame their answers. The responses were simple yes (1) or no (0) answers. So, if a mean or average is calculated, that indicates the proportion of respondents experiencing a particular natural hazard. The following table rank orders the responses, indicating the most likely to least likely natural hazards experienced by the respondents to this survey.

Natural Hazard	**Percent**
Wind or Thunder Storm	29.1%
Hail	28.3%
Drought	25.7%
Flooding	24.3%
Extreme Heat	22.4%
Tornado	20.4%
Lightning	19.6%
Hurricane	14.5%
Winter Storm	13.9%
Expansive Soils	9.6%
Urban Wildfire	2.0%
Dam Failure	.3%

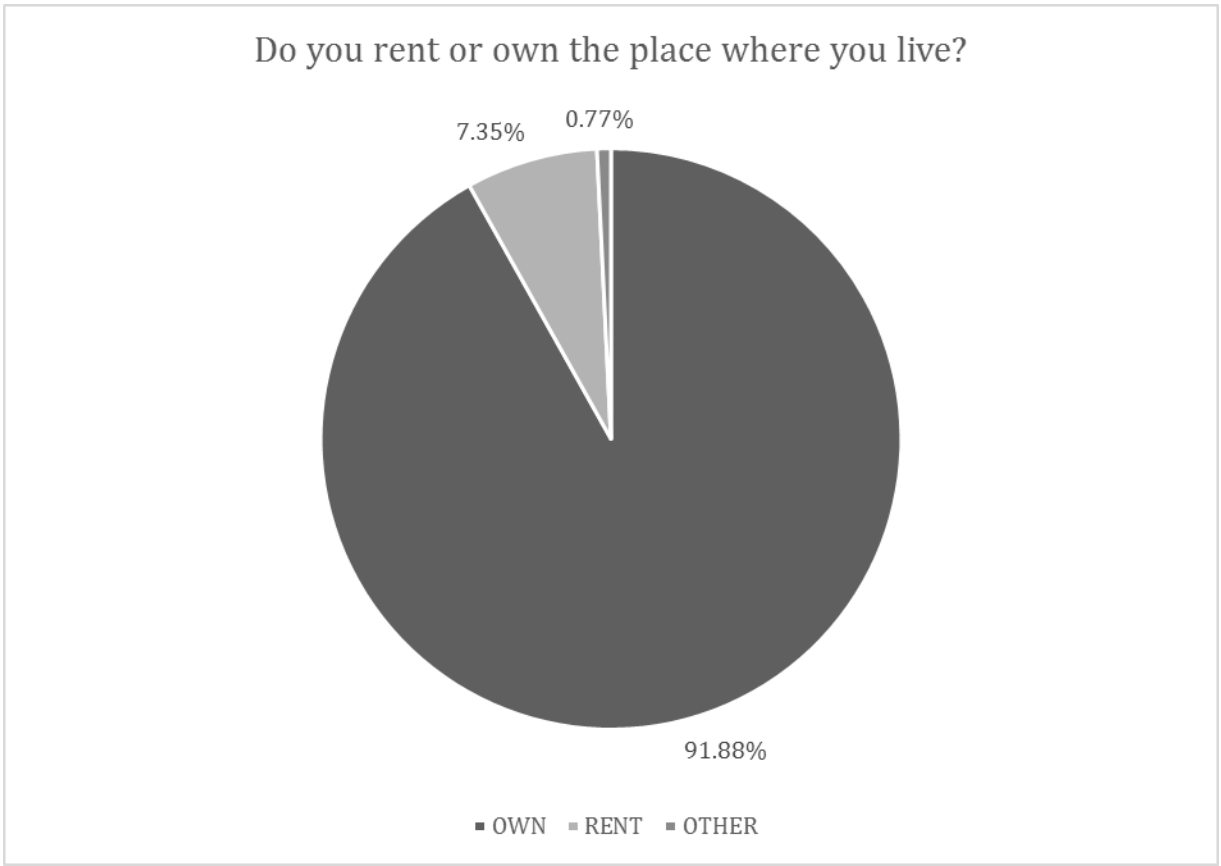
Please see chart of results on following page.

As can be seen from the chart below, the highest proportion of nearly 30% reported having experienced a wind/thunder storm, 28.3% hail, 25.7% drought, etc. Dam failure was the hazard least experienced by the respondents at .3%.



4. **Do you rent or own the place where you live?**

Do you own or rent the place where you live?	Frequency	Percent	Cumulative
Own	600	91.88%	91.88%
Rent	48	7.35%	99.23%
Other	5	0.77%	100.00%
Total	653	100.00%	



5. Please select the housing type that best describes your dwelling.

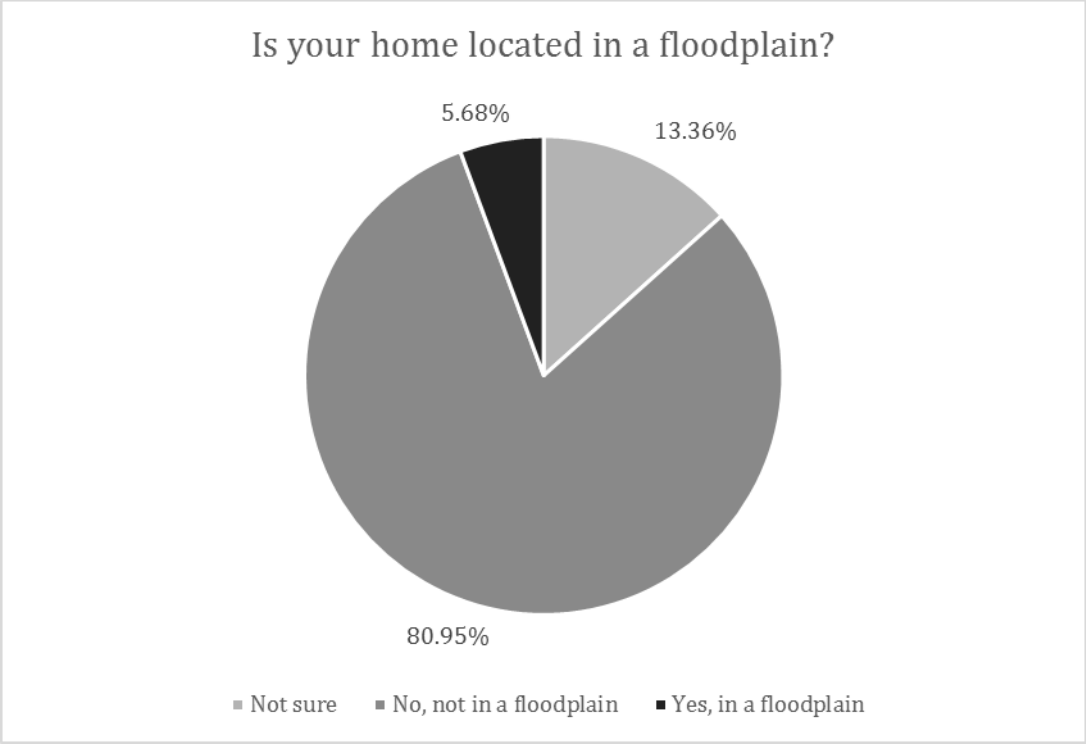
Type of Home	Frequency	Percent	Cumulative
Single Family	601	92.18%	92.18%
Duplex	5	0.77%	92.94%
Apartment	12	1.84%	94.79%
Condo/Townhome	9	1.38%	96.17%
Manufactured Home	25	3.83%	100.00%
Total	652	100.00%	

Tenure by Ownership:

	Do you own or rent the place where you live?			
Type of Home	**Own**	**Rent**	**Other**	**Total**
Single Family	574	22	5	601
Row Percentage	*95.51%*	*3.66%*	*0.83%*	*100.00%*
Column Percentage	*95.83%*	*45.83%*	*100.00%*	*92.18%*
Duplex	1	4	0	5
Row Percentage	*20.00%*	*80.00%*	*0.00%*	*100.00%*
Column Percentage	*0.17%*	*8.33%*	*0.00%*	*0.77%*
Apartment	0	12	0	12
Row Percentage	*0.00%*	*100.00%*	*0.00%*	*100.00%*
Column Percentage	*0.00%*	*25.00%*	*0.00%*	*1.84%*
Condo/Townhome	5	4	0	9
Row Percentage	*55.56%*	*44.44%*	*0.00%*	*100.00%*
Column Percentage	*0.83%*	*8.33%*	*0.00%*	*1.38%*
Manufactured Home	19	6	0	25
Row Percentage	*76.00%*	*24.00%*	*0.00%*	*100.00%*
Column Percentage	*3.17%*	*12.50%*	*0.00%*	*3.83%*
Total	599	48	5	652
	91.87%	*7.36%*	*0.77%*	*100.00%*
	100.00%	*100.00%*	*100.00%*	*100.00%*

6. **Is your home in a floodplain? Floodplains are areas that are vulnerable to flooding and are identified by the Federal Emergency Management Agency (FEMA) through the National Flood Insurance Program (NFIP).**

Is your home located in a floodplain?	Frequency	Percent	Cumulative
Not Sure	87	13.36	13.36
No, not in a floodplain	527	80.95	94.32
Yes, in a floodplain	37	5.68	100.00
Total	651	100.00	



7. **Do you have flood insurance? Flood insurance is not included in a standard home owner's insurance policy/renter's insurance policy and must be purchased separately.**

Do you have flood insurance?	Frequency	Percentage	Cumulative
Not Sure	49	7.55%	7.55%
No Flood Insurance	512	78.89%	86.44%
Yes, I have Flood Insurance	88	13.56%	100.00%
Total	649	100.00%	

7.1 Flood insurance by owning and renting:

This table suggests that both renters and homeowners *that responded to the survey* are carrying flood insurance.

	Do you own or rent the place where you live?			
Do you have flood insurance?	**Own**	**Rent**	**Other**	**Total**
Not Sure	41	7	1	49
%	6.88%	14.58%	20.00%	7.55%
No Flood Insurance	477	31	4	512
%	80.03%	64.58%	80.00%	78.89%
Yes, I have Flood Insurance	78	10	0	88
%	13.09%	20.83%	0.00%	13.56%
Total	596	48	5	649
%	100%	100%	100%	100%

7.2 How about the relationship between having (and not having) flood insurance when the respondent says their home is location in a floodplain?

This table is specific to the people indicating that they are in a floodplain:

	Do you own or rent the place where you live?			
Do you have flood insurance?	**Own**	**Rent**	**Other**	**Total**
Not Sure	2	1	0	3
%	6.67%	16.67%	0.00%	8.11%
No Flood Insurance	11	3	1	15
%	36.67%	50.00%	100.00%	40.54%
Yes, I have Flood Insurance	17	2	0	19
%	56.67%	33.33%	0.00%	51.35%
Total	30	6	1	37
%	100%	100%	100%	100%

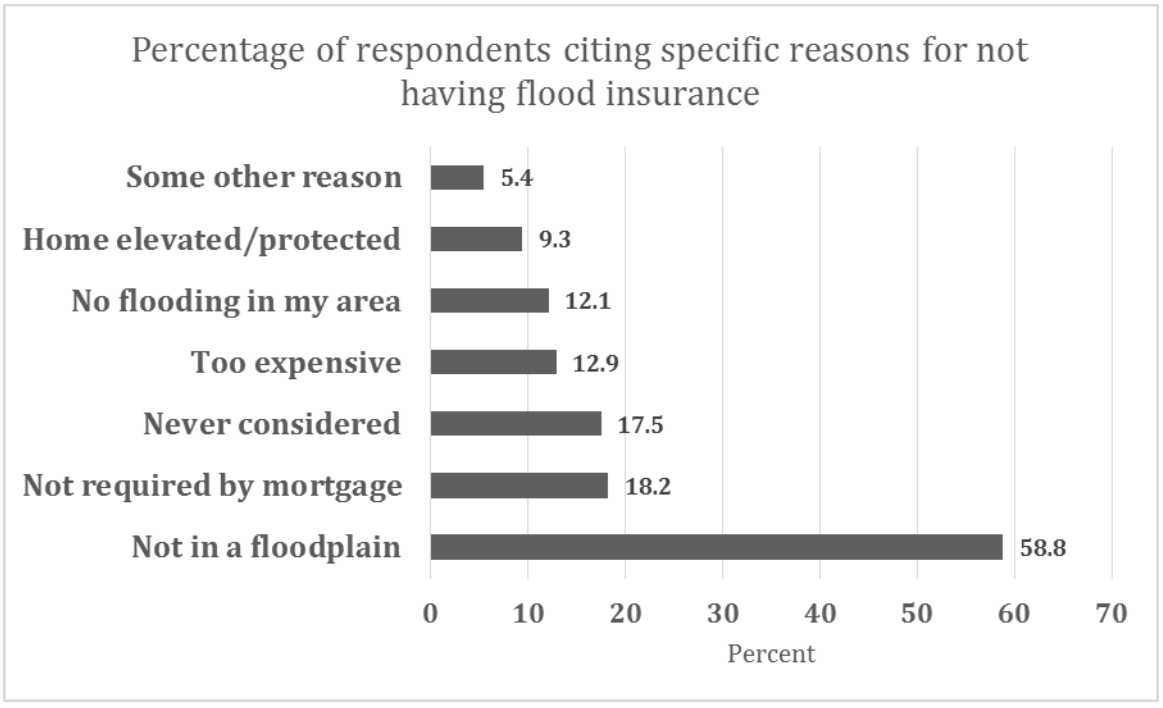
** Note - There are 15 of the 37 respondents (51.4%) that report knowing they are in a floodplain but, DO NOT have flood insurance.*
** Note - This includes 17 of 30 homeowners (56.7%) and 2 of 6 (33.3%) renters.*
** Again, be cautious, since this is not a random sample, it is unknown if these figures hold true for the full population of Brazos County and participating entities.*

8. If you do not have flood insurance, why?

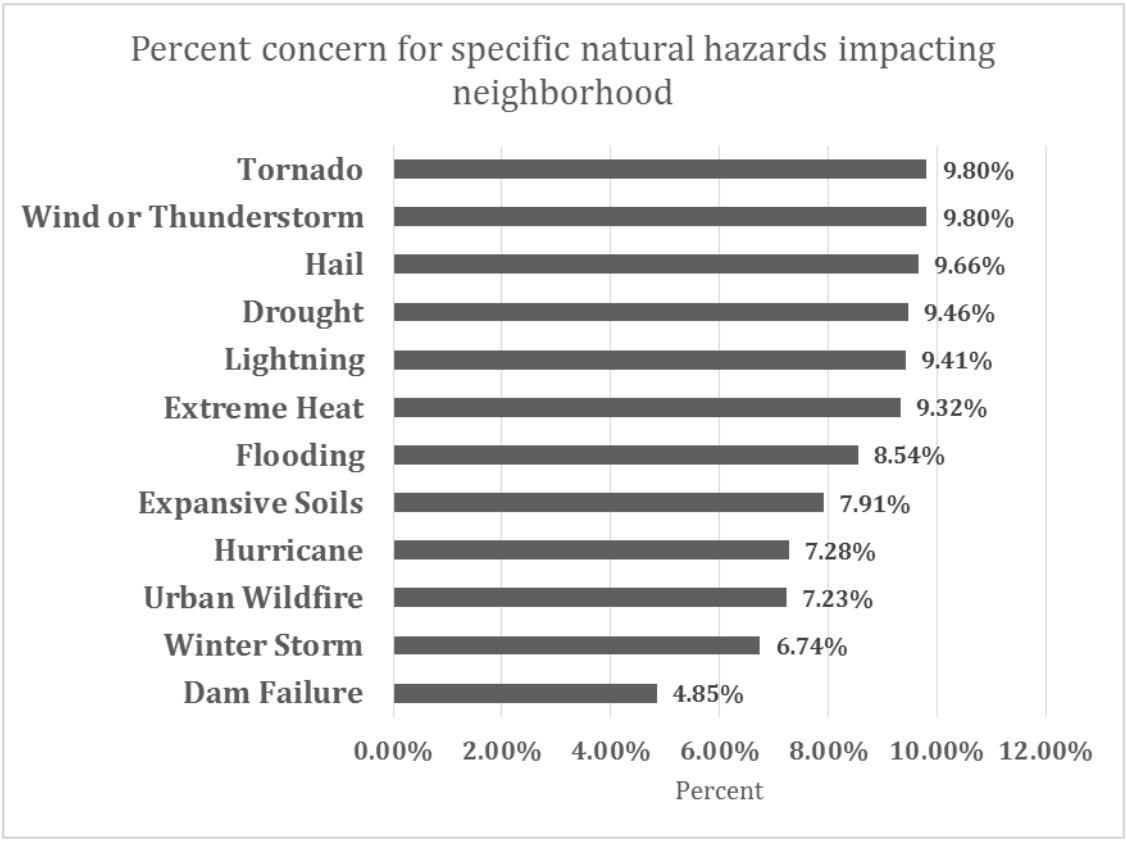
The following table summarizes the detail tables below – it presents the proportion of respondents that indicated specific reasons for not having flood insurance. This is for both homeowners and renters.

The highest proportion of respondents, reported that they did not have flood insurance because they do not think they are located in a floodplain. This may or may not be technically correct, but they believe they are not in a floodplain, and that is the main reason they report not having flood insurance.

Reason For No Flood Insurance?	Percent
Not in a floodplain	58.8%
Not required by mortgage	18.2%
Never considered	17.5%
Too expensive	12.9%
No flooding in my area	12.1%
Home is elevated or protected	9.3%
Some other reason	5.4%



9. **Please indicate how concerned you are that your neighborhood would be impacted by these natural hazards.**

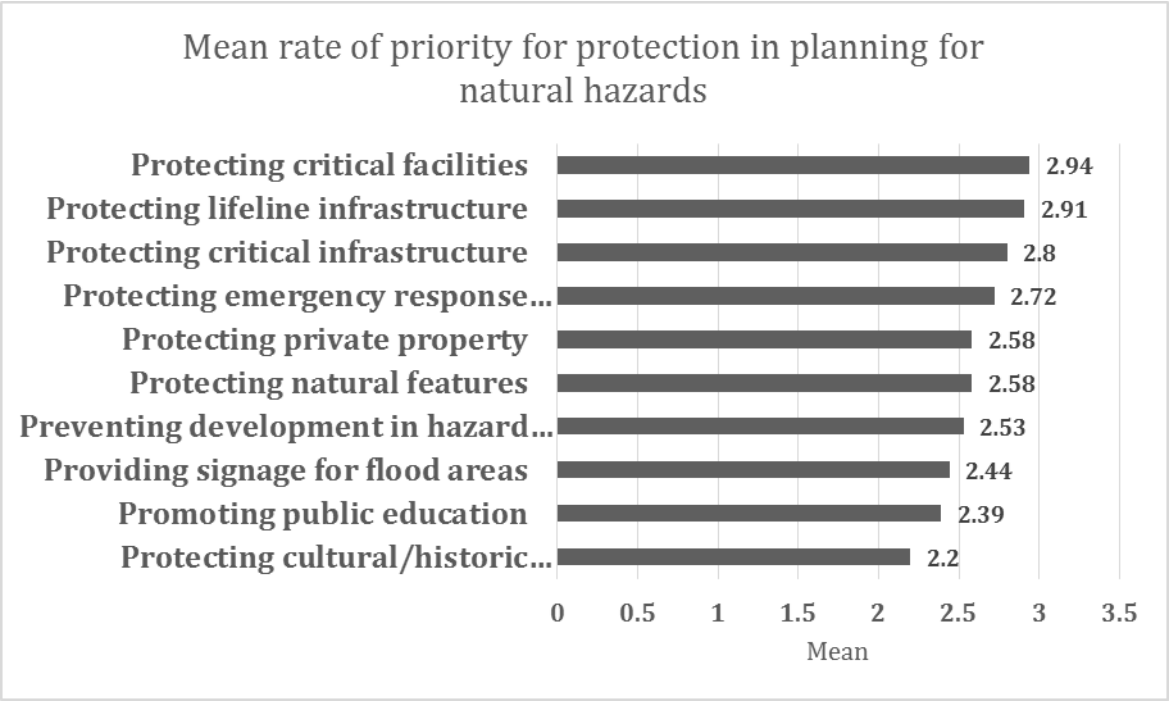


****Respondents were asked to rate between Not Concerned (1) at all to Extremely concerned (3).*
However, a variable number of respondents did not rate some of these at all such as the 19 that did not rate tornados and 50 that did not rate wildfires.
These were left in with a value of 0, which would deflate the ratings, perhaps better capturing the overall concern of this group of respondents.
In general, therefore, the higher the rating, the greater the concern over each of these natural hazards for this particular group of respondents.

10. Natural hazards can have significant impacts, but planning for these impacts can help to reduce them. The following statements will help determine citizen priorities regarding planning for natural hazards. Thinking about the community as a whole, how important are the following priorities?

For this set of questions, respondents were asks to rate how important different criteria or principles were for them when it comes to planning for natural hazards and hazard mitigation. These ranged from private property rights to preserving the environment. Ratings ranged from very important (3) to not very important (1). Again a few (9 to 7) people did not answer some, they were coded with a 0 and left in this analysis. So the table below presents the average importance scoring for each of the criteria or principle rated by these respondents. The closer the value is to 3, the more important the priority when planning for natural hazards.

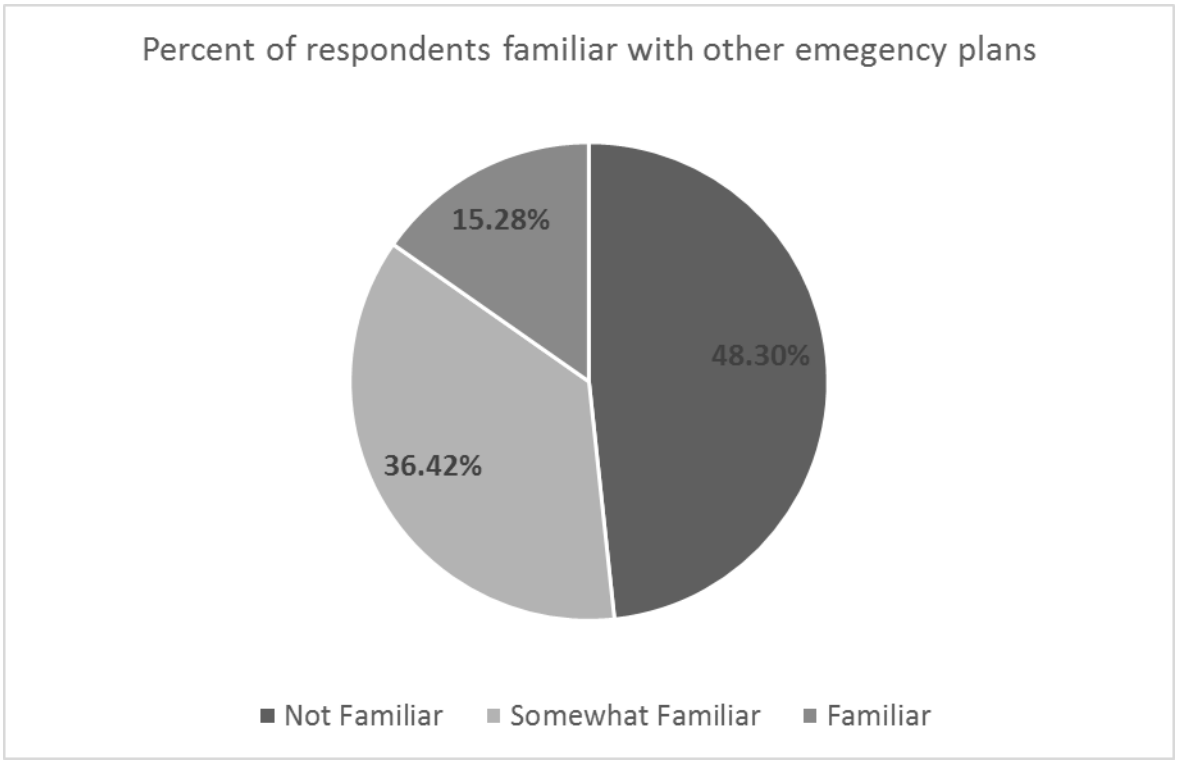
Interestingly protecting critical facilities (hospitals, fire station, etc.) and lifeline infrastructure (utilities) were rated the highest priorities. These were followed by critical infrastructure (bridges, roads, etc.) and emergency response services. Even more interesting, to me, was the virtual tie between protecting private property rights and environmental features such as wetlands. These two are often in conflict – and here they are tied in terms of priorities. The least, but still in the somewhat important range, was protecting cultural and historic landmarks. It is worth noting that signage was a somewhat important priority – something that many in the development community do not want to necessarily see prominently displayed.



11. Disasters occur at different times of the day. Are you aware of local school, business or religious organization emergency plans?

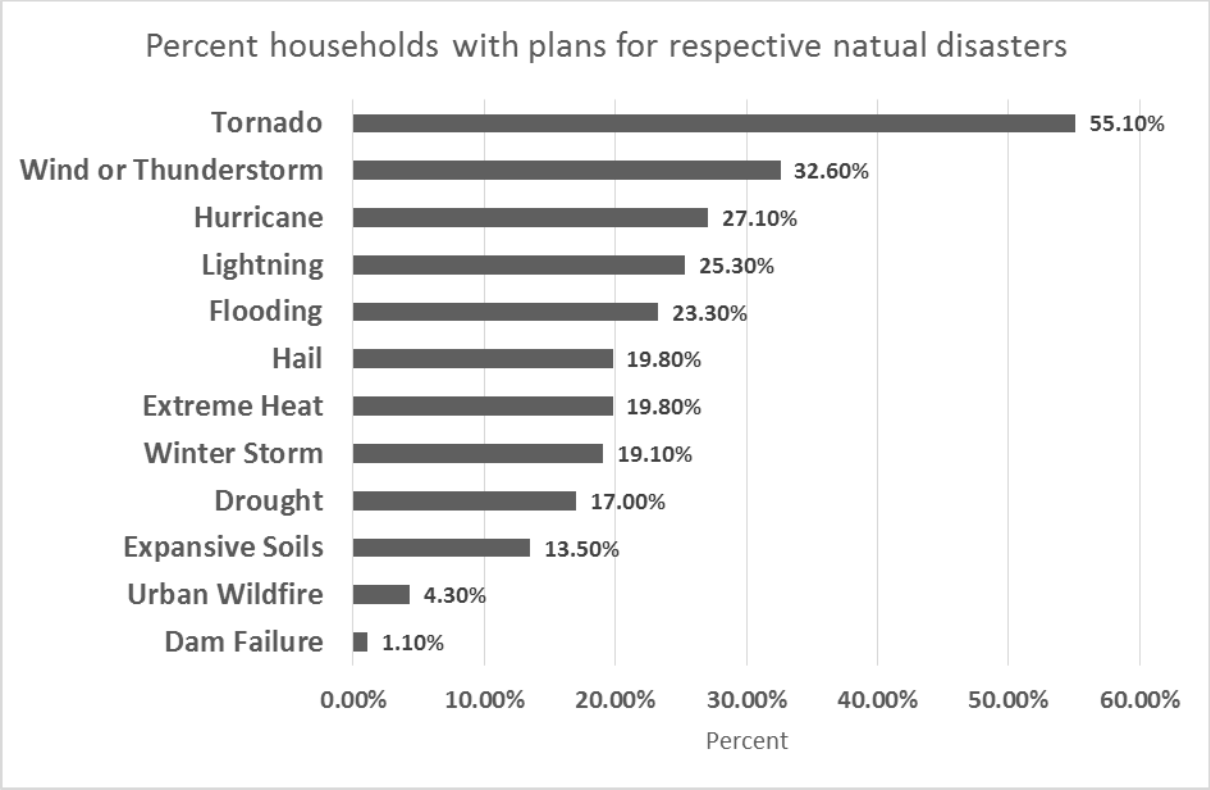
In general there does not appear to be much solid familiarity, but perhaps limited only familiarity with the emergency planning efforts of other organizations in the community among the respondents to this survey.

Familiarity with Emergency Plans of Schools and Religious Organizations?	Frequency	Percent	Cumulative
Not Familiar	313	48.30%	48.30%
Somewhat Familiar	236	36.42%	84.72%
Familiar	99	15.28%	100.00%
Total	648	100.00%	



****In general there does not appear to be much solid familiarity, but perhaps limited only familiarity with the emergency planning efforts of other organizations in the community among the respondents to this survey.*

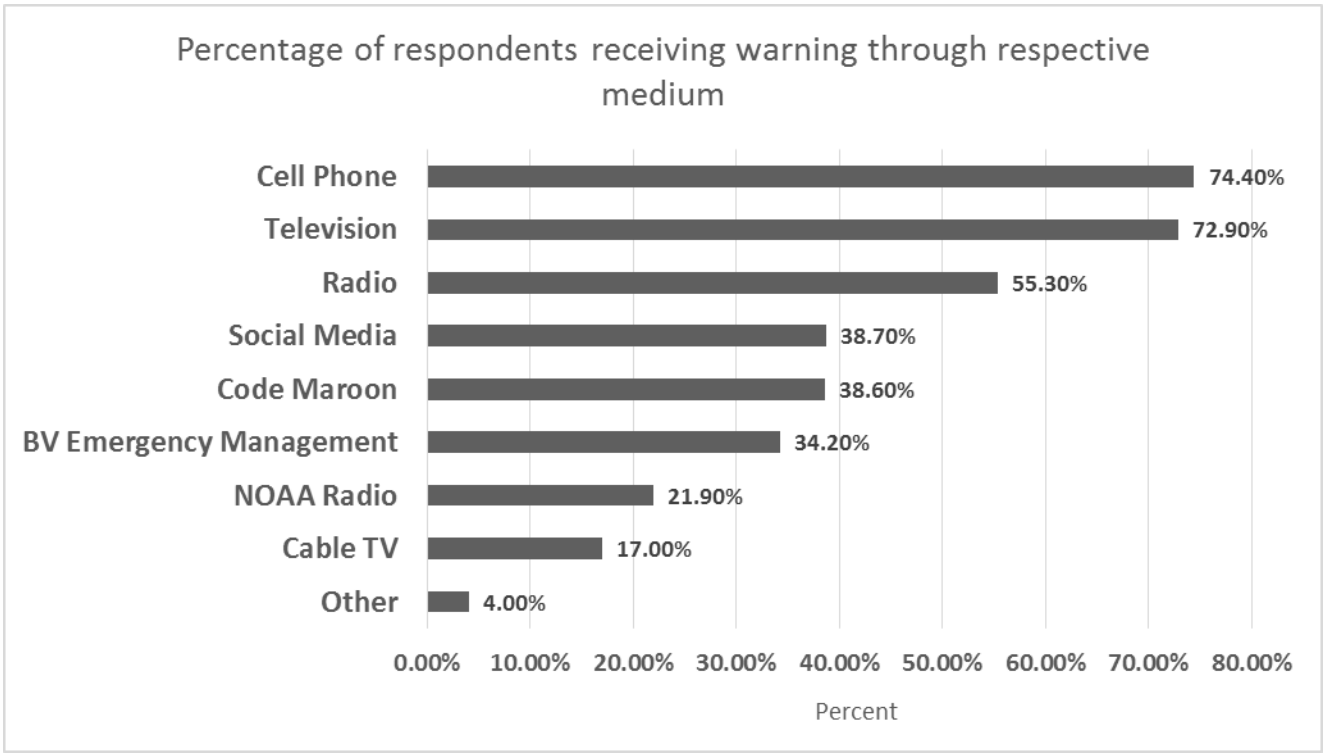
12. Families may want to have household plans for a variety of events. Which of the following has your family planned for?



13. How do you receive warnings regarding severe weather events?

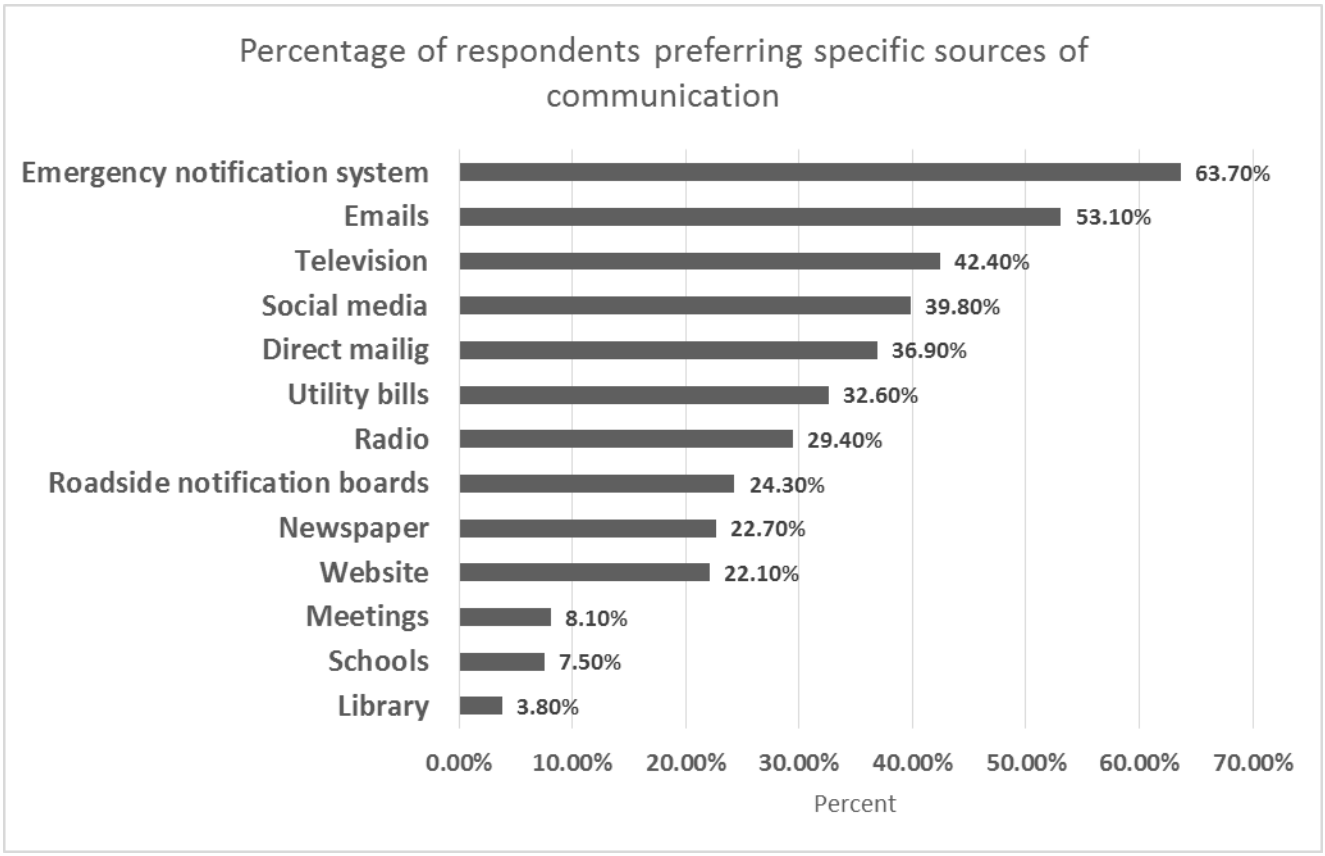
Respondent were asked to indicated how they received sever weather warnings for a specific set of media types. The responses were codes yes (1) or no (0). The following table indicates the percentage of respondents indicating that they receive warnings from each media source. Cell phone and television far surpass other media forms when considering this group of respondents.

Source	Percent
Cell Phone	74.45%
Television	72.90%
Radio	55.30%
Social Media	37.70%
Code Maroon	38.60%
Brazos County Emergency Management	34.20%
NOAA Radio	21.90%
Cable TV	17.00%
Other	4.00%



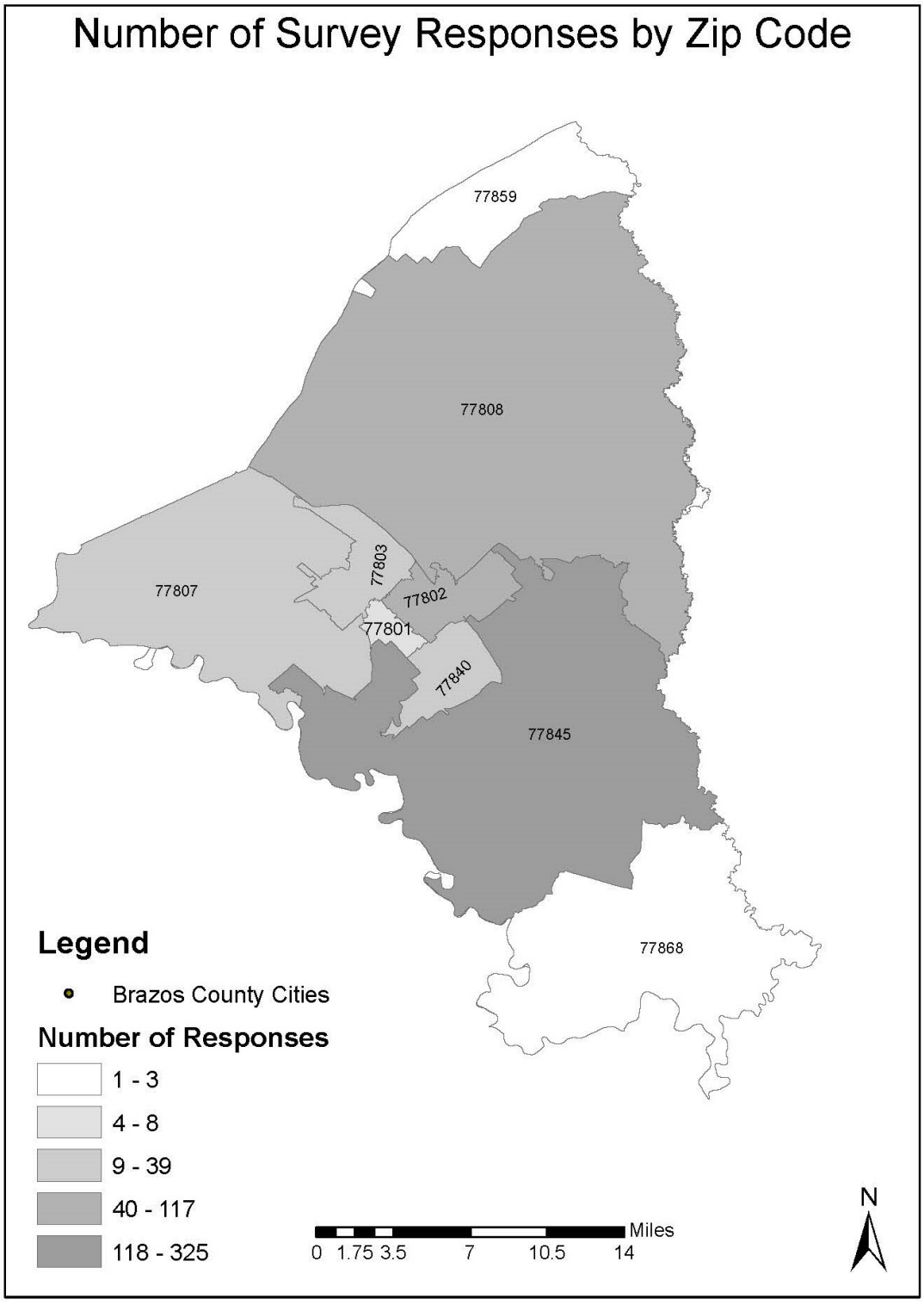
14. What would be the most effective way for you to receive information about how to make your home and neighborhood more aware and better prepared for natural hazards?

Communication Sources	Percent
Emergency Notification System	63.70%
Emails	53.10%
Television	42.40%
Social Media	39.80%
Direct Mailing	36.90%
Utility Bills	32.60%
Radio	29.40%
Roadside Notification Boards	24.30%
Newspapers	22.70%
Website	22.10%
Meetings	8.10%
Schools	7.50%
Library	3.80%


Percentage of respondents preferring specific sources of communication
Emergency notification system
Emails
Television
Social media
Direct mailig
Utility bills
Radio
Roadside notification boards
Newspaper
Website
Meetings
Schools
Library
63.70%
53.10%
42.40%
39.80%
36.90%
32.60%
29.40%
24.30%
22.70%
22.10%
8.10%
7.50%
3.80%
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
Percent

15. Zip code

The map below shows a breakdown of the number of survey responses received from each zip code within Brazos County.



Strengths and limitations of the survey:

As with any data collection method there are advantages and disadvantages to the process and the results. The '*Public Survey for the Brazos County Hazard Mitigation Plan Update – 2017*' proved to garner more information from public participation than the previous survey conducted in 2012. Although over 650 community members responded to the survey, it must be noted that the data presented reflects only the responses of the survey-takers and may not accurately reflect the County as a whole. The survey results have helped local officials better understand some of the community's perceived risks and in turn, this information will help to provide education to the residents that will create better preparedness and assist in the implementation of mitigation actions.

Conclusions:

Public participation during the drafting stage of the planning process is required in the guidelines laid out by the Federal Emergency Management Agency (FEMA) as part of an acceptable Plan. At the same time, the intent of the survey is to provide the citizens of Brazos County and participating entities an opportunity to offer input on community vulnerabilities and mitigation activities and for officials to inform the citizens as to what the community is doing on their behalf.

APPENDIX C: LOCAL HAZARD MITIGATION TEAM

Michele Meade	EMC, Emergency Management, Brazos County
Jason Ware	Deputy EMC, Emergency Management, Brazos County
Kim Hinton	Floodplain Coordinator, Road & Bridge Department, Brazos County
Megan Lott	GIS Coordinator, Road & Bridge Department, Brazos County
James Hall	Environmental Deputy, Sheriff's Office, Brazos County
Mike Paulus	Emergency Preparedness and Response Coordinator, Brazos County
Roger Sheridan	Manager, Public Safety Planning, Brazos Valley Council of Governments
Robert Santarsiero	Homeland Security Senior Planner, Public Safety Planning, Brazos Valley Council of Governments
Jerry Henry	EMC, Emergency Management, City of Bryan
Johnnie Price	Engineering, Development Services, City of Bryan
Cody Cravatt	Development Manager, Development Services, City of Bryan
Brian Hilton	EMC, Emergency Management, City of College Station
Monica Martinez	EMC, Office of Safety & Security, Texas A&M University
Leslie Lutz	Assistant EMC, Office of Safety & Security, Texas A&M University
Jeff Truss	Assistant Director, EHS, Texas A&M University
Ralph Davila	Director, Facilities, Texas A&M University
Valerie Hadley	Assistant Director, Facilities and Dining Administration, Texas A&M University
Rob Meyer	Supervisor, UES, Texas A&M University

Robert Meyer	Assistant Chief of Police, University PD, Texas A&M University
Shannon Van Zandt	Professor & Interim Head, Landscape Architecture & Urban Planning, Texas A&M University
Walter Peacock	Professor, Landscape Architecture & Urban Planning, Texas A&M University
John T. Cooper	Associate Professor of Practice, Landscape Architecture & Urban Planning, Texas A&M University
Kelly Trietsch-Hall	Graduate Student, Master's Level, Texas A&M University
Jim Soefje	Mayor, City of Wixon Valley
Philip Mundine	Mayor, City of Kurten

APPENDIX D: CRITICAL FACILITIES IN BRAZOS COUNTY AND PARTICIPATING ENTITIES

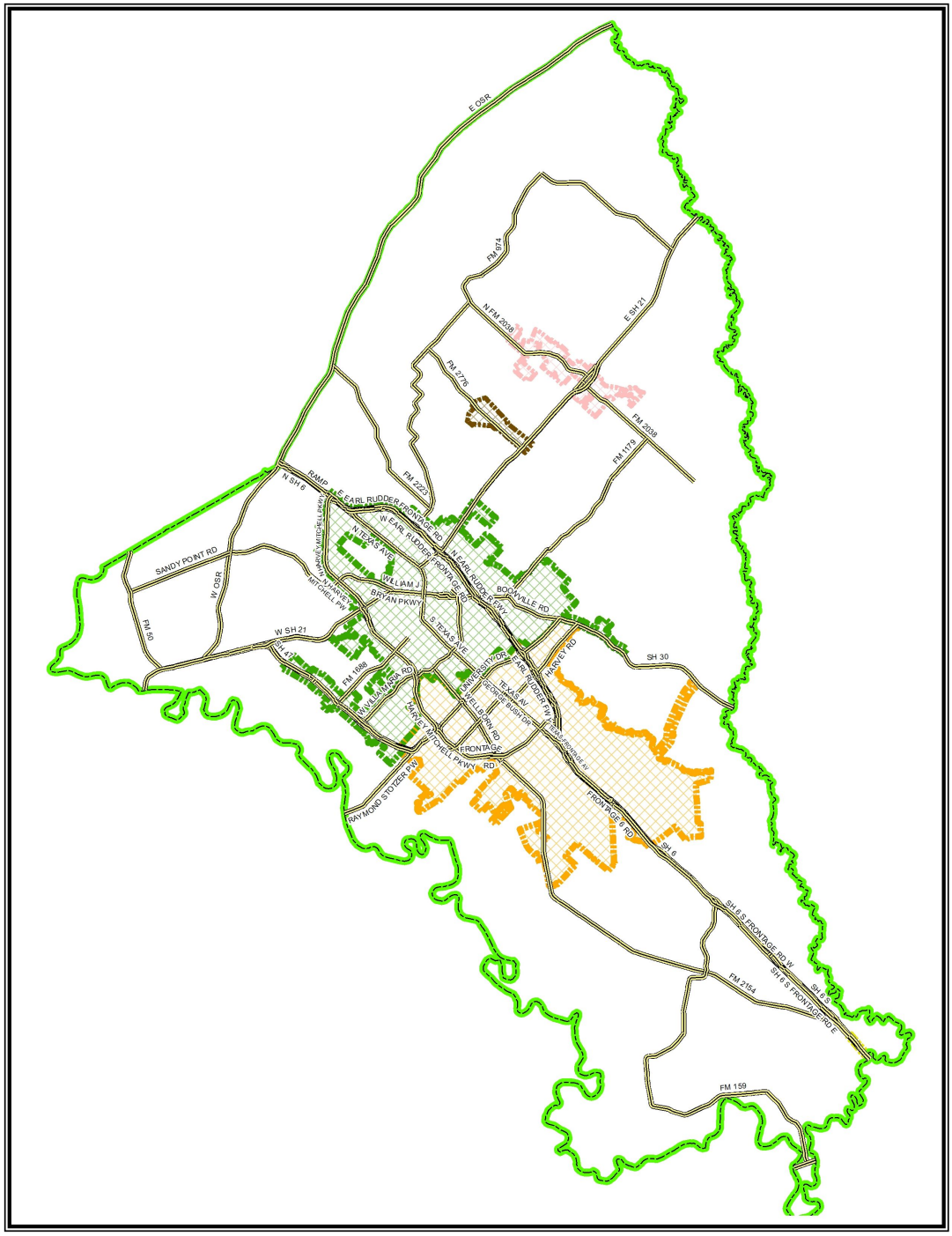
Name	Type	Jurisdiction
Coulter Field	Airport	COB
Easterwood Field	Airport	COCS, TAMU
Brazos Transit District	Bus	COB
Greyhound Bus Station	Bus	COB
Transportation Services	Bus	TAMU
City of Bryan City Hall	City Hall	COB
City of College Station City Hall	City Hall	COCS
City of Wixon Valley City Hall	City Hall	WV
KYLE	Communication	COB
WTAW	Communication	COCS
KEOS	Communication	COB
KNFX-FM	Communication	COB
KKYS	Communication	COB
KORA	Communication	COB
KAMU	Communication	TAMU
KBTX	Communication	COB
Brazos County Courthouse	Courthouse	BC
Bryan Texas Utilities	Electric	COB
College Station Utilities	Electric	COCS
Central Utilities Plant	Electric	TAMU
West Campus Cogeneration Company	Electric	TAMU
Community Emergency Operations Center	Emergency	COB
Kyle Field Command	Emergency	TAMU
College Station Fire Department Station #1	Fire Station	COCS
College Station Fire Department Station #2	Fire Station	COCS
College Station Fire Department Station #3	Fire Station	COCS
College Station Fire Department Station #4	Fire Station	COCS
College Station Fire Department Station #5	Fire Station	COCS
College Station Fire Department Station #6	Fire Station	COCS
Bryan Fire Department Station #1	Fire Station	COB
Bryan Fire Department Station #2	Fire Station	COB
Bryan Fire Department Station #3	Fire Station	COB
Bryan Fire Department Station #4	Fire Station	COB
Bryan Fire Department Station #5	Fire Station	COB
Brazos County District 2 VFD Station #1	Fire Station	BC
Brazos County District 2 VFD Station #2	Fire Station	BC

Brazos County Precinct 3 VFD Station #1	Fire Station	BC
Brazos County Precinct 3 VFD Station #2	Fire Station	BC
Brazos County Precinct 3 VFD Station #3	Fire Station	BC
Brazos County Precinct 4 VFD Station #1	Fire Station	BC
Brazos County Precinct 4 VFD Station #2	Fire Station	BC
Brazos county Precinct 4 VFD Station #3	Fire Station	BC
South Brazos County FD Station #1	Fire Station	BC
South Brazos County FD Station #2	Fire Station	BC
South Brazos County FD Station #3	Fire Station	BC
South Brazos County FD Station #4	Fire Station	BC
Business 6/ Texas Avenue	Highway	BC, COB, COCS
Earl Rudder Freeway/ State Highway 6	Highway	BC, COB, COCS
Farm to Market 50	Highway	BC
Farm to Market 60 (Raymond Stotzer/University Dr)	Highway	BC, COB, COCS
Farm to Market 158 (Boonville Road/ William J. Bryan Parkway)	Highway	COB, BC
Farm to Market 159	Highway	BC
Farm to Market 974 (Tabor Road)	Highway	BC, COB
Farm to Market 1179 (Briarcrest/ Villa Maria)	Highway	COB, BC
Farm to Market 1687 (Sandy Point Road)	Highway	COB, BC
Farm to Market 1688 (Leonard Road)	Highway	COB, BC
Farm to Market 2038	Highway	BC
Farm to Market 2154 (Wellborn Road)	Highway	BC, COB, COCS
Farm to Market 2223 (Old Cameron Ranch Road)	Highway	BC
Farm to Market 2347 (George Bush Dr)	Highway	COCS
Farm to Market 2776	Highway	BC, WV
Farm to Market 2818 (Harvey Mitchell Parkway)	Highway	BC, COB, COCS
Old San Antonio Road (OSR)	Highway	BC
State Highway 21	Highway	BC, COB, WV, Kurten
State Highway 30 (Harvey Road)	Highway	BC, COB, COCS
State Highway 40	Highway	COCS
State Highway 47	Highway	COCS, COB, BC
State Highway 105	Highway	BC
College Station Medical Center	Medical	COCS
St Joseph Regional Health Ctr	Medical	COB
Scott and White	Medical	COCS
The Physician Center	Medical	COB
Rock Prairie Behavioral Health	Medical	COCS

University Emergency Medical Service	Medical	TAMU
City of Bryan Police Department	Police Station	COB
City of College Station Police	Police Station	COCS
Brazos County Sheriff's Office	Police Station	BC
Texas Department of Public Safety	Police Station	COB
University Police Department	Police Station	TAMU
Union Pacific Railroad	Railway bridge	BC, COB, COCS
Burlington Northern Santa Fe	Railway bridge	BC,COB, COCS
A & M Consolidated High School	School	COCS
A&M Consolidated Middle School	School	COCS
Aggieland Country School	School	COCS
Allen Academy	School	COB
Anson Jones Elementary	School	COB
Arthur Davila Middle School	School	COB
Ben Milam Elementary	School	COB
Bonham Elementary	School	COB
Brazos Christian School	School	COB
Bryan Collegiate High School	School	COB
Bryan High School	School	COB
Center For Alternative Learning	School	COCS
College Hills Elementary	School	COCS
College Station High School	School	COCS
College Station Middle School	School	COCS
Cornerstone Christian Academy	School	COB
Creekview Elementary School	School	COCS
Crockett Elementary	School	COB
Cypress Grove Intermediate	School	COCS
Disciplinary Alternative Educational Program	School	COB
Fannin Elementary	School	COB
Forest Ridge Elementary School	School	COCS
Greens Prairie Elementary School	School	COCS
Harmony Science Academy	School	COB
Harvey Mitchell Elementary	School	COB
Henderson Elementary	School	COB
Jane Long Middle	School	COB
Johnson Elementary	School	COB
Kemp Elementary	School	COB
Keystone Montessori School	School	COB
Mary Branch Elementary	School	COB
Mary Catherine Harris School of Choice High School	School	COB
Montessori School House	School	COB

Navarro Elementary	School	COB
Neal Elementary	School	COB
Oakwood Intermediate	School	COCS
Pebble Creek Elementary	School	COCS
Rock Prairie Elementary	School	COCS
Rudder High School	School	COB
Sam Houston Elementary	School	COB
Sam Rayburn Middle	School	COB
South Knoll Elementary	School	COCS
Southwood Valley Elementary	School	COCS
Special Opportunity School	School	COB
St. Michaels Academy	School	COB
St. Joseph Catholic School	School	COB
Stephen F Austin Middle	School	COB
Still Creek Christian School	School	BC
Sul Ross Elementary	School	COB
Burton Creek Wastewater Treatment Plant	Wastewater	COB
City of Bryan Thompsons Creek Wastewater Treatment Plant	Wastewater	COB
Texas A&M University	Wastewater	TAMU
Carter Creek Wastewater Treatment	Wastewater	COCS
Lick Creek Wastewater Treatment	Wastewater	COCS
City of Bryan Still Creek Wastewater Treatment	Wastewater	COB
Utilities and Energy Services	Wastewater	TAMU

Legend: COB - City of Bryan, COCS - City of College Station, BC - Brazos County, TAMU - Texas A&M University, WV - City of Wixon Valley, and Kurten - City of Kurten


E OSR
FM 974
N FM 2038
E SH 21
FM 2776
FM 2038
FM 1179
FM 2224
RAMP
N SH 6
E EARL RUDDER FRONTAGE RD
W EARL RUDDER FRONTAGE RD
N TEXAS AVE
N EARL RUDDER FWY
BOONVILLE RD
SANDY POINT RD
W OSR
FM 60
WILLIAM J
BRYAN PKWY
S TEXAS AVE
W SH 21
SH 30
HARVEY RD
SH 47
FM 1688
W VILLA MARIA RD
TEXAS AV
HARVEY MITCHELL PKWY
FRONTAGE RD
RAYMOND STOZIER PW
SH 6
SH 6 S FRONTAGE RD W
SH 6 S FRONTAGE RD E
FM 2154
FM 159

APPENDIX E: LOCAL ADOPTION RESOLUTIONS

Resolution

Adoption of the Brazos County Hazard Mitigation Plan:
Mitigating Risk: Protecting Brazos County From All Hazards, 2019-2024

WHEREAS, Brazos County is subject to periodic flooding and other natural hazards with the potential to cause damages to people and properties within the area; and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency (FEMA) requires that local jurisdictions have in place a FEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, this Plan, a five-year blueprint for the future, aimed at making communities in Brazos County disaster resistant by reducing or eliminating the long-term risk of loss of life and property from the full range of natural disasters; and

WHEREAS, this Plan meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390); Section 44 of the Code of Federal Regulations, Part 201.6 and Part 206; and State of Texas Division of Emergency Management standards.

NOW, THEREFORE, BE IT RESOLVED BY THE COMMISSIONERS COURT OF BRAZOS COUNTY, TEXAS:

PART 1: That the Commissioners Court of Brazos County hereby adopts and approves the Brazos County Hazard Mitigation Plan entitled, "Mitigating Risk: Protecting Brazos County from All Hazards, 2019-2024".

PART 2: That this resolution shall take effect immediately from and after its passage.

PASSED AND ADOPTED this 14 day of May, 2019.

Duane Peters, County Judge

Commissioner Steve Aldrich, Precinct 1

Commissioner Sammy Catalena, Precinct 2

Commissioner Nancy Berry, Precinct 3

Commissioner Irma Canley, Precinct 4

RESOLUTION NO. 3824

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF BRYAN, TEXAS, APPROVING THE BRAZOS COUNTY HAZARD MITIGATION ACTION PLAN AS IT APPLIES TO THE CITY OF BRYAN WITH THE PLAN BEING TITLED "MITIGATING RISK: PROTECTING THE BRAZOS VALLEY FROM ALL HAZARDS, "2019-2024"; AND PROVIDING AN EFFECTIVE DATE.

WHEREAS, certain areas of Bryan are subject to periodic flooding and other natural hazards with the potential to cause damages to people and properties within the area, and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency (FEMA) requires that local jurisdictions have in place a FGEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, this plan, a five-year blueprint for the future, aimed at making communities in Brazos County disaster resistant by reducing or eliminating the long-term risk of loss of life and property from the full range of natural disasters; and

WHEREAS, this plan meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-30); Section 44 of the Code of Federal Regulations, Part 201.6 and Part 206; and State of Texas Division of Emergency Management standards.

NOW THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BRYAN, TEXAS, THAT:

PART 1.

The City Council hereby approves those portions of the Plan entitled, *Mitigating Risk: Protecting the Brazos Valley rom All Hazards, 2019-2024,* that pertains to the City of Bryan.

PART 2.

The City Council hereby approves the Emergency Management Coordinator with the responsibility, authority, and the means to:

a. Inform all concerned parties of this action.

b. Develop an addendum to this Hazard Mitigation Plan if Bryan's unique situation warrants such an addendum.

PART 3.

The City Council hereby agrees to appoint the Emergency Management Coordinator to assure that the Hazard Mitigation Plan be reviewed at least annually and that any needed adjustment to the City of Bryan addendum to the Hazard Mitigation Plan be developed and presented to the City Council for consideration.

APPROVED AND ADOPTED on this 11th day of June, 2019.

ATTEST:

Mary Lynne Stratta, City Secretary

APPROVED:

Andrew Nelson, Mayor

APPROVED AS TO FORM:

Jams K. Hampton, City Attorney

RESOLUTION NO. 05-13-19-2e

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF COLLEGE STATION, TEXAS, ADOPTING AND APPROVING THE COLLEGE STATION PORTION OF "MITIGATING RISK: PROTECTING THE BRAZOS VALLEY FROM ALL HAZARDS, 2019-2024 PLAN" (PLAN).

WHEREAS, certain areas of College Station are subject to periodic flooding and other natural hazards with the potential to cause damages to people and properties within the area; and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency (FEMA) requires that local jurisdictions have in place a FEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, This Plan, a five-year blueprint for the future, aimed at making communities in Brazos County disaster resistant by reducing or eliminating the long-term risk of loss of life and property from the full range of natural disasters; and

WHEREAS, This Plan meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390); Section 44 of the Code of Federal Regulations, Part 201.6 and Part 206; and State of Texas Division of Emergency Management standards.

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF COLLEGE STATION, TEXAS:

PART 1: That the City Council hereby adopts and approves those portions of the Plan entitled, Mitigating Risk: Protecting the Brazos Valley from All Hazards, 2019-2024, that pertain to the City of College Station attached as Exhibit A.

PART 2: That the City Council hereby approves and authorizes Brian Hilton, Emergency Management Coordinator with the responsibility, authority, and the means to:

a. Inform all concerned parties of this action.
b. Develop an addendum to this Hazard Mitigation Plan if College Station's unique situation warrants such an addendum.

PART 3: That the City Council hereby appoints the Emergency Management Coordinator to assure the Hazard Mitigation Plan is reviewed at least annually and that amendments to the City of College Station addendum to the Hazard Mitigation Plan be developed and presented to the City Council for consideration and approval

PART 4: That this Resolution shall take effect immediately from and after its passage.

ADOPTED this 13th day of May, 2019.

ATTEST:

Tanya Smith
City Secretary

APPROVED:

Fred Money
Mayor

APPROVED:

City Attorney

City of Kurten

Resolution # 02-2019

For Adoption of the Hazard Mitigation Plan for the Brazos Valley

WHEREAS, certain areas of Kurten, Texas are subject to periodic flooding and other natural and man-caused hazards with the potential to cause damages to people and properties within the area; and

WHEREAS, the City of Kurten desires to prepare and mitigate for such circumstances; and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency (FEMA) requires that local jurisdictions have in place a FEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, the Hazard Mitigation Plan, which covers 4 cities, 1 County, and Texas A&M University, has been significantly updated within the past year with input from the local entities within Brazos County including a number of professionals and community members including Kurten, and;

NOW, therefore; be it resolved that the City Council hereby;

Adopts those portions of the Plan entitled, *Mitigating Risk: Protecting Brazos County from All Hazards, 2019 - 2024,* that pertain to the City of Kurten; and

Vest the Mayor of the City of Kurten with the responsibility, authority, and the means to:

a) Inform all concerned parties of this action.
b) Develop an addendum to this Hazard Mitigation Plan if the town's unique situation warrants such an addendum.

Appoints the Mayor of the City of Kurten to assume that the Hazard Mitigation plan be reviewed at least annually and that any needed adjustment to the City of Kurten addendum to the Hazard Mitigation Plan be developed and presented to the City Council for consideration.

Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted on May 28, 2019

By: _____
Mayor

Certified by: _____
City Secretary

Date: 5/28/2019

RESOLUTION NO. 328

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WIXON VALLEY, TEXAS, APPROVING THE WIXON VALLEY PORTION OF "MITIGATING RISKS: PROTECTING THE BRAZOS COUNTY FROM ALL HAZARDS, 2019-2024".

WHEREAS, certain areas of Wixon Valley are subject to periodic flooding and other natural hazards with the potential to cause damages to people and properties within the area, and

WHEREAS, under the Disaster Mitigation Act of 2000, the United States Federal Emergency Management Agency (FEMA) requires that local jurisdictions have in place a FEMA-approved Hazard Mitigation Action Plan as a condition of receipt of certain future Federal mitigation funding after November 1, 2004; and

WHEREAS, This plan, a five-year blueprint for the future, aimed at making communities in Brazos County disaster resistant by reducing or eliminating the long-term risk of loss and property from the full range of natural disasters; and

WHEREAS, This plan meets the requirements of the Disaster Mitigation Act of 2000 (P.L. 106-390); Section 44 of the Code of Federal Regulations, Part 201.6; and State of Texas Division of Emergency Management standards.

BE IT RESOLVED BY THE CITY COUNCIL OF WIXON VALLEY, TEXAS:

PART 1: That the City Council hereby approves those portions of the Plan entitled, *Mitigating Risk: Protecting the Brazos County from all Hazards, 2019-2024,* that pertain to the City of Wixon Valley.

PART 2: That the City Council hereby approves James Soefje, Emergency Management Coordinator with the responsibility, authority, and means to:

a. Informed all concerned parties of this action.
b. Develop an addendum to this Hazard Mitigation Plan if Wixon Valley's unique situation warrants such an addendum.

PART 3: That the City Council hereby agrees to appoint the Emergency Management Coordinator to assure that the Hazard Mitigation Plan be reviewed at least annually and that any needed adjustment to the City of Wixon valley addendum to the Hazard Mitigation Plan be developed and presented to the City Council for consideration.

PART 4: That this resolution shall take effect immediately from and after its passage.

ADOPTED this the 6th day of June , A.D. 2019.

ATTEST:

Barbara Riley

Barbara Riley, City Secretary

APPROVED:

James T. Soefje, Mayor

(CITY SEAL)

RESOLUTION FOR TEXAS A&M UNIVERSITY
APPROVAL OF THE BRAZOS COUNTY MITIGATION ACTION PLAN

WHEREAS, the Federal Disaster Mitigation Act of 2000 and Federal Emergency Management Agency (FEMA) require communities to adopt a hazard mitigation action plan to be eligible for the full range of pre-disaster and post disaster federal funding for mitigation purposes; and

WHEREAS, FEMA requires the communities update Hazard Mitigation Action Plan every five years in order to be eligible for the full range of pre-disaster and post-disaster federal funding for mitigation purposes; and

WHEREAS, TEXAS A&M UNIVERSITY has assessed the University's potential risks and hazards and is committed to planning for a sustainable community and reducing the long-term consequences of natural and man-caused hazards; and

WHEREAS, TEXAS A&M UNIVERSITY outlines a mitigation vision, goals and objectives; assesses risk from a range of hazards; and identifies risk reduction strategies and actions for hazards the threaten the community.

NOW THEREFORE BE IT RESOLVED THAT:

1. The BRAZOS COUNTY MITIGATION ACTION PLAN is approved in its entirety;
2. TEXAS A&M UNIVERSITY will pursue available funding opportunities for implementation of the proposals designated therein, and will, upon receipt of such funding or other necessary resources, seek to implement the actions contained in the mitigation strategies;
3. TEXAS A&M UNIVERSITY vests with the Executive Vice President and Chief Financial Officer the responsibility, authority and means to inform all parties of this action; assure that the Hazard Mitigation Plan will be reviewed at least annually; and that any needed adjustments will be presented to the Associate Vice President of Safety & Security for consideration; and
4. TEXAS A&M UNIVERSITY agrees to take such other action as may be reasonably necessary to carry out the objectives of the Plan and report on progress as required by FEMA and the Texas Division of Emergency Management (TDEM).

ADOPTED this 31 day of May, 2019

Jerry R. Strawser
Executive Vice President and Chief Financial Officer
TEXAS A&M UNIVERSITY