Liberty County Hazard Mitigation Plan 2025 Update

Approved on: [ ]

Acknowledgments

Thank you to all who were involved in the Hazard Mitigation Committee, attended meetings and engagement events, and who dedicated their time to create this plan.

Prepared by: The Houston-Galveston Area Council

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List of Acronyms

ASL	above sea level
ASTDR	Agency for Toxic Substances and Disease Registry
BCA	Benefit-Cost Analysis
CDBG-MIT	Community Development Block Grant Mitigation
CDC	Centers for Disease Control and Prevention
CFM	Certified Floodplain Manager
COLE	Coefficient of Linear Extent
CPZ	Community Protection Zone
CRF	Community Risk Factor
CRS	Community Rating System
DBIR	Data Breach Investigations Report
DDoS	Distributed Denial of Service
DMA 2000	Disaster Mitigation Act of 2000
EAL	expected annual loss
EDT	Eastern Daylight Time
EDDMapS	Early Detection and Distribution Mapping System
EID	Emerging Infectious Diseases
EM	Emergency
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
ETJ	extra-territorial jurisdiction
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Fire Intensity Scale
FMA	Flood Mitigation Assistance
FPF	Federal Policy Fee
FPM	Floodplain Manager
FSA	Farm Service Agency
GIS	Geographic Information Systems
GLO	Texas General Land Office
H-GAC	The Houston-Galveston Area Council
HLR	Historic loss ratio
HMA	Hazard Mitigation Assistance
HMC	Hazard Mitigation Committee
HMAP	Hazard Mitigation Action Plan
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
ICC	Increased Cost of Compliance
K	Susceptibility of the soil to water erosion
LEP	Linear Extensibility Percent
LHMP	Local Hazard Mitigation Plan

LS	Combined effects of slope length and steepness
MRLC	Multi-Resolution Land Characteristics
NCC	Network Control Center
NCEI	National Center for Environmental Information
NCHH	National Center for Healthy Housing
NDFD	National Digital Forecast Database
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NLCD	National Land Cover Database
NLDN	National Lightning Detection Network
nmi	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NRI	National Risk Index
NSSL	NOAA's National Severe Storms Laboratory
NWS	National Weather Service
OSHA	Occupational Safety and Health Administration
P	probability
PMT	Plan Maintenance Team
PT	Planning Team
PVI	Pandemic Vulnerability Index
R	Rainfall and runoff factor
RHMP	Regional Hazard Mitigation Plan
RL	repetitive loss
RUSLE	Revised Universal Soil Loss Equation
S	severity
SED	State Executive Director
SFHA	special flood hazard areas
SPC	Storm Prediction Center
SRL	severe repetitive loss
SVI	Social Vulnerability Index
TCEQ	Texas Commission on Environmental Quality
TDEM	Texas Division of Emergency Management
TRI	Toxics Release Inventory
TWDB	Texas Water Development Board
TWRA	Texas Wildfire Risk Assessment
TxWrap	Texas Wildfire Risk Assessment Portal
USDA	United States Department of Agriculture
USDM	United States Drought Monitor
USLE	Universal Soil Loss Equation
VPI	Vulnerable Population Index
WCID	Water Control Improvement District
WSSI	Winter Storm Severity Index
WUI	wildland urban interface

List of Tables and Figures

Section 1: Introduction

This section contains background context, the planning need, purpose, scope, and organization of the plan.

Section 1: Introduction

In 2011, Liberty County's Hazard Mitigation Plan was updated as part of a seven-county Regional Hazard Mitigation Plan (RHMP) led by H-GAC. In 2018, due to new regulations and planning recommendations, Liberty County prepared a countywide multi-jurisdictional Hazard Mitigation Plan (HMP). Liberty County partnered with the Houston-Galveston Area Council (H-GAC) for the 2006, 2011, and 2018 plans and continued this partnership during the development and adoption of this most recent HMP update.

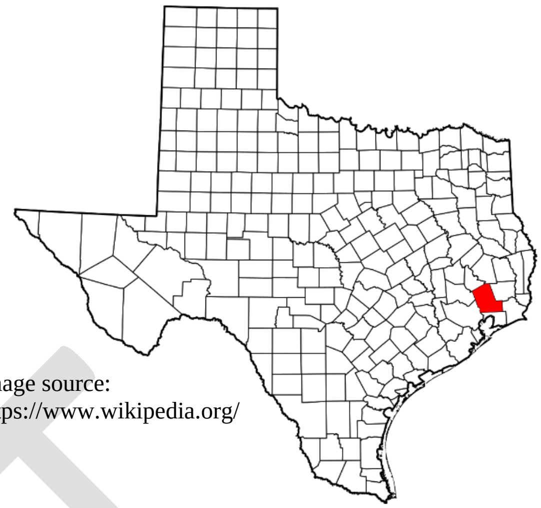


Image source:
https://www.wikipedia.org/

History

On April 28, 2006, the Federal Emergency Management Agency (FEMA) and the Texas Division of Emergency Management (TDEM) approved the first Regional Hazard Mitigation Plan which was later updated in 2011. These RHMPs were a collaboration between 85 local governments to identify regional hazards, vulnerabilities, and 300+ mitigation projects that could be implemented within the region. The 2018, due to new regulation and planning recommendations, Liberty County prepared a new countywide multijurisdictional Hazard Mitigation Plan that included a more robust assessment of natural hazards, newly uncovered vulnerabilities, more advanced analysis techniques, and a more effective and informed mitigation strategy. Liberty County partnered with the H-GAC for both the 2006 and 2011 plans and continued this partnership during the development and adoption of the 2018 HMP. In this HMP update, Liberty County is continuing its partnership with H-GAC.

Purpose of Plan

The purpose of Liberty County's HMP is to reduce the loss of life and property within the county, lessen the negative impacts of natural disasters, and increase the resiliency of the county and communities within the county to hazards. Vulnerability to several natural hazards has been identified through a risk assessment, public input, research, and analysis. These hazards threaten the safety of residents and have the potential to damage or destroy both public and private property, disrupt the local economy, and impact the overall quality of life of individuals who live, work, and play in the county. While natural hazards cannot be eliminated, the effective reduction of a hazard's impact can be accomplished through thoughtful planning and action.

The concept and practice of reducing risks to people and property from known hazards is generally referred to as hazard mitigation. One of the most effective tools a community can use to reduce hazard vulnerability is developing, adopting, and updating a hazard mitigation plan as needed. A hazard mitigation plan establishes the broad community vision and guiding principles for reducing hazard risk, including the development of specific mitigation actions designed to eliminate or reduce identified vulnerabilities.

Planning Need

HMPs should serve as a living document that outlines the communities' long-term strategies to reducing damage to life, and property, and increasing the county and community's resilience to the natural hazards it is affected by. HMPs must be updated every 5 years per the Disaster Mitigation Act of 2000 (DMA 2000). This plan serves as the 2024 multijurisdictional HMP update to the 2018 Liberty County HMP. The 2024 Liberty County HMP adhered to the FEMA updated policy guide (FP-206-21-0002), Released on April 19, 2022. The new policy guide became effective on April 19, 2023. Updates included but were not limited to expanding outreach efforts to include those from various community lifelines within the county in the planning process, extensive mapping updates to critical facilities, community lifelines, and other data to visually highlight vulnerabilities to identified hazards, updating the process for risk and capability assessments, and including new hazards to incorporate based on recent events such as winter storms and the Covid-19 Pandemic.

Scope of Plan

This HMP update includes the following participating jurisdictions:

- Liberty County (Unincorporated)
- City of Ames
- City of Cleveland
- City of Daisetta
- City of Dayton
- City of Devers
- City of Hardin
- City of Kenefick
- City of Liberty
- City of North Cleveland
- City of Plum Grove
- Liberty County Water Control Improvement District (WCID) #1*
- Liberty County WCID #5*

Jurisdictions that were added to this most recent HMP update are denoted with a *

The HMP profiles the following hazards:

- Flooding
- Hurricanes, Tropical Storms & Depressions
- Severe Thunderstorms & Lightning
- Heat Events
- Dam/Levee Failure
- Cyber Security
- HazMat Spill
- Severe Winter Storm
- Terroristic Threats
- Wildfire
- Windstorm
- Drought & Expansive Soils
- Tornado
- Hail
- Erosion
- Emerging Infectious Diseases

Plan Organization

The 2025 Liberty County HMP contains 8 sections:

Section 1 contains background context, the planning need, purpose, scope, and organization of the HMP.

Section 2 identifies the planning process, which involves a description of the HMP methodology and development process, identifying Planning Team members, Hazard Mitigation Committee members, roles and responsibilities of those members, stakeholder involvement efforts, meeting dates and summaries, and plan development resources.

Section 3 contains the county profile, which provides a history of hazard events, an overview of the planning area, geographic setting, land use and land cover, population demographics, vulnerable population information, housing and household arrangements, loss estimations, critical facilities, repetitive loss, and severe repetitive loss properties, NFIP and CRS participation, and NFIP policies in force information.

Section 4 outlines the risk assessment procedures, identifies hazards ranked by risk, and summarizes the hazards that affect Liberty County and the history of hazard events for those identified risks within the county.

Section 5 includes the capability assessment, which includes a summary and description of the existing plans, programs, and regulatory mechanisms that support hazard mitigation within the planning area.

Section 6 is broken down into subsections for each hazard of concern to the county and participating jurisdictions identified during the risk assessment. It contains descriptions of identified hazards, hazard location, extent, history of events, probability of future events, and climate change impacts. Additionally, vulnerability is addressed for all hazards and includes a probable risk level, an estimate of property and crop damages, number of events, fatalities and injuries, average annual events, changes in frequency, and estimated annualized losses, where applicable.

Section 7 covers the mitigation strategy summary, which provides the mitigation goals, objectives, and action items included in the Hazard Mitigation Action Plan in response to identified hazards.

Section 8 provides an overview of plan maintenance procedures which includes information on monitoring, evaluating, and updating the plan, and a description of how this plan will be incorporated into existing programs.

The appendices cover the hazard summary data (Hazus), H-GAC created maps, a comprehensive list of critical facilities, meeting documentation, and plan adoption.

Appendix A- Hazus Results
Appendix B- H-GAC Maps
Appendix C- Critical Facilities
Appendix D- Meeting Documentation
Appendix E- Survey Results
Appendix F- Plan Adoption

Section 2: Planning Process

This section summarizes the planning process, which involves a description of the HMP methodology and development process, identifying Planning Team members, Hazard Mitigation Committee members, roles and responsibilities of those members, stakeholder involvement efforts, meeting dates and summaries, and plan development resources.

Section 2: Planning Process

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to people and property from hazards and their effects. It includes long-term solutions that reduce the impact of disasters in the future. A core assumption of hazard mitigation is that pre-disaster investments will significantly reduce the demand for post-disaster assistance by alleviating the need for emergency response, repair, recovery, and reconstruction. [1]

Hazard mitigation planning is the process of identifying natural hazards, assessing hazard vulnerability and risk, understanding community capabilities and resources, and determining how to minimize or manage those risks. In partnership with Liberty County, H-GAC approached the hazard mitigation planning process by establishing a Planning Team (PT) and a Hazard Mitigation Committee (HMC) as outlined in the tables below. The PT included H-GAC staff and the point of contact for the County's Office of Emergency Management. The HMC was comprised of representatives from Liberty County, including the participating jurisdictions of the City of Ames, City of Cleveland, City of Daisetta, City of Dayton, City of Dayton Lakes, City of Devers, City of Hardin, City of Kenefick, City of Liberty, City of North Cleveland, City of Plum Grove, Liberty County WCID #1, and Liberty County WCID #5. Invitations were sent to a wide range of stakeholders within the County to participate in the HMC or attend an HMP meeting throughout the planning process via email, city websites, the H-GAC website, and social media postings. All meetings hosted for this plan update were open to the public.

HMC members were given a document titled "Hazard Mitigation Committee Expectations" to read and sign, which included the following:

1) *Participate in the process.*
   a) It must be documented in the plan that each participating jurisdiction participates in the process that generated the plan. At each meeting of the Hazard Mitigation Committee for this planning process, we will be documenting attendance, participation, and the collection of any handouts or worksheets provided to you. If you cannot attend the scheduled Hazard Mitigation Committee meeting, attendance can be supplemented with a 1-1 meeting with H-GAC staff.
2) *Consistency Review.*
   a) Review of existing documents pertinent to each jurisdiction
3) *Action Review.*
   a) For plan updates, a review of the strategies from your prior action plan to determine those that have been accomplished and how they were accomplished; and why those that have not been accomplished were not completed.
4) *Update Localized Risk Assessment.*
   a) Each jurisdiction will complete the Risk Identification/Risk Assessment by either working individually and averaging scores among all participating jurisdictions, working together as a group, or a combination of both to remove hazards not associated with the defined jurisdictional area or determining if any hazards need to be added or updated.
5) *Capability assessment.*
   a) Each planning partner must identify and review their individual regulatory, technical, and financial capabilities with regards to the implementation of hazard mitigation actions.
6) *Personalize mitigation recommendations & create an Action Plan.*
   a) Identify and prioritize mitigation recommendations specific to each jurisdiction's defined area.
7) *Incorporate Public Participation.*
   a) Representatives from a broad range of sectors, community lifelines, organizations that support underserved communities, the public and community-based organizations need to be given the opportunity to provide input on, and participate in, the planning process. The Hazard Mitigation Committee will assist with various tasks, when needed, for these types of events.

Planning Team

Liberty County and H-GAC established the Planning Team in February 2023 during a pre-kickoff meeting in preparation for the full kickoff meeting held on March 27, 2023. Members were asked to attend all public meetings either in person or online (if applicable). Online materials, surveys, forms, and documentation are provided in Appendix A. Representatives from the County Office of Emergency Management served as liaisons between H-GAC and stakeholders, staff, and members of the public who were unable to attend the meetings.

Table 2.1: Liberty County Planning Team Members

Representative Name & Position/Title	Jurisdiction
Madison Gonzalez, Assistant Emergency Management Coordinator	Liberty County
Emergency Management Coordinator	Liberty County
Cheryl Mergo, Senior Manager	H-GAC
Amanda Ashcroft, AICP, Planner	H-GAC

Hazard Mitigation Committee

Liberty County and H-GAC established the Hazard Mitigation Committee in February 2023 in preparation for the kickoff meeting held on 3/22/2023. Members were asked to attend all public meetings either in person or online (if applicable). Online materials, surveys, forms, and documentation are provided in Appendix A. Representatives from the County Office of Emergency Management served as liaisons between H-GAC and stakeholders, staff, and members of the public who were unable to attend the meetings.

Table 2.2: Liberty County Hazard Mitigation Committee Members

Representative Name	Jurisdiction	Position/Title
Rachel Ansley	Bridge Haven Children's Advocacy Center	Operations Director
Barbara L. Domain	City of Ames	Mayor
Sean Anderson	City of Cleveland	Emergency Management Coordinator
Darrell Broussard	City of Cleveland	Chief of Police
Roger Brookes	City of Cleveland	Public Works Director
Eric Thaxton	City of Daisetta	Mayor
Joan Caruthers	City of Daisetta	City Secretary
Eric Thaxton	City of Daisetta	Mayor
Chancie Bailey	City of Daisetta	City Councilmember, 2024 Mayor
April Davenport	City of Dayton	Public Works Administrator
Kimberly Judge	City of Dayton	City Manager
Shane Burleigh	City of Dayton	Emergency Management Coordinator
Steve Smith	City of Dayton	Public Works
Murphy Green	City of Dayton	Public Works
Caroline Wadzeck	City of Dayton	Mayor
Steve Horelica	City of Devers	Mayor
Harry Johnson	City of Hardin	Mayor
Patricia Johnson	City of Hardin	City Secretary
Rory Handley	City of Kenefick	Alderman

Representative Name	Jurisdiction	Position/Title
Jessica Fingleman	City of Kenefick	City Secretary
Brian Hurst	City of Liberty	Fire Chief
Damon Jones	City of Liberty	Public Works
Eric McDaniel	City of Liberty	Asst. Fire Chief
Tom Warner	City of Liberty	City Manager
Misty Dulaney	City of Liberty	Fire Department Office Manager/ EMT
Robert Barlett	City of North Cleveland	Mayor
Brandon Frazier	City of Plum Grove	Chief VFD/PD
James Autrey	City of Plum Grove	Emergency Management Coordinator, Asst. Fire Chief
Mary Arrendell	City of Plum Grove	Mayor
Cheryl Mergo	H-GAC	Senior Manager
Amanda Ashcroft	H-GAC	Planner
Tammie Smith	Hull Daisetta ISD	
Blake Jackson	Liberty/Dayton Regional Medical Center	Emergency Management
Larry Macneil	Liberty/Dayton Regional Medical Center	Public Information Officer / Senior Liaison
Judge Jay Knight	Liberty County	Emergency Management Coordinator
	Liberty County	Emergency Management Coordinator, Fire Marshall
Madison Gonzalez	Liberty County	Asst. Emergency Management Coordinator
	Liberty County	Asst. Fire Marshall
Danielle Andrews	Liberty County	Office Manager
Elanie Rosser	Liberty ISD	Safety & Security
D. McGee	Liberty ISD	Superintendent
James Canfield	Liberty County WCID #1	Project Manager
Scott Krzyanowski	Liberty County WCID #1	Vice President
Deborah Anderson	Liberty County WCID #1	
Linda Trichell	Liberty County WCID #1	Secretary/Treasurer
James Leonard	Liberty County WCID #5	President
Carolyn Horn	Liberty County WCID #5	
James Poitevent	Liberty County WCID #5	General Manager
David Papillion	Liberty County WCID #5	
Justin Smith	Red Cross	Disaster Program Manager
Briana Gallagher	San Jacinto River Authority	Project Manager, Water Resources
Robert Snyder	TDEM	
Merryl Holmes	TDEM	Regional Hazard Mitigation Coordinator- Region 4
Edward Norman	TDEM	District Coordinator- 16D

Other Invitees

The PT reached out to members of the public who signed up for the HMP mailing list to be kept updated on the plan update. These contacts are listed below in Table 2.3, but this is not an exhaustive list and only includes those who attended a meeting, signed in, and checked a box for plan update emails. The Liberty County Emergency Management Coordinator and Assistant Emergency Management Coordinator meet regularly with Chambers County and surrounding jurisdictions. Coordination is regular as some communities share county boundaries with Liberty and Chambers County. These neighboring communities were kept up to date on the HMP status and upcoming HMP meetings through updates that were shared with county staff and leadership at meetings, public events (Hurricane Preparedness Fairs, National Night Out), and in passing. Additionally, H-GAC staff serve as a voting member on the steering committee for the Harris County HMP update, as well as attend Regional Threat and Hazard Identification and Risk Assessment meetings to provide relevant information and plan updates for core capabilities. H-GAC staff shared plan updates at these meetings, invited interested parties to attend future meetings, and provided where more information about future meetings or plan updates could be found, via H-GAC's Hazard Mitigation webpage, since kickoff meetings began in 2023. The Regional Threat and Hazard Identification and Risk Assessment and Harris County HMP update meetings are heavily attended by municipal staff, typically emergency management, and other city and county leadership within the H-GAC region.

Table 2.3: Other Invitees

Representative Name	Position/Title	Organization
Craig Grissom	City of Cleveland	Fire Captain
Branson MacDonald	City of Cleveland	Firefighter
Jacob Watson	City of Cleveland	Firefighter
Travis Strickland	City of Cleveland	Firefighter
M. Cohn	City of Cleveland	Firefighter
Andrew McClusty	City of Daisetta	City Council Member
Kathryn Crapo	City of Dayton	Planning Technician
Sidnie Srader	City of Dayton	Library Program Coordinator
Tami Green	City of Dayton	Director's Assistant, Development & Planning Services
Ryan Taylor	City of Daisetta	Councilman
Skeet Raggio	Owner	Skeet Raggio Publishing
Geovanni De Hoyos		Citizen
Diana Krzyzanowski		Citizen
Curtis Appleby		Citizen
Lori Tidwell		Citizen

Meeting Dates & Details

Members of the HMC, as well as stakeholders, met regularly to identify hazards, assess risks, review critical facilities, and assist at workshops or public events/hearings to organize, set up, assist, and answer questions from the public. All members of the HMC had the opportunity to review the draft plan and assist with public outreach efforts and events. Table 2.4 below outlines the participation by each jurisdiction and member of the HMC at various meetings held throughout the planning process. This does not reflect all planning activities conducted by the PT or HMC. There were individual meetings between jurisdictions and the PT, calls, and other forms of correspondence that are not reflected here. All meeting materials, including agendas, notes, list of attendees, completed handouts and worksheets, event photos, and outreach notices for public meetings can be found in Appendix D- Meeting Documentation.

Table 2.4: Participation Matrix

Rep. Name	Jurisdiction	Kickoff Meeting, 3/27/23	Risk & Capability Assessment, 4/24/23	Public Outreach Strategy, 8/9/23	Public Meeting #1, 9/6/23	Public Meeting #2, 9/7/23	Our Mitigation Strategy, 11/13/23	Action Item Check-in, 12/4/23	Draft Plan Review, 3/7/24	Draft Plan Review, 4/4/24	Draft Plan Review, 7/31/24
Paola Palacio	Bridge Haven Children's Advocacy Center								X	X	
Barbara L. Domain	City of Ames						X	X	X		X
Wellona Godfrey	City of Ames										
Sean Anderson	City of Cleveland			X	X				X		X
Darrell Broussard	City of Cleveland				X					X	
Roger Brookes	City of Cleveland										X
Eric Thaxton	City of Daisetta						X				
Chancie Bailey	City of Daisetta										X
Joan Caruthers	City of Daisetta			X		X	X	X	X		X
April Davenport	City of Dayton		X	X		X					
Kimberly Judge	City of Dayton			X							
Shane Burleigh	City of Dayton	X	X	X			X		X	X	X
Steve Smith	City of Dayton										
Murphy Green	City of Dayton										
Caroline Wadzeck	City of Dayton										
Steve Horelica	City of Devers			X				X			
Harry Johnson	City of Hardin										
Patricia Johnson	City of Hardin								X		
Cheryl Mergo	H-GAC	X	X	X	X	X	X			X	
Amanda Ashcroft	H-GAC	X	X	X	X	X	X	X	X	X	X

Rep. Name	Jurisdiction	Kickoff Meeting, 3/27/23	Risk & Capability Assessment, 4/24/23	Public Outreach Strategy, 8/9/23	Public Meeting #1, 9/6/23	Public Meeting #2, 9/7/23	Our Mitigation Strategy, 11/13/23	Action Item Check-in, 12/4/23	Draft Plan Review, 3/7/24	Draft Plan Review, 4/4/24	Draft Plan Review, 7/31/24
Tammie Smith	Hull Daisetta ISD										
Martin Wells	City of Kenefick										
Rory Handley	City of Kenefick								X		
Brian Hurst	City of Liberty	X	X				X		X	X	X
Damon Jones	City of Liberty	X	X				X				
Eric McDaniel	City of Liberty	X	X				X		X		X
Tom Warner	City of Liberty	X	X			X		X	X	X	X
Misty Dulaney	City of Liberty, Fire Department		X								
Blake Jackson	Liberty/Dayton Regional Medical Center		X								
Larry Macneil	Liberty/Dayton Regional Medical Center		X						X	X	
Robert Barlett	City of North Cleveland										
Brandon Frazier	City of Plum Grove										
James Autrey	City of Plum Grove	X	X								
Mary Arrendell	City of Plum Grove										
	Liberty County	X		X			X				
Madison Gonzalez	Liberty County	X	X	X	X	X	X	X	X	X	X
	Liberty County	X			X						
Danielle Andrews	Liberty County	X	X				X		X		
Elanie Rosser	Liberty ISD	X	X	X				X	X	X	
Dustin McGee	Liberty ISD										
James Canfield	Liberty County WCID #1				X		X				

Rep. Name	Jurisdiction	Kickoff Meeting, 3/27/23	Risk & Capability Assessment, 4/24/23	Public Outreach Strategy, 8/9/23	Public Meeting #1, 9/6/23	Public Meeting #2, 9/7/23	Our Mitigation Strategy, 11/13/23	Action Item Check-in, 12/4/23	Draft Plan Review, 3/7/24	Draft Plan Review, 4/4/24	Draft Plan Review, 7/31/24
Scott Krzyanowski	Liberty County WCID #1					X					
Deborah Anderson	Liberty County WCID #1										
Linda Trichell	Liberty County WCID #1						X				
James Leonard	Liberty County WCID #5			X	X		X	X	X		X
Carolyn Horn	Liberty County WCID #5			X			X				
Cami Jones	Liberty County WCID #5										X
James Poitevent	Liberty County WCID #5	X	X	X		X	X	X		X	X
David Papillion	Liberty County WCID #5						X		X		X
Justin Smith	Red Cross		X								
Briana Gallagher	San Jacinto River Authority										
Robert Snyder	TDEM	X	X								
Merryl Holmes	TDEM								X	X	X

March 27, 2023: Hazard Mitigation Kickoff Meeting

The PT hosted a kickoff meeting of the HMC on March 27, 2023, at the Liberty County Office of Emergency Management and Homeland Security, 2400 Beaumont Avenue, Liberty, Texas 77575. The purpose of the kickoff meeting was to introduce the hazard mitigation planning process and its importance to all attendees, to gather feedback and input about various hazards and local vulnerabilities, and to discuss the risk assessment for the county. The HMC was given a presentation covering the benefits of hazard mitigation, the planning process and timeline, updates to FEMA policies surrounding hazard mitigation plans that took effect in April 2023, and expectations for those participating in the HMC. The committee discussed the next steps for the planning process, and the risk assessment, and used the remaining meeting time to work through and discuss the provided risk assessment worksheet to identify various natural and man-made hazards (both new and old) that could affect jurisdictions within the county. Before the meeting, community members and stakeholders were invited to attend and learn about the hazard mitigation planning process through meeting notices posted on social media, the H-GAC website, and participating jurisdictions' city websites.

April 24, 2023: Risk and Capability Assessment Meeting

The PT hosted a meeting to cover the risk and capability assessment worksheets and review topics, questions, and recap the kickoff meeting on April 24, 2023, at the Liberty County Office of Emergency Management located at 5301 N Hwy 146, Liberty, TX 77575. The purpose of this meeting was to review risk assessment results from the kickoff meeting as well as worksheets that were turned in, compare those changes to the last plan update in 2017, and review the capability assessment worksheet and instructions. The HMC then reviewed the various sections of the capability assessment worksheet. The categories discussed were:

1) Prevention- Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning & zoning, building codes, open space preservation, and floodplain regulations.
2) Property Protection- Modification or removal of existing buildings to protect them from a hazard. Examples include purchase, relocation, raised elevation, and structural retrofits.
3) Natural Resource Protection- Preservation or restoration of the functions of natural systems while minimizing hazard losses. Examples include floodplain protection, forest management, and slope stabilization.
4) Structural Projects- Modification of the natural conditions for or progression of a hazard. Examples include dams, levees, seawalls, detention/retention basins, channel modification, retaining walls, and storm sewers.
5) Emergency Services- Protection of people and property during and immediately after a hazard event. Examples include warning systems, evacuation planning, emergency response training, and protection of emergency facilities.
6) Public Education and Awareness- Informing of citizens about hazards and the techniques they can use to protect themselves and their property. Examples include outreach, school education, library materials, and demonstration events.

The capability assessment also had areas where participants would be tasked with identifying opportunities to enhance local capabilities to better integrate hazard mitigation into their plans, programs, and day-to-day operations.

The committee then discussed the online survey development that would be used to gather input from stakeholders within the county, the next steps for the planning process, the next meeting for public engagement event planning, and then used the remaining time to continue to work through the provided risk assessment worksheet to identify, rank, and categorize various natural and man-made hazards that could affect jurisdictions within the county. Before the meeting, community members and stakeholders were invited to attend and learn about the hazard mitigation planning process through meeting notices posted on social media, the H-GAC website, and participating jurisdictions' city websites.

August 9, 2023: Public Outreach Strategy

The PT hosted a virtual meeting via Microsoft Teams to discuss possible dates, locations, and timing for two public events to solicit feedback on hazards, vulnerabilities, and other pertinent information to the HMP. The HMC decided public meetings should be held in the north and south portions of Liberty County so that citizens could choose a location that was closer to them. Meeting times for these events were scheduled for 6:00-8:00 PM to accommodate the schedules of citizens outside of normal working hours. At the public meetings stakeholders would be introduced to the hazard mitigation plan, the update process, and be engaged in activities meant to gather public input on the plan. The HMC also overviewed survey results and website updates. All members agreed to push out the survey link and QR code flyers via their city websites, postings in City Hall, and via social media or citizen mailing lists. Flyers for the public hearing were also to be posted in the same methods after they were created and distributed to the HMC.

September 6 & 7, 2023: Public Meeting Events

Two public meeting events were hosted on September 6th and 7th, 2023, from 6:00- 8:00 PM. The purpose of these public meeting events was to provide a hazard mitigation planning project overview from the PT and HMC members in attendance and solicit feedback and information from stakeholders. The September 6th public meeting was located at the Cleveland Civic Center, 210 Peach Ave., Cleveland, TX, 77327 and had 16 people in attendance. The public hearing on September 7th was hosted at the Dayton Community Center, 801 S Cleveland St., Dayton, TX, 77535. This public meeting had 19 attendees. Feedback collected was done in a variety of formats from large, printed maps where participants could mark areas of concern within their community or add critical facilities to the map, an input exercise where participants had to assign dollars to mitigation project ideas, feedback worksheets that discussed how emergency notifications were received within the county and how these communications could be improved, and a dot exercise where participants had to notate their top three hazards of concern within the county using stickers.

November 13, 2023: Our Mitigation Strategy (Goals, Actions, and the Action Plan)

The PT hosted a meeting of the HMC and any members of the public that wished to attend from 10 AM-12 PM, at the Liberty County Office of Emergency Management located at 5301 N Hwy 146, Liberty, TX 77575. The purpose of this meeting was to discuss the action items, plan goals, and the action plan. At these meetings a closing date for the online survey was set for October 31, 2023, a presentation was given discussing the action plan and how to form or update action items to go into this section of the HMP update, and H-GAC staff presented maps showcasing critical facilities and various risk data to all in attendance. H-GAC staff highlighted various resources to aid with the brainstorming of action items and presented those in attendance with printed packets containing all created maps, previous meeting notes, survey data, and public input collected. The HMC also discussed an online format to submit action items and an online SharePoint site for plan draft updates to be shared.

March 7, 2024: Draft Plan Review

The PT hosted a meeting of the HMC and any members of the public that wished to attend to discuss and provide feedback on draft sections of the plan that were completed. The HMC overviewed each section, changes since the last plan update, items needed, the FEMA BCA Toolkit, and next steps.

April 4, 2024: Draft Plan Review

The PT hosted a meeting of the HMC and any members of the public who wished to attend to discuss and provide feedback on draft sections of the plan that were completed. This meeting was held virtually and was open to the public.

July 31, 2024: Draft Plan, Final Comments

The PT hosted a meeting of the HMC to discuss and provide final comments on the draft plan before submittal. This meeting was held virtually and was open to the public.

Participation & Public Input

Public input and participation are a crucial element of hazard mitigation planning. Public input was solicited and gathered via the following ways for this plan update:

1) Online survey
   a) The online survey was open from May 8, 2023, to October 31, 2023. In total, there were 65 responses to the survey. Survey questions asked participants about hazards of concern, vulnerable community assets, how they receive information regarding hazards, what the county can do to better communicate about hazards, etc. A full list of survey results can be found in Appendix E.

2) Public Meetings
   a) Two public meetings were hosted on September 6 & 7, 2023, from 6-8 PM on the North and South sides of the County. The purpose of these public meetings was to provide a hazard mitigation planning project overview from the PT and HMC members in attendance and solicit feedback and information from stakeholders. The public meetings included many interactive activities meant to gather input from the public regarding hazards of concerns, critical facilities, action items, etc. Feedback collected was done in a variety of formats from large, printed maps where participants could mark areas of concern within their community or add critical facilities to the map, an input exercise where participants had to assign dollars to mitigation project ideas, feedback worksheets that discussed how emergency notifications were received within the county and how these communications could be improved, and a dot exercise where participants had to notate their top three hazards of concern within the county using stickers.

3) Public Events
   a) A National Night Out event was hosted on September 28, 2023. The Liberty County Emergency Management Office passed out grab bags to all in attendance that included a flyer about the HMP update effort and QR code to the public survey.

4) Draft Plan Public Input Survey
   a) The online survey was opened from April 9th- September 3rd, 2024, to gather public comments regarding the finished draft of the Liberty County Hazard Mitigation Plan Update for 2024. The survey was shared in public spaces (city hall, libraries, public notice boards, etc.), posted to city websites, social media, and shared directly through citizen contact lists and text alerts from city leadership. There was no feedback received from the public regarding the HMP update.

Feedback and input from the public were used to identify vulnerabilities in each jurisdiction, identify valuable assets, identify critical facilities and infrastructure, and further develop the risk assessment. Additionally, H-GAC hosted all HMP-related materials online and advertised meeting information, presentations, and meeting notes for those who were unable to attend through this public-facing website: https://www.h-gac.com/regional-hazard-mitigation-planning.

Plan Development Resources

The Liberty County HMP was developed using existing plans, studies, reports, and technical information. Materials and historical data were used to inform participants throughout the planning process, evaluate and analyze hazards, and develop the mitigation strategy.

Table 2.5: *Plan Development Resources*

Plan Development Resources: Existing Documents and Data	
2017 Texas State Hazard Mitigation Plan	List of Reports and Publications | 2022 Census of Agriculture | USDA/NASS
2023 Data Breach Investigations Report | Verizon	Losing Ground: Flood Data Visualization Tool (nrdc.org)
2023 Texas State Hazard Mitigation Plan	Major Land Resource Area (MLRA) | Natural Resources Conservation Service (usda.gov)
American Community Survey (ACS) (census.gov)	Mayo Clinic
Association of State Dam Safety	MRLC Viewer
Census.gov	National Centers for Environmental Information (NCEI) (noaa.gov)
FEMA 2013 Mitigation Ideas	National Institute of Allergy and Infectious Diseases (NIAID) (nih.gov)
FEMA 2021 Mitigation Action Portfolio	National Institute of Environmental Health Sciences: NIEHS Home page (nih.gov)
FEMA 2022 Local Mitigation Planning Policy Guide	National Oceanic and Atmospheric Administration (noaa.gov)
FEMA 2023 Local Mitigation Planning Handbook	National Weather Service
FEMA Declared Disasters	NOAA National Severe Storms Laboratory
FEMA Flood Map Service Center	NOAA Storm Event Database
FEMA Hazardous Response Capabilities	Office of the Texas State Climatologist (tamu.edu)
Flood Insurance Data and Analytics (floodsmart.gov)	Plan Ahead for Disasters | Ready.gov
HEAT.gov - National Integrated Heat Health Information System	Texas A&M Forest Service Wildfire Risk Assessment Portal
H-GAC 2011 Regional Hazard Mitigation Plan	TSHA (tshaonline.org)
H-GAC 2018 Multijurisdictional Hazard Mitigation Plan	USGS HIFLD Open Data
H-GAC Regional Demographic Snapshot	Vaisala National Lightning Detection Network (NLDN) Flash Data (Restricted) (noaa.gov)
H-GAC Regional Flood Information	Web Soil Survey - Home (usda.gov)
Liberty County Strategic Plan, 2016-2036	

Section 3: County Profile

This section contains the county profile, which provides a history of hazard events, an overview of the planning area, geographic setting, land use and land cover, population demographics, vulnerable population information, housing and household arrangements, loss estimations, critical facilities, repetitive loss, and severe repetitive loss properties, NFIP and CRS participation, and NFIP policies in force information.

Section 3: County Profile

History of Hazard Events

Table 3.1 below lists the presidentially declared emergency and major disaster declarations that Liberty County has experienced since 1991.[2] Presidential disaster declarations are issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government. A presidential disaster declaration mobilizes federal recovery programs to assist disaster victims, businesses, and public entities. A review of these presidential disaster declarations helps establish the probability of reoccurrence and assists in identifying targets for risk reduction through potential mitigation actions.

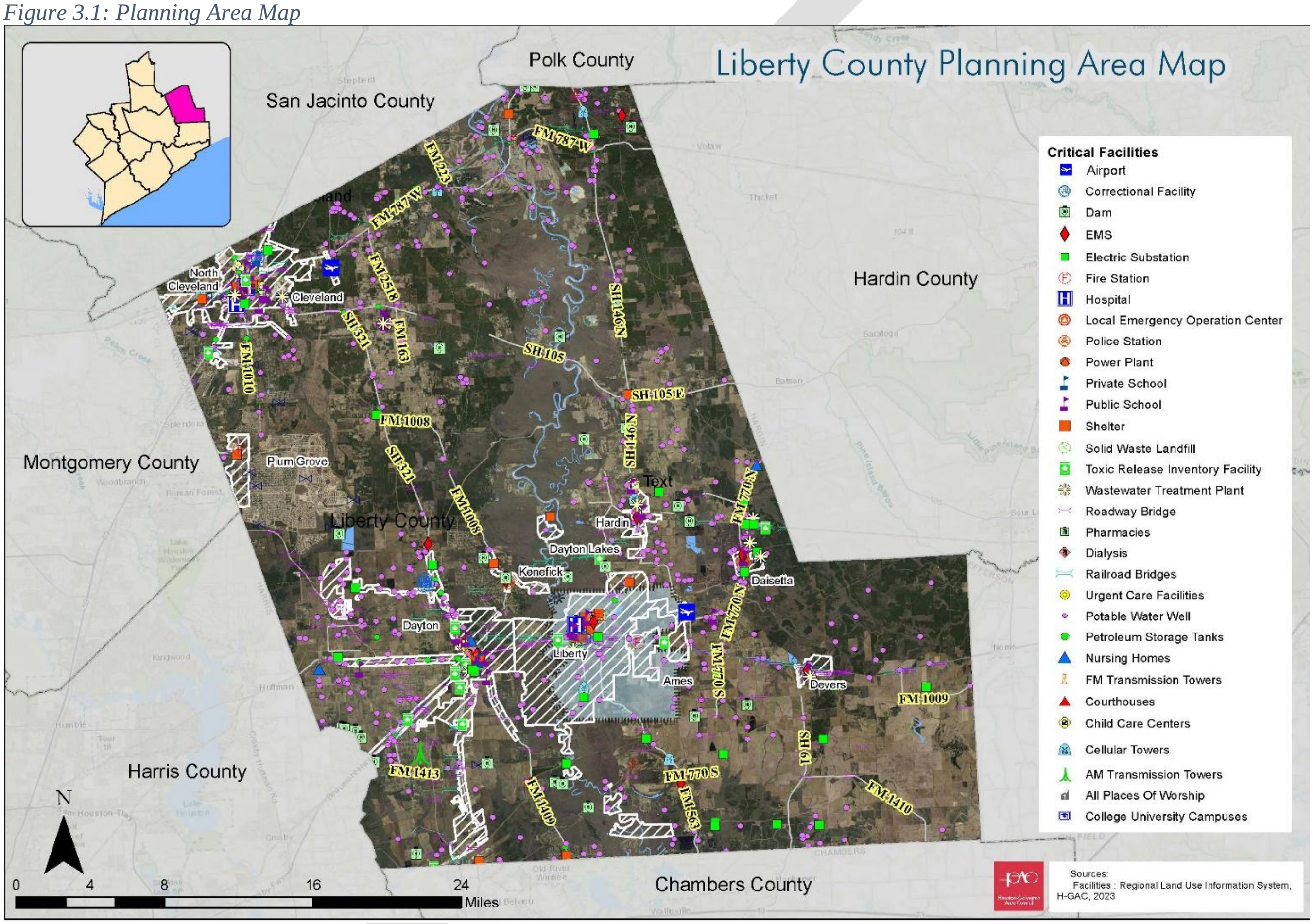
Table 3.1: Presidential Disaster Declarations

Declaration Date	Disaster No.	Declaration Type	Incident Type	Title
12/26/1991	930	Major Disaster Declaration	Flood	Severe Thunderstorms
9/10/1993	3113	Emergency Declaration	Drought	Extreme Fire Hazard
10/18/1994	1041	Major Disaster Declaration	Flood	Severe Thunderstorms and Flooding
8/26/1998	1239	Major Disaster Declaration	Severe Storm	Tropical Storm Charley
10/21/1998	1257	Major Disaster Declaration	Flood	TX-Flooding 10/18/98
9/1/1999	3142	Emergency Declaration	Fire	Extreme Fire Hazards
9/2/2005	3216	Emergency Declaration	Hurricane	Hurricane Katrina Evacuation
9/21/2005	3261	Emergency Declaration	Hurricane	Hurricane Rita
9/24/2005	1606	Major Disaster Declaration	Hurricane	Hurricane Rita
1/11/2006	1624	Major Disaster Declaration	Fire	Extreme Wildfire Threat
3/14/2008	3284	Emergency Declaration	Fire	Wildfires
8/29/2008	3290	Emergency Declaration	Hurricane	Hurricane Gustav
9/10/2008	3294	Emergency Declaration	Hurricane	Hurricane Ike
9/13/2008	1791	Major Disaster Declaration	Hurricane	Hurricane Ike
5/29/2015	4223	Major Disaster Declaration	Severe Storm	Severe Storms, Tornadoes, Straight-Line Winds and Flooding
4/25/2016	4269	Major Disaster Declaration	Flood	Severe Storms and Flooding
6/11/2016	4272	Major Disaster Declaration	Flood	Severe Storms and Flooding
8/25/2017	4332	Major Disaster Declaration	Hurricane	Texas Hurricane Harvey
3/13/2020	3458	Emergency Declaration	Biological	COVID-19
3/25/2020	4485	Major Disaster Declaration	Biological	COVID-19 Pandemic
2/14/2021	3554	Emergency Declaration	Severe Ice Storm	Severe winter storm
2/19/2021	4586	Major Disaster Declaration	Severe Ice Storm	Severe winter storms
5/17/2024	4781	Major Disaster Declaration	Flood	Severe Storms, Straight-line Winds, Tornadoes, and Flooding
7/9/2024	4798	Major Disaster Declaration	Hurricane	Hurricane Beryl

Planning Area Overview

The largest industries in Liberty County, TX are construction (5,432 people), manufacturing (3,718 people), and retail trade (3,592 people). The highest-paying industries in the county are utilities ($126,673), transportation & warehousing ($110,500), manufacturing ($106,876), and construction ($90,252). The most common job groups, by number of people living in Liberty County are management, business, sciences, and arts occupations (7,999 people), service occupations (5,206 people), sales and office occupations (6,447 people), natural resources, construction, and maintenance occupations (7,518 people) and production, transportation, and material moving occupations (6,538 people).[3,4] The county's unemployment rate in 2022 was 5.8%, which is higher than the 2022 national average of 3.9%.[5,6] The annual median household income within the county was reported at $59,605, far below the $73,035 median income for the State of Texas.[7]

Figure 3.1: Planning Area Map



According to the US Census data, Liberty County's population was 91,632 as of April 1, 2020. Population for the county, according to the Texas Demographic Center Population Estimates Program, is expected to slowly increase over time. The county saw a 2% increase from 2020 to 2023.[8] Population change includes two major components: natural increase (births minus deaths) and net migration (in-migrants minus out-migrants). Net migration includes both international migrants from other countries and domestic migrants (those who moved from other counties in other states or other counties within Texas.) A component of change is determined to be a driver if it comprises more than 50% of the total population change. Between 2010 and 2019, population change in Texas was comprised of 51% net migration and 49% natural increase. From 2021-2022 population change in Texas was comprised of 74% net migration and 25% natural increase. Drivers of population change within Liberty County are due primarily to net migration. The most recent data available shows the Liberty County population at 101,992 as of July 1, 2022.

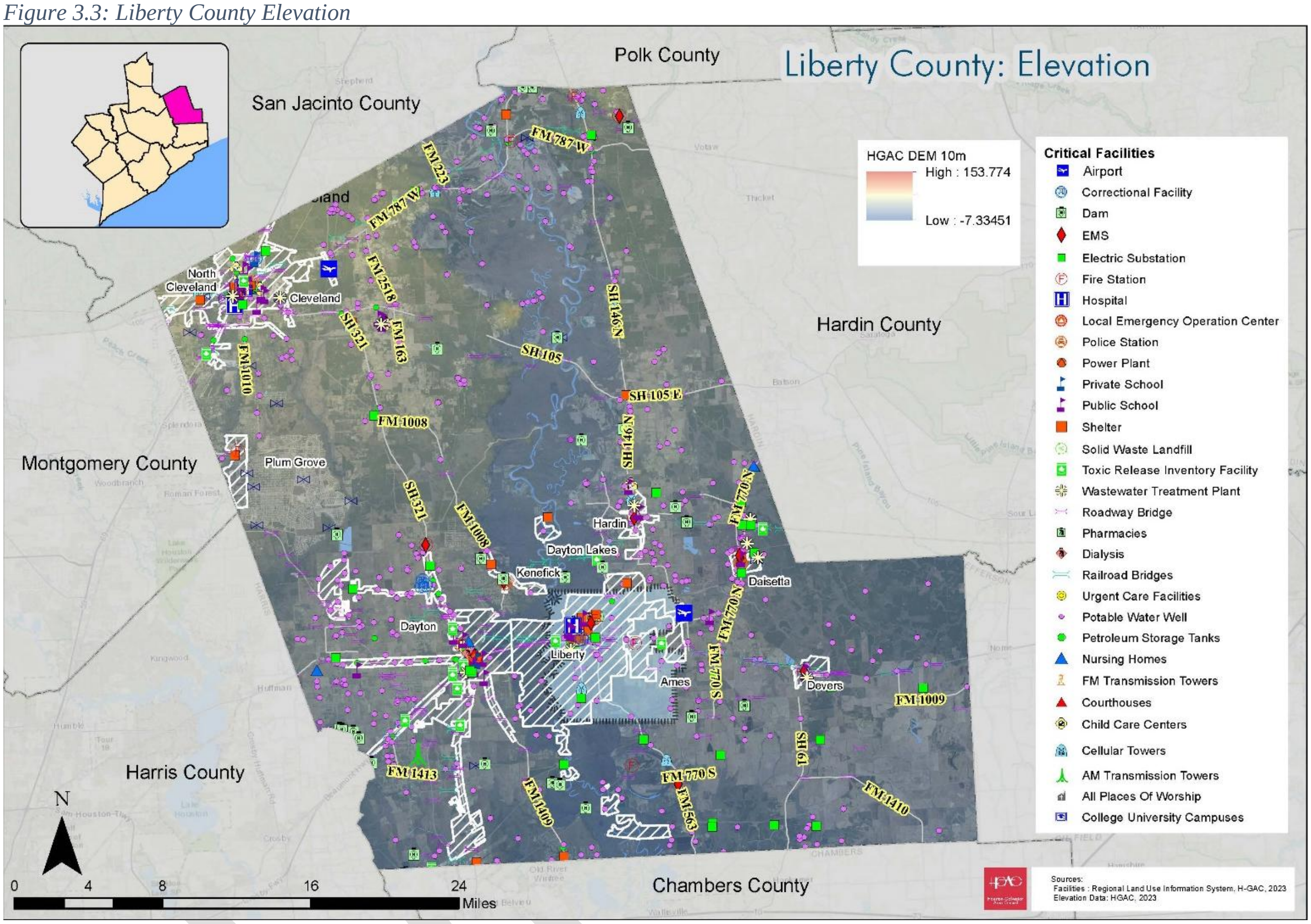
The three largest cities within the county are the City of Liberty (8,777 people), the City of Dayton (8,279 people), and the City of Cleveland (7,471 people). The City of Liberty also serves as the county seat.[9] Major highways within the county include U.S. Highway 59, Interstate Highway 69, U.S. Highway 90, State Highway 61, State Highway 99 (Grand Parkway), State Highway 105, State Highway 146, and State Highway 321. There are 2 airports within the county, the Liberty County Municipal Airport located east of the City of Liberty, and the Cleveland Municipal Airport located east of the City of Cleveland. There are also 2 national protected areas within the county, the Trinity River National Wildlife Refuge (30,000 acres) and portions of the Big Thicket National Preserve.

Figure 3.2: Map of Liberty County, Texas. Highways, Cities, and Railroads.[10]

Geographic Setting

Liberty County is split into two sections by the Trinity River which runs north to south, intersecting the City of Liberty. Elevations range from 200 feet above sea level (ASL) in the northwest area of the county, to 20 feet ASL in the southern portions of the county. Elevation is depicted in Figure 3.3 below. Neighboring counties include San Jacinto and Polk counties to the north, Hardin and Jefferson counties to the east, Chambers County to the south, and Montgomery and Harris counties to the west.

Figure 3.3: Liberty County Elevation

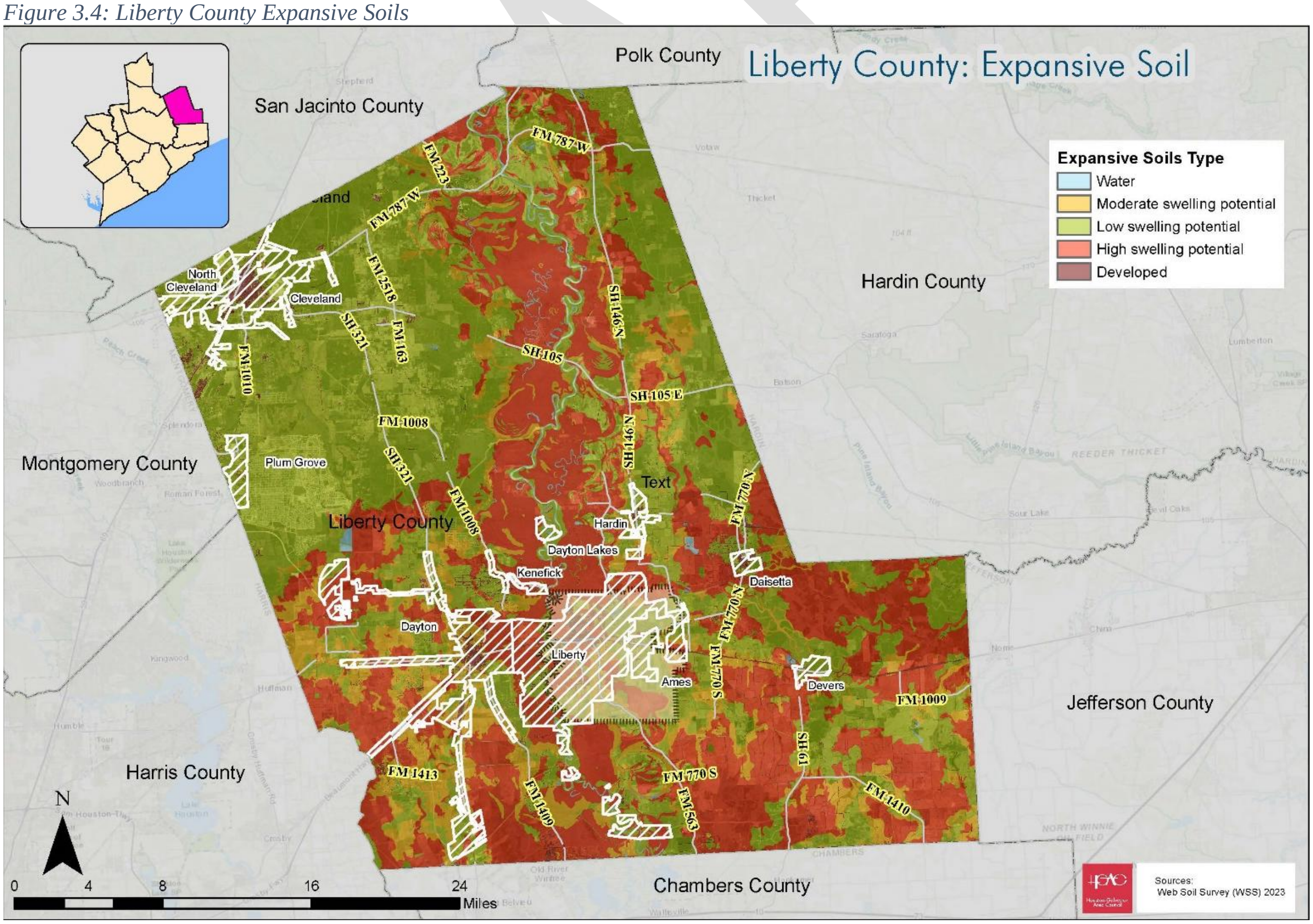


Soil Composition

Liberty County soils range from dark clays, clay loams, and sandy loams from within the major land resource areas of the East Texas Timberland, Flatwoods, and Coast Prairie.[11] East Texas Timberland Soils consists of soils with surface drainage that is moderate to rapid. Most soils in this area are deep, light-colored, acid sands and loams over loamy and clayey subsoils. Flatwoods soils are located just north of the Coast Prairie and extend into Louisiana. Surface drainage is for these soils are slow as the water table is near the surface at least part of the year. Coast Prairie Soils comprise about 8.7 million acres near the Gulf Coast. Much like the Flatwoods soils, the landscape is level to gently undulating with slow surface drainage. Upland soils are mostly deep, dark-gray, neutral to slightly acid clay loams and clays, while bottomland soils are mostly deep, dark-colored clays and loams along small streams but are greatly varied along the rivers.

Expansive soils refer to those that are clay rich. Due to their clay content, these soils can absorb large quantities of water that cause them to expand, whereas in dry periods the soils will contract and cause the ground to shrink and crack. In areas where development exists, these soils can cause issues with slab-on-grade foundations and infrastructure due to the potential uneven change in volume. This can cause subsidence, cracked foundations, broken pipes, or other detrimental effects to buried infrastructure. Liberty County is covered primarily with low swell potential soils, followed closely by soils with high swelling potential.[12, 13] Figure 3.4 below shows the expansive soils and shrink-swell potential for Liberty County and participating jurisdictions. Full-size maps created by H-GAC can be found in Appendix B.

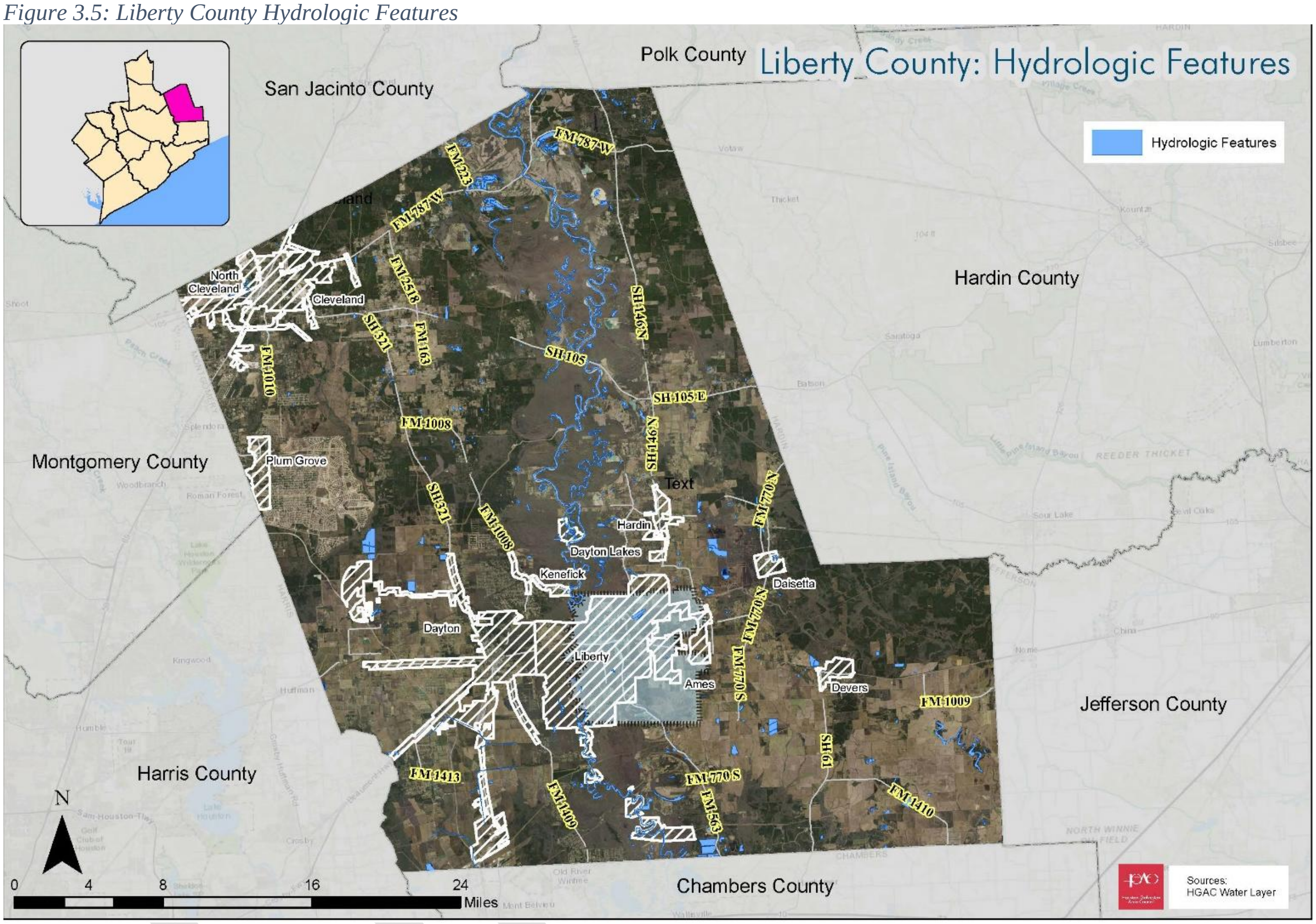
Figure 3.4: Liberty County Expansive Soils



Hydrologic Features

17.9 square miles or 1.5% of Liberty County is covered by surface water in rivers, creeks, and other hydrologic features. Most of the 1,176.3 square miles that comprise Liberty County lie within the drainage basin of the Trinity River, while the remaining area falls within the San Jacinto River Basin and the Trinity-San Jacinto.[10] Figure 3.5 shows hydrologic features located across the county.

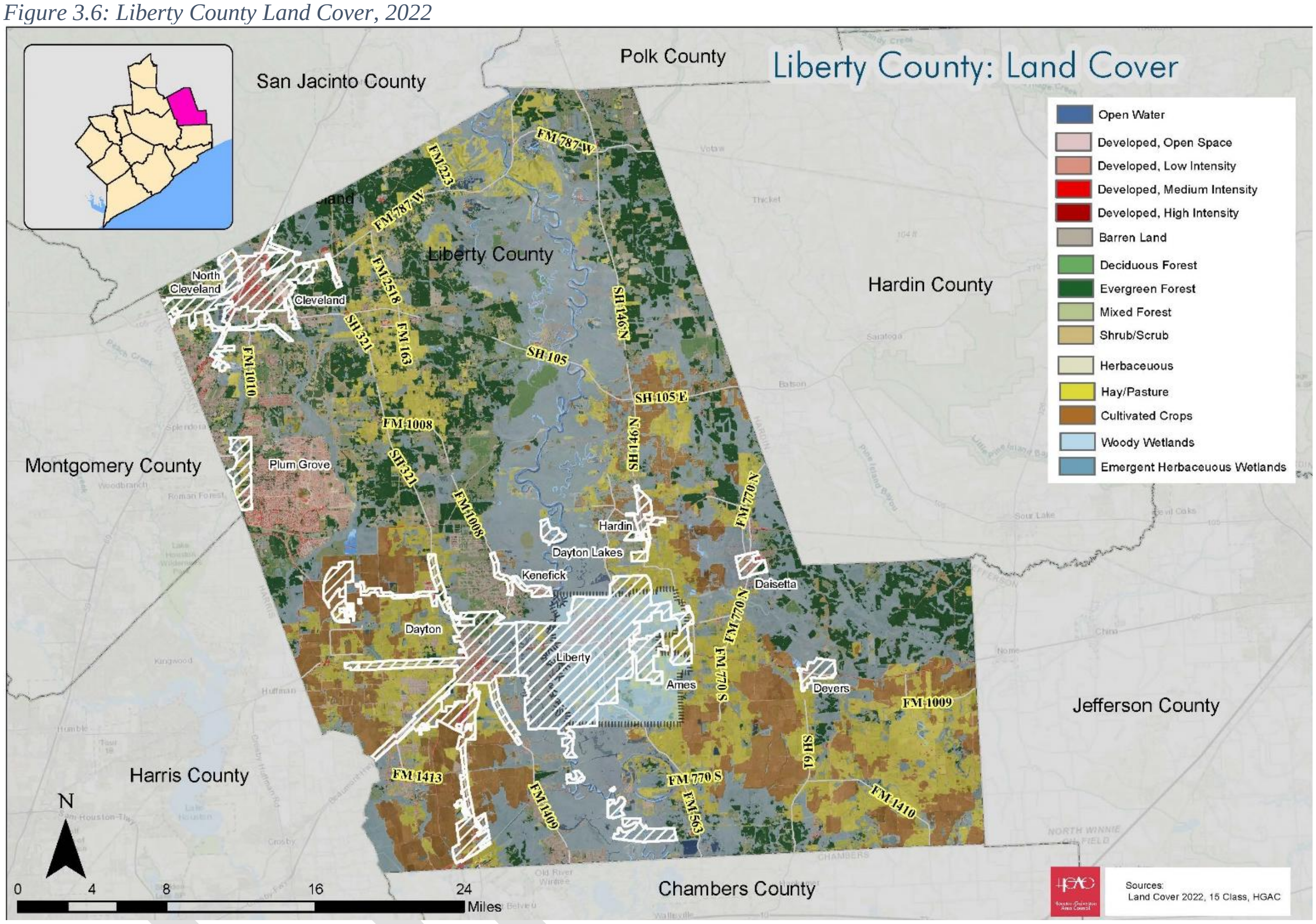
Figure 3.5: Liberty County Hydrologic Features



Land Use and Land Cover

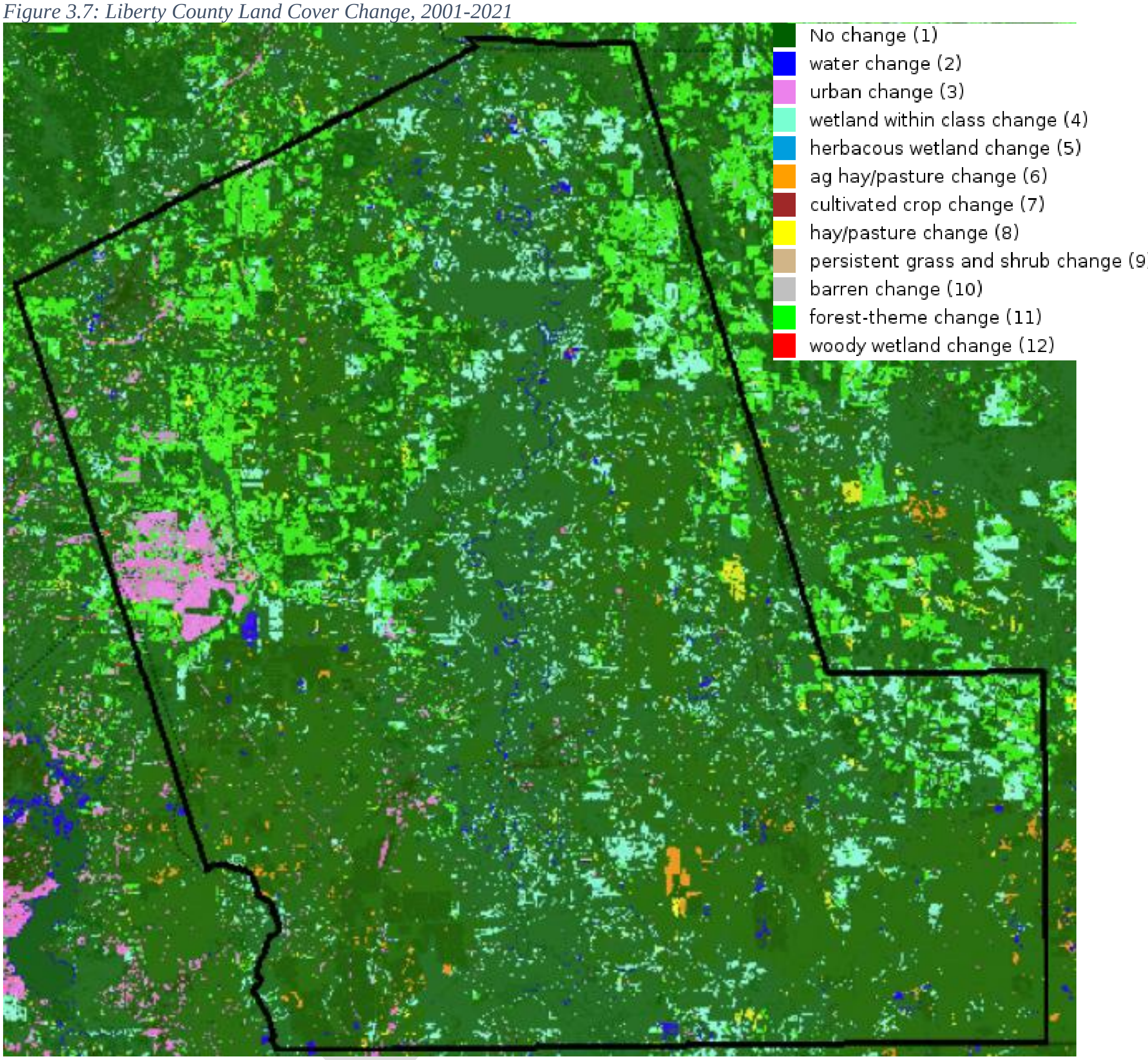
The county is largely rural with pockets of development within and surrounding incorporated areas and the larger cities and communities within the county. Land cover includes a variety of woody wetlands, evergreen forests, cultivated crops, and hay/pastureland with developed areas interspersed throughout the county. Figure 3.6 shows the land cover composition of Liberty County.

Figure 3.6: Liberty County Land Cover, 2022



Land cover change from 2001-2021, as seen in Figure 3.7, has seen an influx of urban development, primarily within and to the east of the City of Plum Grove. An increase in forest-themed/ tree and wetland cover and clusters of water change and agricultural hay/pasture changes makes up the remaining land use changes seen within the last 20 years.[14]

Figure 3.7: Liberty County Land Cover Change, 2001-2021



Zoning

Zoning refers to the process by which a municipality divides its geographic area into different zones or districts, each with its own set of regulations governing land use, building heights, density, and other characteristics. The authority for Texas municipalities to regulate land use through zoning is found in Chapter 211 of the Texas Local Government Code. Specifically, Section 211.001 provides: "A municipality may regulate the use of land within its boundaries by establishing zoning districts for the municipality and by regulating the location, use, and construction of buildings, structures, and other improvements within those zoning districts."[15] Zoning regulations are intended to promote orderly development, protect property values, and ensure that land uses are compatible with their surrounding areas. Zoning regulations can be used to accomplish a variety of goals, such as promoting residential, commercial, or industrial development in certain areas; protecting natural resources or historic landmarks and separating incompatible land uses such as industrial and residential areas. Jurisdictions that have adopted zoning include the City of Cleveland and the City of Dayton.

Building Codes

Building codes are the minimum design and construction requirements to ensure safe and resilient structures. These codes reduce casualties, costs, and damage by creating stronger buildings designed to withstand disasters. They also help communities get back on their feet faster by minimizing indirect costs such as business interruptions and lost income. Up-to-date building codes protect from a wide range of hazards such as safe wiring, fire prevention, or stronger structural integrity.[16] The participating jurisdictions of this plan update have adopted the following building codes or ordinances to guide development within their city limits and ETJ.

Liberty County utilizes its 2021 Subdivision and Development Regulations to guide development within unincorporated areas of the county.

The City of Ames utilizes its code of ordinances and building codes to guide development within the city limits and extra-territorial jurisdiction (ETJ). The City of Ames has adopted the following Codes:

- 2024 International Building Code
- 2021 International Energy Code
- 2021 International Fuel Gas Code
- 2021 International Fire Code
- 2021 Property Maintenance Code
- 2024 International Mechanical Code
- 2023 National Electric Code
- 2024 International Plumbing Code
- 2024 Pool and Spa Code
- 2021 International Residential Code

The City of Cleveland utilizes its code of ordinances and building codes to guide development within the city limits and ETJ. The City of Cleveland has adopted the following Codes:

- 2015 International Building Code
- 2015 International Fire Code
- 2015 International Fuel Gas Code
- 2015 International Mechanical Code
- 2014 National Electric Code
- 2015 International Plumbing Code
- 2015 International Private Sewage Disposal Code
- 2015 Pool and Spa Code
- 2015 International Residential Code
- 2015 International Solar Energy Code
- 2015 International Wildlife Urban Interface Code

The City of Daisetta utilizes its code of ordinances and building codes to guide development within the city limits and ETJ. The City of Daisetta has adopted the following Codes:

- 2021 International Energy Code
- 2021 International Fuel Gas Code
- 2021 International Mechanical Code
- 2021 International Plumbing Code
- 2021 International Building Code
- 2021 International Residential Code
- 2021 International Electrical Code
- 2021 International Fire Code
- 2021 Property Maintenance Code
- 2021 Pool and Spa Code
- 2021 International Private Sewage Disposal Code
- 2021 Energy Conservation Code
- NEC National Electrical Code

The City of Dayton utilizes its code of ordinances and building codes to guide development within the city limits and ETJ. The City of Dayton has adopted the following Codes:

- 2012 International Property Maintenance Code
- 2015 International Building Code
- 2015 International Residential Code
- 2015 International Mechanical Code
- 2015 International Plumbing Code
- 2015 International Energy Conservation Code
- 2015 International Fire Code
- 2015 International Fuel Gas Code
- 2015 International Private Sewage Disposal Code
- 2017 NEC National Electrical Code

The City of Devers utilizes its Subdivision Ordinance (2020) to guide development within the city.
The City of Hardin utilizes its Subdivision Ordinance to guide development within the city limit.

The City of Kenefick utilizes its code of ordinances and building codes to guide development within the city limits and ETJ. The City of Kenefick has adopted the following Codes:

- 2018 International Building Code
- 2018 International Energy Code
- 2018 International Fuel Gas Code
- 2018 International Fire Code
- 2018 Property Maintenance Code
- 2018 International Mechanical Code
- 2020 National Electric Code
- 2018 International Plumbing Code
- 2018 Pool and Spa Code
- 2018 International Residential Code

The City of Liberty utilizes the following development codes to guide development within the city limits and ETJ:

- Subdivision Ordinance (Article 10.02)
- Sign Ordinance (Article 3.09)
- Parking Ordinance (Article 3.12)
- Flood Damage Prevention Ordinance
- Tower Ordinance
- 2021 International Mechanical Code
- 2021 International Plumbing Code
- 2021 International Building Code
- 2021 International Residential Code
- 2021 International Fire Code
- 2018 International Energy Code
- 2023 National Electrical Code

The City of Plum Grove utilizes its code of ordinances and building codes to guide development within the city limits and ETJ. The City of Plum Grove has adopted the following Codes:

- 2012 International Building Code
- 2012 International Energy Code
- 2012 International Fuel Gas Code
- 2012 International Fire Code
- 2012 Property Maintenance Code
- 2012 International Mechanical Code
- 2014 NFPA 70 National Electric Code
- 2012 International Plumbing Code
- 2012 Pool and Spa Code
- 2012 International Residential Code

Future Development

The changes in development since the last plan update, and how they have increased or decreased the community's vulnerability are referenced in each hazard profile under "Populations at Risk", where applicable. The information and figures below highlight areas of future development for participating jurisdictions. Jurisdictions that had no future development updates for this HMP update were included below. All current planned developments and any future developments within the planning area will adhere to the applicable ordinances and codes of the participating jurisdiction they are governed by, including a Flood Damage Prevention Ordinance (FDPO) for any development that occurs within special flood hazard areas (SFHA). These future development areas will not increase the vulnerability of these areas to the hazards within this plan update that are location specific, such as flooding, as there are already strategies in place to mitigate these risks. Hazards that affect the entire county and participating jurisdictions, specifically those that have no set boundaries, will increase vulnerability as future development adds property and other assets to the area and has the potential to attract more people to live and work in the county.

Liberty County (Unincorporated areas)- There are various planned or future residential developments the county is aware of. These future development areas will not increase the vulnerability of these areas to the hazards within this plan update as there are already strategies in place, such as the FDPO to mitigate these risks.

City of Ames- There are no known future developments, business or residential, for the city as of this plan update.

City of Cleveland- Future development includes expanding a parking lot in the downtown area, a new sports complex, and a development agreement on the western edge of the city and south of 105.

City of Daisetta- There are no known future developments, business or residential, for the city as of this plan update.

City of Dayton- Areas in the figures below show the city's proposed future land use map with development agreements overlayed, and new/proposed developments as of August 2024. These future development areas will not increase the vulnerability of these areas to the hazards within this plan update as there are already strategies in place, such as the FDPO to mitigate these risks.

Figure 3.8: City of Dayton, Future Land Use and Development Agreements

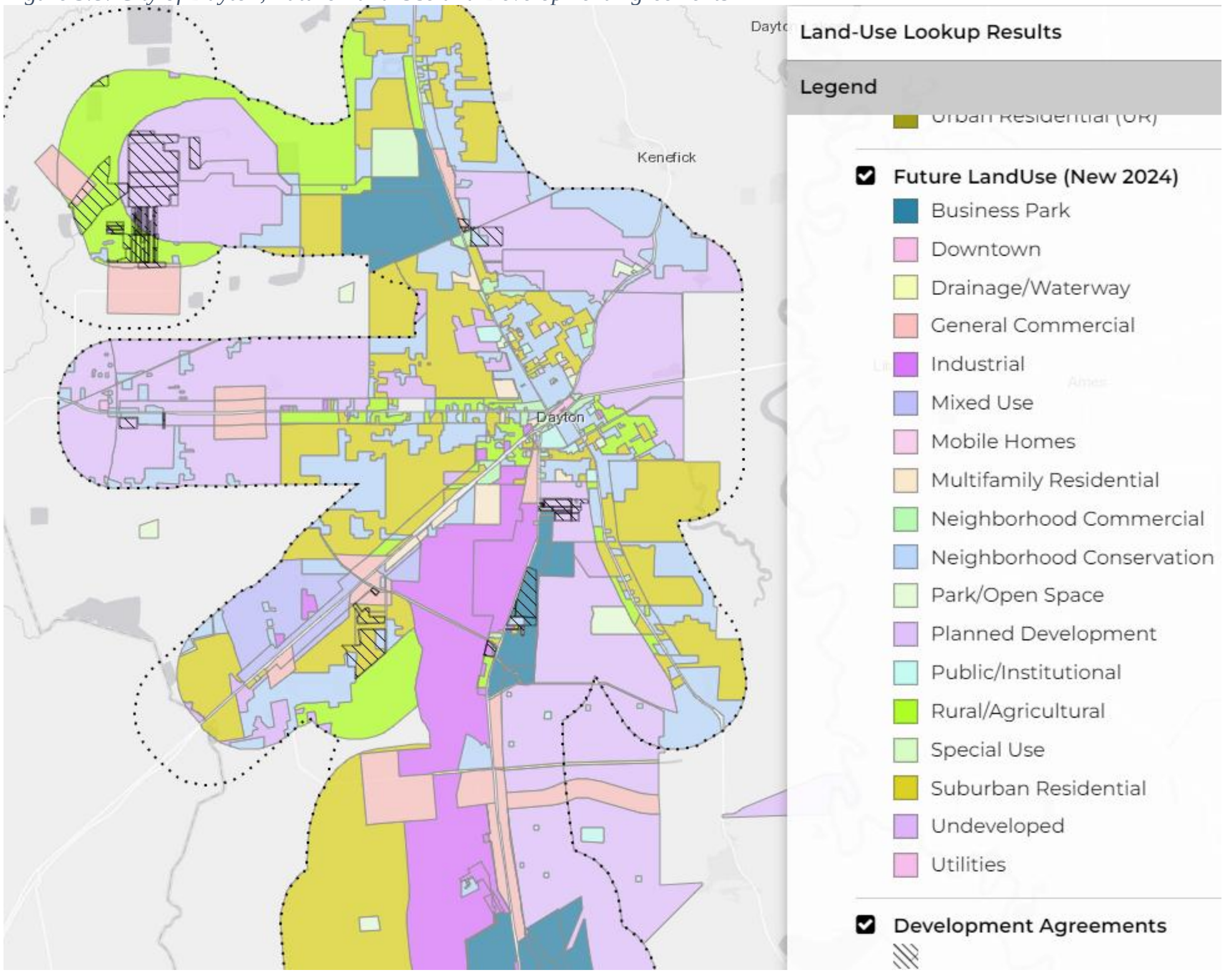
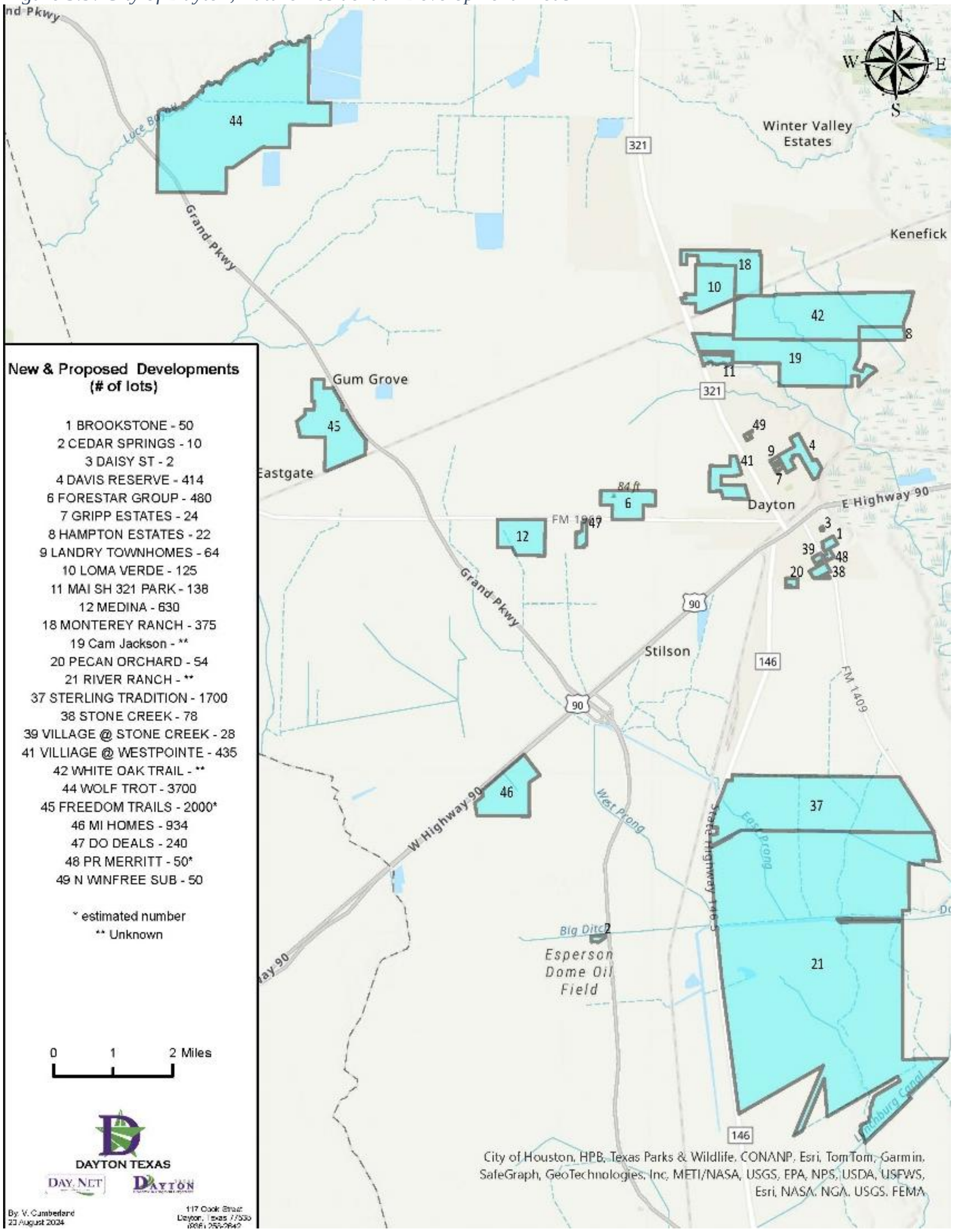


Figure 3.9: City of Dayton, Future Residential Development Areas



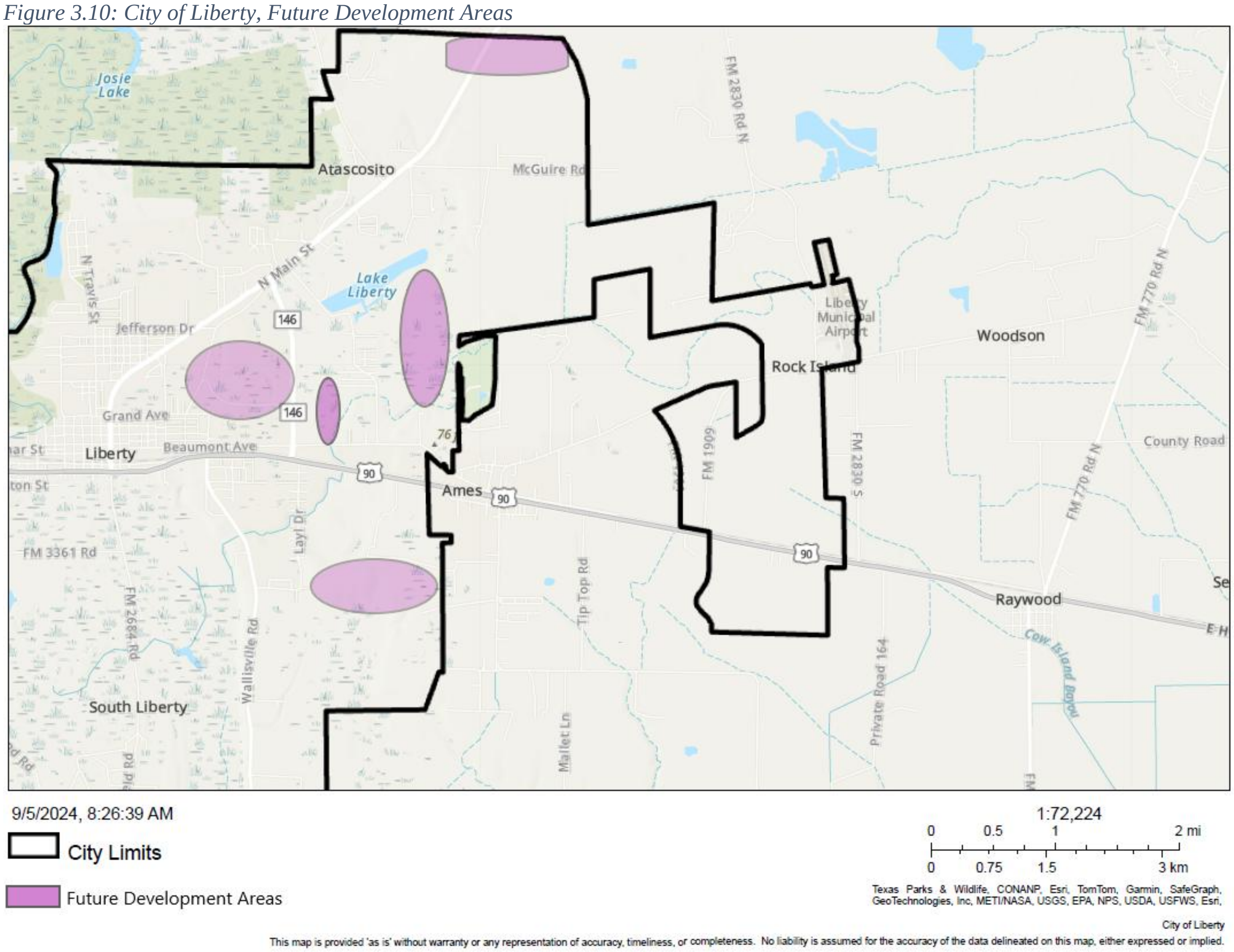
City of Devers- The city has seen very little development since the last plan update. Business additions include a Fuel Maxx and the Line Camp Cowboy Church located along Highway 90. There are no known future developments, business or residential, for the city as of this plan update.

City of Hardin- There are no known future developments, business or residential, for the city as of this plan update.

City of Kenefick- There are no known future developments, business or residential, for the city as of this plan update.

City of Liberty- The figure below shows the city's future development areas. These future development areas will not increase the vulnerability of these areas to the hazards within this plan update as there are already strategies in place, such as the FDPO to mitigate these risks.

Figure 3.10: City of Liberty, Future Development Areas



City of North Cleveland- There are no known future developments, business or residential, for the city as of this plan update.

City of Plum Grove- There are no known future developments, business or residential, for the city as of this plan update.

Liberty County WCID #1- There are no known future developments as of this plan update.

Liberty County WCID #5- There are no known future developments as of this plan update.

Population and Demographics

Liberty County has seen its population grow steadily since 1971, with an average of a 2.1% increase per year. Population growth slowed from 2000 to 2010 at only 6% compared to other 10-year periods. Liberty County saw population increases for 46 out of the 51 years where data is available.[17] The projected population for 2040 is expected to reach 125,681, which is a 37.2% increase. The population from 2020-2060 is projected to see an 83.9% increase with 168,484 residents calling the county home.[18] Figure 3.11 shows the population distribution per 1000 persons by census tract, while Table 3.2 highlights population change in the county since 1970. While the county has seen a steady increase in population since the last plan update, this growth has had no change in vulnerability for the planning area. Population growth has been factored into the current planning and mitigation strategies seen in Section 7 of this plan update.

Figure 3.11: Population Distribution Map

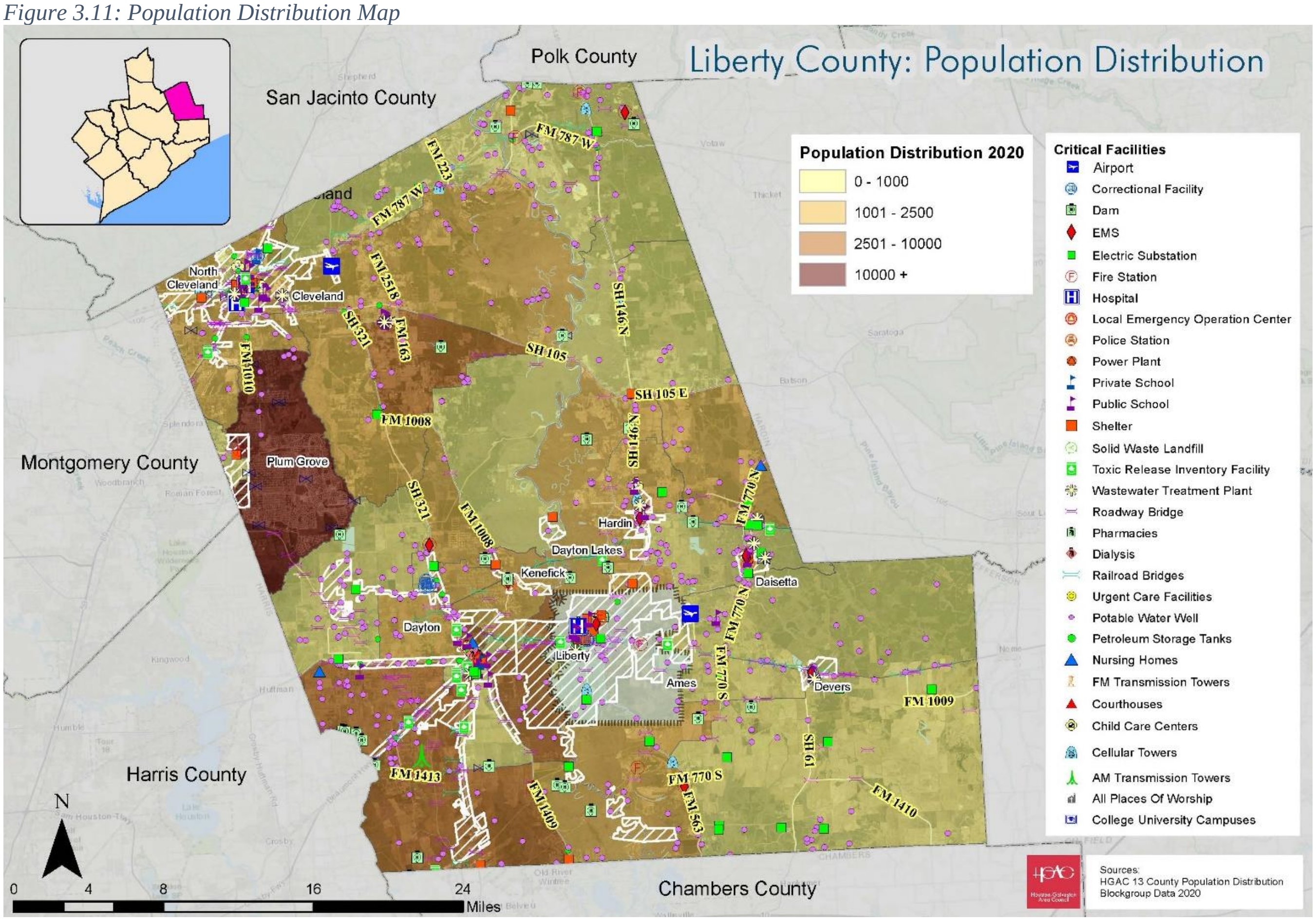


Table 3.2: Liberty County Population Trends, 1970 to 2020

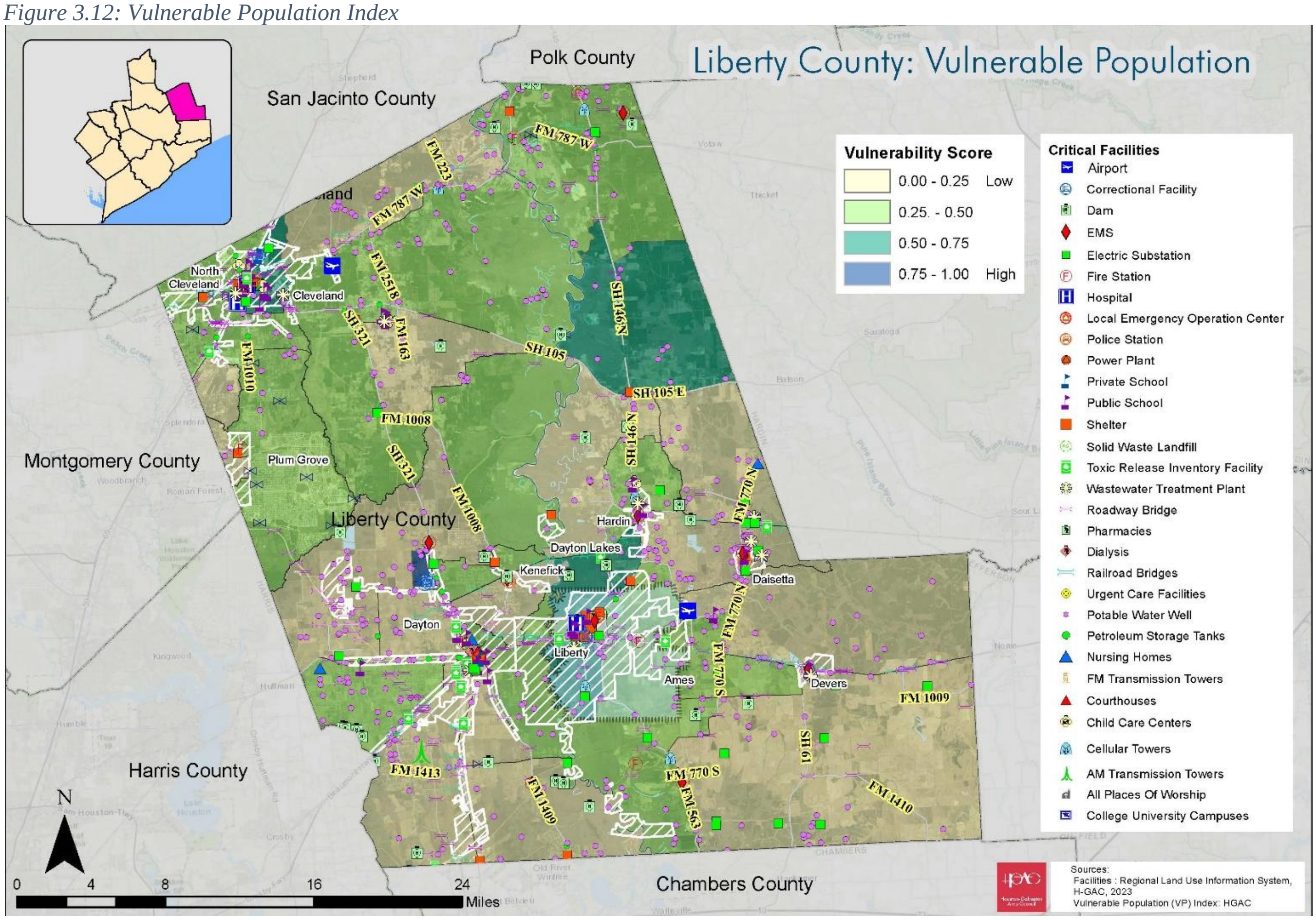
Year	Population Count	Population Change	Percent (%) Change
1970	33,014		
1980	47,088	14,074	43%
1990	52,887	5,799	12%
2000	71,723	18,836	36%
2010	75,870	4,147	6%
2020	91,632	15,762	21%

Liberty County's population demographics, per the 2020 census, consists of 61.5% White population, a 29.3% Hispanic or Latino population, 9% African American population, and less than 1% American Indian and Alaska Native or Asian population. 12.2% of the population in Liberty County is 65 or older, this is lower than the State average of 13.4%. The poverty rate for the County is 19.9%, much higher than the State average of 14%.[19]

Vulnerable Populations

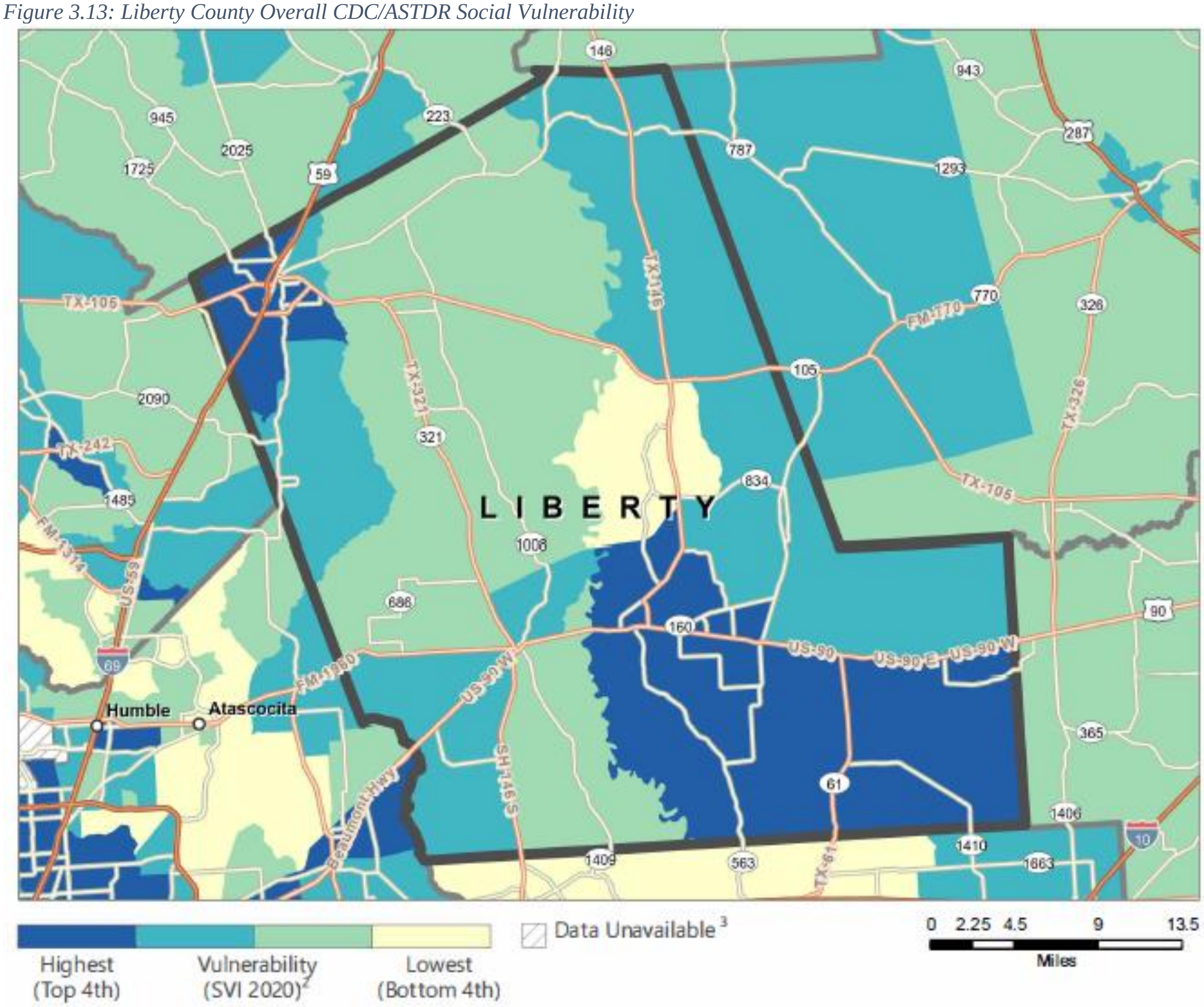
The Vulnerable Population Index, a dataset developed by H-GAC, identifies areas throughout Liberty County that may not have the means or the resources to act when a natural disaster occurs. For this plan, vulnerable populations include any households without a car, single female households with a child or children in the home, individuals living below the poverty line, individuals who are disabled, Hispanic individuals, individuals who are non-Hispanic, and non-white, and individuals who are 65 years and older.[20] The areas in the county with the greatest proportion of these individuals are defined as the most vulnerable areas in Liberty County, denoted by a higher vulnerability score in Figure 3.10. Defining and mapping vulnerable populations provides the opportunity to demonstrate where the most need is throughout the county.

Figure 3.12: Vulnerable Population Index



While age and income have been traditional indicators of vulnerable populations, the Centers for Disease Control and Prevention (CDC) in partnership with the Agency for Toxic Substances and Disease Registry (ASTDR) has developed a Social Vulnerability Index (SVI) that can be generated at the county level. This is a more recent tool used to identify socially vulnerable populations with additional risk factors. The CDC and ASTDR define socially vulnerable populations using factors such as poverty, lack of access to transportation, and crowded housing, to name a few. These factors may weaken a community's ability to prevent human suffering and financial loss in a disaster. The SVI uses U.S. Census data to determine the social vulnerability of every census tract. The SVI ranks each tract on a total of 16 social factors and groups them into four related themes. Figure 3.13 below depicts the social vulnerability of communities in Liberty County by census tract.[21] Factoring in these additional aspects of social vulnerability and grouping them by themes gives the county a bigger picture of vulnerable populations. Liberty County's social vulnerability score is 0.9787 overall. Scores range from 0-1, with 1 being the highest level of vulnerability within the nation. This indicates the county has a high level of social vulnerability.[21]

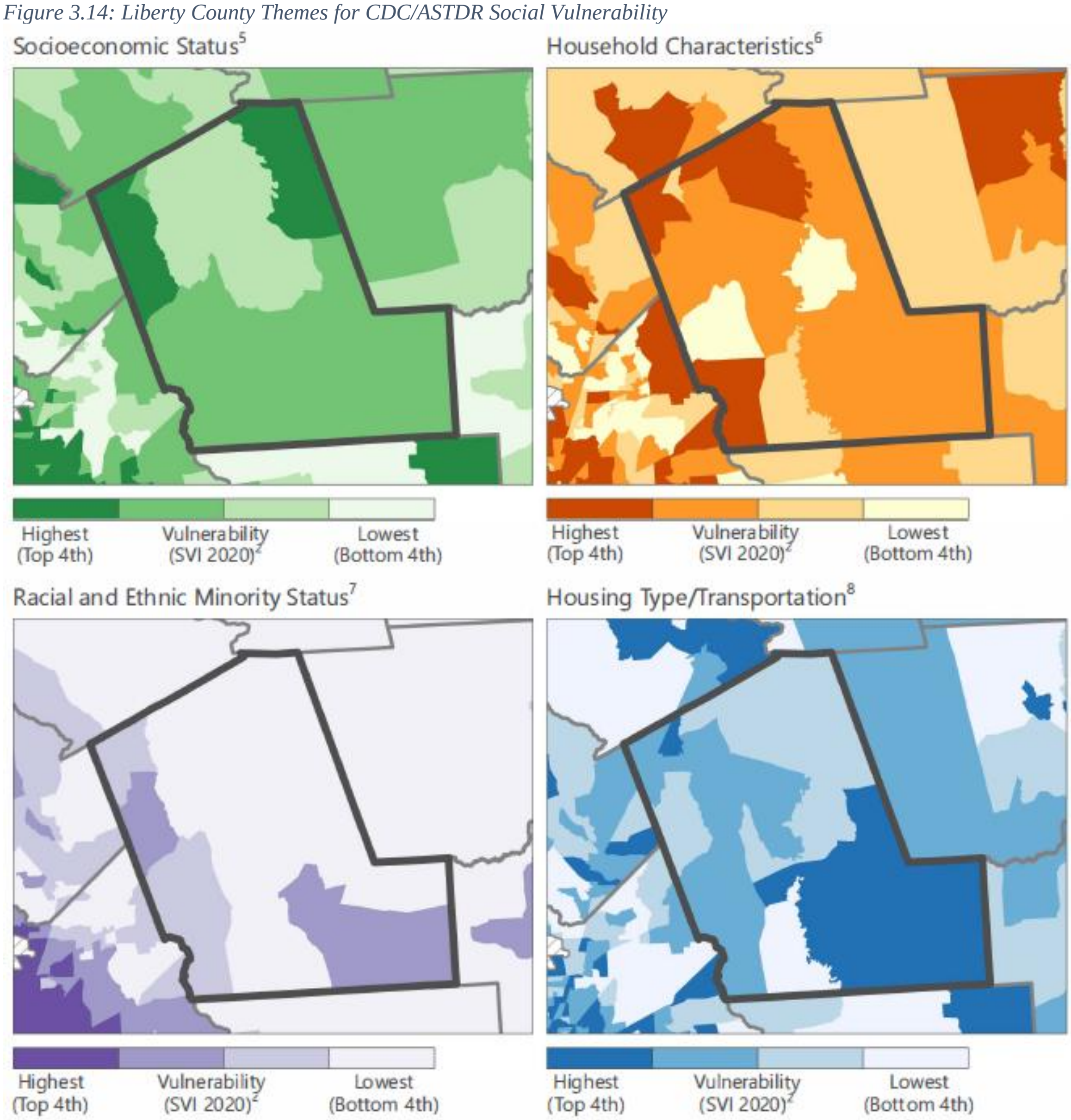
Figure 3.13: Liberty County Overall CDC/ASTDR Social Vulnerability



Areas of the county with the highest vulnerability scores cover the cities of Cleveland, North Cleveland, Liberty, and Devers. To be inclusive of the rural nature of the county, areas with higher concentrations of vulnerable populations, and residents within the county that may not have access to transportation, as well as those who may be unable to attend a meeting within normal working hours; there were two public meetings hosted on September 6 & 7, 2023, from 6-8 PM on the North and South sides of the county within the cities of Cleveland and Liberty. The purpose of these meetings was to provide a hazard mitigation planning project overview from the PT and HMC members and solicit feedback regarding hazards of concern and preparedness from attendees. Meetings took place at the City of

Cleveland Civic Center and the City of Dayton Community Center. Meetings were hosted at times outside normal working hours where those working regular shift times could make plans to attend. Additionally, meetings were announced 1 month prior to scheduled dates, events were advertised and shared by participating jurisdictions on city websites, calendars, and social media pages. Jurisdictions also shared the public meeting flyer and public survey flyer, which included a QR code linking to the online public input survey for those who could not attend the scheduled events. All HMC meetings were open to the public and hybrid meeting options were offered when requested. Elected officials and representatives from fire and police departments, hospitals, local businesses, and government agencies were invited to represent the communities they serve throughout the process, and act as a voice for their communities when members of the general public were not present.

Figure 3.14: Liberty County Themes for CDC/ASTDR Social Vulnerability



Housing and Living Arrangements

As of July 1, 2022, there were 14,198 housing units in Liberty County, with 35,893 households. A household is defined by the U.S. Census Bureau as all the persons who occupy a housing unit and a housing unit as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. The median price of a single-family home in Liberty County was listed at $145,400 from 2018-2021.[6]

Loss Estimations

A Hazus analysis was conducted for 4 scenarios within Liberty County: a 100-year flood scenario, a 500-year flood scenario, a 100-year hurricane scenario, and a 500-year hurricane scenario. Hazus is a regional multi-hazard loss estimation model that was developed by FEMA and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state, and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.[22] For this section, the 100-year flood scenario will be highlighted regarding potential losses of building stock, debris generation, and shelter requirements. The full Hazus analysis for all scenarios can be found in Appendix A.

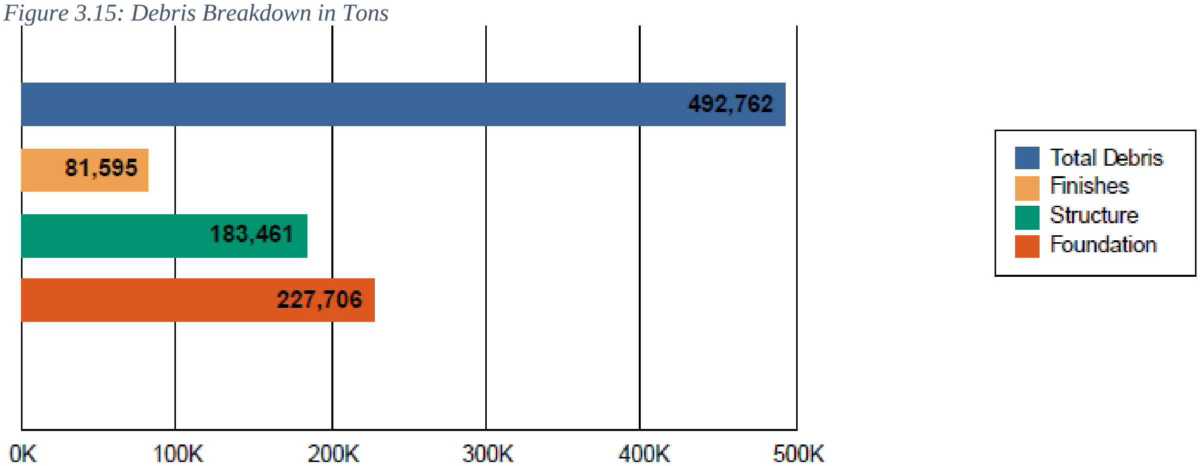
Table 3.3: Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	$5,896,727	57.5%
Commercial	$3,169,463	30.9%
Industrial	$245,199	2.4%
Agricultural	$130,513	1.3%
Religion	$155,036	1.5%
Government	$120,458	1.2%
Education	$546,346	5.3%
Total	**$10,263,742**	**100%**

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood scenario. The model breaks debris into three general categories: 1) Finishes (drywall, insulation, etc.), 2) Structural (wood, brick, etc.), and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris. The model estimates that a total of 492,762 tons of debris will be generated. Of the total amount, Finishes comprises 17% of the total, Structure comprises 37% of the total, and Foundation comprises 46%. If the debris tonnage is converted into an estimated number of truckloads, it will require 19,711 truckloads (estimating 25 tons/truck) to remove the debris generated by the flood.

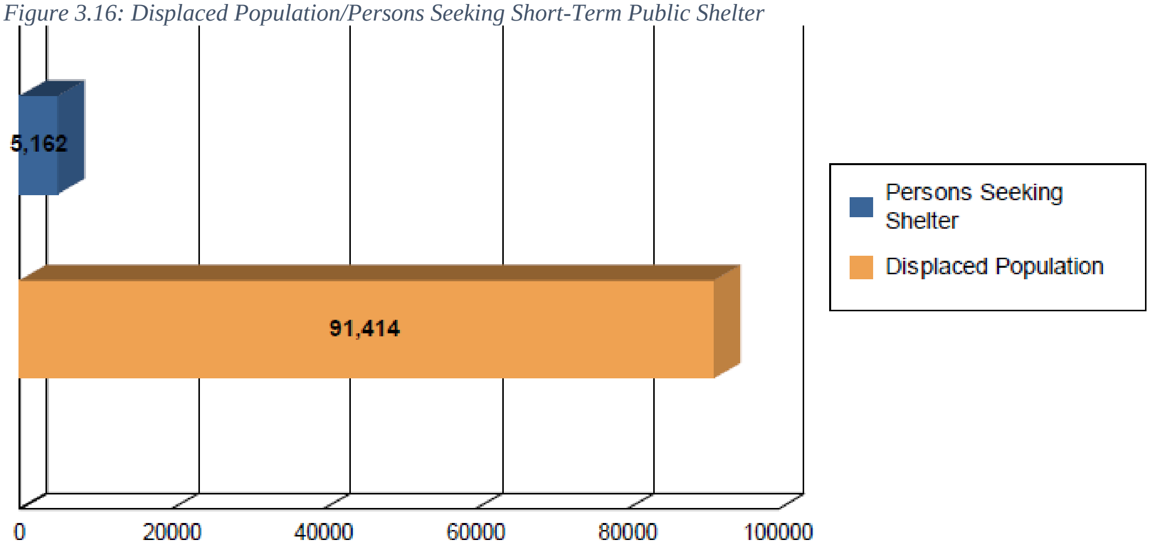
Figure 3.15: Debris Breakdown in Tons



Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodation in temporary public shelters. The model estimates that 30,471 households (or 91,414 people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5,162 people (out of a total estimated population of 91,492) will seek temporary shelter in public shelters.

Figure 3.16: Displaced Population/Persons Seeking Short-Term Public Shelter



Critical Facilities and Lifelines

H-GAC maintains a database of critical facilities that was greatly expanded for this plan update to include more community lifelines and additional critical facilities that were not considered in the 2017 HMP. The HMC provided additional critical facility data when available at meetings hosted by H-GAC. The PT also collected critical facility information from stakeholders at the public hearings hosted in July. It was determined that there are 232 facilities are considered critical or valuable assets, a summary of these facilities is provided below in Table 3.4.[7,23] A full list of critical facilities can be found in Appendix C.

Table 3.4: Critical Facilities & Community Lifelines

Asset Description	Quantity	Amount within a Floodplain
AM Transmission Tower	1	0
Airport	2	0
Cellular Tower	11	2
Childcare Facility	16	0
College	0	0
Correctional Facility	5	0
Courthouse	1	0
Dam	25	16
Dialysis Center	2	0
Elder Care Facility	10	0
Electric Substation	30	7
Emergency Medical Services (EMS)	12	1
Fire Station	19	3
FM Transmission Tower	6	1
Hospital	3	0
Local Emergency Operation Center	2	0
Petroleum Storage Tank	83	4
Pharmacy	12	1
Place of Worship	38	3
Police Station	7	1
Potable Water Well	576	127
Power Plant	0	0
Private Schools	2	0
Public Schools	37	0
Railroad Bridge	61	39
Roadway Bridge	231	119
Shelters	29	2
Solid Waste Landfill	0	0
Toxic Release Inventory Facility	17	3
Urgent Care	2	0
Wastewater Outfall	10	2
Wastewater Treatment Plant	10	3
Residential Units	37,533	
Commercial Units	1,157	

National Flood Insurance Program (NFIP) Participation

The NFIP is a federal program administered through FEMA that enables property owners in participating communities to purchase insurance as a protection against flood losses. Communities must maintain eligibility in the NFIP by adopting and enforcing floodplain management regulations intended to prevent unsafe development in the floodplain, thus reducing future flood damage. FEMA creates flood maps, or Flood Insurance Rate Maps (FIRMs) to support the NFIP.[24, 25] These flood maps are periodically updated and outline the SFHA. The SFHA is the area where the NFIP floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.[26] The NFIP provides affordable flood insurance for property owners, renters, and businesses in participating communities. This reduces the socio-economic impacts of flooding on communities through risk reduction via flood insurance and reduces the physical impacts of flooding through beneficial floodplain regulation. Each of the participating jurisdictions has a floodplain manager (FPM) on staff, and/or function under the regulatory umbrella of Liberty County. To remain NFIP compliant, the FPM conducts jurisdiction wide permitting of new development, permit review, flood code enforcement, educates the public, and provides public assistance. The Liberty County Certified Floodplain Manager (CFM), part of the Permits and Inspection Department, regulates new development by determining if the property in question is in a SFHA designated by FEMA and determining the base flood elevation for new structures, based FEMA maps and data. All structures within the floodplain must obtain an elevation certificate and a No Rise Certificate.

While the County regulates the floodplain as described above, the City of Cleveland, Daisetta, Dayton, Kenefick, Liberty, and Plum Grove have all adopted a Flood Damage Prevention Ordinance into their current city codes to help regulate development within the floodplain and SFHAs. These ordinances allow for jurisdiction-wide permitting of new development, permit review, engineering review, and flood code enforcement. The City of Ames does not have a FDPO as it is considered to have no SFHA and is not considered to have high flood risk. The City of Devers regulates development within the floodplain and flood-prone areas through its 2020 Subdivision Ordinance, however, this does not define how substantial damage or improvements are handled. The City of Devers has noted the adoption of a formal FDPO as an expansion to their capabilities within Section 5 of this plan. The City of Hardin does not have a FDPO and have noted the adoption of one within their capability expansion opportunities found in Section 5 of this plan. The City of North Cleveland is an active participant in the NFIP. However, as a small, incorporated city within Liberty County they have few resources to enforce such policies, and thus look to the County for guidance, development review, and permit review.

Table 3.5: NFIP Participation

Jurisdiction	NFIP Participation	Date Joined	Current Effective FIRM Date	FDPO Adoption Date	Designee for NFIP Requirements
Liberty County	Yes	5/24/1977	1/19/2018	10/13/2020	Floodplain Administrator, Engineering Administrator
City of Ames	Yes	5/2/2008	NSFHA	N/A	N/A
City of Cleveland	Yes	3/8/1974	5/2/2008	8/11/2009	Floodplain Administrator, appointed by City Manager
City of Daisetta	Yes	7/2/1976	1/19/2018	3/30/2007	Code Enforcement Officer
City of Dayton	Yes	6/28/1974	1/19/2018	5/20/2019	Floodplain Administrator, appointed by City Manager
City of Devers	Yes	4/24/1979	1/19/2018	N/A	N/A
City of Hardin	Yes	5/2/2008	1/19/2018	N/A	N/A
City of Kenefick	Yes	4/24/1979	1/19/2018	1/11/2018	Mayor
City of Liberty	Yes	12/20/1974	1/19/2018	8/11/2020	Building Official

Jurisdiction	NFIP Participation	Date Joined	Current Effective FIRM Date	FDPO Adoption Date	Designee for NFIP Requirements
City of North Cleveland	Yes	5/6/1977	5/2/2008	N/A	N/A
City of Plum Grove	Yes	6/19/1979	5/2/2008	1/8/2008	Emergency Management Coordinator

N/A- Not Applicable
NSFHA- No Special Flood Hazard Area, an area that has been determined to lack any special flood hazard area and is not considered to have high flood risk.

Each jurisdiction, as part of its FDPO (as applicable), manages substantial damage or improvements using the same language and format provided by the model FDPO available through the Texas Water Development Board (TWDB). An excerpt from this ordinance outlining these standards can be seen below:

Flood Damage Prevention Ordinance

ARTICLE 5 PROVISIONS FOR FLOOD HAZARD REDUCTION

SECTION A. GENERAL STANDARDS

In all areas of special flood hazards the following provisions are required for all new construction and substantial improvements:

(1) All new construction or substantial improvements shall be designed (or modified) and adequately anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;

(2) All new construction or substantial improvements shall be constructed by methods and practices that minimize flood damage;

(3) All new construction or substantial improvements shall be constructed with materials resistant to flood damage;

(4) All new construction or substantial improvements shall be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/ or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(5) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;

(6) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the system and discharge from the systems into flood waters; and,

(7) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

SECTION B. SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data has been provided as set forth in (i) Article 3, Section B, (ii) Article 4, Section B (8), or (iii) Article 5, Section C (3), the following provisions are required:

(1) **Residential Construction** - new construction and substantial improvement of any residential structure shall have the lowest floor (including basement), elevated to at least 12 inches above the base flood elevation. A registered professional engineer, architect, or land surveyor shall submit a certification to the Floodplain Administrator that the standard of this subsection as proposed in Article 4, Section C (1) a., is satisfied.

(2) **Nonresidential Construction -** new construction and substantial improvements of any commercial, industrial or other nonresidential structure shall either have the lowest floor (including basement) elevated to at least 12 inches above the base flood level or together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls

substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. A registered professional engineer or architect shall develop and/ or review structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction are in accordance with accepted standards of practice as outlined in this subsection. A record of such certification which includes the specific elevation (in relation to mean sea level) to which such structures are floodproofed shall be maintained by the Floodplain Administrator.

(3) **Enclosures** - new construction and substantial improvements, with fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria:

(a) A minimum of two openings on separate walls having a total net area of not less than 1 square inch for every square foot of enclosed area subject to flooding shall be provided.

(b) The bottom of all openings shall be no higher than 1-foot above grade.

(c) Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

(4) **Manufactured Homes**

(a) Require that all manufactured homes to be placed within Zone A on a community's FIRM shall be installed using methods and practices that minimize flood damage. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces.

(b) Require that manufactured homes that are placed or substantially improved within Zones Al-30, AH, and AE on the community's FIRM on sites

(i) outside of a manufactured home park or subdivision,

(ii) in a new manufactured home park or subdivision,

(iii) in an expansion to an existing manufactured home park or subdivision, or

(iv) in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as a result of a flood, be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.

(c) Require that manufactured homes be placed or substantially improved on sites in an existing manufactured home park or subdivision with Zones Al-30, AH and AE on the community's FIRM that are not subject to the provisions of paragraph (4) of this section be elevated so that either:

(i) the lowest floor of the manufactured home is at least 12 inches above the base flood elevation, or

(ii) the manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.

The Community Rating System (CRS)

The CRS is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Participation in the CRS program is voluntary and includes many benefits for a community, such as discounted flood insurance premiums that relate to the community's level of efforts that reduce risk from flooding and strengthen floodplain management. Currently, there are no communities within Liberty County, including the County itself, that participate in the CRS Program.[27]

Table 3.6: Community Participation in the NFIP and CRS Program.[28]

Jurisdiction	CRS Participation
Liberty County	No
City of Ames	No
City of Cleveland	No
City of Daisetta	No
City of Dayton	No
City of Devers	No
City of Hardin	No
City of Kenefick	No
City of Liberty	No
City of North Cleveland	No
City of Plum Grove	No

Repetitive Loss and Severe Repetitive Loss Properties

FEMA defines a repetitive loss (RL) structure as "a structure covered under an NFIP flood insurance policy that:

(1) Has incurred flood-related damage on 2 occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and
(2) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage."[29]

A severe repetitive loss (SRL) property is defined as "a structure that is covered under an NFIP flood insurance policy and has incurred flood-related damage:

(1) For which 4 or more separate claims payments have been made under flood insurance coverage under subchapter B of this chapter, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
(2) For which at least 2 separate flood insurance claims payments (building payments only) have been made, with a cumulative amount of such claims exceeding the value of the insured structure.[30]

According to available data from 2023, Liberty County has a total of 338 RL properties, of which 82 are designated as SRL properties.[31] This does not include RL or SRL properties that have already been mitigated. Table 3.6 outlines the jurisdiction, structure type (residential, commercial, institutional, etc.), and number of records for RL and SRL properties within the county, including the number of those properties that were insured under the NFIP.

Table 3.7: RL and SRL Properties, Liberty County
(FEMA Region 6, Floodplain Management and Insurance Branch, Personal Communication, January 12, 2023)

Jurisdiction Name	Residential RLPs	Non-Residential RLPs	Total RLPs	SRL Properties	Number of NFIP Insured Properties
Liberty County	201	4	205	42	63
City of Ames	5	0	5	1	44
City of Cleveland	19	1	20	3	14
City of Daisetta	1	0	1	0	0
City of Dayton	39	1	40	10	6
City of Devers	0	0	0	0	0
City of Hardin	1	0	1	0	1
City of Kenefick	0	0	0	0	0
City of Liberty	53	10	63	26	31
City of North Cleveland	0	0	0	0	0
City of Plum Grove	3	0	3	0	0
TOTALS:	**322**	**16**	**338**	**82**	**159**

NFIP Policies In-Force

Table 3.7 summarizes the NFIP policies in force for Liberty County by jurisdiction. An "In-force" policy means that the contract between the insurer and the policyholder is active, and the insurance company is liable to pay the benefits as defined in the policy agreement if the insured event occurs. In total, there are 2,205 NFIP insured properties within the county. [32]

Table 3.8: NFIP Insured Properties by Community, Liberty County

Community Name (Number)	Policies In-Force	Total Coverage	Total Written Premium + FPF
Liberty County (480438)	1,332	$361,403,000	$889,346
City of Ames (480044)	21	$5,697,000	$12,228
City of Cleveland (480439)	135	$41,415,000	$117,702
City of Daisetta (481101)	10	$2,235,000	$5,057
City of Dayton (480440)	278	$88,753,000	$149,407
City of Devers (481514)	18	$4,221,000	$12,450
City of Hardin (481270)	16	$4,155,000	$8,147
City of Kenefick (481523)	9	$1,809,000	$4,272
City of Liberty (480441)	352	$114,858,000	$234,794
City of North Cleveland	ND	ND	ND
City of Plum Grove (481269)	32	$8,189,000	$24,761
TOTALS:	2,205	$633,435,000	$1,459,509

Community Name- The official NFIP name of the community in which the policy resides.
Community Number- The 6-character community ID in which the policy resides.
Total Coverage- The total building and contents coverage for the policies in force.
Total Written Premium + FPF (Federal Policy Fee)- This represents the sum of the premium and FPF for the policies in force.
ND- No Data

NFIP Claims

FEMA Guidance specifies that NFIP flood insurance claim information is subject to The Privacy Act of 1974, as amended. The Act prohibits public release of policyholder names, or names of financial assistance recipients and the amount of the claim payment or assistance. After flooding events, local officials are responsible for inspecting flood-damaged structures in the SFHA to determine if they are substantially damaged (50% or more damaged). If so, the property owner is required to bring a non-conforming structure into compliance with the local floodplain ordinance. In Liberty County, the County Judge and individual jurisdictions' Floodplain Administrators are responsible for handling these NFIP claims. There have been 269 NFIP claims submitted, with over $39 million in payments for Liberty County, as seen in Table 3.8.

Table 3.9: NFIP Claims, Liberty County
(FEMA Region 6, Floodplain Management and Insurance Branch, Personal Communication, January 12, 2023)

State	Number of Records	Total Payments
LIBERTY COUNTY	269	$39,803,492.16

Total Payments- The total amount of payments for all claims, including building, contents, and ICC payments.

Section 4: Risk Assessment

This section outlines the risk assessment procedures and identifies hazards ranked by risk that affect Liberty County.

Section 4: RISK ASSESSMENT

The 2023 Texas State Hazard Mitigation Plan identified 11 major natural hazards that affect the region. These include hurricanes, floods, wildfires, drought, and tornados.[33] The local planning team identified 18 hazards, 15 of which are natural hazards, which could affect the county and local jurisdictions. Severe Thunderstorms & Lightning were combined to one hazard profile (Section 6.3) Other hazards of concern brought up by the HMC that have limited data, historic occurrences, or a low-risk level combined with one of the items previously mentioned were grouped into a separate profile, Manmade Hazards. These included Cyber Threats, Biological/HazMat, and terrorism. Summaries of these hazards can be found in Section 6.14- Manmade Hazards.

The HMC was provided with a Risk Assessment worksheet prepared by H-GAC staff. The worksheet outlined the purpose of the Risk Assessment, important items to keep in mind while completing the worksheet, probability, and severity scores, including characteristics for those scores that were relatable, and a guide for how to calculate hazard rankings determined by the probability and severity scores. The Risk Assessment ranked the hazards identified by scoring the probability and severity of each hazard. A risk score was then determined by multiplying the probability (P) by the severity (S). Tables including scores and associated characteristics can be found below. Appendix D includes completed worksheets and a summary of hazard ranking scores from participating jurisdictions.

Table 4. 1: Risk Assessment, Probability

Probability	Characteristics
4 – Highly Likely	Event is probable within the next calendar year These events have occurred, on average, once every 1-2 years in the past
3 – Likely	Event is probable within the next 10 years Event has a 10-50% chance of occurring in any given year These events have occurred, on average, once every 3-10 years in the past
2 – Possible	Event is probable within the next 50 years Event has a 2-10% chance of occurring in any given year These events have occurred, on average, once every 10-50 years in the past
1 – Unlikely	Event is probable within the next 200 years Event has a 0.5-2% chance of occurring in any given year These events have occurred, on average, once every 50-200 years in the past

Table 4. 2: Risk Assessment, Severity

Severity	Characteristics
8 – Catastrophic	Multiple deaths Complete shutdown of facilities for 30 or more days More than 50% of property is severely damaged
4 – Critical	Injuries and/or illnesses result in permanent disability Complete shutdown of critical facilities for at least 14 days More than 25% of property is severely damaged
2 – Limited	Injuries and/or illnesses do not result in permanent disability Complete shutdown of critical facilities for more than seven days More than 10% of property is severely damaged.
1 – Negligible	Injuries and/or illnesses are treatable with first aid Minor quality of life lost Shutdown of critical facilities and services for 24 hours or less Less than 10% of property is severely damaged

Hazards Ranked by Risk

Each identified hazard in the table below poses a risk to Liberty County. Ranking the hazards from greatest to lowest risk allows the communities to prioritize their resources and focus efforts where they are most needed. Identified hazards were given a risk score as determined by participating jurisdictions and the HMC, those hazards were then categorized with a risk rating of High, Moderate, or Low.

Risk Rating	Ranking	Hazards
High	1	Flooding
	2	Hurricanes, Tropical Storms, & Depressions
Moderate	3	Severe Thunderstorms & Lightning
	4	Heat Events
	5	Dam/Levee Failure
	6	Severe Winter Storm
	7	Wildfire
	8	Windstorm
	9	Drought & Expansive Soils
Low	10	Tornado
	11	Hail
	12	Erosion
	13	Emerging Infectious Diseases
	14	Manmade Hazards (Cybersecurity, HazMat, Terrorism) *

* Indicates a hazard that was not profiled fully but was identified as a hazard of concern by the HMC.

Section 5: Capability Assessment

This section includes the capability assessment, which contains a summary and description of the existing plans, programs, and regulatory mechanisms that support hazard mitigation within the planning area.

Section 5: CAPABILITY ASSESSMENT

A Capability Assessment is a process of evaluating the existing capabilities, including resources such as staff time, funding, and infrastructure, that the county currently has at its disposal to utilize for hazard risk reduction. The participating jurisdictions completed local capability and risk assessment surveys to collect data on hazards that affect communities, the communities' ability to mitigate damages from these hazards, and current plans or programs in place to help mitigate natural hazards. The jurisdictions also identified factors impacting their capabilities to address hazards in their communities. The PT used the information to assess the overall risk within each community and to determine a strategy to integrate the HMP into their current planning mechanisms. A condensed version of the information is provided below. The full capability assessment worksheets and responses can be found in Appendix D- Meeting Documentation.

List of Existing Plans & Regulations

CIP: Capital Improvements Plan
COMP: Comprehensive Land Use Plan
COOP: Continuity of Operations Plan
DRP: Disaster Recovery Plan
EDP: Economic Development Plan
EOP: Emergency Operations Plan
FMP: Floodplain Management Plan
FDPO: Flood Damage Prevention Ordinance
FPO: Floodplain Ordinance
HMP: Hazard Mitigation Plan
NHSO: Natural Hazard Specific Ordinance
REP: Radiological Emergency Plan
SMP: Stormwater Management Plan
SO: Subdivision Regulation
TP: Transportation Plan
ZO: Zoning Ordinance

Table 5.1: Existing Plans and Regulations by Participating Jurisdictions

Jurisdiction	CIP	COMP	COOP	DRP	EDP	EOP	FMP	FDPO	FPO	HMP	NHSO	REP	SMP	SO	TP	ZO
Liberty County (Unincorporated)						X		X		X						
City of Ames										X						
City of Cleveland			X				X	X		X		X		X	X	X
City of Daisetta								X		X				X		
City of Dayton								X		X				X		X
City of Devers										X	X			X		
City of Hardin	X									X						
City of Kenefick								X		X						
City of Liberty	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
City of North Cleveland										X						
City of Plum Grove								X		X						
Liberty County WCID #1																
Liberty County WCID #5																

Capability Limitations and Expansion Opportunities

Participating jurisdictions examined their existing authorities, policies, programs, and resources. Participating jurisdictions then identified ways to improve upon and expand their existing authorities to support the mitigation strategy.

Table 5.2: Capability Limitations and Expansion Opportunities by Participating Jurisdictions

Jurisdiction	Capability Limitations and Expansion Opportunities
Liberty County (Unincorporated)	Identified their local budget as a factor that decreases their capability to implement mitigation actions and reduce future damages. Liberty County will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards.
City of Ames	Need for technical staff and a larger budget. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards.
City of Cleveland	Identified an almost out-of-date comprehensive plan as a weakness in helping create sound land use in the city. Will consider updating the current comprehensive plan.
City of Daisetta	Identified the local budget, time, and the lack of technical and city staff to implement the mitigation strategy. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards.
City of Dayton	Have a strong technical staff but need to increase public engagement of city planning. Implementing planning workshop meetings to discuss future growth of the city.
City of Devers	Devers will supplement their local budget by applying for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards. Additionally, capabilities could be expanded by adopting a FDPO.
City of Hardin	Expand their NFIP compliance practices and send staff to continuing education courses. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards. Additionally, capabilities could be expanded by adopting a FDPO.
City of Kenefick	Identified a need for technical staff and a larger budget. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards.
City of Liberty	Identified barriers such as a lack of citizen involvement in boards and committees, lack of funding, and a lack of consistent low-cost funding sources from State and Federal agencies as limitations for implementing the mitigation strategy. Expansion opportunities were identified as a strong political will- the City Council has been receptive to regulations that minimize or eliminate damages from natural hazards. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards and increase educational outreach to developers, contractors, and homeowners on the importance of development and building codes put in place to reduce risk.
City of North Cleveland	Need for technical staff and a larger budget. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards. Additionally, capabilities could be expanded by adopting a FDPO.
City of Plum Grove	Identified low budget as a barrier to implementing projects and plans. Will apply for state and federal funding to help fund mitigation actions that reduce the impact of natural hazards. Additionally, capabilities could be expanded by adopting a FDPO.
Liberty County WCID #1	Identified the lack of personnel & funding as a limitation.
Liberty County WCID #5	Identified the lack of personnel & funding as a limitation. HMP would allow for other potential funding sources for increased resiliency through engineering and construction projects.

Section 6: Hazard Identification & Risk Analysis

This section is broken down into subsections for each hazard of concern to Liberty County and participating jurisdictions that were identified during the risk assessment. It contains descriptions of identified hazards, hazard location, extent, history of events, probability of future events, and climate change impacts. Additionally, vulnerability is addressed for all hazards and includes a probable risk level, an estimate of property and crop damages, number of events, fatalities and injuries, average annual events, changes in frequency, and estimated annualized losses, where applicable.

Section 6: HAZARD IDENTIFICATION & RISK ANALYSIS

6.1 Flooding
6.2 Hurricanes, Tropical Storms, & Depressions
6.3 Severe Thunderstorms & Lightning
6.4 Heat Events
6.5 Dam/Levee Failure
6.6 Severe Winter Storm
6.7 Wildfire
6.8 Windstorm
6.9 Drought & Expansive Soils
6.10 Tornado
6.11 Hail
6.12 Erosion
6.13 Emerging Infectious Diseases
6.14 Manmade Hazards (Cybersecurity, HazMat, Terrorism)

Section 6.1: Flooding

6.1 Flooding

Floodplains are the primary tool used by FEMA to determine areas at risk of flooding. The periodic flooding of lands adjacent to rivers, streams, and shorelines is a natural and inevitable occurrence that can be expected based on established recurrence intervals. The recurrence interval of a flood is the average time interval, in years, that can be anticipated between flood events of a certain magnitude. Using the recurrence interval with land and precipitation modeling, forecasters can estimate the probability and likely location of flooding. These are expressed as floodplains. The most commonly used floodplain measurements are the 100-year floodplain and the 500-year floodplain. The 100-year floodplain is a SFHA that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent (1 in 100) annual chance flood is also referred to as the base flood.[34] The 500-year floodplain, or the 0.2% annual chance flood, is a flooding event that has a 0.2 percent (1 in 500) chance of occurring in any given year at any given location.

Four different types of flooding can affect an area: coastal, riverine, flash flooding, and groundwater flooding. For this HMP update, the flooding section focuses on riverine and flash flooding as those are historically the types of floods that have occurred within the county. Riverine Flooding is when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow and water overflows the banks, spilling out into adjacent low-lying, dry land.[35] Riverine flooding can occur during heavy periods of rain that cause rivers and streams to crest their banks and can take days, weeks, to months to subside back to normal levels. Flash Flooding is defined by the National Weather Service as “A rapid and extreme flow of high water into a normally dry area or a rapid water level rise in a stream or creek above a predetermined flood level. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. Commonly it occurs within six hours of a heavy rain event. However, flash floods can also occur within hours or even minutes if a dam or levee fails or rapid ponding of water caused by torrential rainfall.”[36]

Location

Figure 6.1.1 below shows the location of floodplains within Liberty County and participating jurisdictions. Figures 6.1.2 through 6.1.11 show the floodplains within each participating jurisdiction of this plan. Areas depicted by differentiating colors on the map show the locations of the floodway, 100-year, and 500-year floodplains.

Boundaries for Liberty County WCID #1 covers 37,423 acres of land and maintains 83 miles of channels in the lower southwest corner of Liberty County, Texas. All the channels empty into Cedar Bayou. WCID #1 boundaries (outlined in red to the southwest of the map below) overlap partially with the City of Dayton and its ETJ. Boundaries for Liberty County WCID #5 (outlined in black crosshatching) partially overlap with the City of Liberty, the City of Ames, and unincorporated areas of Liberty County.

Figure 6.1.1: Floodplain Location, Liberty County

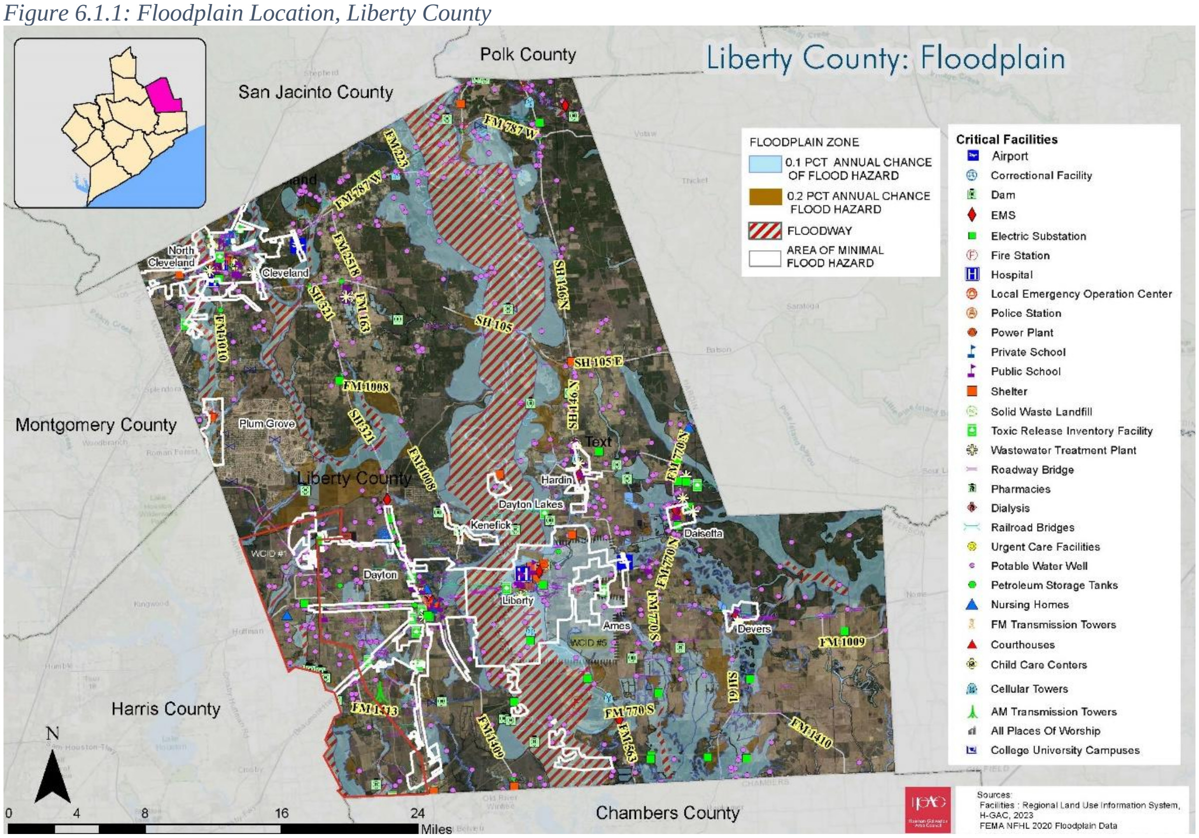


Figure 6.1.2: Floodplain Location, City of Ames

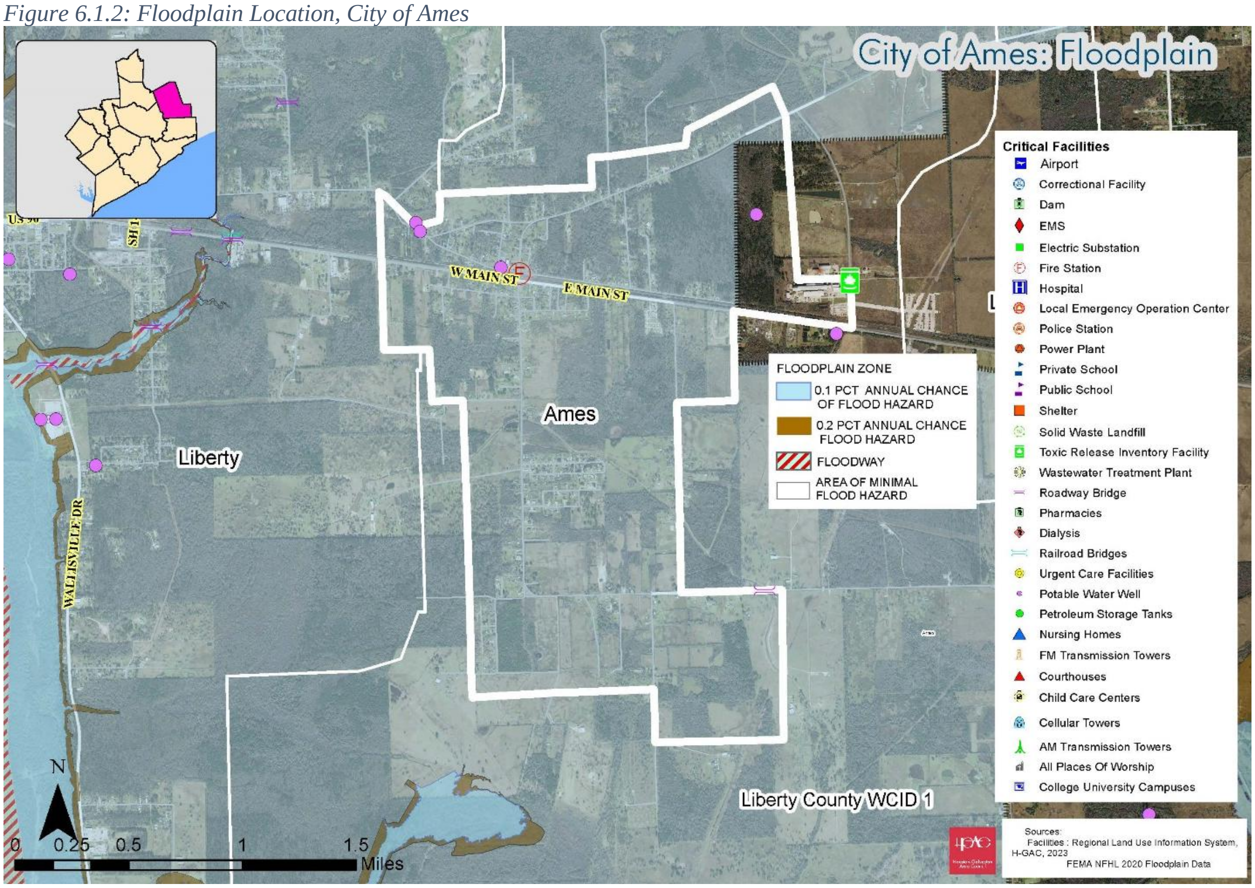


Figure 6.1.3: Floodplain Location, City of Cleveland

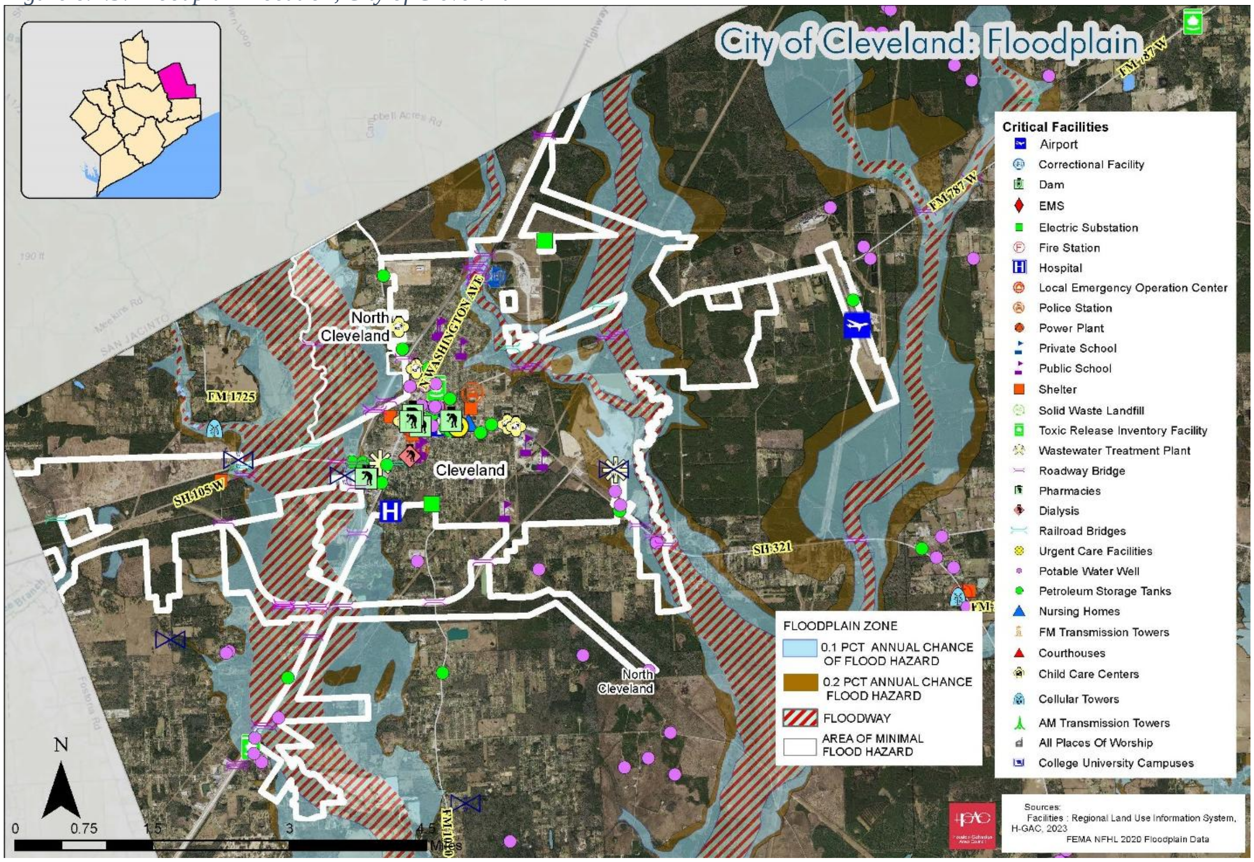


Figure 6.1.4: Floodplain Location, City of North Cleveland

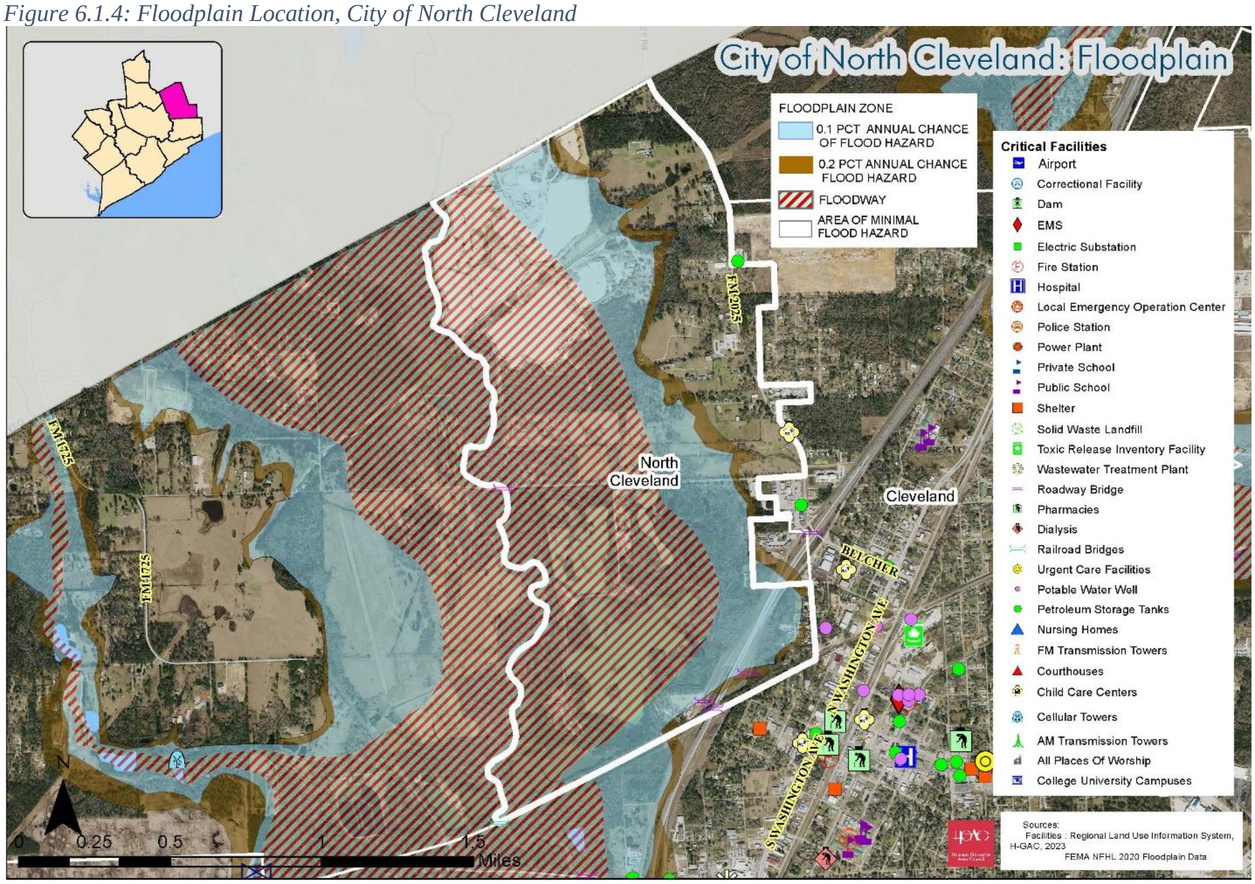


Figure 6.1.5: Floodplain Location, City of Daisetta

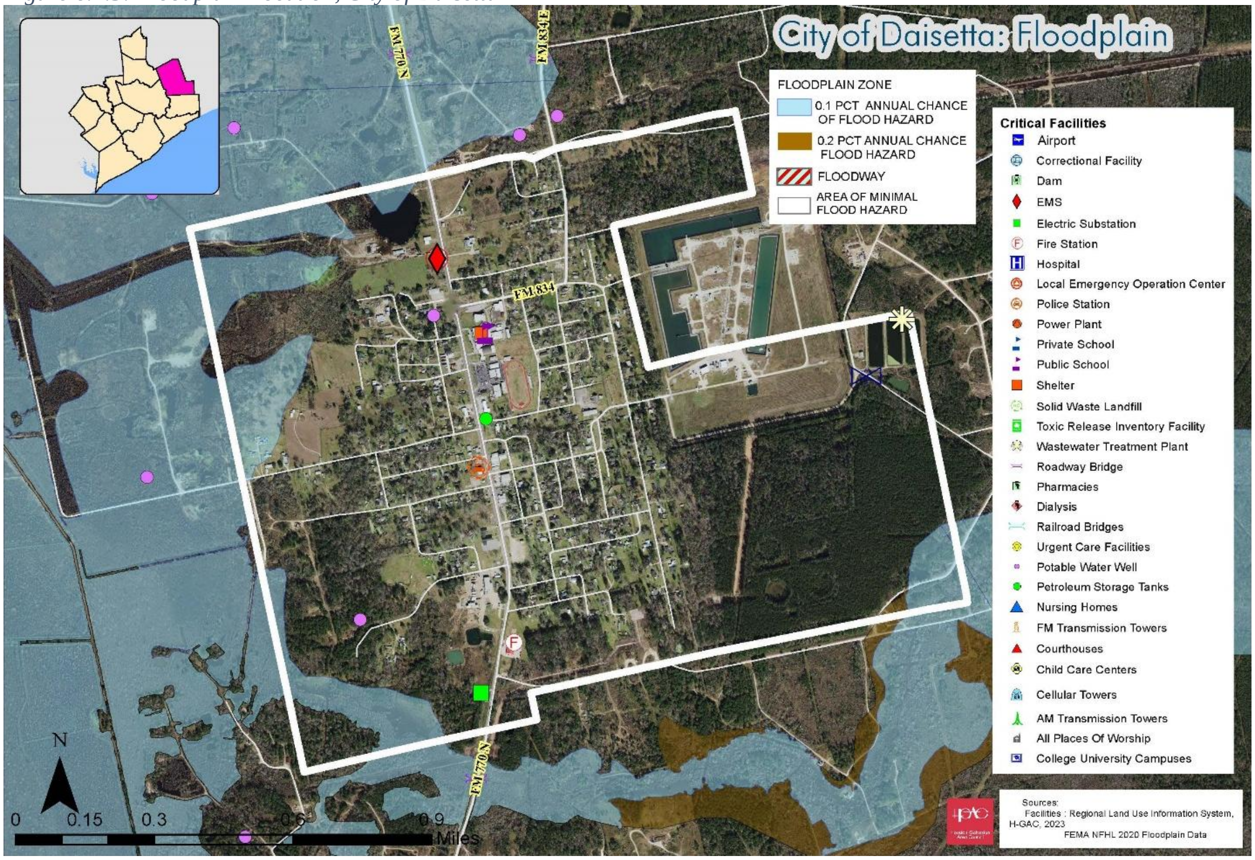


Figure 6.1.6: Floodplain Location, City of Dayton

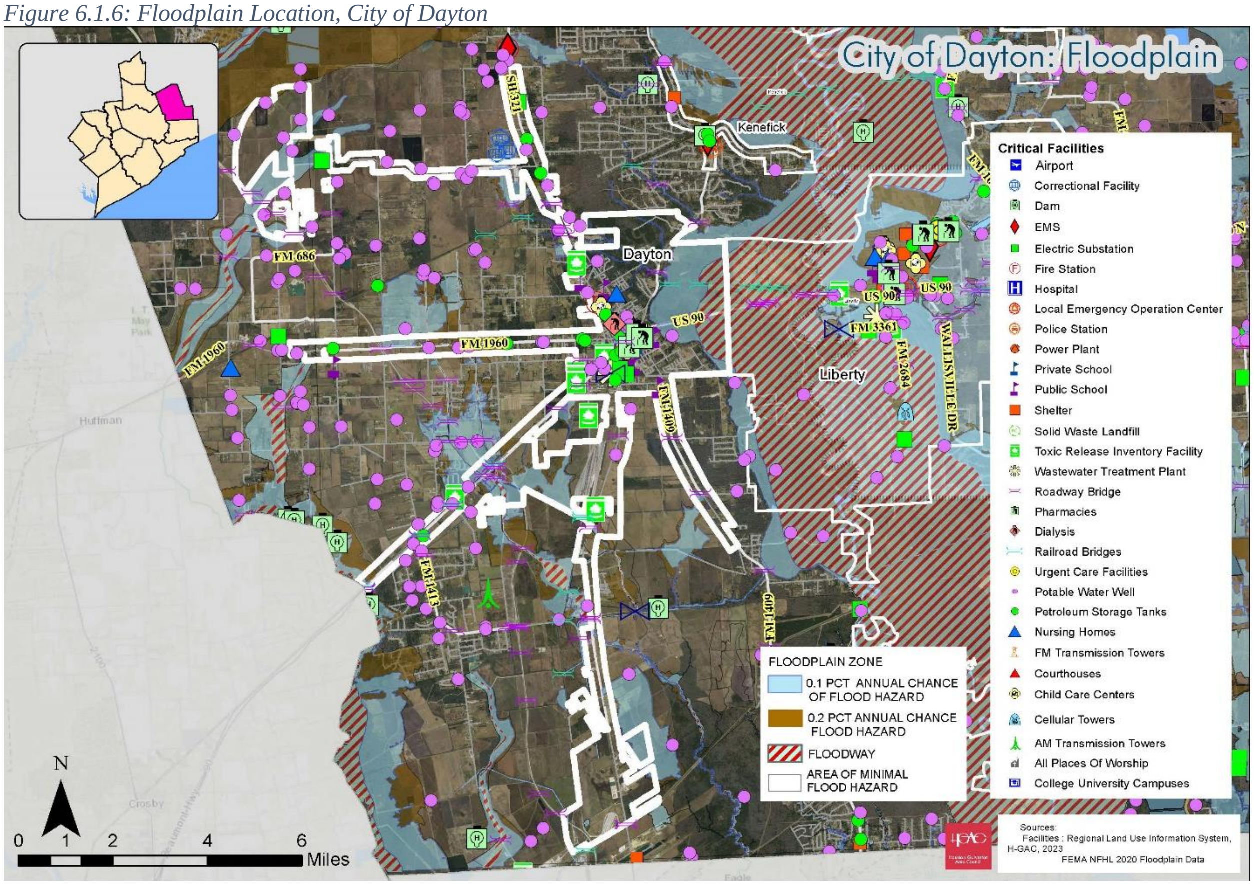


Figure 6.1.7: Floodplain Location, City of Devers

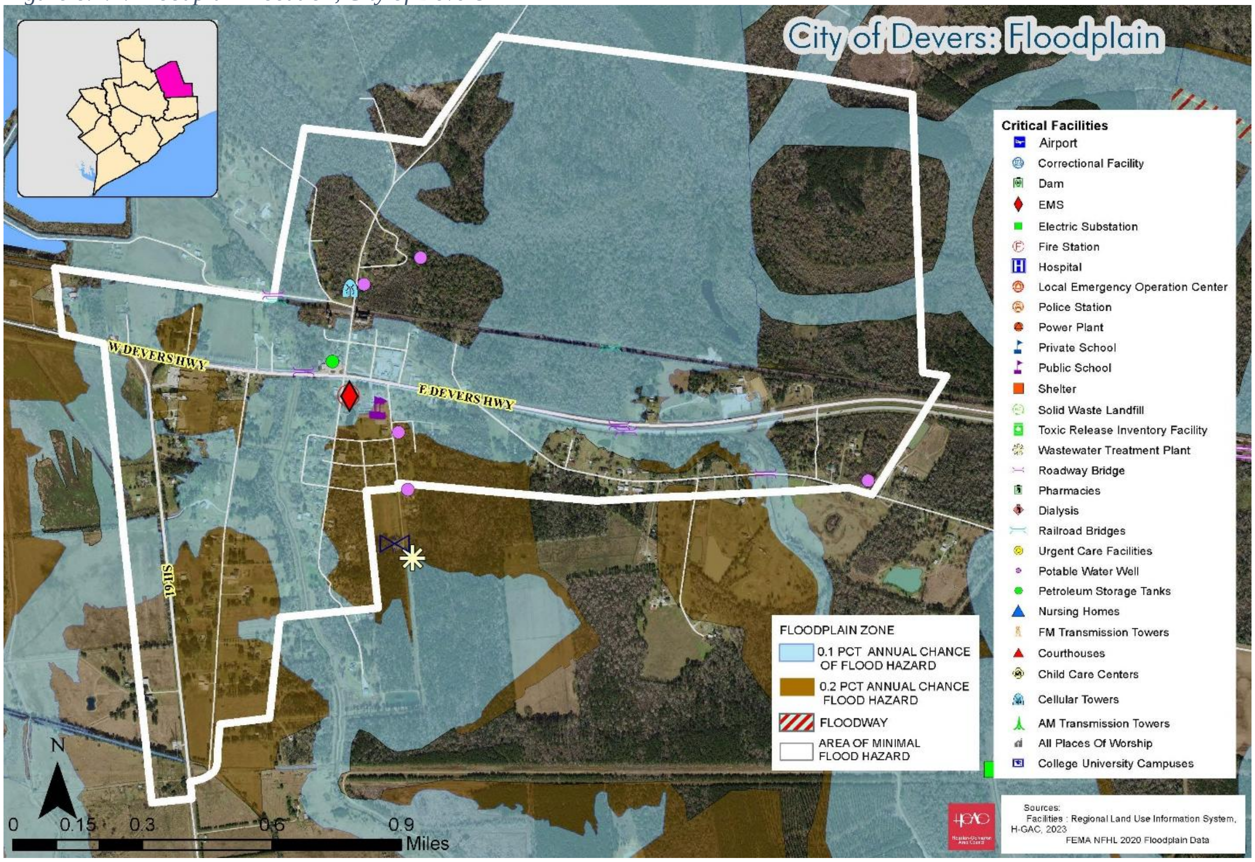


Figure 6.1.8: Floodplain Location, City of Hardin

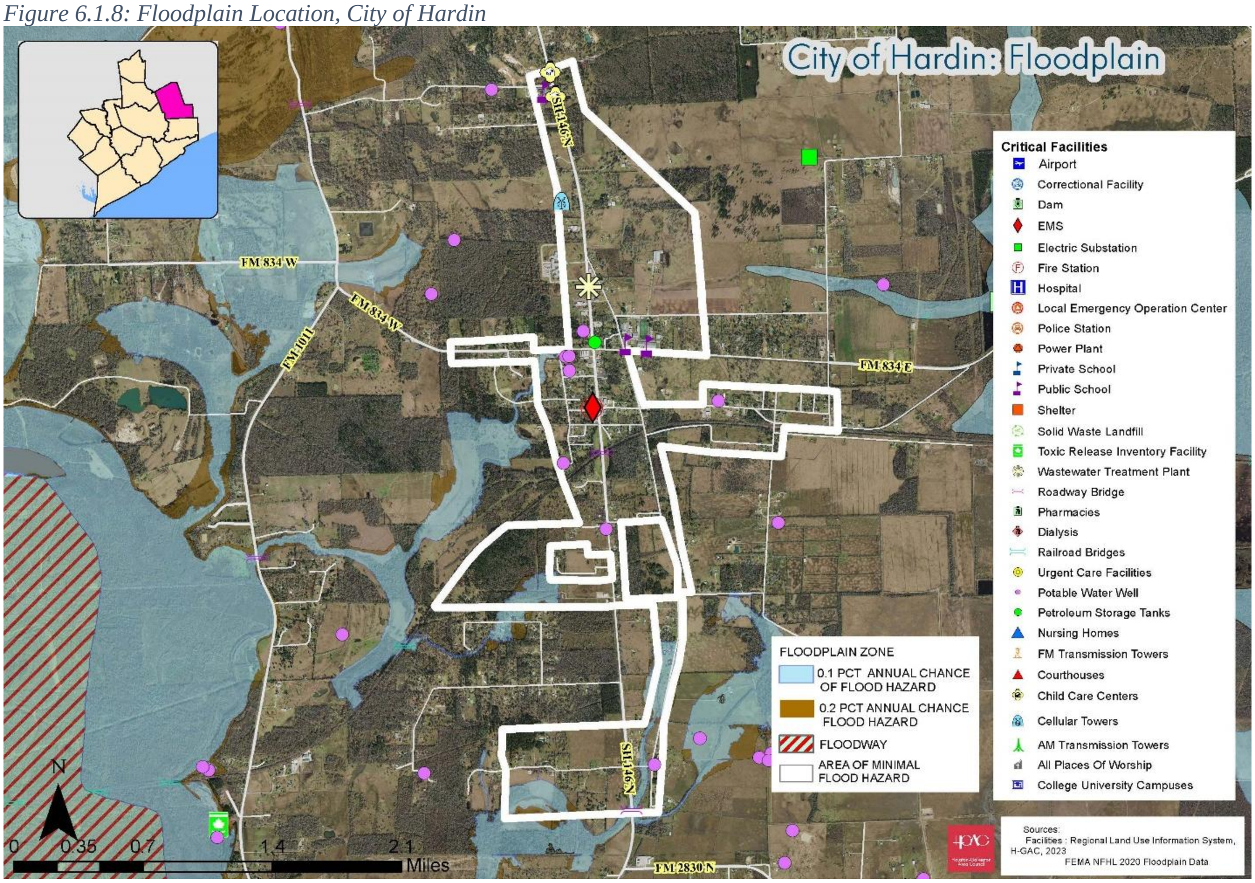


Figure 6.1.9: Floodplain Location, City of Kenefick

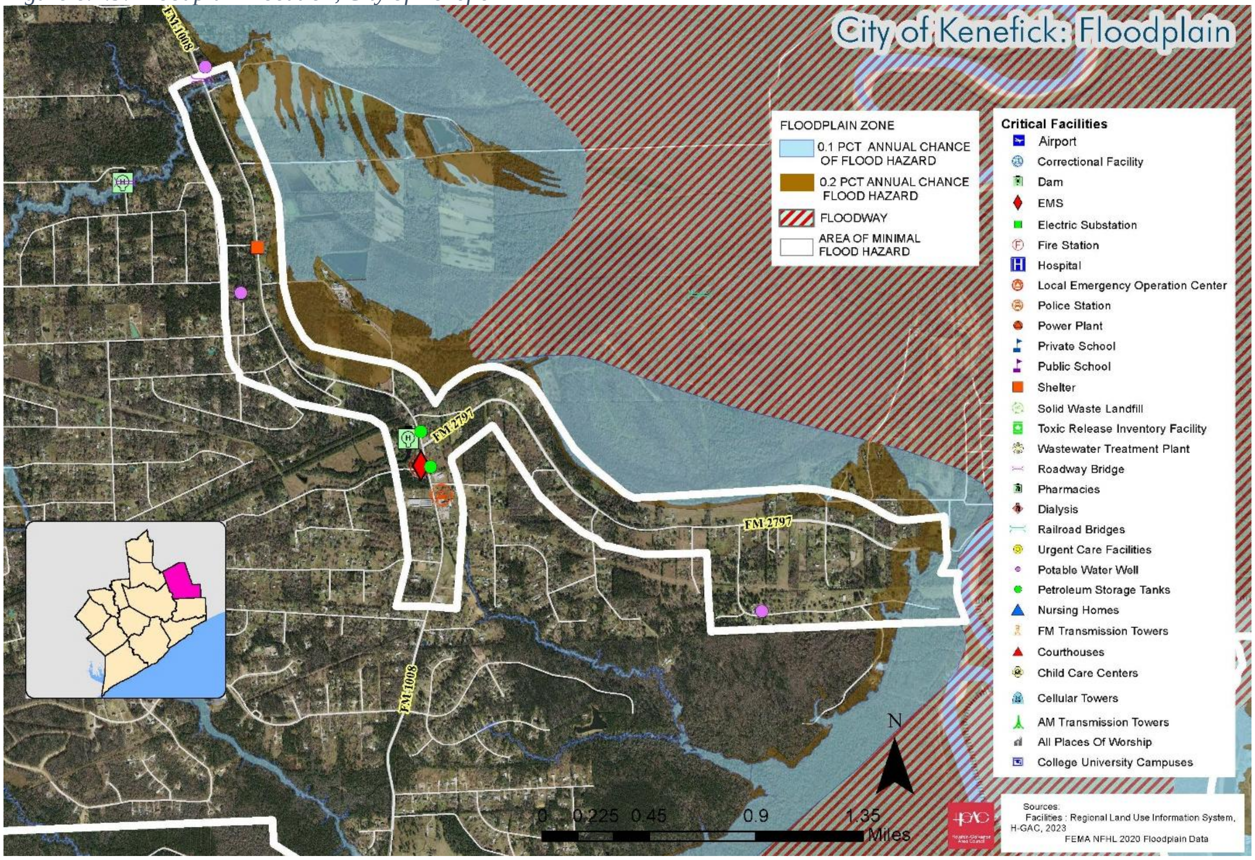


Figure 6.1.10: Floodplain Location, City of Liberty

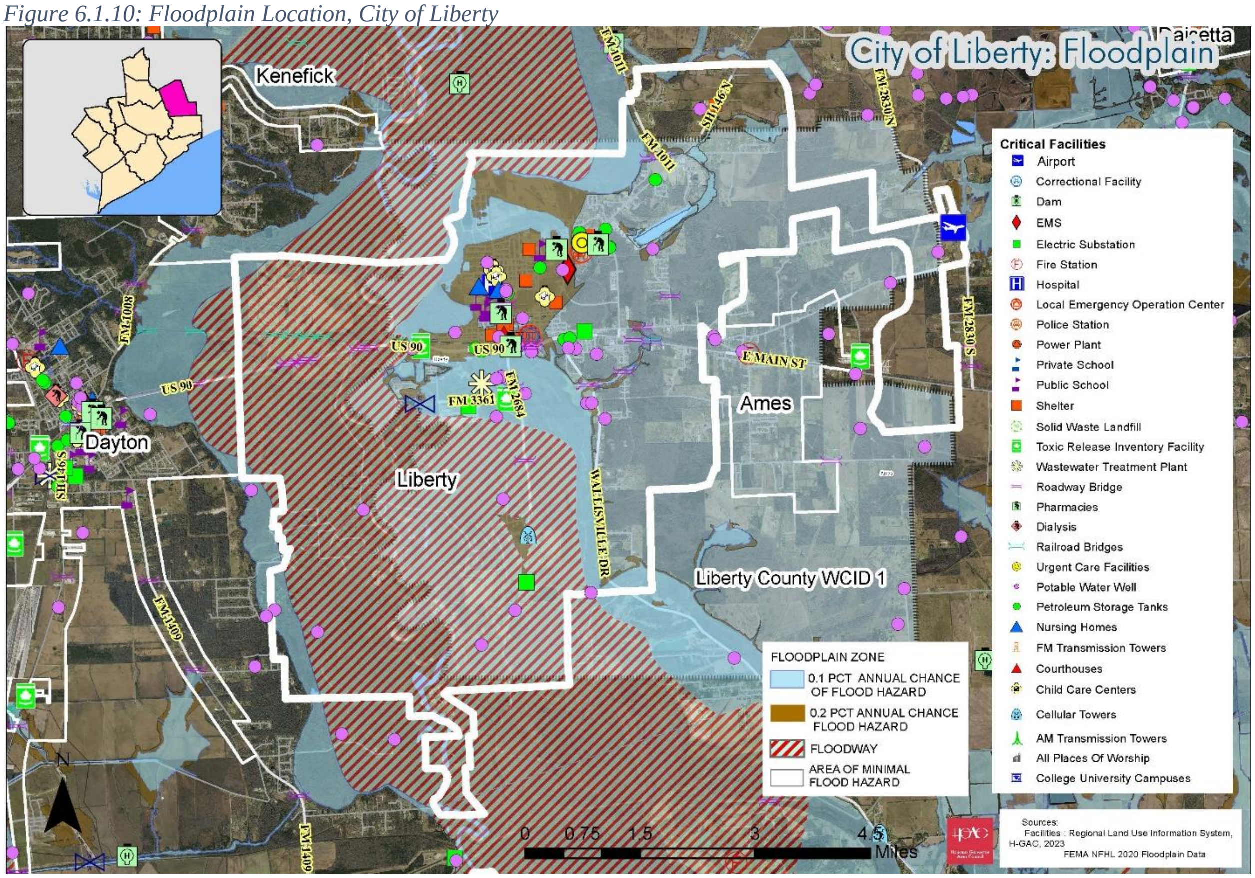


Figure 6.1.11: Floodplain Location, City of Plum Grove

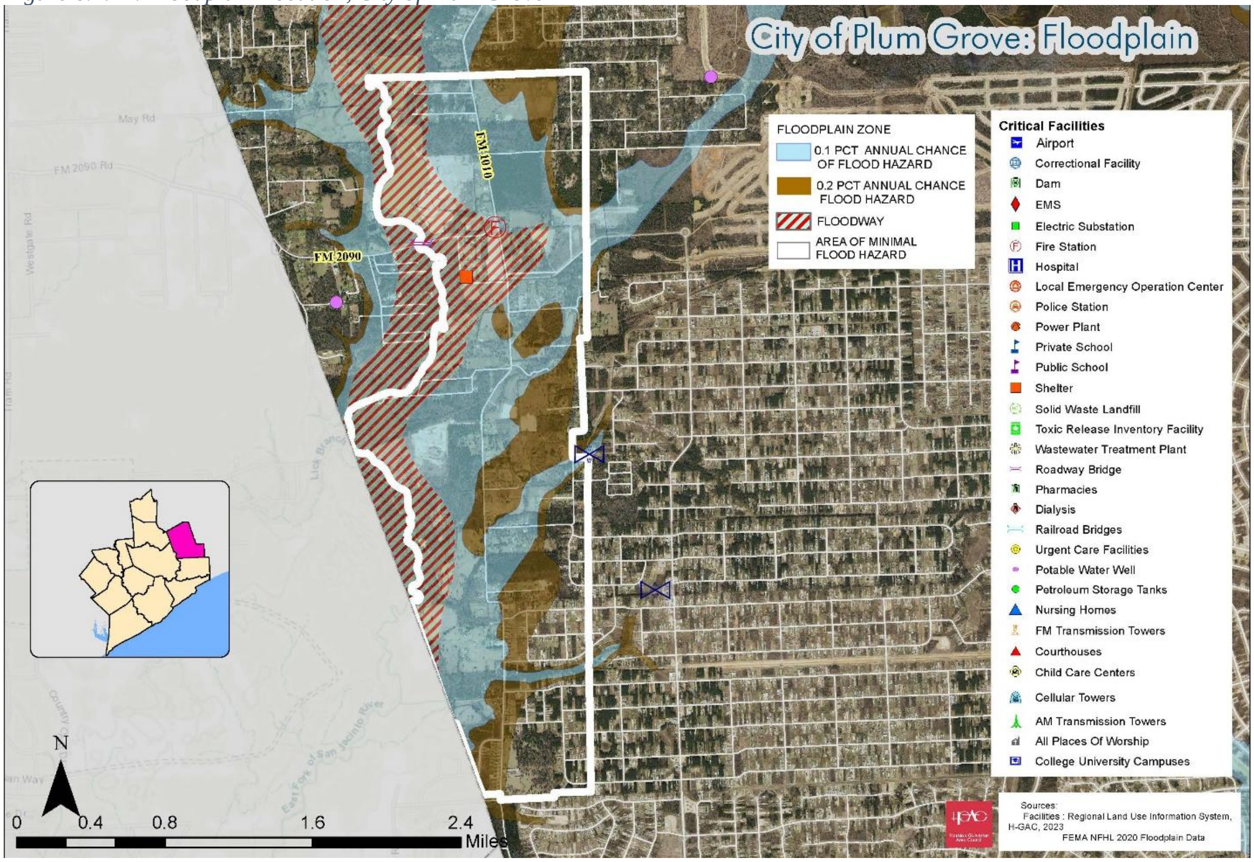
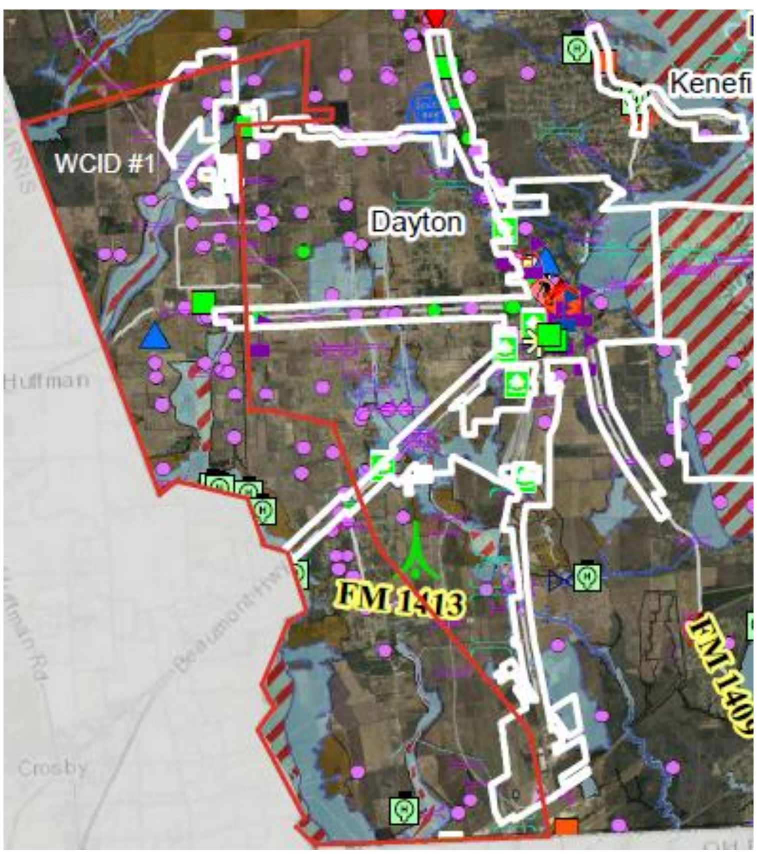
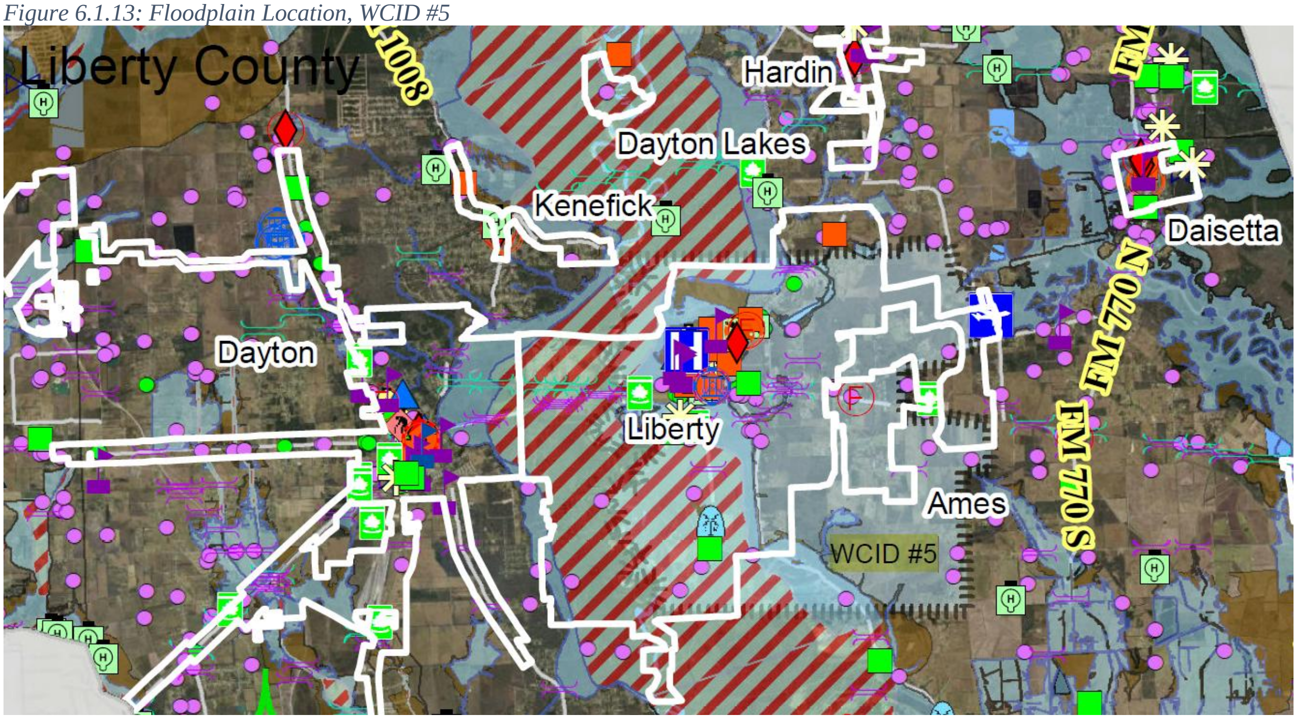


Figure 6.1.12: Floodplain Location, WCID #1



The outer boundary of WCID #1 is depicted by the red outline.

Figure 6.1.13: Floodplain Location, WCID #5



The outer boundary of WCID #5 is depicted by the black crosshatched outline.

Extent

The National Weather Service (NWS) categorizes riverine flooding levels into four categories, minor, moderate, major, and record flooding. Table 6.1.1 below outlines these categories and their descriptions. Once a river reaches flood stage, an established gage height for a given location in which a rise in surface water begins to create a hazard to lives, property, or businesses, the NWS utilizes these categories to describe flood severity.

Table 6.1.1: NWS Flood Categories

Flood Category	Description
Minor Flooding	Minimal or no property damage is expected, but the flooding could possibly cause some public threat or inconvenience.
Moderate Flooding	Some inundation of structures and roads near streams is expected. Some evacuations of people and or a transfer of property to higher elevations are necessary.
Major Flooding	Extensive inundation of structures and roads in addition to the possible significant evacuations of people and/or transfer of property to higher elevations.
Record Flooding	Flooding which equals or exceeds the highest stage or discharge observed at a given site during the period of record.

Flash Floods can be caused by several factors, but they are most often caused due to extremely heavy rainfall from thunderstorms. The intensity of rainfall, the location and distribution of the rainfall, the land use and topography, vegetation types and growth/density, soil type, and soil water content all determine how quickly flooding may occur, and influence where it may happen.[37]

Flooding causes widespread and varying degrees of damage. The magnitude or extent of flood damage is expressed by using the maximum depth of flood water during a specific flood event. Structures inundated by 4 feet or more of flood water are considered an absolute loss. Other forms of loss include damage to roads and bridges, agriculture damages, loss of services, injury, or death. “In addition to property damage, flooding can also cut off access to utilities, emergency services, and transportation, and may impact the overall economic well-being of an area. The figures below highlight expected flood depths for Liberty County and participating jurisdictions under 1% and 0.2% annual chance storm events based on best available data from FEMA’s Estimated Base Flood Elevation Viewer and flood inundation maps from the Chambers-Liberty Flood Protection Study. These maps depict water depths of 5+ feet over land surfaces within city limits for a majority of participating jurisdictions with flood depth data to this plan update, including various unincorporated areas of the county. The Estimated Base Flood Elevation Viewer does not contain data from the Lower Trinity River Watershed which includes all or partial areas of the cities of Kenefick, Hardin, Ames, Liberty, Dayton, and Daisetta. This data is in progress through studies being conducted by the Texas General Land Office and is a noted data deficiency to this HMP update. This is addressed by an action item in Section 7: Mitigation Action Plan for all plan participants.

Flood Depths- Liberty County:

Figure 6.1.14: Base Level Engineering Data Availability, Liberty County

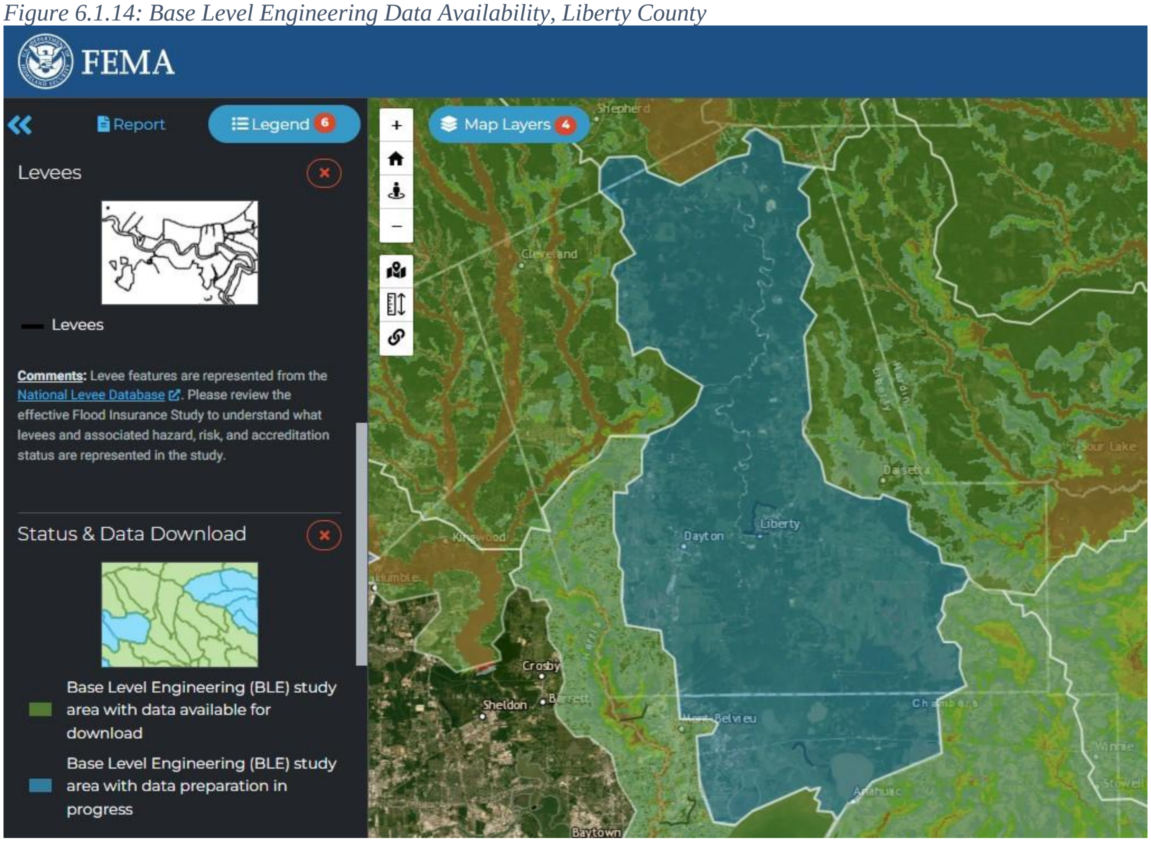


Figure 6.1.15: Flood Depths, Liberty County, 1% (100-year) Storm

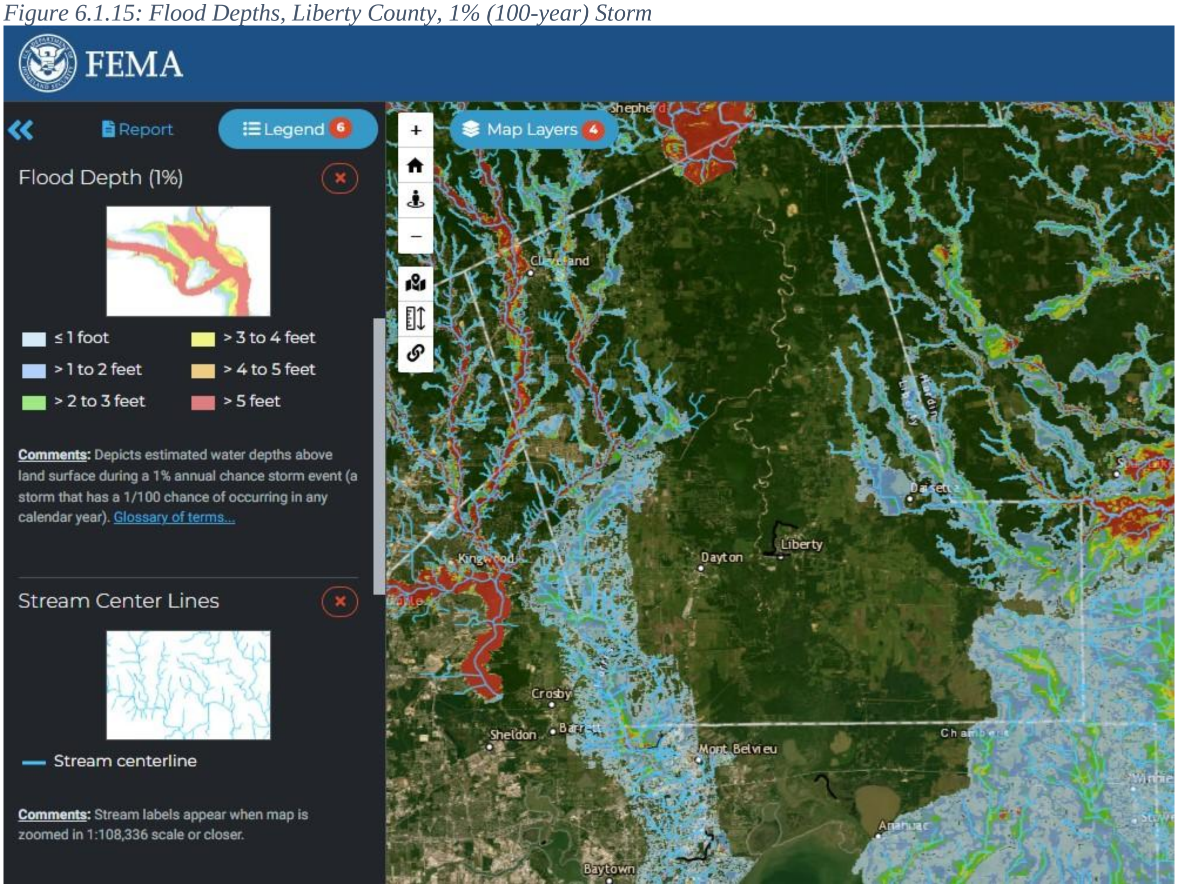
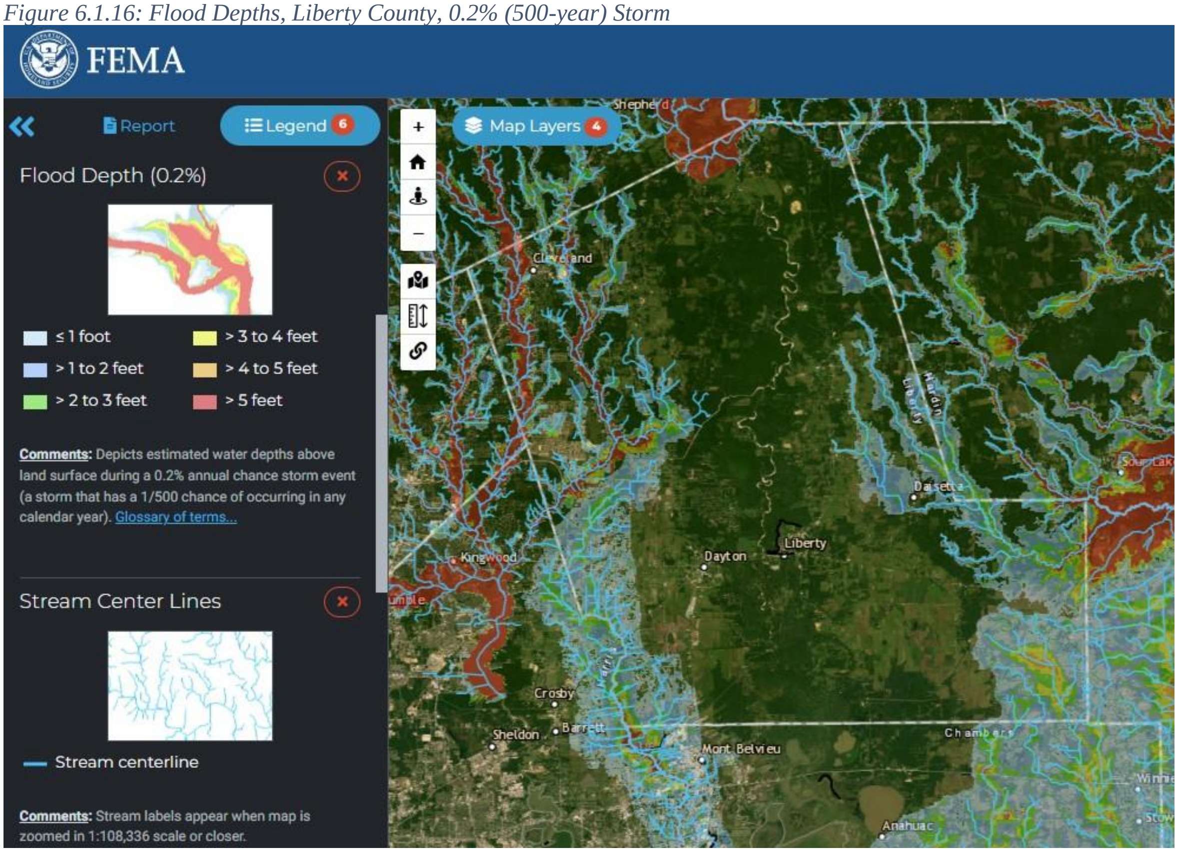
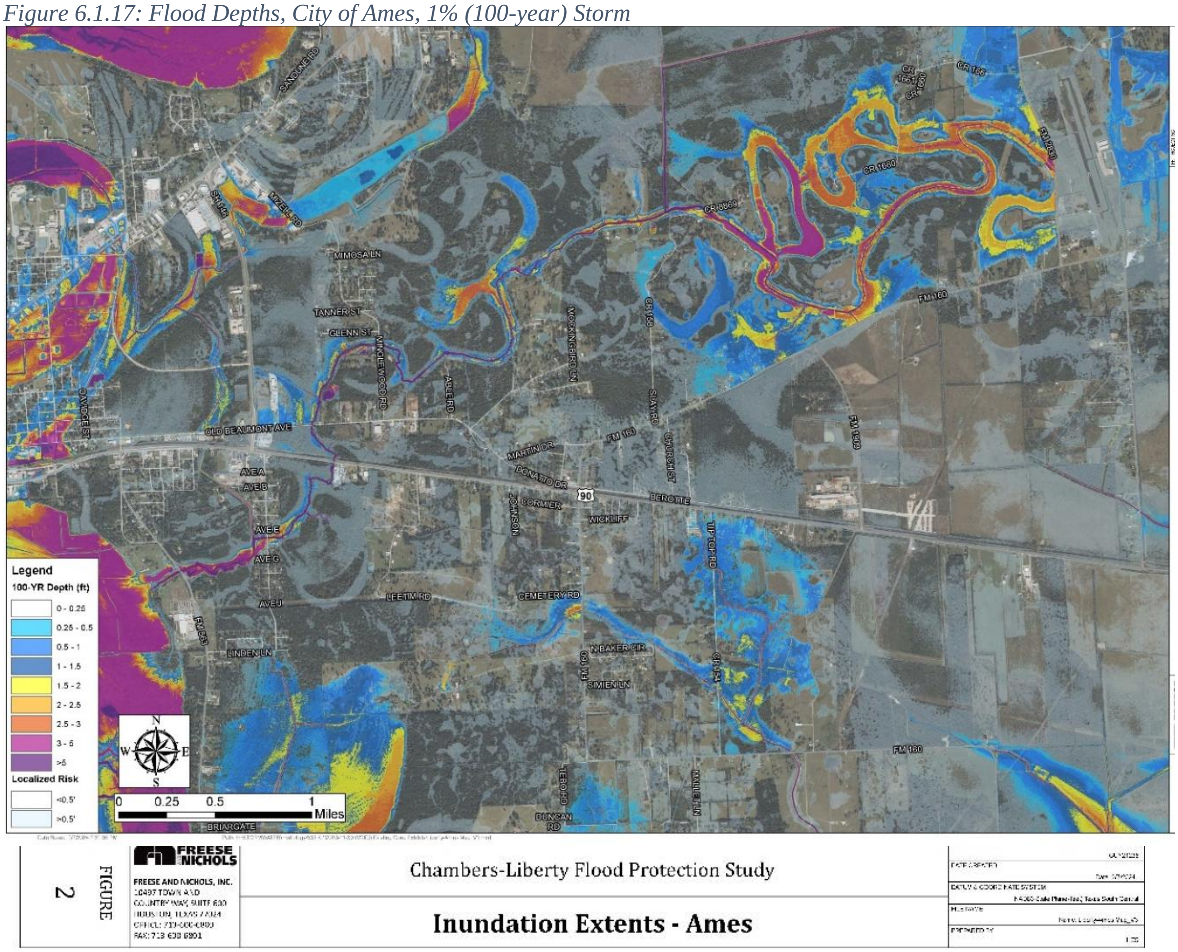


Figure 6.1.16: Flood Depths, Liberty County, 0.2% (500-year) Storm



Flood Depths: City of Ames

Figure 6.1.17: Flood Depths, City of Ames, 1% (100-year) Storm



Flood Depths: City of Cleveland

Figure 6.1.18: Flood Depths, City of Cleveland, 1% (100-year) Storm

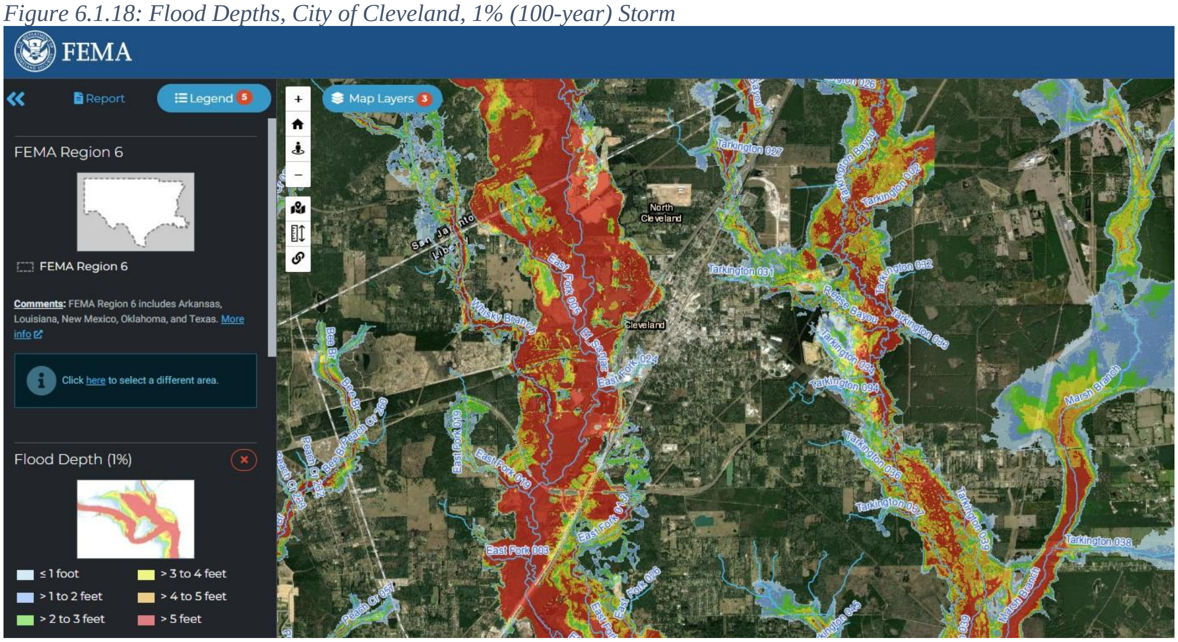


Figure 6.1.19: Flood Depths, City of Cleveland, 0.2% (500-year) Storm

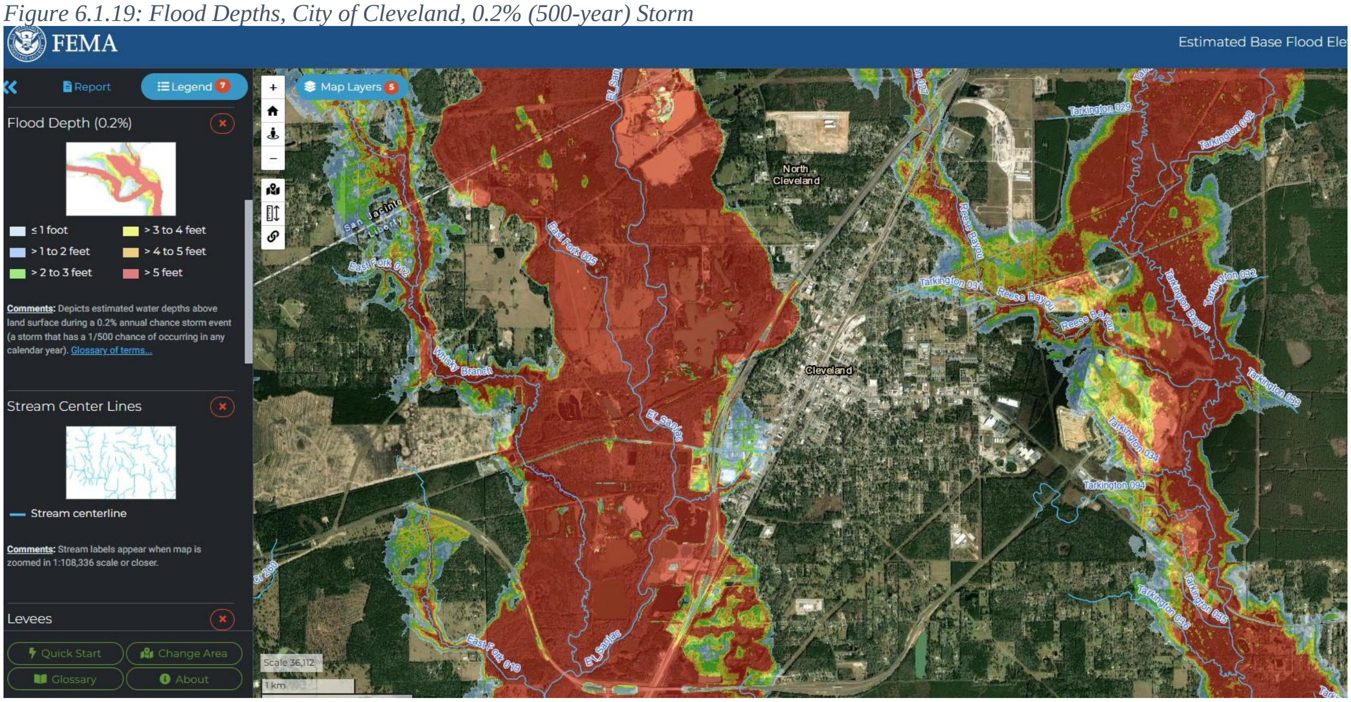
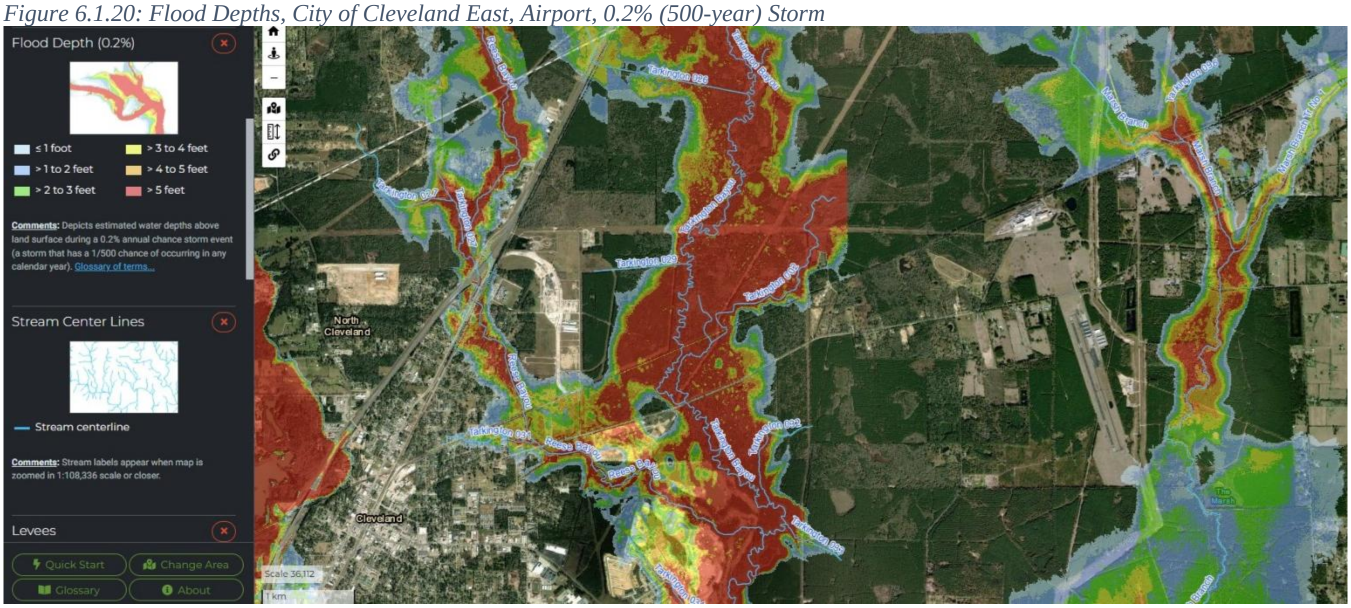


Figure 6.1.20: Flood Depths, City of Cleveland East, Airport, 0.2% (500-year) Storm



Flood Depths: City of North Cleveland

Figure 6.1.21: Flood Depths, City of North Cleveland, 1% (100-year) Storm

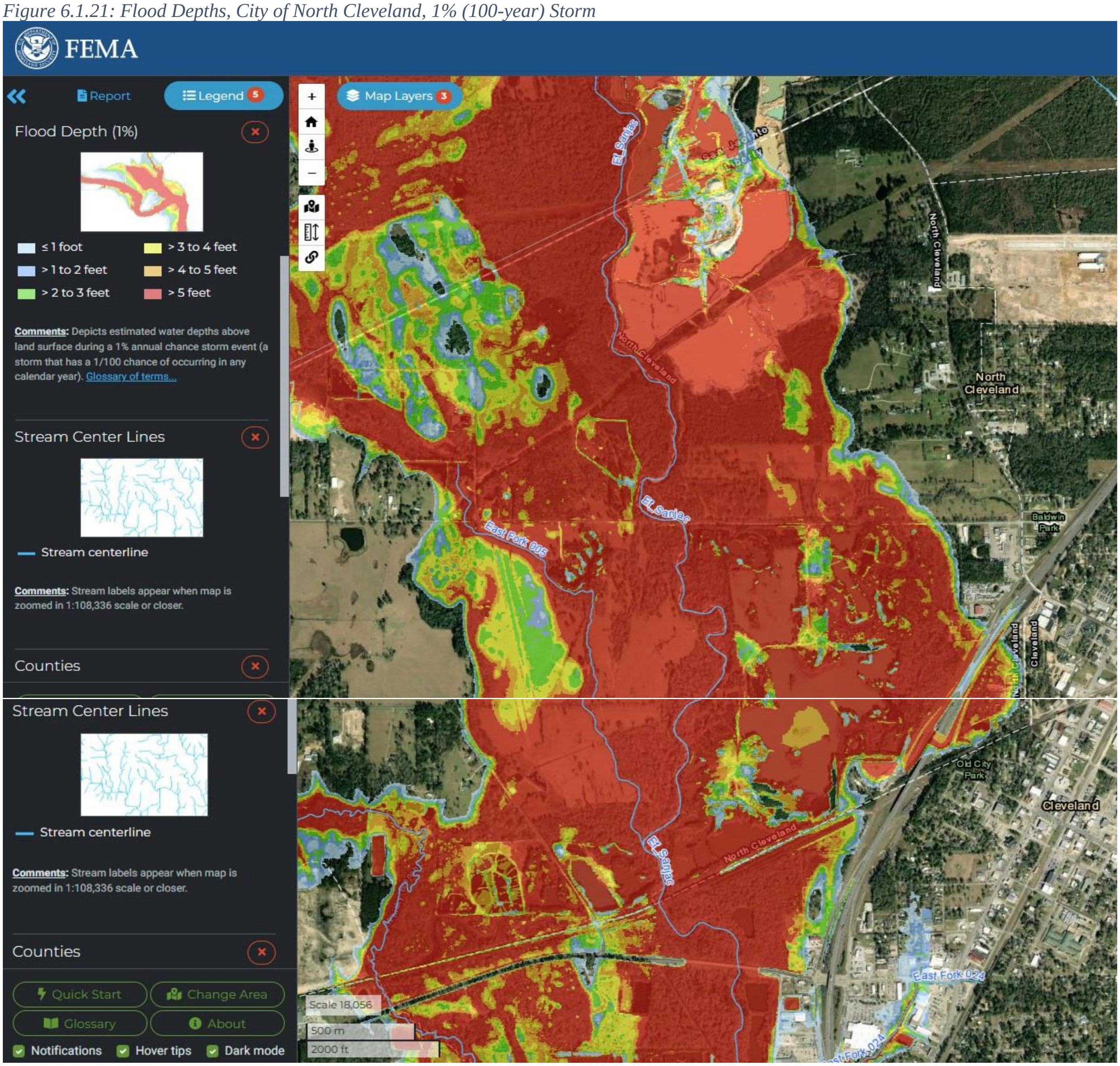
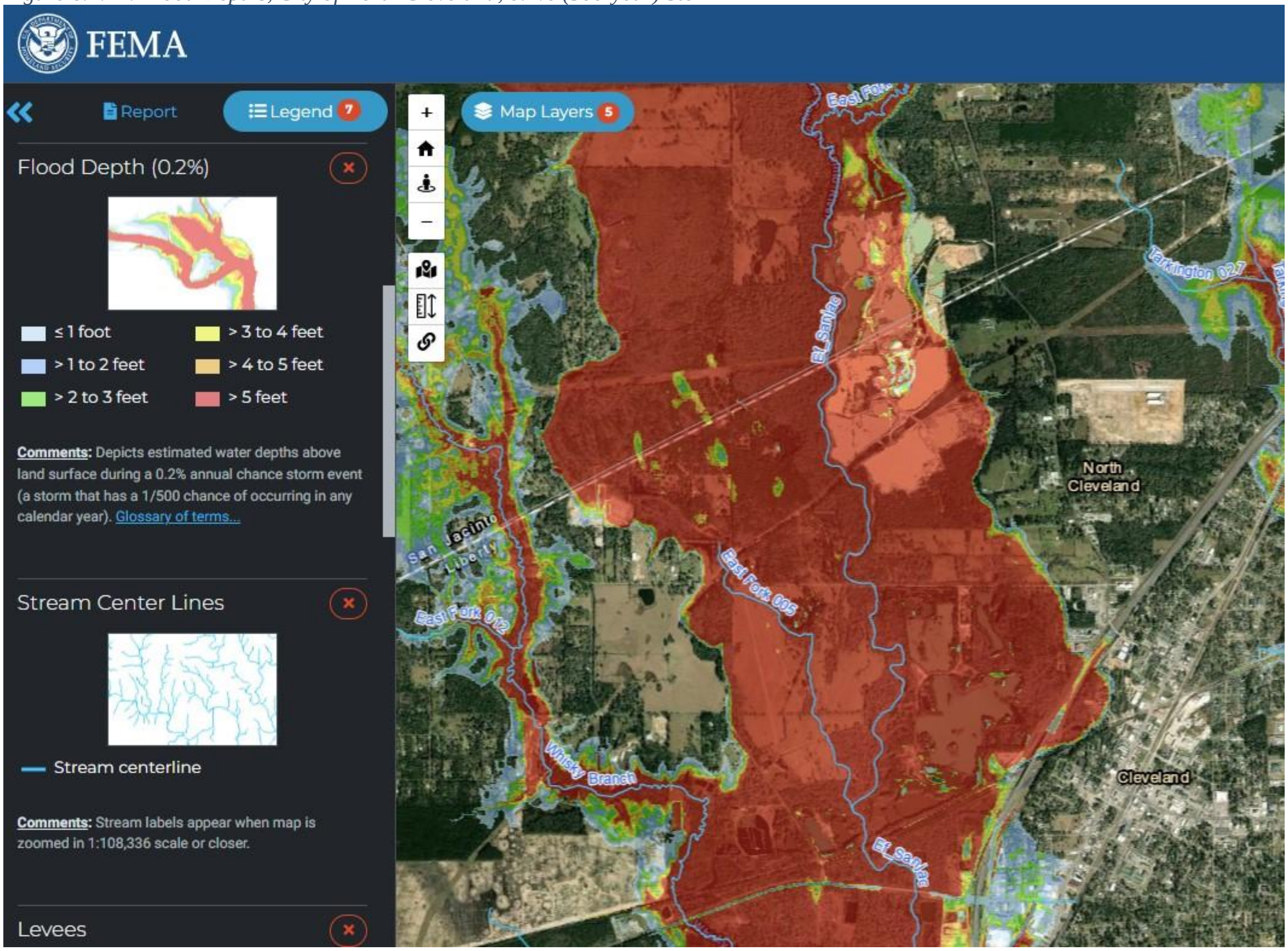


Figure 6.1.22: Flood Depths, City of North Cleveland, 0.2% (500-year) Storm



Flood Depths: City of Daisetta

Figure 6.1.23: Flood Depths, City of Daisetta, 1% (100-year) Storm

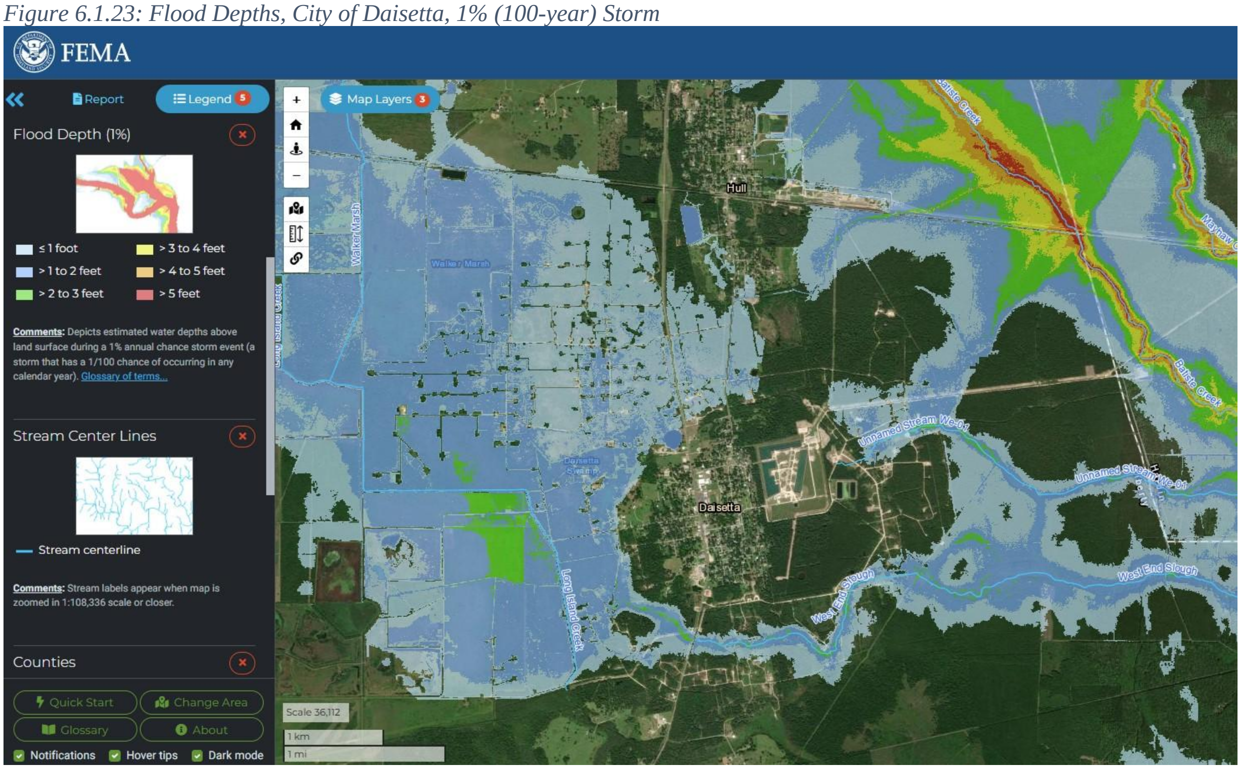
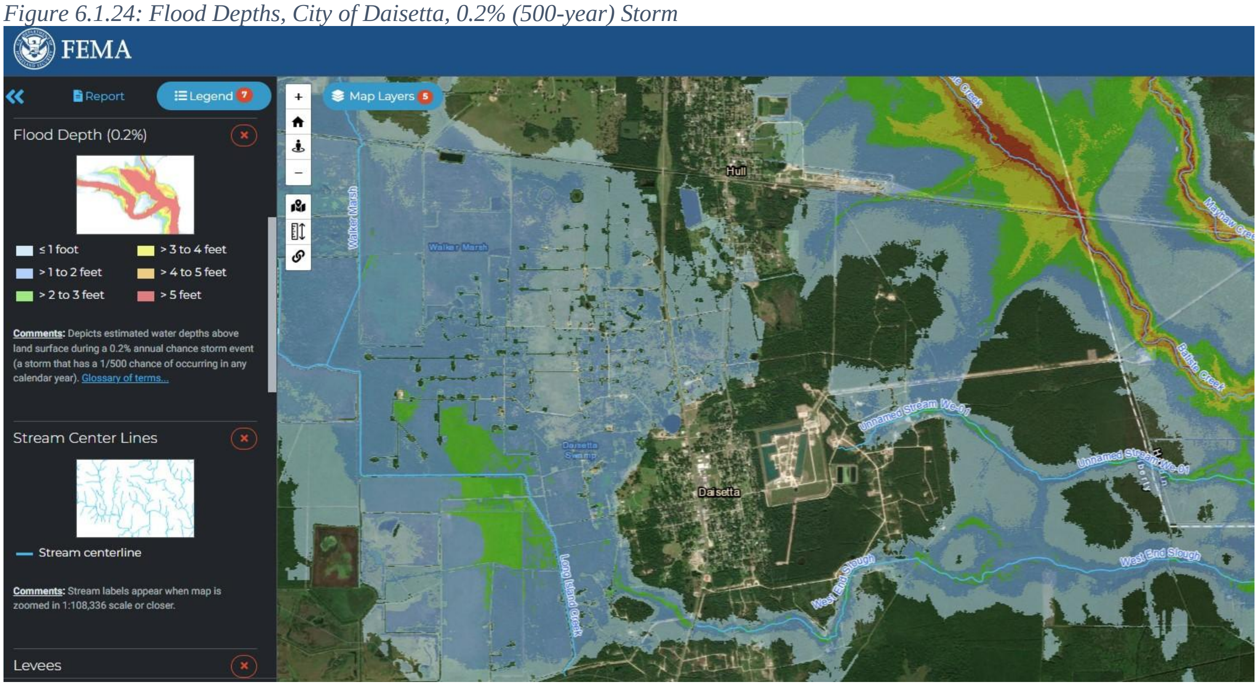
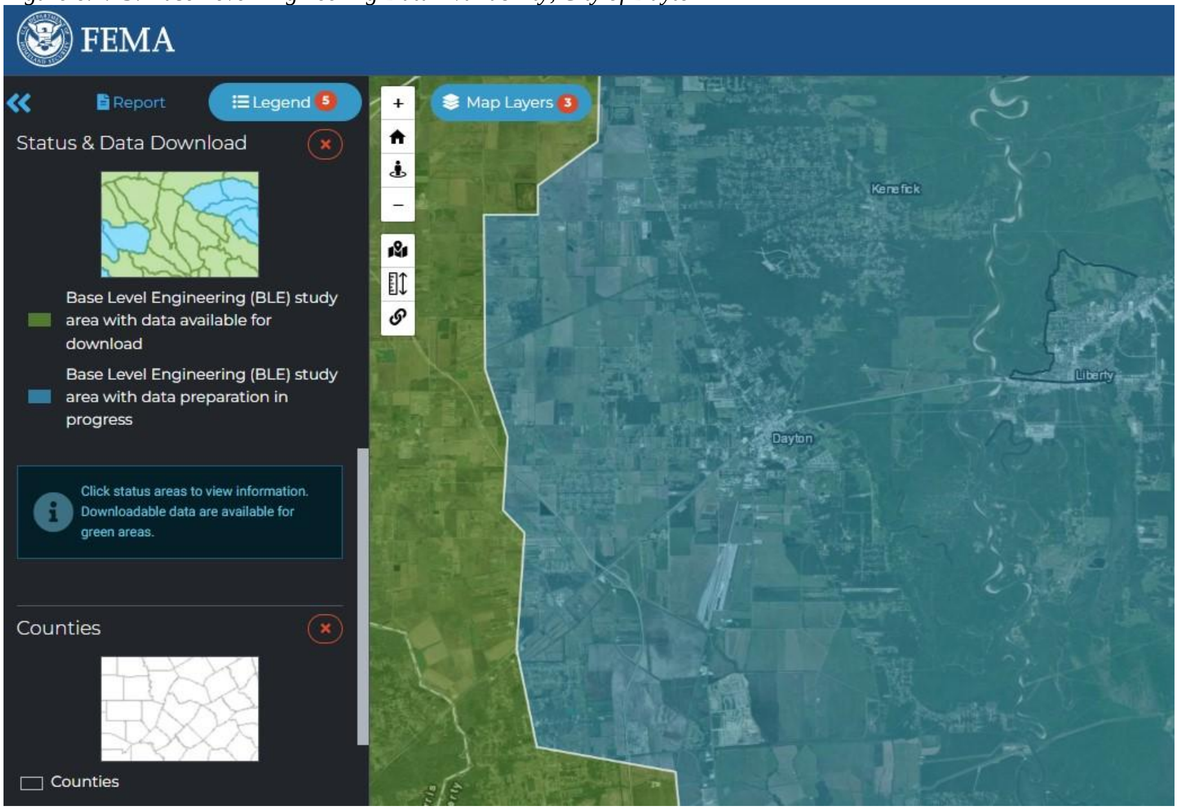


Figure 6.1.24: Flood Depths, City of Daisetta, 0.2% (500-year) Storm



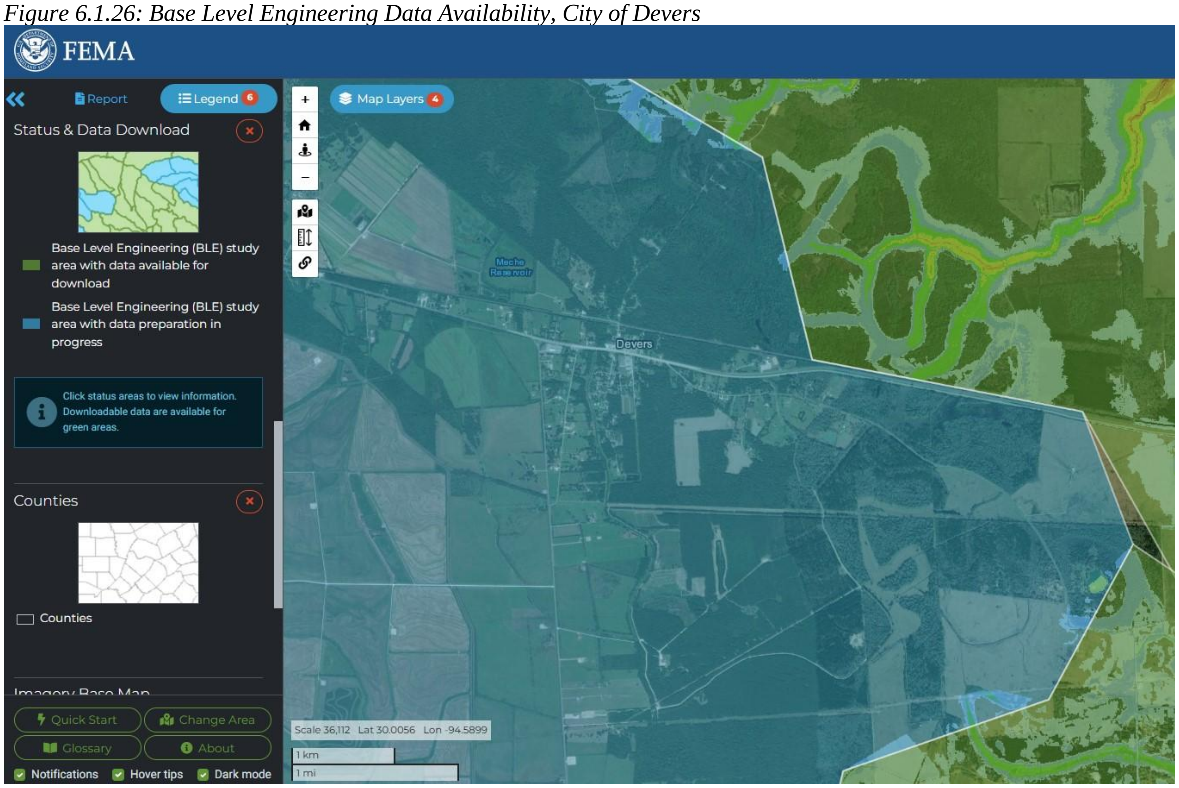
Flood Depths: City of Dayton

Figure 6.1.25: Base Level Engineering Data Availability, City of Dayton



Flood Depths: City of Devers

Figure 6.1.26: Base Level Engineering Data Availability, City of Devers



Flood Depths: City of Hardin

Figure 6.1.27: Base Level Engineering Data Availability, City of Hardin

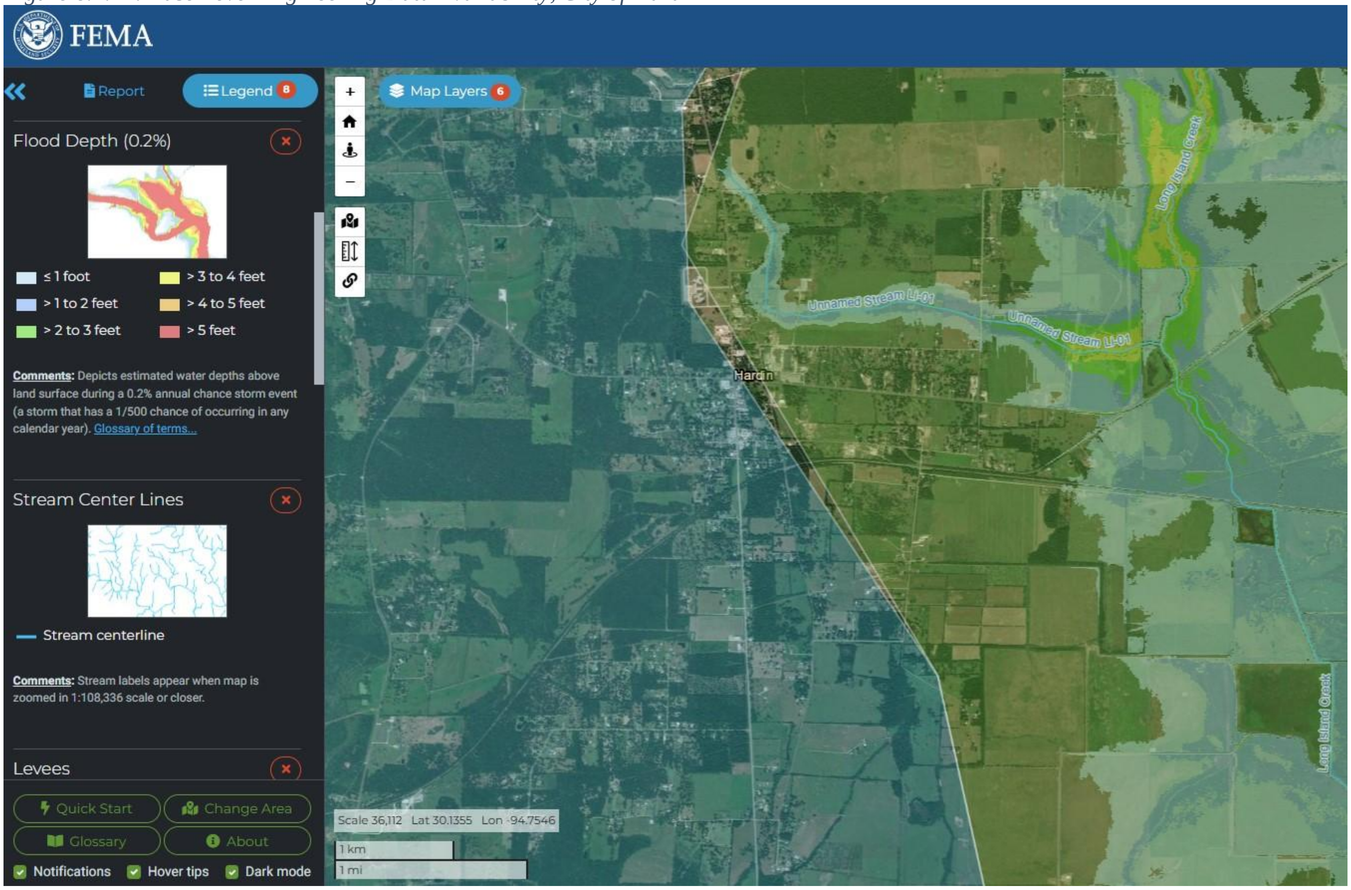


Figure 6.1.28: Flood Depths, City of Hardin, 1% (100-year) Storm

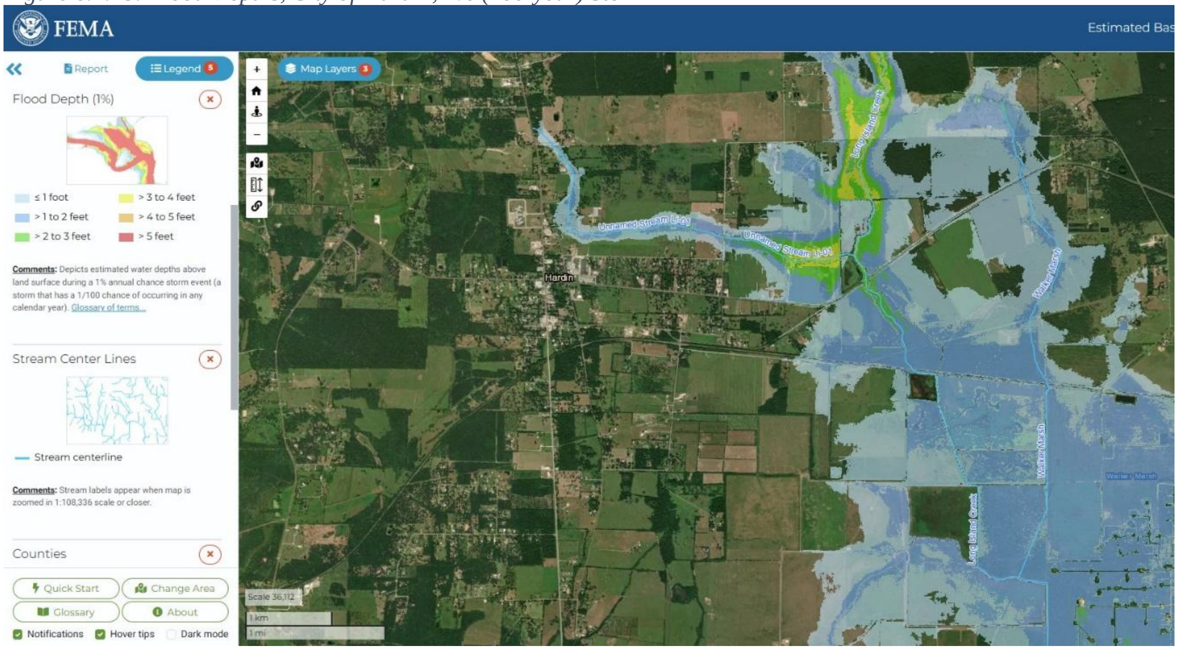
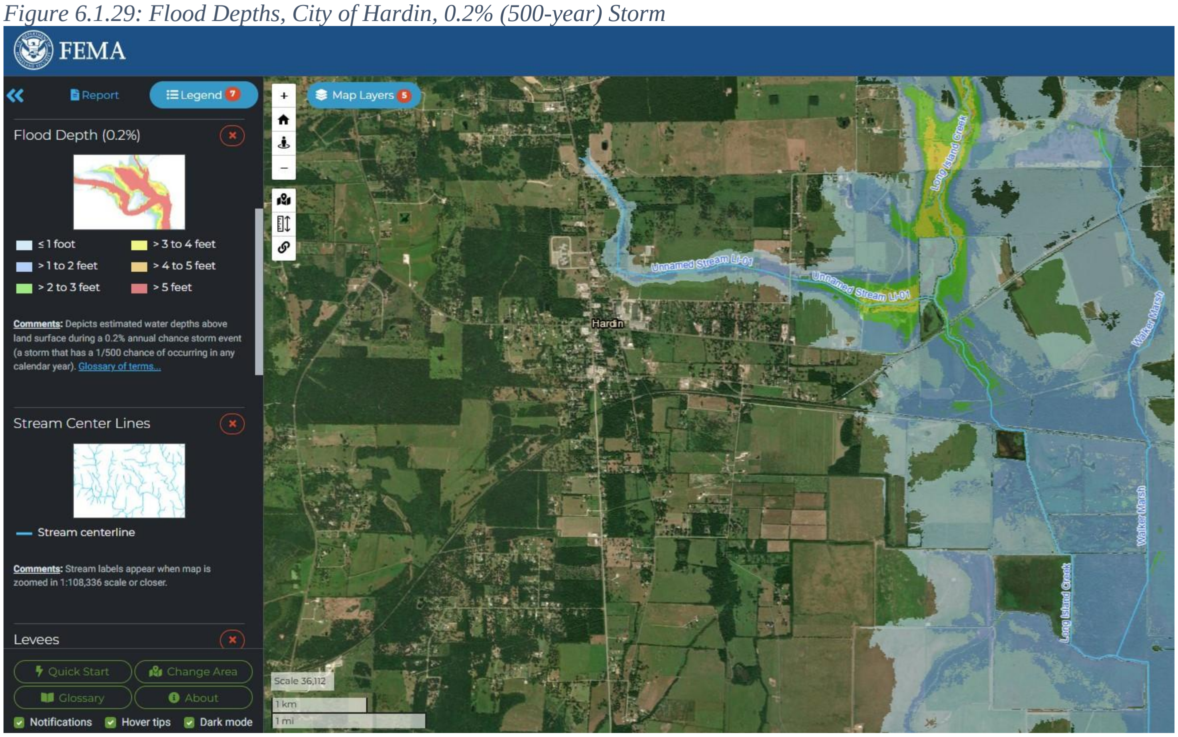
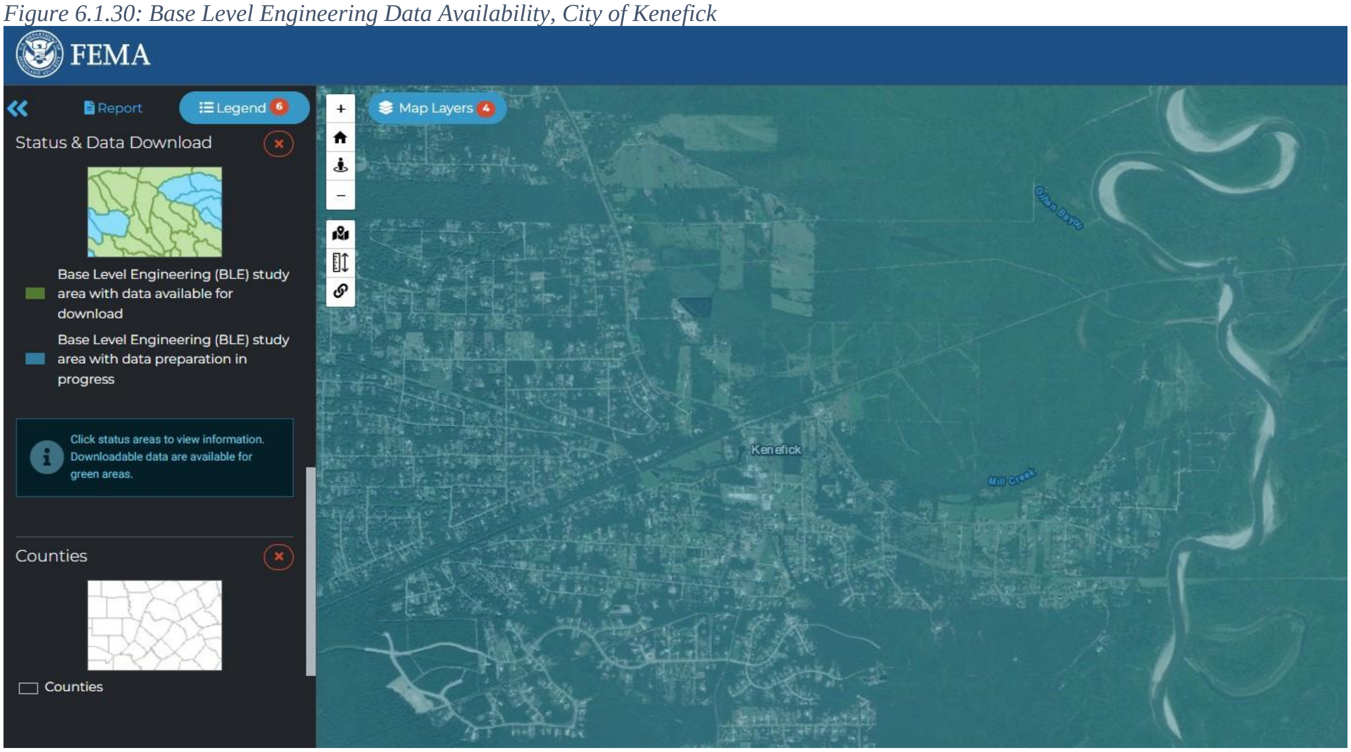


Figure 6.1.29: Flood Depths, City of Hardin, 0.2% (500-year) Storm



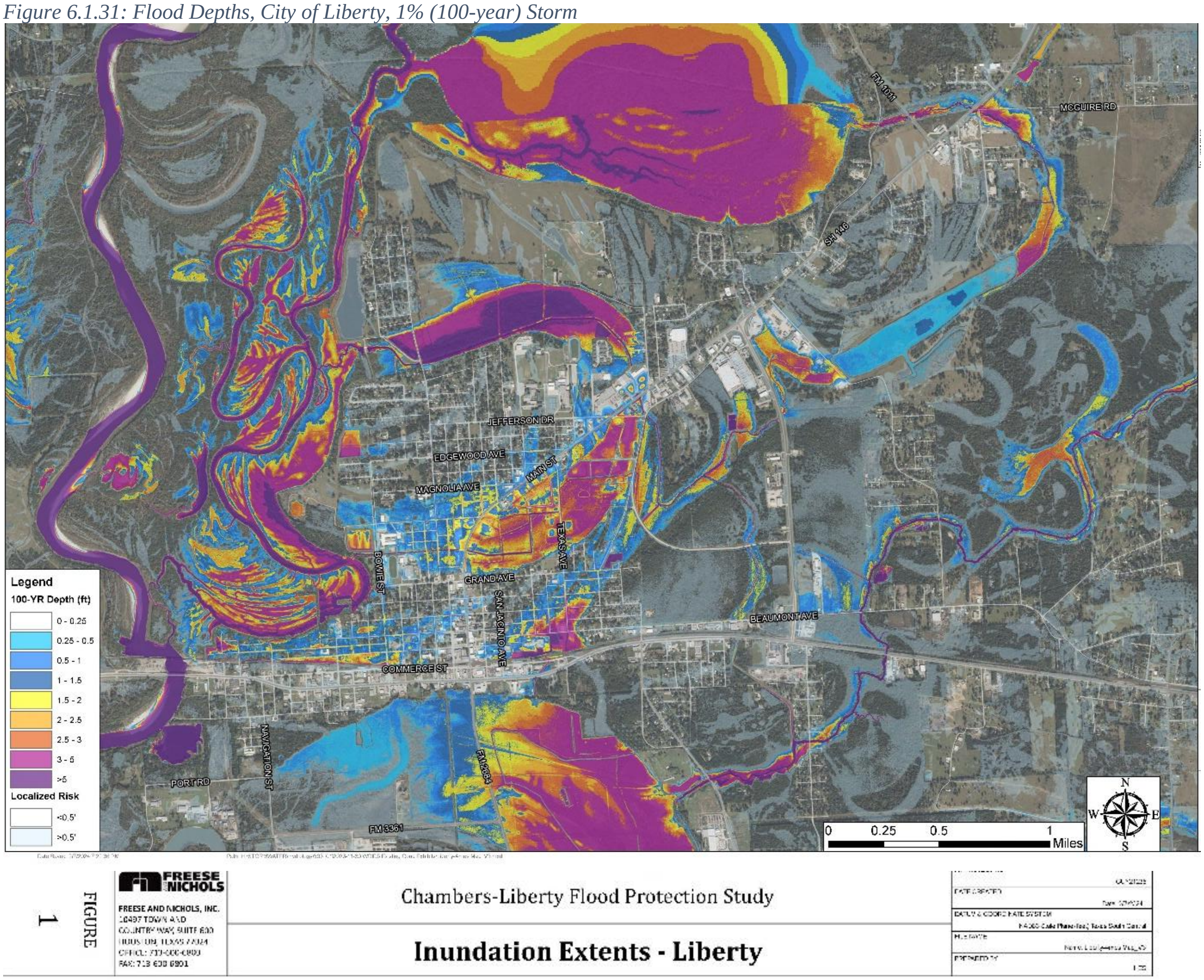
Flood Depths: City of Kenefick

Figure 6.1.30: Base Level Engineering Data Availability, City of Kenefick



Flood Depths: City of Liberty

Figure 6.1.31: Flood Depths, City of Liberty, 1% (100-year) Storm



Flood Depths: City of Plum Grove

Figure 6.1.32: Flood Depths, City of Plum Grove, 1% (100-year) Storm

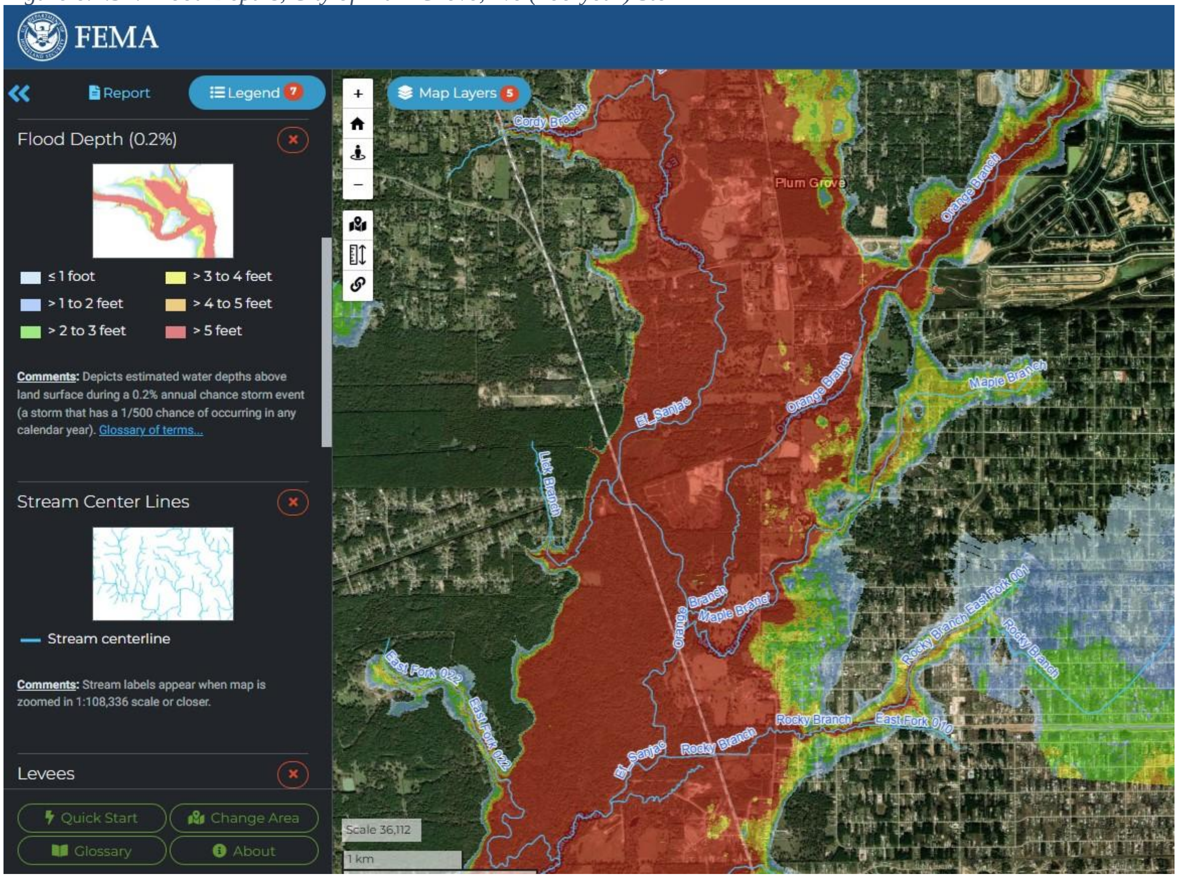


Figure 6.1.33: Flood Depths, City of Plum Grove and nearby development, 1% (100-year) Storm

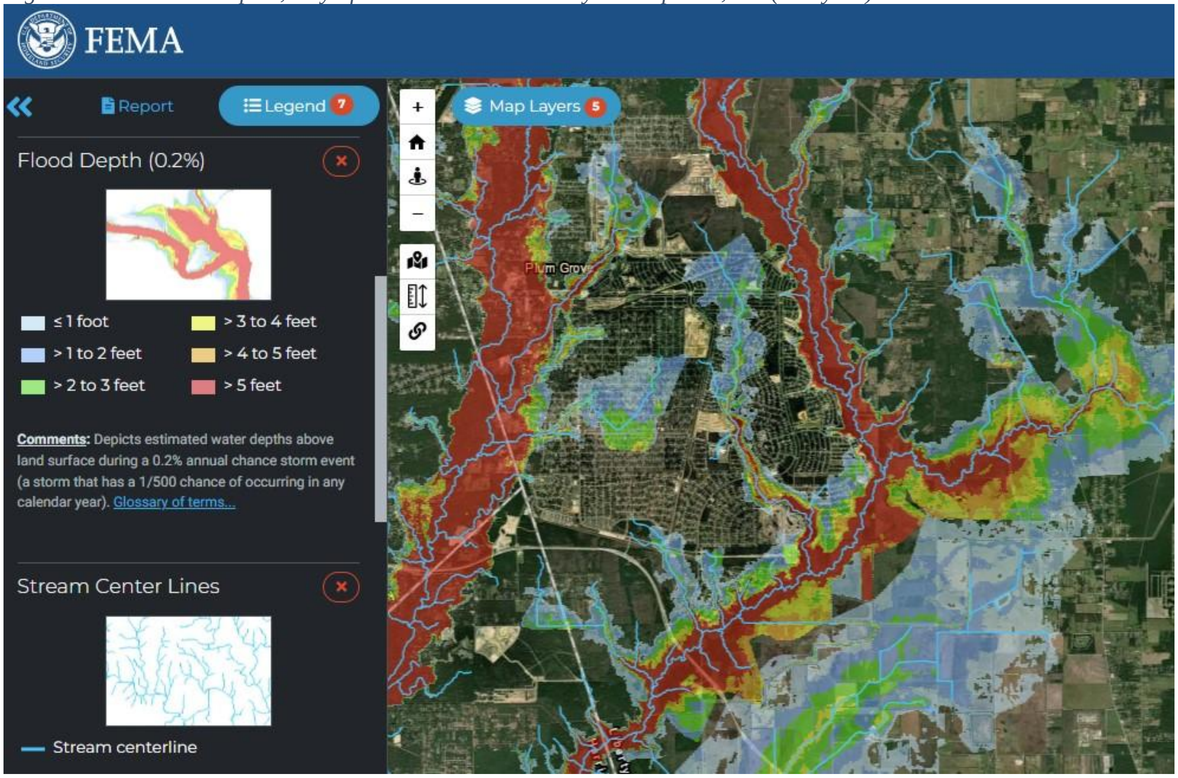
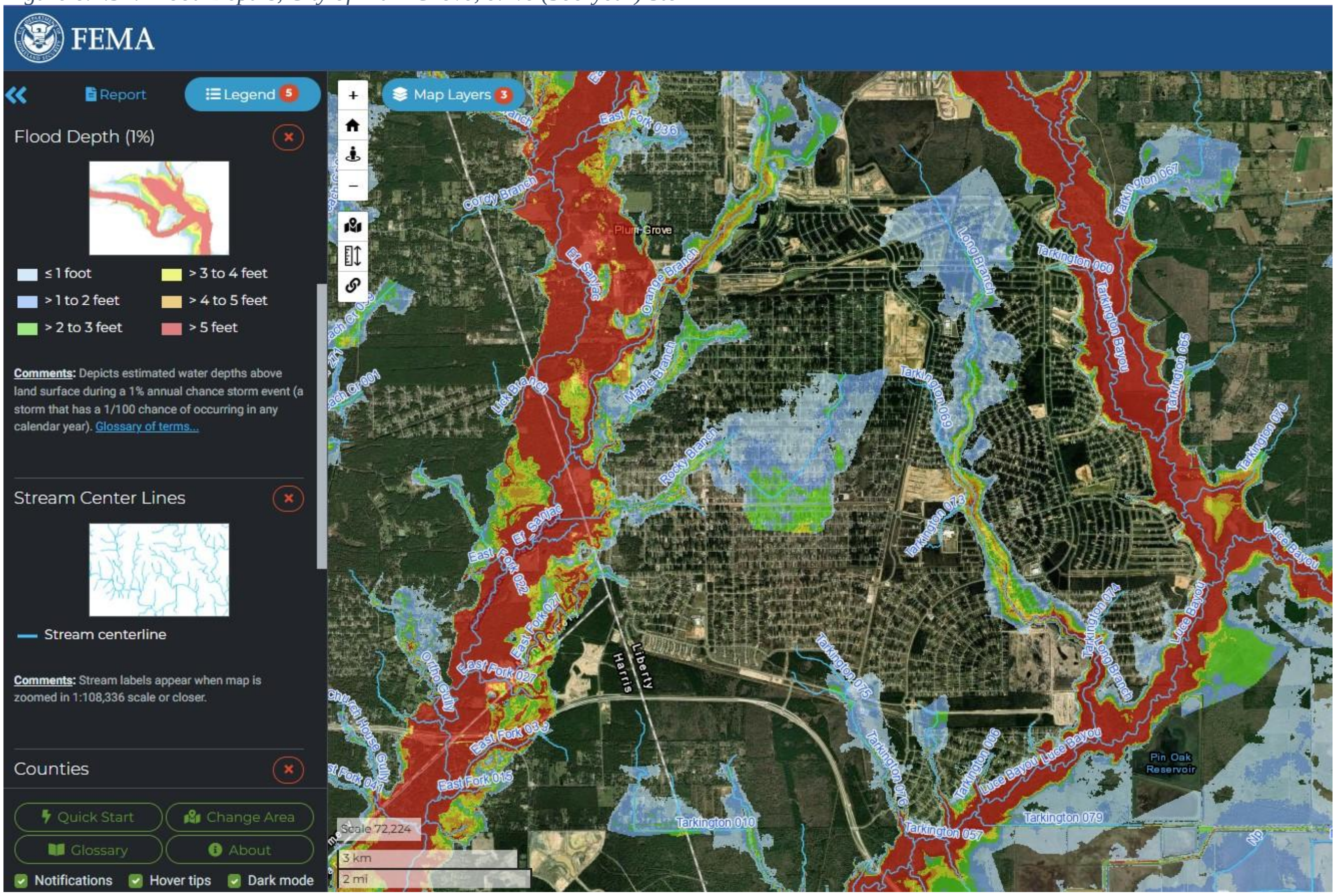


Figure 6.1.34: Flood Depths, City of Plum Grove, 0.2% (500-year) Storm



Flood Depths: WCID #1

Figure 6.1.35: Flood Depths, Liberty County WCID #1, 1% (100-year) Storm

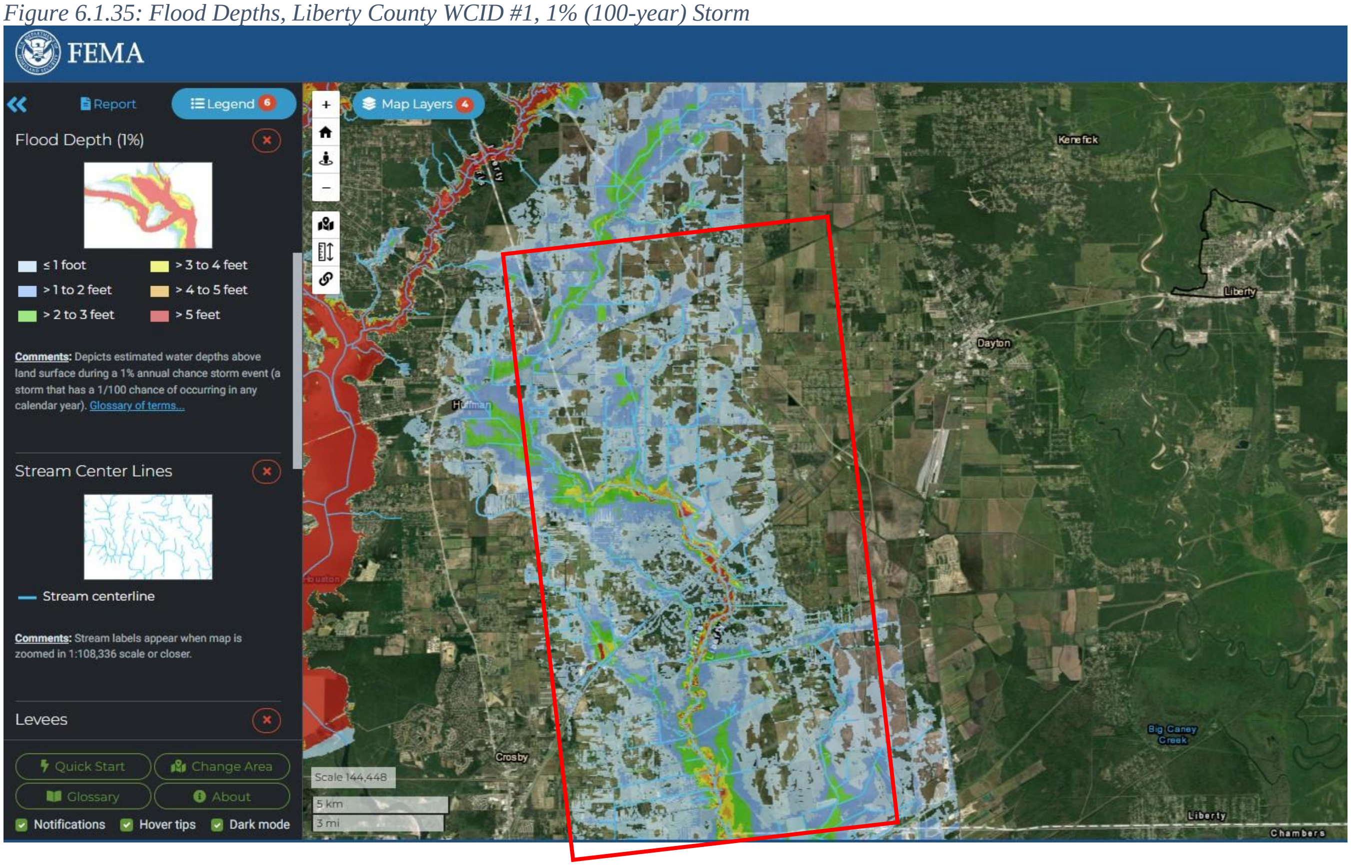
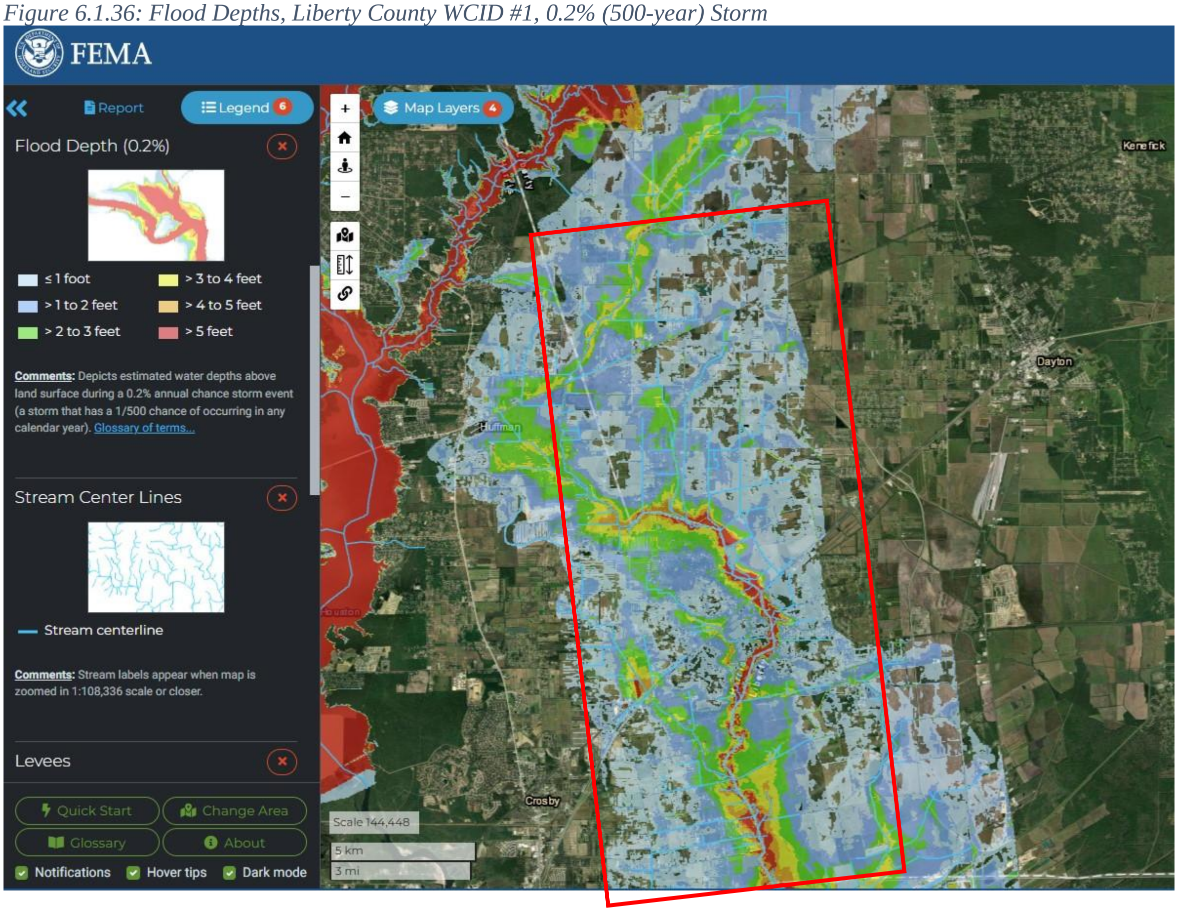
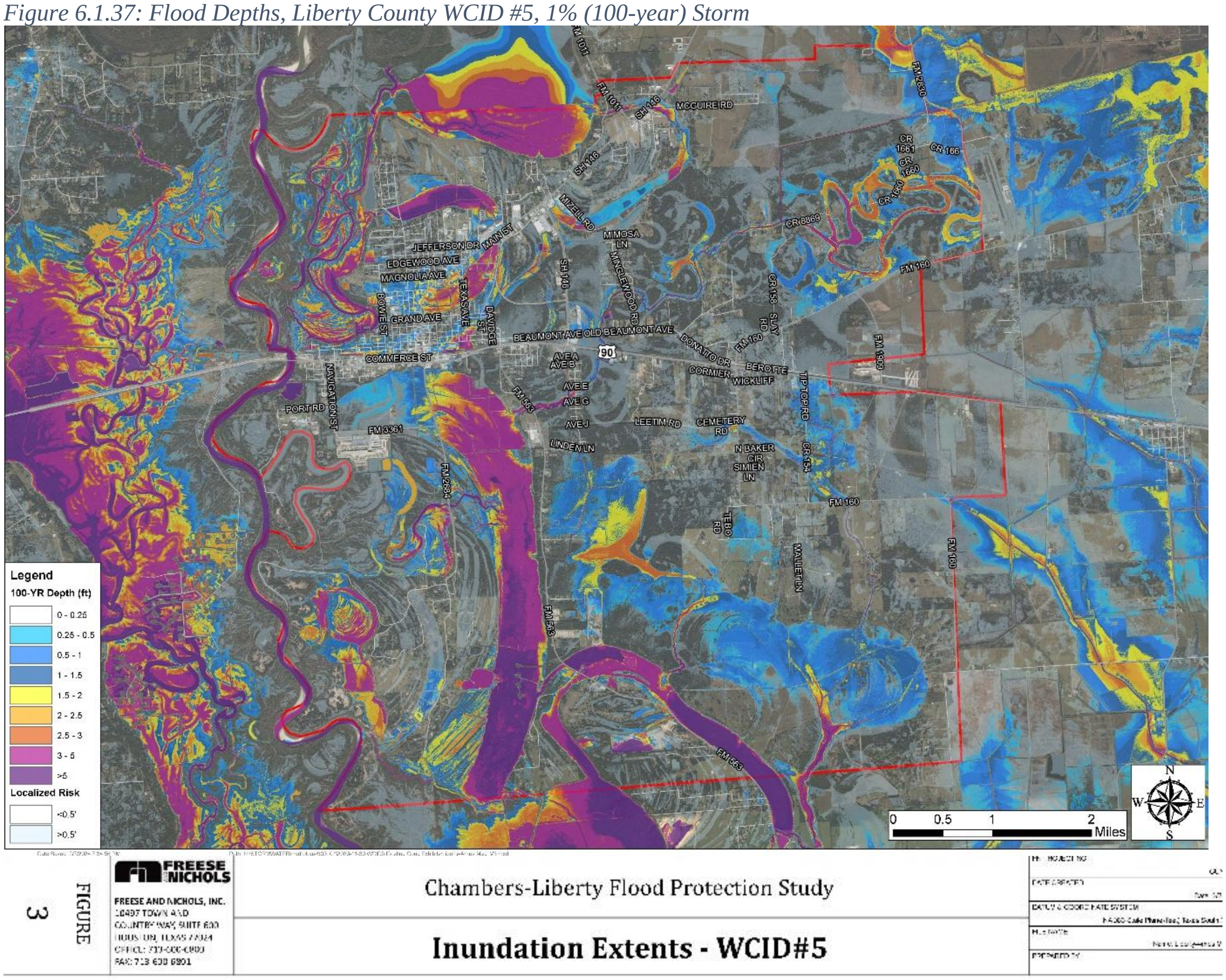


Figure 6.1.36: Flood Depths, Liberty County WCID #1, 0.2% (500-year) Storm



Flood Depths: WCID #5

Figure 6.1.37: Flood Depths, Liberty County WCID #5, 1% (100-year) Storm



Previous occurrences within the County and participating jurisdictions have seen major flooding events with up to 14' of flooding, high-water rescues of stranded residents, roads and railroads washed out, and the destruction of critical facilities and infrastructure. A worst-case scenario for this hazard would include a 0.2% (500-year storm) event that results in dangerous, life-threatening, historic-level riverine and flash flooding. A storm of this severity would see flood depths of 5+ feet above land surfaces throughout the planning area, inundated roadways cutting off access to neighborhoods, emergency services, and critical facilities. Hazardous travel conditions via roads and bridges being washed out, especially at low water crossings. This would be like events that occurred in May 2024. Additionally, a hazard of this magnitude could damage critical infrastructure and lead to a prolonged power outage. If this occurs during a heat event or a drought and disrupts power supply, secondary hazards will pose increased risks to citizens due to the heat and the inability to keep homes and buildings cool. This scenario is similar to what occurred within the region during the 2024 derecho and Hurricane Beryl. Power lines were destroyed by debris and falling trees due to the severe thunderstorms and winds. This event occurred in July when the region was under an excessive heat advisory. Power line restoration and infrastructure repairs took 10+ days to restore in some areas. This resulted in the multi-day activation of cooling centers.

Historic Occurrences

The National Oceanic and Atmospheric Administration (NOAA) collects historic climate data for the nation. NOAA's storm event data can be accessed on the National Climatic Data Center (NCDC) storm events database. A condensed version of the Liberty County flood events data from 1950-2023 is provided in the table below. There have been 57 flood events reported within the county since 1950.[38]

Table 6.1.2: Liberty County Flood Events (1950-2023)

Event Date	Event Type	Fatalities	Property Damage Estimate	Crop Damage Estimate
9/27/1996	Flash Flood	0	$25,000.00	$-
1/27/1997	Flash Flood	0	$5,000.00	$-
2/20/1997	Flash Flood	0	$5,000.00	$-
12/20/1997	Flash Flood	0	$5,000.00	$-
1/6/1998	Flash Flood	0	$3,000.00	$-
1/6/1998	Flash Flood	0	$10,000.00	$-
9/14/1998	Flash Flood	0	$5,000.00	$-
10/6/1998	Flash Flood	0	$2,000.00	$-
10/17/1998	Flood	0	$-	$-
10/18/1998	Flash Flood	0	$15,000.00	$-
10/18/1998	Flash Flood	0	$-	$-
11/12/1998	Flood	0	$-	$-
11/12/1998	Flash Flood	0	$3,000.00	$-
11/12/1998	Flash Flood	0	$5,000.00	$-
11/13/1998	Flash Flood	0	$3,000.00	$-
11/13/1998	Flash Flood	0	$10,000.00	$-
11/13/1998	Flash Flood	0	$5,000.00	$-
5/19/2000	Flash Flood	0	$10,000,000.00	$-
10/22/2000	Flash Flood	0	$500,000.00	$-
6/7/2001	Flash Flood	0	$-	$-
6/7/2001	Flash Flood	0	$-	$-
6/9/2001	Flash Flood	0	$-	$-
9/8/2002	Flash Flood	0	$10,000.00	$-
9/19/2002	Flash Flood	0	$35,000.00	$-
10/28/2002	Flash Flood	0	$100,000.00	$-
11/17/2003	Flash Flood	0	$225,000.00	$-
11/17/2004	Flash Flood	0	$-	$-
5/29/2005	Flash Flood	0	$40,000.00	$-
12/14/2005	Flash Flood	0	$5,000.00	$-
6/19/2006	Flash Flood	0	$-	$-
10/16/2006	Flash Flood	0	$2,000.00	$-
10/16/2006	Flash Flood	1	$10,000.00	$-
10/18/2006	Flash Flood	0	$55,000.00	$-
10/26/2006	Flash Flood	0	$100,000.00	$-
10/26/2006	Flash Flood	0	$12,000.00	$-
10/26/2006	Flash Flood	0	$6,000.00	$-
10/26/2006	Flash Flood	0	$17,000.00	$-
9/14/2008	Flash Flood	0	$-	$-
2/3/2012	Flash Flood	0	$10,000.00	$50,000.00
9/18/2014	Flash Flood	0	$-	$-
4/16/2015	Flash Flood	0	$-	$-
5/13/2015	Flash Flood	0	$-	$-
5/25/2015	Flash Flood	0	$-	$-
6/28/2015	Flash Flood	0	$-	$-
10/31/2015	Flash Flood	0	$700,000.00	$5,000.00

Event Date	Event Type	Fatalities	Property Damage Estimate	Crop Damage Estimate
5/26/2016	Flash Flood	0	$400,000.00	$-
8/27/2017	Flash Flood	0	$-	$-
8/28/2017	Flash Flood	0	$-	$-
8/29/2017	Flash Flood	0	$-	$-
7/8/2018	Flash Flood	0	$-	$-
9/19/2019	Flash Flood	0	$95,000,000.00	$-
9/19/2019	Flash Flood	0	$100,000.00	$-
9/19/2019	Flash Flood	0	$-	$-
5/17/2021	Flash Flood	0	$-	$-
5/17/2021	Flash Flood	0	$-	$-
1/8/2022	Flash Flood	0	$-	$-
1/8/2022	Flash Flood	0	$-	$-
5/16/2024	Flash Flood	0	$-	$-
TOTALS:		**1**	**$107,428,000.00**	**$55,000.00**

Presidential Disaster Declarations

There have been 7 federally declared flood disasters in Liberty County since 1950. These events are considered the most significant flood events in Liberty County's recent history.[2]

Table 6.1.3: Federally Declared Disasters, Flood

Declaration Year	Title	Disaster Number
1991	SEVERE THUNDERSTORMS AND FLOODING	930
1994	SEVERE THUNDERSTORMS AND FLOODING	1041
1998	TX-FLOODING 10/18/98	1257
2016	SEVERE STORMS AND FLOODING	4269
2016	SEVERE STORMS AND FLOODING	4272
2017	TX-HURRICANE HARVEY	4332
2024	TX- HURRICANE BERYL	4798

U.S. Department of Agriculture (USDA) Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as USDA FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies the USDA FSA of the primary counties named in the presidential declaration. USDA disaster declarations for Liberty County since 2018 are listed in the table below.[39]

Table 6.1.4: USDA Declared Disasters (2018-2023), Flood

Crop Disaster Year	Disaster Description	Designation Number
2021	Excessive Moisture	S5088

NFIP Participation

The NFIP is a federal program administered through FEMA that enables property owners in participating communities to purchase insurance as a protection against flood losses. Communities must maintain eligibility in the NFIP by adopting and enforcing floodplain management regulations intended to prevent unsafe development in the floodplain, thus reducing future flood damage. FEMA creates flood maps, or Flood Insurance Rate Maps (FIRMs) to support the NFIP.[22,23] These flood maps are periodically updated and outline SFHA. The SFHA is the area where the NFIP floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.[24]

Each of the participating jurisdictions has a floodplain manager FPM on staff, and/or function under the regulatory umbrella of Liberty County. To remain NFIP compliant, the FPM conducts jurisdiction wide permitting of new development, permit review, flood code enforcement, educates the public, and provides public assistance. The Liberty County Certified Floodplain Manager (CFM), part of the Permits and Inspection Department, regulates new development by determining if the property in question is in a SFHA designated by FEMA and determining the base flood elevation for new structures, based on FEMA maps and data. All structures within the floodplain must obtain an elevation certificate and a No Rise Certificate.

While the County regulates the floodplain as described above, the City of Cleveland, Daisetta, Dayton, Kenefick, Liberty, and Plum Grove have all adopted a Flood Damage Prevention Ordinance into their current city codes to help regulate development within the floodplain and SFHAs. These ordinances allow for jurisdiction-wide permitting of new development, permit review, engineering review, and flood code enforcement. The City of Ames does not have a FDPO as it is considered to have no SFHA and is not considered to have high flood risk. The City of Devers regulates development within the floodplain and flood-prone areas through its 2020 Subdivision Ordinance, however, this does not define how substantial damage or improvements are handled. The City of Devers has noted the adoption of a formal FDPO as an expansion to their capabilities within Section 5 of this plan. The City of Hardin does not have a FDPO and have noted the adoption of one within their capability expansion opportunities found in Section 5 of this plan. The City of North Cleveland is an active participant in the NFIP. However, as a small, incorporated city within Liberty County they have few resources to enforce such policies, and thus look to the County for guidance, development review, and permit review.

Table 3.10: NFIP Participation

Jurisdiction	NFIP Participation	Date Joined	Current Effective FIRM Date	FDPO Adoption Date	Designee for NFIP Requirements
Liberty County	Yes	5/24/1977	1/19/2018	10/13/2020	Floodplain Administrator, Engineering Administrator
City of Ames	Yes	5/2/2008	NSFHA	N/A	N/A
City of Cleveland	Yes	3/8/1974	5/2/2008	8/11/2009	Floodplain Administrator, appointed by City Manager
City of Daisetta	Yes	7/2/1976	1/19/2018	3/30/2007	Code Enforcement Officer
City of Dayton	Yes	6/28/1974	1/19/2018	5/20/2019	Floodplain Administrator, appointed by City Manager
City of Devers	Yes	4/24/1979	1/19/2018	N/A	N/A
City of Hardin	Yes	5/2/2008	1/19/2018	N/A	N/A
City of Kenefick	Yes	4/24/1979	1/19/2018	1/11/2018	Mayor
City of Liberty	Yes	12/20/1974	1/19/2018	8/11/2020	Building Official
City of North Cleveland	Yes	5/6/1977	5/2/2008	N/A	N/A

Jurisdiction	NFIP Participation	Date Joined	Current Effective FIRM Date	FDPO Adoption Date	Designee for NFIP Requirements
City of Plum Grove	Yes	6/19/1979	5/2/2008	1/8/2008	Emergency Management Coordinator

N/A- Not Applicable
NSFHA- No Special Flood Hazard Area, an area that has been determined to lack any special flood hazard area and is not considered to have high flood risk.

The County represents all participating jurisdictions except the City of Dayton, the City of Cleveland, and the City of Liberty. Liberty's Fire Chief, Dayton's City Planner, and Cleveland's Fire Director represent their respective jurisdictions. While the County regulates the floodplain as described above, the City of Liberty, Dayton, and Cleveland adopted a FDPO into their current city code to help regulate the development within the floodplain. These ordinances allow for jurisdiction-wide permitting of new development, permit review, engineering review, and flood code enforcement.

The Community Rating System (CRS)

The CRS is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Participation in the CRS program is voluntary and includes many benefits for a community, such as discounted flood insurance premiums that relate to the community's level of efforts that reduce risk from flooding and strengthen floodplain management. Currently, there are no communities within Liberty County, including the County itself, that participate in the CRS Program.[25]

Table 6.1.5: Community Participation in the NFIP and CRS Program[26]

Jurisdiction	NFIP Participation	Date Joined	Current Effective FIRM Date	CRS Participation
Liberty County	Yes	5/24/1977	1/19/2018	No
City of Ames	Yes	5/2/2008	NSFHA	No
City of Cleveland	Yes	3/8/1974	5/2/2008	No
City of Daisetta	Yes	7/2/1976	1/19/2018	No
City of Dayton	Yes	6/28/1974	1/19/2018	No
City of Devers	Yes	4/24/1979	1/19/2018	No
City of Hardin	Yes	5/2/2008	1/19/2018	No
City of Kenefick	Yes	4/24/1979	1/19/2018	No
City of Liberty	Yes	12/20/1974	1/19/2018	No
City of North Cleveland	Yes	5/6/1977	5/2/2008	No
City of Plum Grove	Yes	6/19/1979	5/2/2008	No
Liberty County WCID #1	N/A	N/A	N/A	N/A
Liberty County WCID #5	N/A	N/A	N/A	N/A

Repetitive Loss and Severe Repetitive Loss Properties

FEMA defines a repetitive loss (RL) structure as "a structure covered under an NFIP flood insurance policy that:

(3) Has incurred flood-related damage on 2 occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and
(4) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage."[27]

A severe repetitive loss (SRL) property is defined as "a structure that is covered under an NFIP flood insurance policy and has incurred flood-related damage:

(3) For which 4 or more separate claims payments have been made under flood insurance coverage under subchapter B of this chapter, with the amount of each claim (including building and contents payments) exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
(4) For which at least 2 separate flood insurance claims payments (building payments only) have been made, with a cumulative amount of such claims exceeding the value of the insured structure.[28]

According to available data from 2023, Liberty County has a total of 343 RL properties, of which 82 are designated as SRL properties.[29] This does not include RL or SRL properties that have already been mitigated. Table 3.6 outlines the jurisdiction, structure type (residential, commercial, institutional, etc.), and number of records for RL and SRL properties within the county, including the number of those properties that were insured under the NFIP.

Table 6.1.6: RL and SRL Properties, Liberty County[30]
(FEMA Region 6, Floodplain Management and Insurance Branch, Personal Communication, January 12, 2023)

Jurisdiction Name	Residential RLPs	Non-Residential RLPs	Total RLPs	SRL Properties	Number of NFIP Insured Properties
Liberty County	201	4	205	42	63
City of Ames	5	0	5	1	44
City of Cleveland	19	1	20	3	14
City of Daisetta	1	0	1	0	0
City of Dayton	39	1	40	10	6
City of Devers	0	0	0	0	0
City of Hardin	1	0	1	0	1
City of Kenefick	0	0	0	0	0
City of Liberty	53	10	63	26	31
City of North Cleveland	0	0	0	0	0
City of Plum Grove	3	0	3	0	0
Liberty County WCID #1	N/A	N/A	N/A	N/A	N/A
Liberty County WCID #5	N/A	N/A	N/A	N/A	N/A
TOTALS:	**201**	**4**	**205**	**42**	**63**

Flood Mitigation Assistance (FMA) Repetitive Loss and Severe Repetitive Loss Properties

FEMA supports a handful of Hazard Mitigation Assistance (HMA) programs that support mitigation activities by providing funding that helps support mitigation projects. One such program is Flood Mitigation Assistance (FMA), this competitive program provides funding to states, local communities, federally recognized tribes, and territories that can be used for projects that reduce or eliminate the risk of repetitive flood damage to structures insured by the NFIP. While individual homeowners are not eligible to apply for FMA grant funds, a community in good standing (those that have a FEMA approved HMP and are in good standing with the NFIP) can apply on their behalf. Homeowners who receive FMA grant funds are required to have active NFIP flood insurance policies that must be maintained for the life of the structure.[40] Table 6.1.4 outlines the jurisdiction, structure type (residential, commercial, institutional, etc.), and number of records for RL and SRL properties under the FMA program within the county.

Table 6.1.7: FMA RL and SRL Properties, Liberty County (Source: FEMA, Floodplain Management and Insurance Branch)

Jurisdiction Name	Residential FMA RLPs	Non-Residential FMA RLPs	Total FMA RLPs	FMA SRL Properties
Liberty County	24	0	24	14
City of Ames	1	0	1	1
City of Cleveland	2	0	2	2
City of Daisetta	0	0	0	0
City of Dayton	0	0	0	0
City of Devers	0	0	0	0
City of Hardin	0	0	0	0
City of Kenefick	0	0	0	0
City of Liberty	9	1	10	6
City of North Cleveland	0	0	0	0
City of Plum Grove	0	0	0	0
Liberty County WCID #1	N/A	N/A	N/A	N/A
Liberty County WCID #5	N/A	N/A	N/A	N/A
TOTALS:	**36**	**1**	**37**	**23**

NFIP Policies In-Force

Table 3.7 summarizes the NFIP policies in force for Liberty County by jurisdiction. An "In-force" policy means that the contract between the insurer and the policyholder is active, and the insurance company is liable to pay the benefits as defined in the policy agreement if the insured event occurs. In total, there are 2,205 NFIP insured properties within the county.[31]

Table 6.1.8: NFIP Insured Properties by Community, Liberty County

Community Name (Number)	Policies In-Force	Total Coverage	Total Written Premium + FPF
Liberty County (480438)	1,332	$361,403,000	$889,346
City of Ames (480044)	21	$5,697,000	$12,228
City of Cleveland (480439)	135	$41,415,000	$117,702
City of Daisetta (481101)	10	$2,235,000	$5,057
City of Dayton (480440)	278	$88,753,000	$149,407
City of Devers (481514)	18	$4,221,000	$12,450
City of Hardin (481270)	16	$4,155,000	$8,147
City of Kenefick (481523)	9	$1,809,000	$4,272
City of Liberty (480441)	352	$114,858,000	$234,794

Community Name (Number)	Policies In-Force	Total Coverage	Total Written Premium + FPF
City of North Cleveland	ND	ND	ND
City of Plum Grove (481269)	32	$8,189,000	$24,761
TOTALS:	2,205	$633,435,000	$1,459,509

Community Name- The official NFIP name of the community in which the policy resides.
Community Number- The 6-character community ID in which the policy resides.
Total Coverage- The total building and contents coverage for the policies in force.
Total Written Premium + FPF (Federal Policy Fee)- This represents the sum of the premium and FPF for the policies in force.
ND- No Data

Probability of Future Occurrences

According to RiskFactor, a site that publishes climate risk data to quantify and communicate risk for properties with the U.S., Liberty County has a moderate risk of flooding over the next 30 years. This means flooding is likely to impact day-to-day life within the community. This is based on the level of risk the properties face rather than the proportion of properties with risk."[41] Flooding and flash floods will continue to occur within Liberty County. The Federal Emergency Management Agency's (FEMA) National Risk Index (NRI) utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. According to the FEMA NRI for riverine flooding, the risk index rating average for the county is relatively moderate. Annualized frequency values are 1.4 events per year over 24 years of record 1996-2019, with 34 events on record.[42]

Populations at Risk

Populations at risk for flooding include the entirety of Liberty County and participating jurisdictions as this hazard has no set geographic boundaries. Those living within or near 100 or 500-year floodplains, as well as floodways, are at a higher risk of impacts from this specific hazard. Flooding can cause property damage, displacement, and lack of access to critical facilities that provide food, water, medications, or other forms of medical assistance. Flooding and flood events can also lead to a lack of access to utilities such as electricity and clean water, which can increase the risk of illness. The National Center for Healthy Housing (NCHH) summarizes at-risk populations for several hazards. For flooding these include older adults, children, people experiencing homelessness, people with disabilities, and people with chronic health conditions. In addition to the dangers listed above, older adults can face social isolation, lack of electricity needed to run medical equipment, lack of access to a vehicle for evacuation, and lack of access to other critical supplies. In younger populations, flood events can disrupt schooling and the normal day-to-day routines children thrive on. This can not only jeopardize their academic success but can also cause mental and emotional stress. Children are more at risk and vulnerable to certain medical conditions like asthma, lead poisoning, allergies, and bacterial infections which can be caused by the resulting flood damage and increased moisture. For people experiencing homelessness, adequate shelter is critical in keeping populations safe during flood events. People with disabilities may require additional assistance to stay safe and prepare for these hazards such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment. Likewise, those with chronic health conditions may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to diseases or illnesses from standing water and increased exposure to these illnesses when utilizing a shelter or evacuation center to escape the flood. Additionally, flooding of homes and businesses can cause mold to thrive if not treated promptly. This can exacerbate illness among the general population but especially among those with chronic health conditions.[43]

The vulnerability of communities to this hazard increases as impervious surface is added from new construction/future development, especially if the location of these new additions are within or near SFHAs.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. [44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. Expected annual loss (EAL) represents the average economic loss in dollars resulting from natural hazards each year, the Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards), and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions). The outcome, the risk index, represents the potential negative impacts of natural hazards on the county level or individually by census tracts. The NRI EAL score and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level. [45]

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.

Risk Index Ratings, according to the FEMA NRI for riverine flood events, for these census tracts are listed as very high for 1 census tract, relatively high for 12 census tracts, relatively moderate for 3 census tracts, and relatively low for 1 census tract. EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the historic loss ratio (HLR), a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for riverine flooding within Liberty County as very low.[45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.1.38: Risk Index, Liberty County, Riverine Flooding

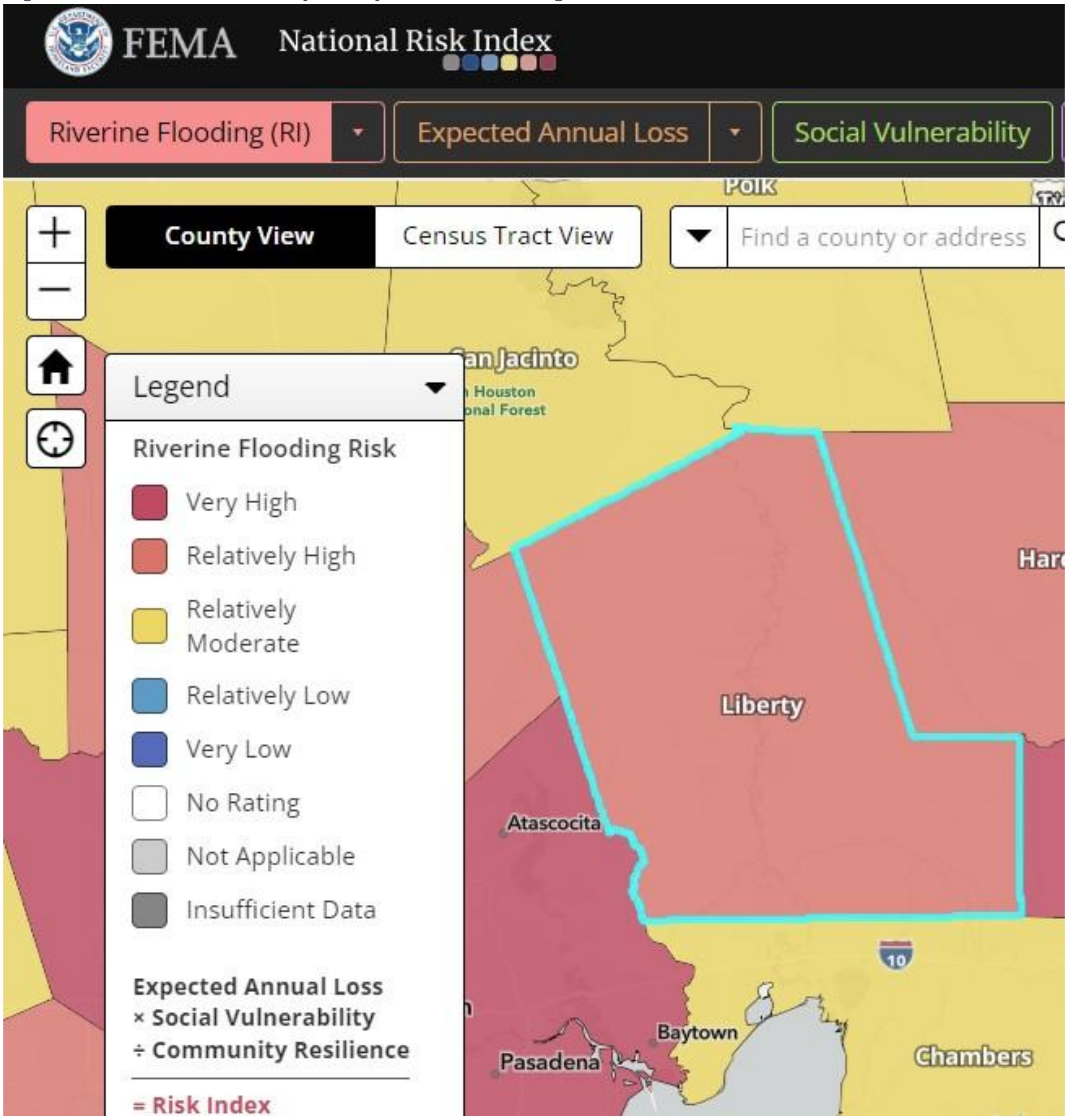


Figure 6.1.39: Risk Index by Census Tract, Liberty County, Riverine Flooding

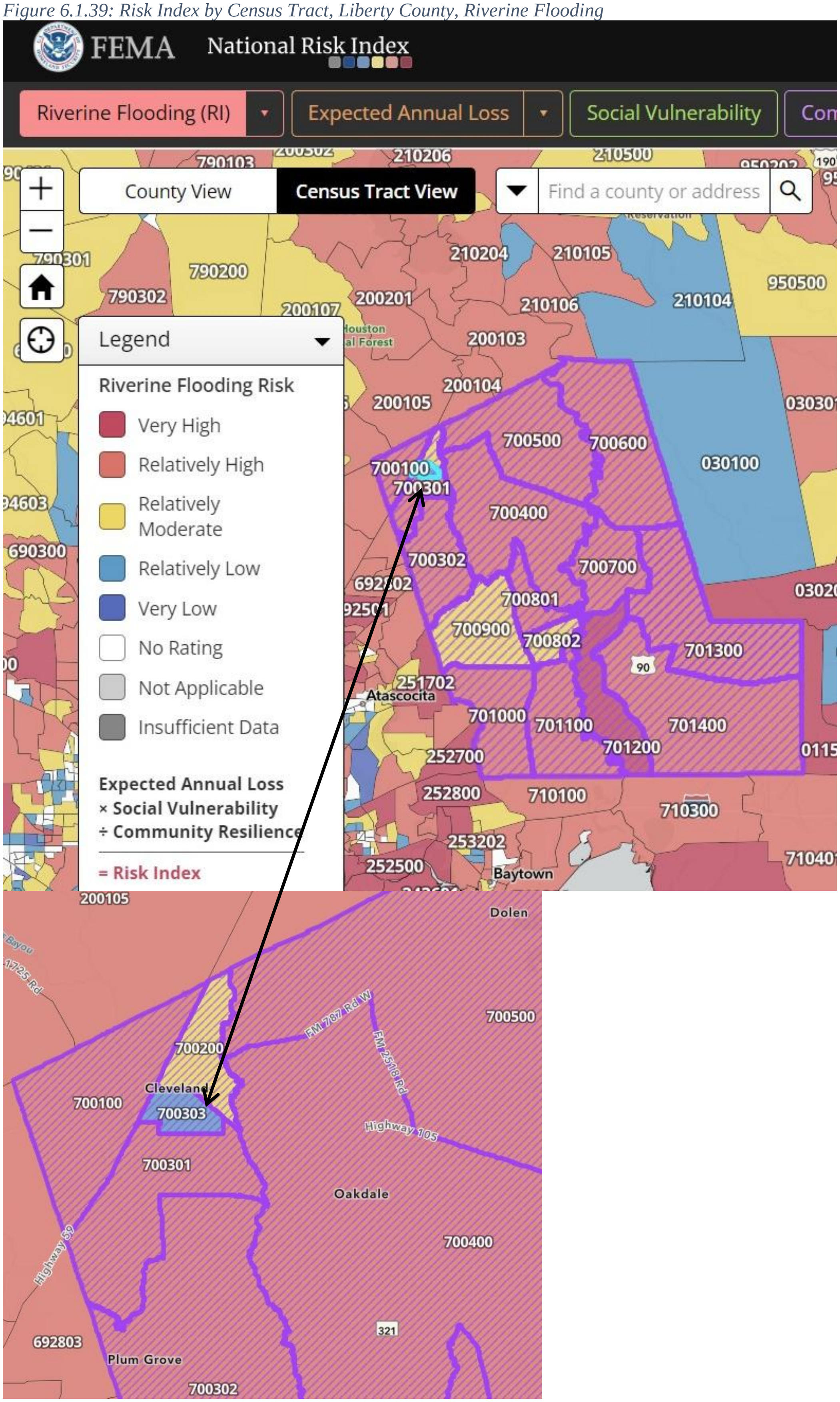


Figure 6.1.40: Social Vulnerability by Census Tract, Liberty County

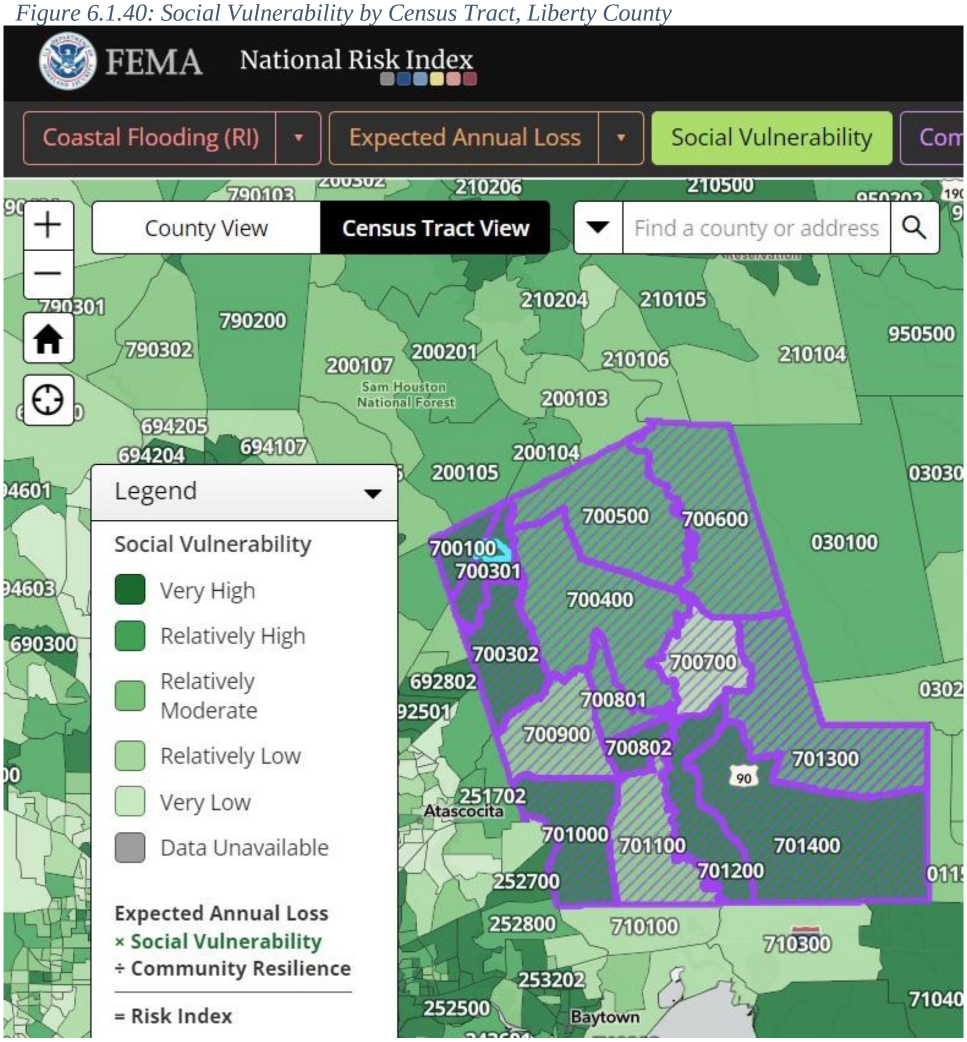


Figure 6.1.41: Social Vulnerability, Liberty County

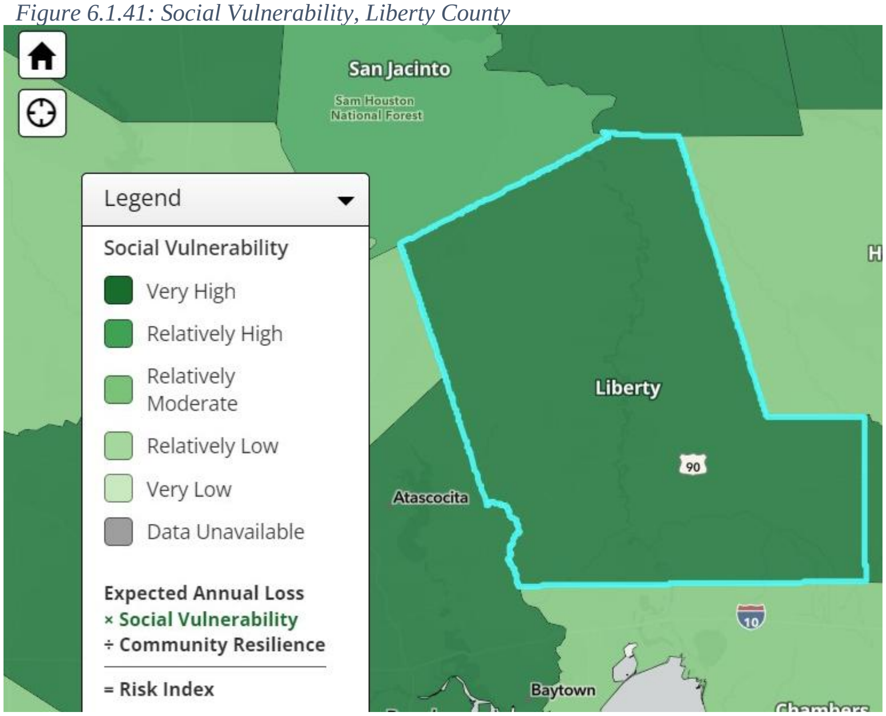


Figure 6.1.42: Community Resilience by Census Tract, Liberty County

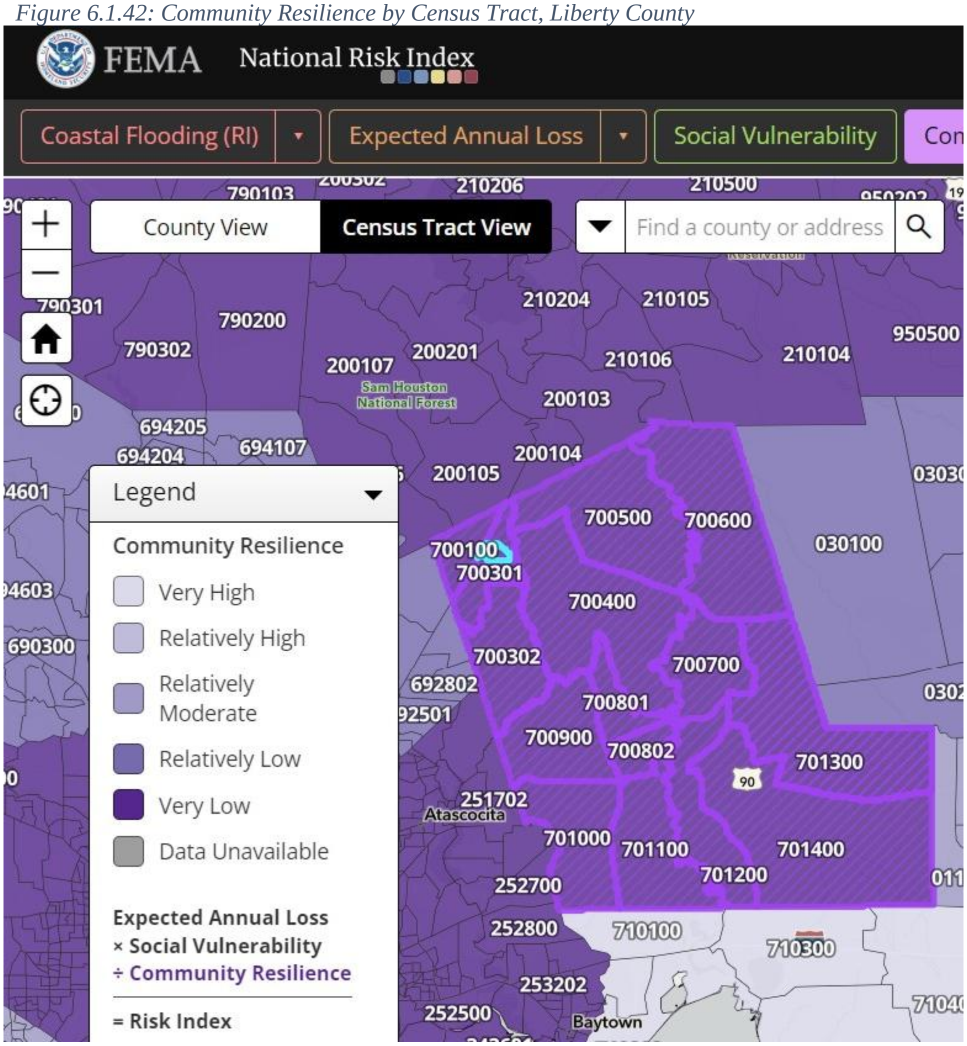


Figure 6.1.43: Community Resilience, Liberty County

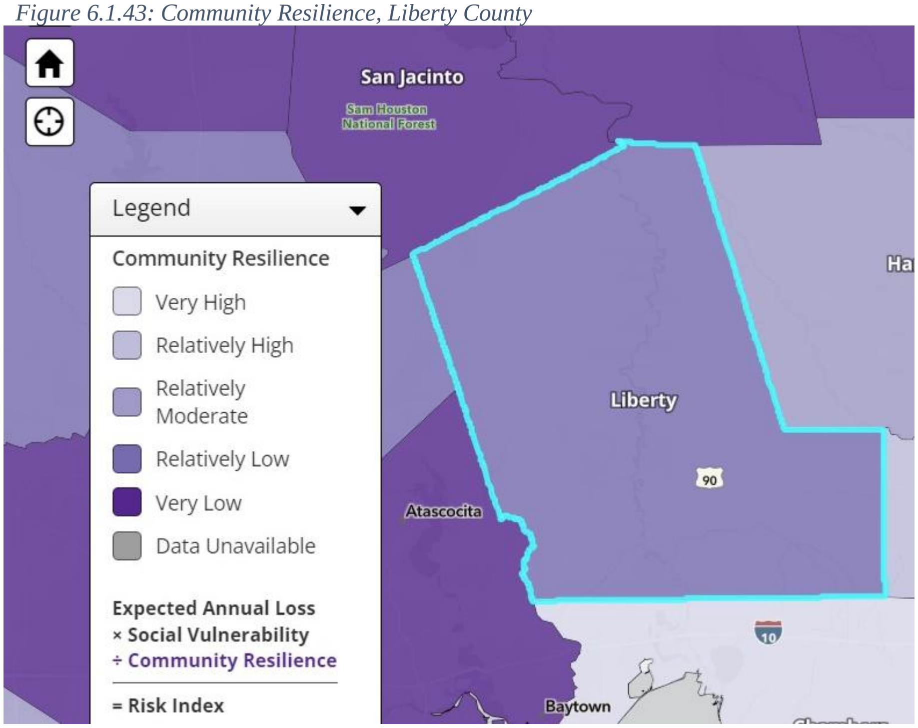


Figure 6.1.44: FEMA NRI Summary by Census Tract, Liberty County, Riverine Flooding

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291701200	TX	Very High	99.44	0 100
2	Census tract 48291700100	TX	Relatively High	98.3	0 100
3	Census tract 48291701000	TX	Relatively High	97.97	0 100
4	Census tract 48291700600	TX	Relatively High	97.93	0 100
5	Census tract 48291700500	TX	Relatively High	97.89	0 100
6	Census tract 48291701400	TX	Relatively High	97.83	0 100
7	Census tract 48291700400	TX	Relatively High	97.58	0 100
8	Census tract 48291700302	TX	Relatively High	96.95	0 100
9	Census tract 48291700301	TX	Relatively High	96.41	0 100
10	Census tract 48291700700	TX	Relatively High	93.18	0 100
11	Census tract 48291700801	TX	Relatively High	92.93	0 100
12	Census tract 48291701300	TX	Relatively High	92.9	0 100
13	Census tract 48291701100	TX	Relatively High	92.08	0 100
14	Census tract 48291700200	TX	Relatively Moderate	89.64	0 100
15	Census tract 48291700900	TX	Relatively Moderate	85.32	0 100
16	Census tract 48291700802	TX	Relatively Moderate	85.2	0 100
17	Census tract 48291700303	TX	Relatively Low	44.56	0 100

Figure 6.1.45: FEMA NRI EAL Summary by Census Tract, Liberty County, Riverine Flooding

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291701200	TX	$1,362,605	Very High	Very Low	1.75	$2,382,519	99.44
2	Census tract 48291700100	TX	$586,703	Very High	Very Low	1.65	$968,909	98.3
3	Census tract 48291701000	TX	$500,804	Very High	Very Low	1.64	$819,034	97.97
4	Census tract 48291700600	TX	$562,318	Relatively High	Very Low	1.43	$806,515	97.93
5	Census tract 48291700500	TX	$627,263	Relatively High	Very Low	1.27	$799,675	97.89
6	Census tract 48291701400	TX	$451,019	Very High	Very Low	1.72	$776,767	97.83
7	Census tract 48291700400	TX	$519,730	Relatively High	Very Low	1.35	$701,745	97.58
8	Census tract 48291700302	TX	$373,511	Very High	Very Low	1.53	$573,004	96.95
9	Census tract 48291700301	TX	$281,664	Very High	Very Low	1.75	$494,106	96.41
10	Census tract 48291700700	TX	$267,575	Relatively Low	Very Low	0.97	$259,926	93.18
11	Census tract 48291700801	TX	$192,198	Relatively High	Very Low	1.3	$250,101	92.93
12	Census tract 48291701300	TX	$172,054	Relatively High	Very Low	1.45	$249,053	92.9
13	Census tract 48291701100	TX	$183,583	Relatively Moderate	Very Low	1.2	$219,599	92.08
14	Census tract 48291700200	TX	$99,650	Very High	Very Low	1.63	$162,174	89.64
15	Census tract 48291700900	TX	$86,976	Relatively Moderate	Very Low	1.19	$103,157	85.32
16	Census tract 48291700802	TX	$65,678	Very High	Very Low	1.55	$101,959	85.2
17	Census tract 48291700303	TX	$2,524	Very High	Very Low	1.81	$4,559	44.56

Climate Change Impacts

Factors such as climate-driven changes like increasing precipitation and warmer sea surface temperatures may affect the probability of future floods within Liberty County. Precipitation changes within the next 15 to 30 years are expected to be 10%-15% heavier due to increased surface temperatures. These increased temperatures cause more evaporation, making more water available in the atmosphere for rain events. Increased sea surface temperatures can cause a greater intensity of hurricanes and precipitation. Storms are also likely to be more severe.[42] According to the Office of the Texas State Climatologist, riverine flooding in Texas is projected to have no substantial change through 2036. This is due to the construction of dams and reservoirs for flood management that occurred and continues to occur within the 20th century. There is a mixture of historical trends categorized by season, but there is no one clear trend to project future flood probabilities. In addition, meteorological drivers of riverine flooding (increased rainfall intensity and decreased soil moisture) are projected to have competing influences. If there is an increasing trend present in riverine flooding, it will be at the most extreme flood events or in the wettest parts of the state where there is so much rainfall that a decrease in soil moisture would have little mitigating impact.[47] The table below summarizes the expected climate change impacts of flooding.

Table 6.1.9: Climate Change Impacts, Flooding

Location	The location of floods is not expected to change
Extent/Intensity	The extent and intensity of flooding within the county may change due to increased precipitation, stronger storms, and rising surface temperatures.
Frequency	There are no clear trends in flood frequency due to considerable variability, flood management measures, and competing meteorological drivers.
Duration	The duration of flood events is not likely to change.

Section 6.2: Hurricanes, Tropical Storms, and Tropical Depressions

6.2 Hurricanes, Tropical Storms, and Tropical Depressions

Hurricanes form from the development of thunderstorms that are fueled by warm water and air over the ocean. Tropical waves and disturbances can lead to the formation of tropical cyclones. A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation. Tropical cyclones can produce intense rainfall of more than 6 inches, resulting in heavy flooding. Other dangers associated with the formation of these storms include storm surges, damaging winds, rip currents, and tornadoes.[48] Slower moving larger storms can produce more rainfall and more dangerous outcomes. Classifications of tropical cyclones; tropical depressions, tropical storms, hurricanes, and major hurricanes are defined in the table below.[49]

Table 6.2.1: Tropical Cyclone Classifications

Classification	Definition
Tropical Depression	A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less. Tropical depressions can bring heavy downpours and sustained winds strong enough to generate rough surf and life-threatening rip currents.
Tropical Storm	A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots). These storms are assigned a name and begin to become more organized and circular.
Hurricane	A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. Hurricanes have very pronounced circulation of which an area of clear weather, an “eye” forms in the center.
Major Hurricane	A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Hurricane season for Texas officially begins on June 1 and ends on November 30. The greatest threat of landfall for the Texas coast occurs between the beginning of June and the end of October. The NWS issues hurricane and tropical storm watches and warnings when these hazards are forming. These watches and warnings are issued or will remain in effect after a tropical cyclone becomes post-tropical when such a storm poses a significant threat to life and property. The National Weather Service (NWS) allows the National Oceanic and Atmospheric Administration’s (NOAA) National Hurricane Center (NHC) to issue advisories during the post-tropical stage. Whenever a tropical cyclone or a subtropical storm has formed in the Atlantic or Eastern North Pacific, the NOAA NHC issues tropical cyclone advisory products at least every 6 hours at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time (EDT). When a coastal tropical storm or hurricane watches or warnings are in effect, the NHC issues Tropical Cyclone Public Advisories every 3 hours. The table below provides definitions of these tropical watches and warnings.[50]

Table 6.2.2: Tropical Watches and Warnings

Watch/Warning	Definition
Advisories	
Tropical Cyclone Public Advisory	Contains a list of all current coastal watches and warnings associated with an ongoing or potential tropical cyclone, a post-tropical cyclone, or a subtropical cyclone. Provides the cyclone position, maximum sustained winds, current motion, and a description of the hazards associated with the storm.
Watches	
Tropical Storm Watch	Tropical storm conditions (sustained winds of 39 to 73 mph) are possible within the specified area within 48 hours.
Storm Surge Watch	There is a possibility of life-threatening inundation from rising water moving inland from the shoreline somewhere within the specified area, generally within 48 hours.
Hurricane Watch	Hurricane conditions (sustained winds of 74 mph or greater) are possible within your area. Because it may not be safe to prepare for a hurricane once winds reach tropical storm force, The NHC issues hurricane watches 48 hours before it anticipates tropical-storm-force winds.

Watch/Warning	Definition
Warnings	
Tropical Storm Warning	Tropical storm conditions (sustained winds of 39 to 73 mph) are expected within your area within 36 hours.
Storm Surge Warning	There is a danger of life-threatening inundation from rising water moving inland from the shoreline somewhere within the specified area, generally within 36 hours. If you are under a storm surge warning, check for evacuation orders from your local officials.
Extreme Wind Warning	Extreme sustained winds of a major hurricane (115 mph or greater), usually associated with the eyewall, are expected to begin within an hour. Take immediate shelter in the interior portion of a well-built structure.
Hurricane Warning	Hurricane conditions (sustained winds of 74 mph or greater) are expected somewhere within the specified area. NHC issues a hurricane warning 36 hours in advance of tropical-storm-force winds to give you time to complete your preparations. All preparations should be complete. Evacuate immediately if so ordered.

Location

Liberty County is located approximately 23 miles North of the Gulf of Mexico. Wind and rains generated by hurricanes, tropical storms, and depressions do have a significant impact on flooding and windstorm-related damages within the county and participating jurisdictions. Flooding is profiled in Section 6.1 of this HMP, while the Windstorm profile can be found in Section 6.8. The figures below, based on NOAA's Historical Hurricane Tracks interactive map, show the historical hurricanes, tropical storms, and tropical depression tracks that have crossed into Liberty County and participating jurisdictions. It is important to remember that these storms, named or unnamed, do not have to cross the county or city boundaries for the planning area to be at risk from their impacts. There has been a total of 81 of these storms that have occurred within 60 nmi of Liberty County, while 22 storms have crossed through the county directly.[51]

Figure 6.2.1: Historical Hurricane Tracks within 60 nmi, Liberty County

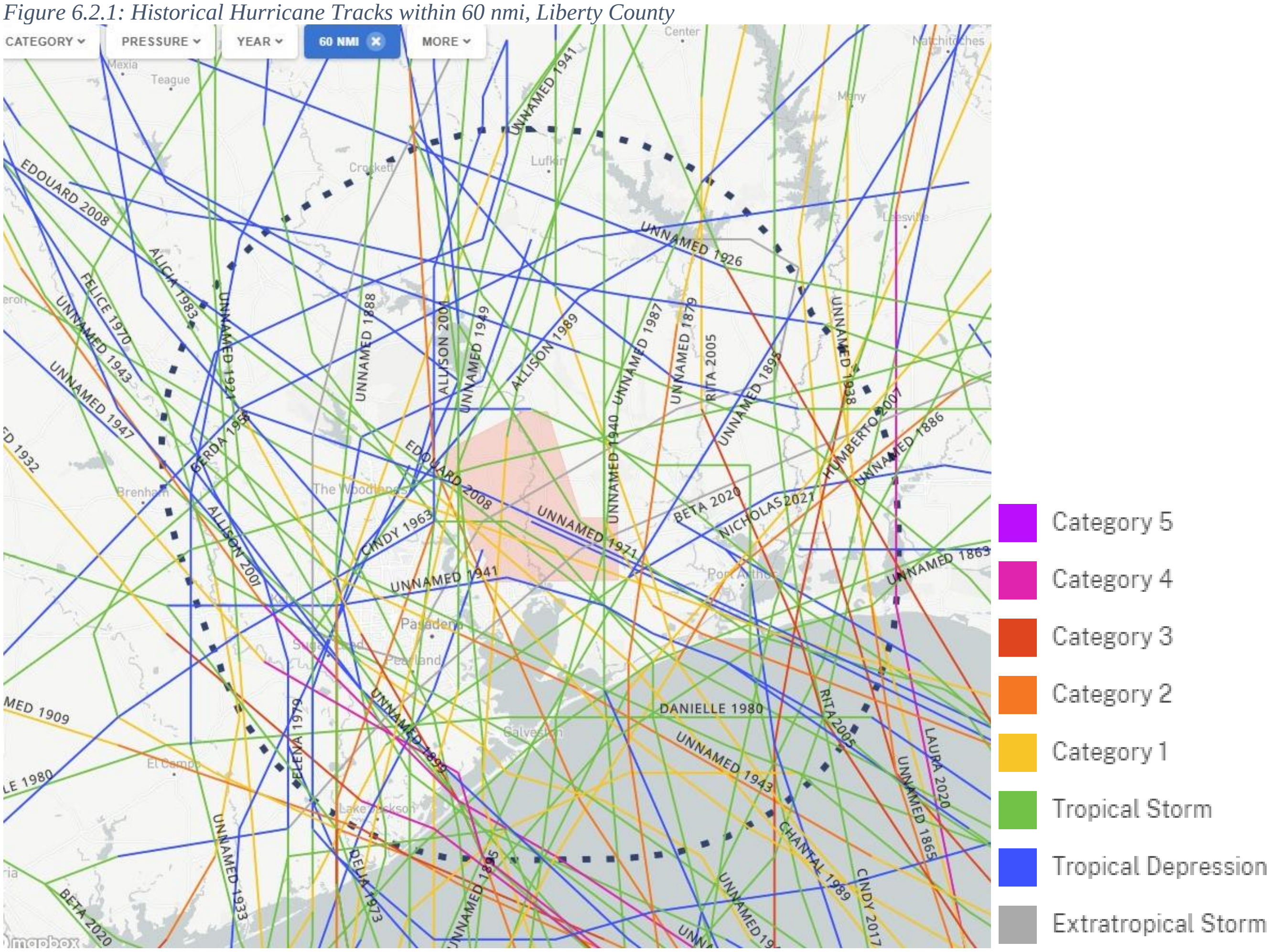
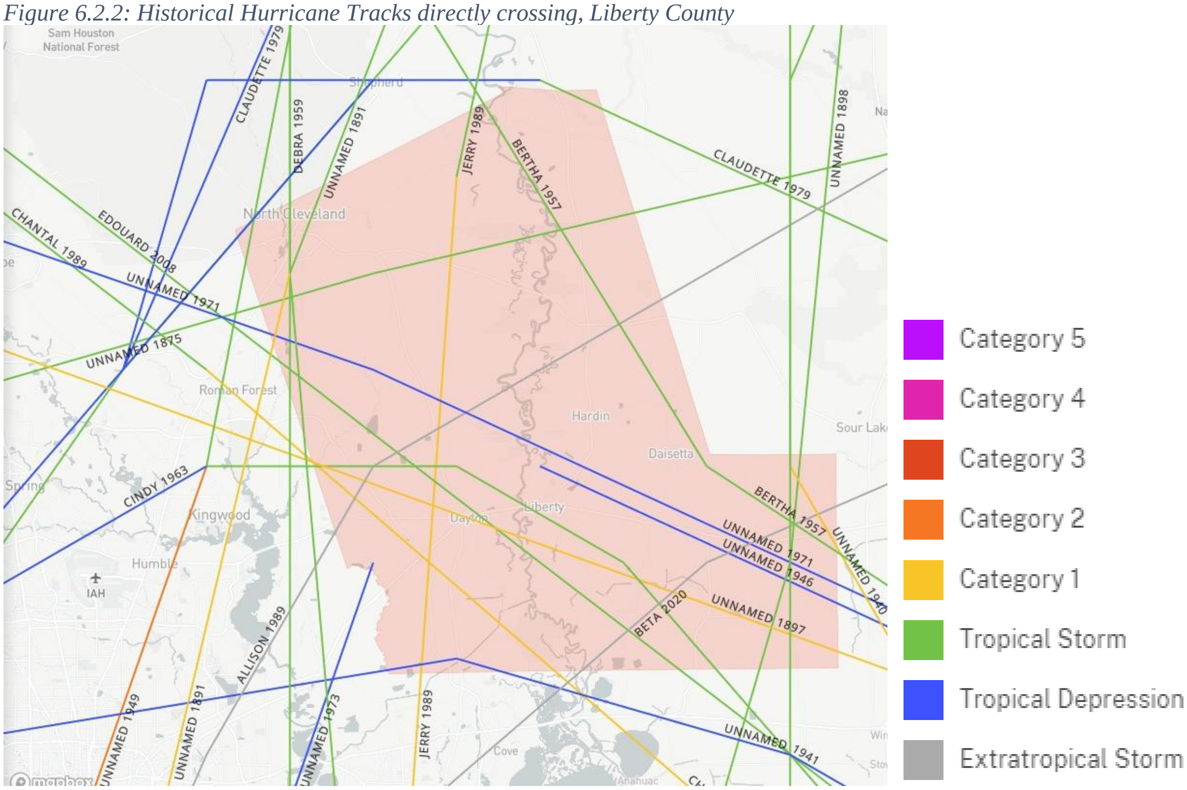


Figure 6.2.2: Historical Hurricane Tracks directly crossing, Liberty County



Extent

Hurricane intensity is measured through the Saffir-Simpson Hurricane Wind Scale. Wind engineer Herb Saffir and meteorologist Bob Simpson originally developed the scale. It has been an excellent tool for alerting the public about the possible impacts of various intensity hurricanes. The scale does not address the potential for other hurricane-related impacts, such as storm surges, rainfall-induced floods, and tornadoes. This wind caused damage general descriptions of the scale are to an extent dependent upon the local building codes in effect and how well and how long they have been enforced.[52] The scale gives a 1 to 5 rating based only on a hurricane's maximum sustained wind speed and estimates potential property damage at each scale. Hurricanes of Category 3 and higher are known as major hurricanes. These hurricanes can cause devastating to catastrophic wind damage and significant loss of life due to the strength of their winds. Hurricanes of all categories can produce deadly storm surges, rain-induced floods, and tornadoes. These hazards require people to take protective action, including evacuating from areas vulnerable to storm surges.[53]

Table 6.2.3: The Saffir-Simpson Hurricane Wind Scale

Category	Sustained Wind Speeds	Types of Damage Due to Hurricane Winds
1	74-95 mph	**Very dangerous winds will produce some damage**: People, livestock, and pets struck by flying or falling debris could be injured or killed. Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph	**Extremely dangerous winds will cause extensive damage**: There is a substantial risk of injury or death to people, livestock, and pets due to flying and falling debris. Older (mainly pre-1994 construction) manufactured homes have a very high chance of being destroyed and the flying debris generated can shred nearby manufactured homes. Newer manufactured homes can also be destroyed. Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129 mph	**Devastating damage will occur**: There is a high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) manufactured homes will be destroyed. Newer manufactured homes will sustain severe damage with the potential for complete roof failure and wall collapse. Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electric and water will be unavailable for several days to weeks after the storm passes.
4	130-156 mph	**Catastrophic damage will occur**: There is a very high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) manufactured homes will be destroyed. A high percentage of newer manufactured homes also will be destroyed. Poorly constructed homes can sustain complete collapse of all walls as well as the loss of the roof structure. Well-built homes also can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Category	Sustained Wind Speeds	Types of Damage Due to Hurricane Winds
5	157 mph or higher	**Catastrophic damage will occur**: People, livestock, and pets are at very high risk of injury or death from flying or falling debris, even if indoors in manufactured homes or framed homes. Almost complete destruction of all manufactured homes will occur, regardless of age or construction. A high percentage of frame homes will be destroyed, with total roof failure and wall collapse. Extensive damage to roof covers, windows, and doors will occur. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

A worst-case scenario for this hazard would be a category 5 hurricane making landfall near Chambers or Liberty County, leading to catastrophic damage and creating an environment inducive to severe thunderstorms, heavy rains, strong tornadoes, and large hail as it passes near or through Liberty County. Widespread flooding, dangerous winds, and other secondary hazards like power outages, loss of life, and extensive damage to buildings, critical facilities, and infrastructure could occur. Additionally, this hazard could damage critical infrastructure that leads to a prolonged power outage and even result in a loss of communication within the county if a radio or cell tower is destroyed. If a hurricane or tropical storm occurs during a heat event or drought and disrupts power supply in the area for a prolonged amount of time, secondary hazards will pose increased risks to citizens due to the heat and inability to keep homes and buildings cool. This scenario is similar to what occurred within the region during the 2024 derecho and Hurricane Beryl. Power lines were destroyed by debris and falling trees due to the severe thunderstorms and winds, in July, when the region was under an excessive heat advisory. Power line restoration/repairs took longer than anticipated leading to the activation of cooling centers for residents. The strongest winds ever recorded in Liberty County were from Hurricane Ike in 2008 that saw maximum sustained winds at landfall estimated at 95 knots (110 mph) with gusts to 110 knots (127 mph). At landfall, Ike was only a Category 2 hurricane on the Saffir-Simpson scale based on wind speed.

Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCEI storm events database. These events are often shown at the county level; thus, the table below highlights all events for this hazard that have occurred within Liberty County from 1950-2023.[39]

Table 6.2.4: Liberty County Hurricane, Tropical Storms, and Tropical Depressions (1950-2023)

Date	Area Impacted	Event Type	Injuries	Fatalities	Property Damage	Crop Damage
9/7/1998	Liberty County	Tropical Storm	0	0	$100,000	$-
6/7/2001	Liberty County	Tropical Storm, Allison	0	0	$7,600,000	$-
8/30/2003	Liberty County	Tropical Storm, Grace	0	0	$-	$-
9/23/2005	Liberty County	Hurricane, Rita	0	2	$7,000,000	$-
9/12/2008	Liberty County	Hurricane, Ike	0	0	$220,000,000	$-
6/21/2017	Liberty County	Tropical Storm, Cindy	0	0	$-	$-
8/25/2017	Liberty County	Tropical Storm, Harvey	0	0	$1,000,000,000	$-
9/13/2021	Liberty County	Tropical Storm, Nicholas	0	0	$-	$-
		TOTALS:	**0**	**2**	**$1,234,700,000**	**$-**

$- No dollar amount ($0.00).

Presidential Disaster Declarations

There have been 11 federally declared hurricanes, tropical storms, or tropical depression-related disasters in Liberty County since 1950.[2]

Table 6.2.5: Federal Disaster Declarations for Hurricanes, Tropical Storms, and Tropical Depressions

Date	Disaster Number	Declaration Types	Incident Type	Declaration Title
8/19/1983	689	Major Disaster Declaration	Hurricane	HURRICANE ALICIA
6/9/2001	1379	Major Disaster Declaration	Coastal Storm	TX- TROPICAL STORM ALLISON, 06-06-2001
9/2/2005	3216	Emergency Declaration	Hurricane	HURRICANE KATRINA EVACUATION
9/21/2005	3261	Emergency Declaration	Hurricane	HURRICANE RITA
9/24/2005	1606	Major Disaster Declaration	Hurricane	HURRICANE RITA
8/29/2008	3290	Emergency Declaration	Hurricane	HURRICANE GUSTAV
9/10/2008	3294	Emergency Declaration	Hurricane	HURRICANE IKE
9/13/2008	1791	Major Disaster Declaration	Hurricane	HURRICANE IKE
8/25/2017	4332	Major Disaster Declaration	Hurricane	HURRICANE HARVEY
8/24/2020	3540	Emergency Declaration	Hurricane	TROPICAL STORMS MARCO AND LAURA
7/9/2024	4798	Major Disaster Declaration	Hurricane	HURRICANE BERYL

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as USDA FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor’s authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies the USDA FSA of the primary counties named in the presidential declaration. USDA disaster declarations for Liberty County since 2018 are listed in the table below.[40]

Table 6.2.6: USDA Declared Disasters (2018-2023), Hurricane, Tropical Storms, and Tropical Depressions

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

The State of Texas HMP, developed by TDEM, estimates the occurrence of hurricanes, tropical storms, and tropical depressions is trending upward, with a 400% increase in the 5-year planning cycle between 2017-2021.[33] According to the FEMA’s NRI for hurricanes within Liberty County, annualized frequency values are 0.2 events per year over 73 years of record (1949-2021), with 30 events on record for this timeframe.[44]

Populations at Risk

Populations at risk for hurricanes, tropical storms, and tropical depressions include the entire county as this hazard has no geographic boundaries. Hurricanes can cause property damage, flooding, lack of access to critical facilities that provide food, water, medications, or other forms of medical assistance, and lack of utilities such as electricity and clean water, which can increase the risk of illness. The NCHH website for emergency preparedness and response includes information on at-risk populations for several hazards. For hurricanes, these include older adults, children, people experiencing homelessness, people with disabilities, and people with chronic health conditions. In addition to the dangers listed above, older adults can face social isolation, lack of electricity needed to run medical equipment, lack of access to a vehicle for evacuation, and lack of access to other critical supplies. In younger populations, such as children, flood events can disrupt schooling and the normal day-to-day routines they thrive on. This can not only jeopardize their academic success but can also cause mental and emotional stress. Children are more at risk and vulnerable to certain medical conditions like asthma, lead poisoning, allergies, and bacterial infections which can be caused by the resulting flood damage and increased moisture of hurricanes. For people experiencing homelessness, housing and adequate shelter are critical in keeping populations safe during these types of hazard events so hurricanes can be life-threatening for this population if adequate shelter is not located and utilized. People with disabilities may require additional assistance to stay safe and prepare for these hazards such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment. Likewise, those with chronic health conditions may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to diseases or illnesses from standing water and increased exposure to these illnesses when utilizing a shelter or evacuation center. Additionally, flooding of homes and businesses can cause mold to thrive if not treated promptly. This can exacerbate illness among the general population but especially among those with chronic health conditions.[44] People living in mobile homes are also at greater risk of injury and death from these hazards. Despite mobile homes providing a form of shelter, tornadoes and dangerous winds produced by hurricanes, tropical storms, and tropical depressions can cause mobile homes and even mobile homes that utilize anchoring to be seriously damaged or destroyed when winds gust over 80 mph.[54]

All areas of future growth and development within the county will increase the risk to this hazard, and the vulnerability of people and property, as it has no geographic boundaries and a wide area of impact with various secondary hazards.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year, the Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards), and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions). The outcome, the risk index, represents the potential negative impacts of natural hazards on the county level or individually by census tracts. The NRI EAL score and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings, according to the FEMA NRI for hurricane events, for these census tracts are listed as very high for 4 census tracts, relatively high for 12 census tracts, and relatively moderate for 1 census tract.[43] EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the historic loss ratio (HLR), a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for hurricanes within Liberty County as relatively high. [45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.2.3: Risk Index, Liberty County, Hurricane

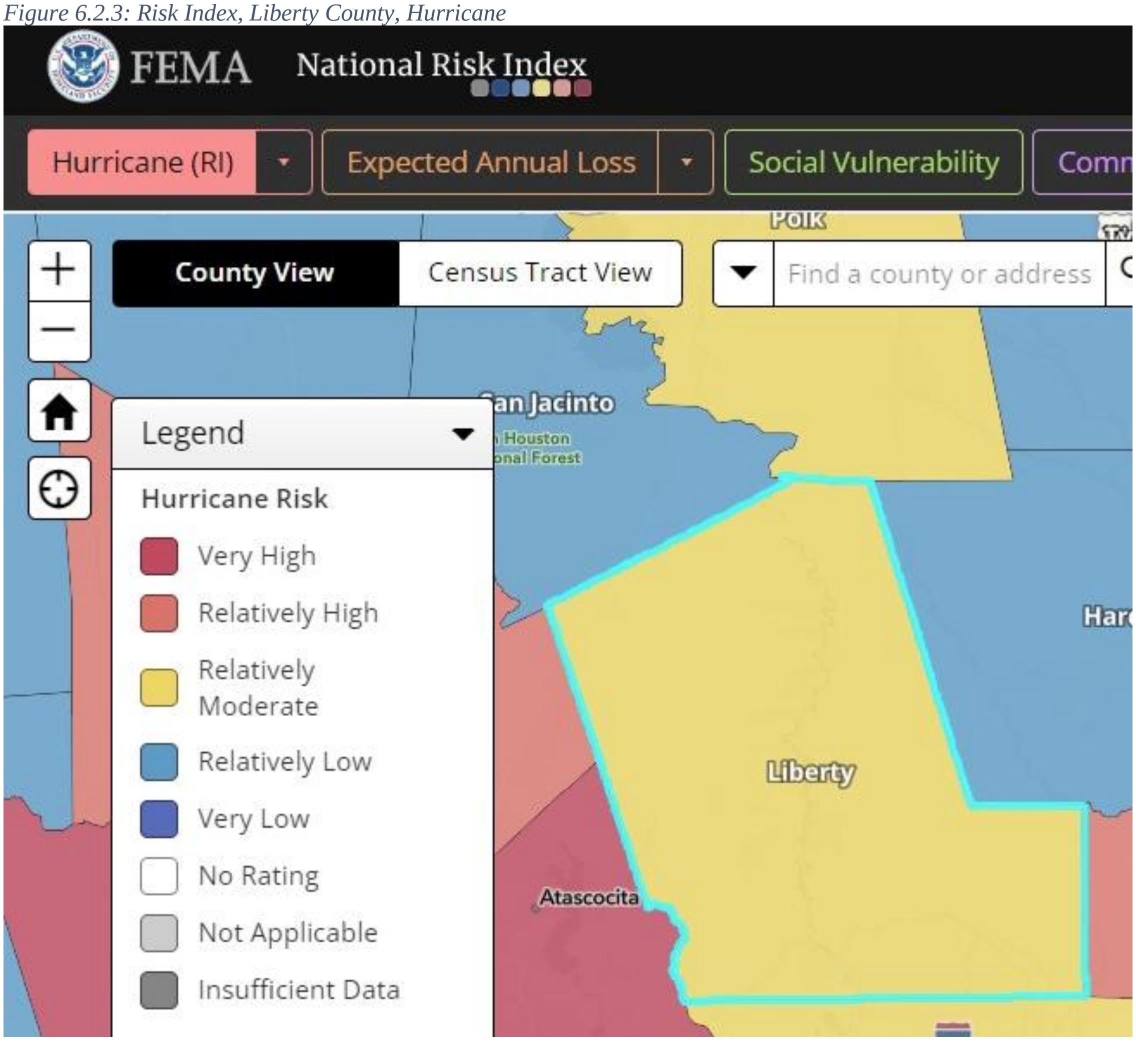


Figure 6.2.4: Risk Index by Census Tract, Liberty County, Hurricane

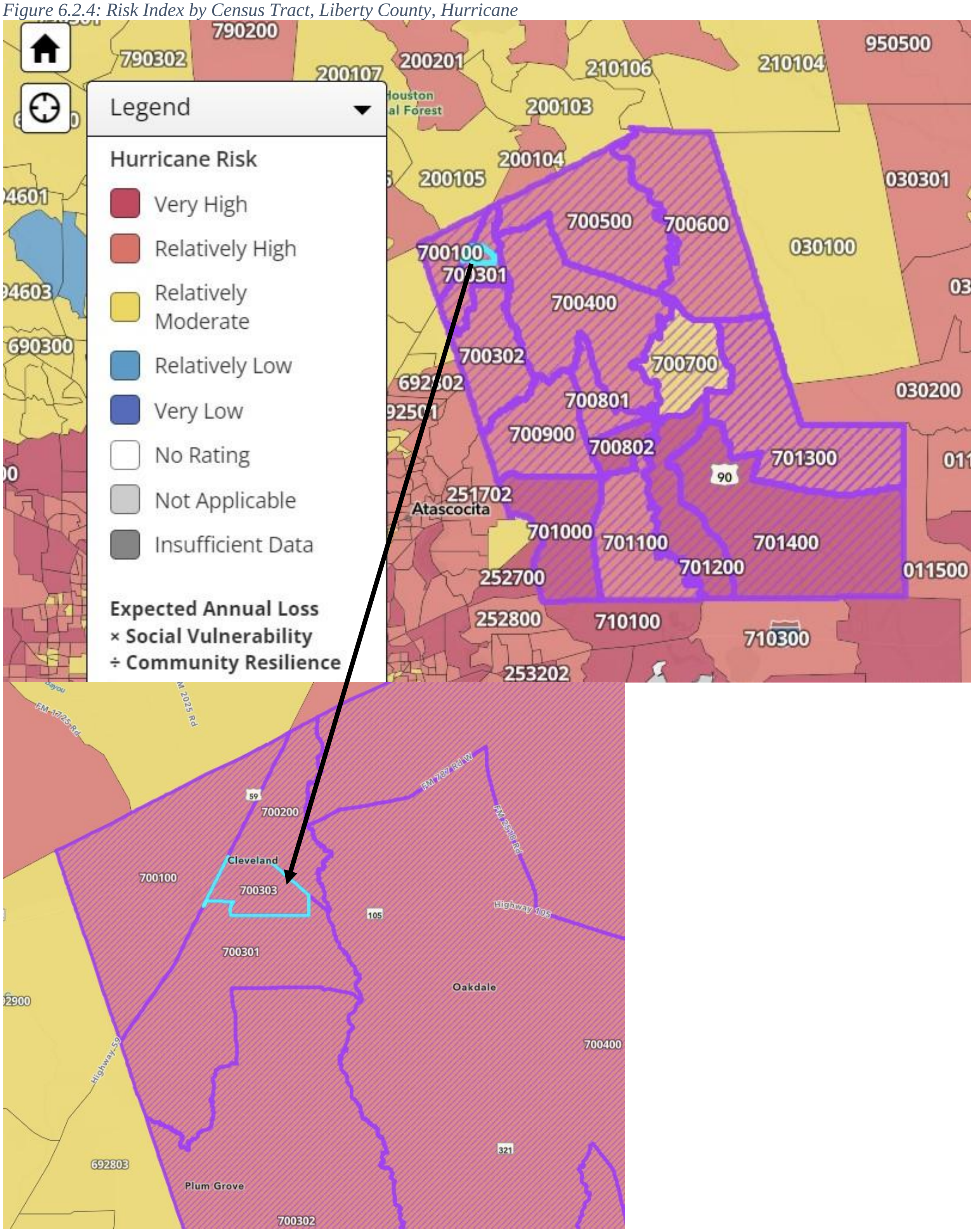


Figure 6.2.5: Social Vulnerability by Census Tract, Liberty County

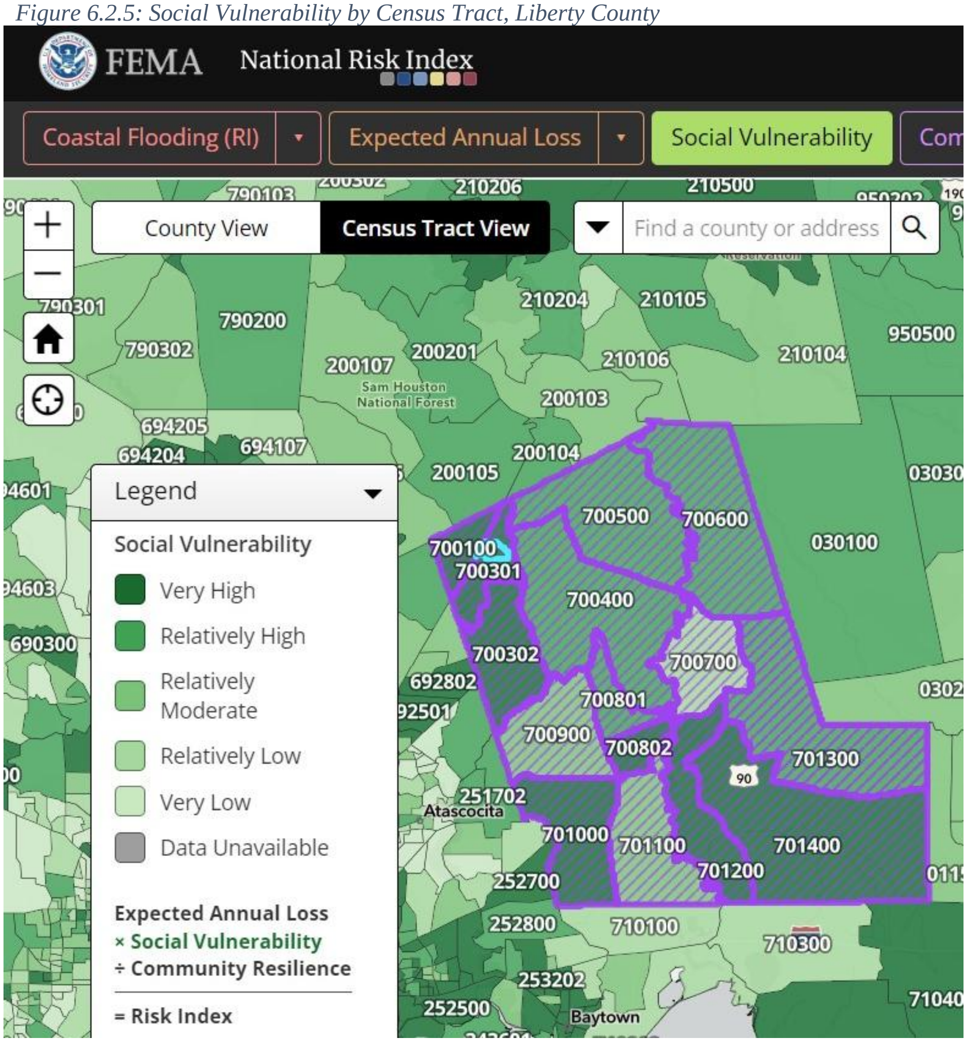


Figure 6.2.6: Social Vulnerability, Liberty County

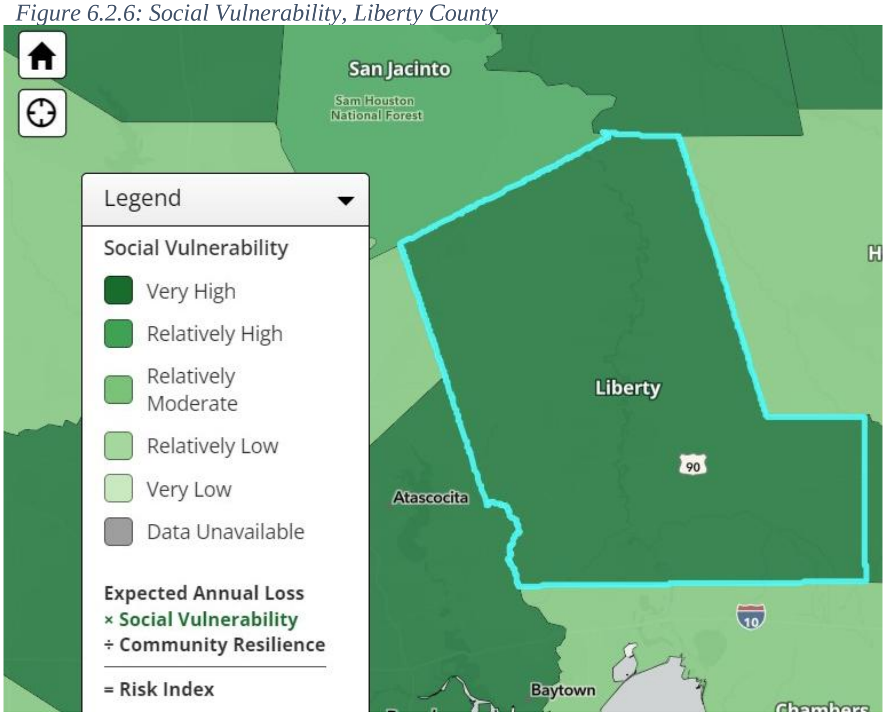


Figure 6.2.7: Community Resilience by Census Tract, Liberty County

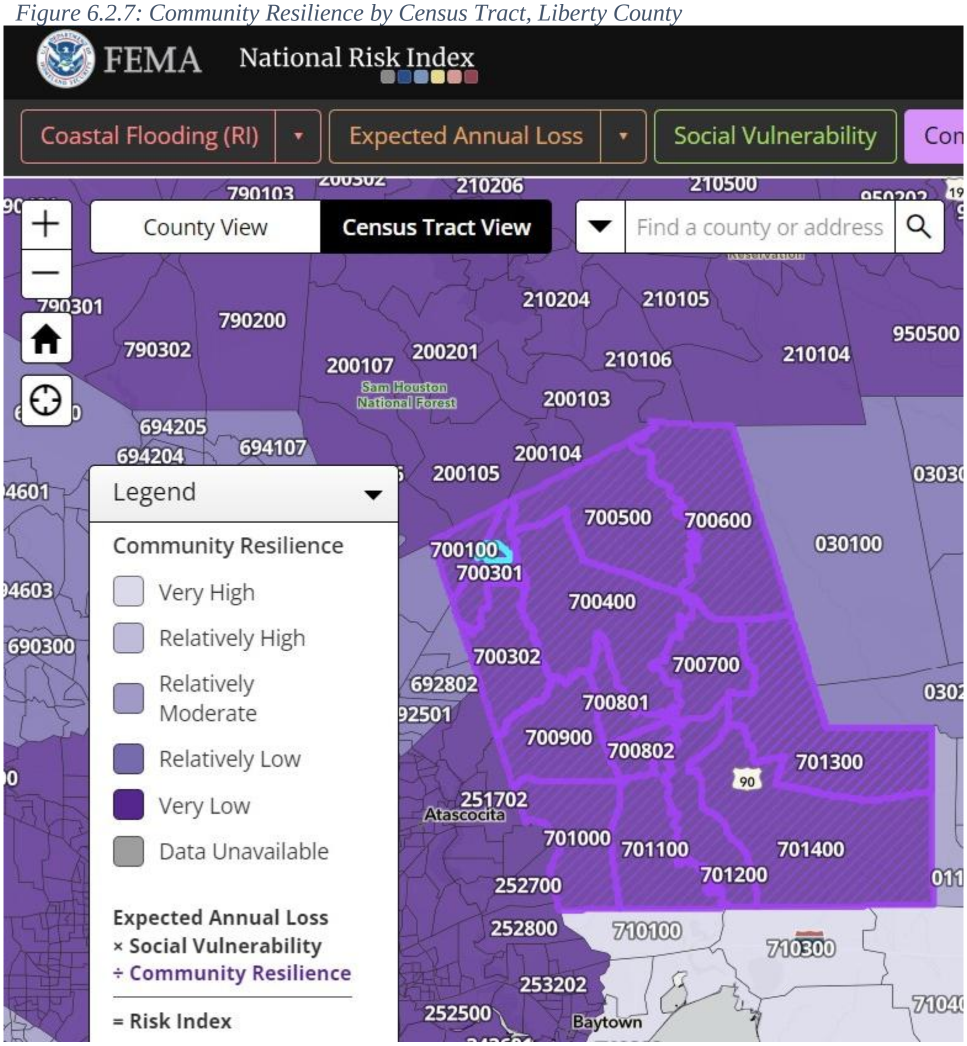


Figure 6.2.8: Community Resilience, Liberty County

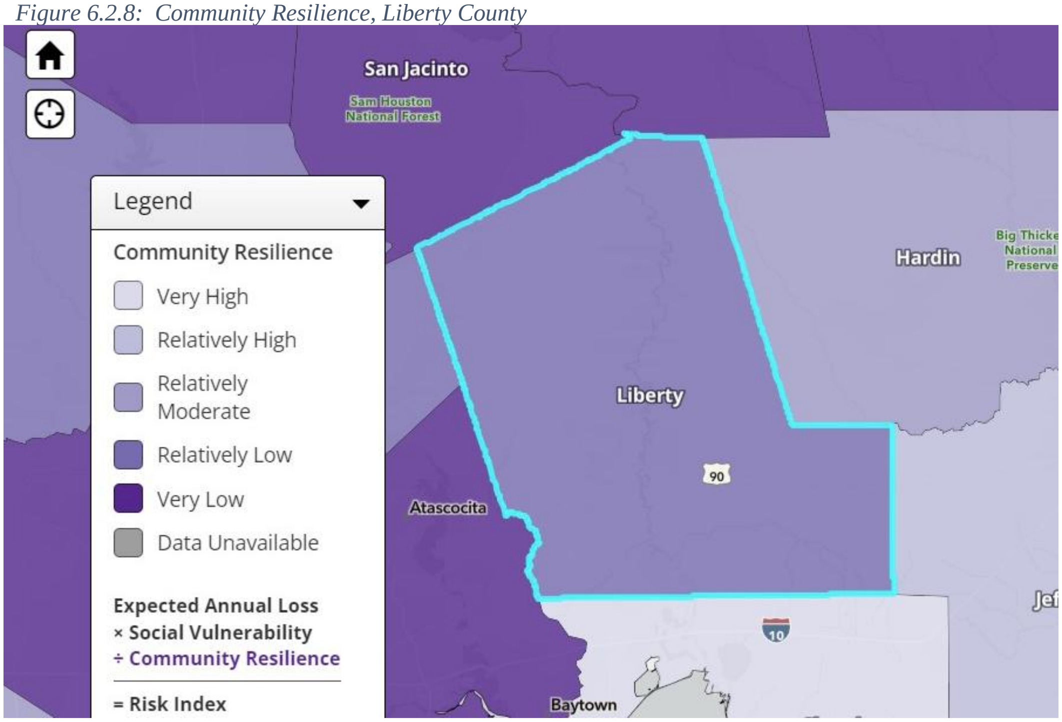


Figure 6.2.9: FEMA NRI Summary by Census Tract, Liberty County, Hurricane

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291701200	TX	Very High	98.43	0 100
2	Census tract 48291701400	TX	Very High	98.26	0 100
3	Census tract 48291701000	TX	Very High	96.26	0 100
4	Census tract 48291700802	TX	Very High	95.59	0 100
5	Census tract 48291701100	TX	Relatively High	94.9	0 100
6	Census tract 48291700100	TX	Relatively High	94.4	0 100
7	Census tract 48291700400	TX	Relatively High	94.09	0 100
8	Census tract 48291700302	TX	Relatively High	93.53	0 100
9	Census tract 48291700303	TX	Relatively High	91.06	0 100
10	Census tract 48291701300	TX	Relatively High	90.22	0 100
11	Census tract 48291700200	TX	Relatively High	89.82	0 100
12	Census tract 48291700900	TX	Relatively High	87.81	0 100
13	Census tract 48291700301	TX	Relatively High	87.09	0 100
14	Census tract 48291700500	TX	Relatively High	86.8	0 100
15	Census tract 48291700801	TX	Relatively High	86.64	0 100
16	Census tract 48291700600	TX	Relatively High	86.5	0 100
17	Census tract 48291700700	TX	Relatively Moderate	84.65	0 100

Figure 6.2.10: FEMA NRI EAL Summary by Census Tract, Liberty County, Hurricane

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291701200	TX	$2,192,594	Very High	Very Low	1.75	$3,833,758	98.43
2	Census tract 48291701400	TX	$2,128,490	Very High	Very Low	1.72	$3,665,789	98.26
3	Census tract 48291701000	TX	$1,510,654	Very High	Very Low	1.64	$2,470,583	96.26
4	Census tract 48291700802	TX	$1,443,626	Very High	Very Low	1.55	$2,241,082	95.59
5	Census tract 48291701100	TX	$1,702,625	Relatively Moderate	Very Low	1.2	$2,036,657	94.9
6	Census tract 48291700100	TX	$1,159,824	Very High	Very Low	1.65	$1,915,389	94.4
7	Census tract 48291700400	TX	$1,368,138	Relatively High	Very Low	1.35	$1,847,277	94.09
8	Census tract 48291700302	TX	$1,131,874	Very High	Very Low	1.53	$1,736,410	93.53
9	Census tract 48291700303	TX	$713,357	Very High	Very Low	1.81	$1,288,453	91.06
10	Census tract 48291701300	TX	$816,991	Relatively High	Very Low	1.45	$1,182,613	90.22
11	Census tract 48291700200	TX	$694,807	Very High	Very Low	1.63	$1,130,749	89.82
12	Census tract 48291700900	TX	$752,398	Relatively Moderate	Very Low	1.19	$892,367	87.81
13	Census tract 48291700301	TX	$466,506	Very High	Very Low	1.75	$818,364	87.09
14	Census tract 48291700500	TX	$618,240	Relatively High	Very Low	1.27	$788,172	86.8
15	Census tract 48291700801	TX	$594,212	Relatively High	Very Low	1.3	$773,231	86.64
16	Census tract 48291700600	TX	$530,230	Relatively High	Very Low	1.43	$760,492	86.5
17	Census tract 48291700700	TX	$603,942	Relatively Low	Very Low	0.97	$586,679	84.65

Climate Change Impacts

According to the Office of the Texas State Climatologist, hurricanes, tropical storms, and tropical depressions, though unpredictable in quantity between 5-year planning cycles, will continue to intensify due to other climate-related factors such as the environmental conditions for thunderstorm intensity rising, warmer temperatures, and increasing ocean temperatures. As temperatures increase, the amount of energy available to fuel these storms, especially those that form over warm tropical waters of the Atlantic Ocean and Gulf of Mexico is expected to increase.[47]

Table 6.2.7: Climate Change Impacts Summary, Hurricane, Tropical Storms, and Tropical Depressions

Location	The location of hurricanes, tropical storms, and tropical depressions is not expected to change.
Extent/Intensity	The extent and intensity of hurricanes, tropical storms, and tropical depressions are not expected to change.
Frequency	There are no clear trends in hurricanes, tropical storms, and tropical depression frequency. This is due to considerable variability in conditions that lead to these hazards occurring. However, these hazards occur most frequently in warmer months. For the Texas coast, hurricane season officially begins on June 1 and ends on November 30. The greatest threat of landfall for these hazards occurs between the beginning of June through October.
Duration	The duration of hurricanes, tropical storms, and tropical depressions is not likely to change, however, their intensity is expected to increase due to rising temperatures and the proximity of the county and city to the Gulf of Mexico, which aids in fueling thunderstorms and tropical cyclone formation when waters are warm and thunderstorm development is more likely.

Section 6.3: Severe Thunderstorms & Lightning

6.3 Severe Thunderstorms & Lightning

he NWS defines a thunderstorm as "A local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder." A severe thunderstorm is defined as "A thunderstorm that produces a tornado, winds of at least 58 mph (50 knots), and/or hail at least 1" in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. A thunderstorm wind equal to or greater than 40 mph (35 knots) and/or hail of at least 1" is defined as approaching severe."[55] Thunderstorms form when certain factors are present. These are moisture, instability, lifting, and in the case of severe thunderstorms wind shear. The difference between thunderstorms and severe thunderstorm formation resides in the wind field or wind sheer.[56] There are different types of thunderstorms with varying characteristics and degrees of severity.[57] Descriptions of these can be found in the table below.

Table 6.3.1: Thunderstorm Classifications

Type of Thunderstorm	Description
Ordinary Cell (Pulse Thunderstorm)	A one-time updraft and one-time downdraft. The rising updraft will suspend growing raindrops until the point where the weight of the water is greater than what can be supported. Drag between the air and the falling drops begins to diminish the updraft, which allows more raindrops to fall. While hail and gusty wind can develop, these occurrences are typically not severe. However, if atmospheric conditions are right and the ordinary cell is strong enough, more than one cell can potentially form and can include microburst winds (usually less than 70 mph or 112 km/h) and weak tornadoes.
Multi-Cell Cluster	A thunderstorm with numerous cells in various stages of development merging together. While each individual thunderstorm cell in a multi-cell cluster behaves as a single cell, the prevailing atmospheric conditions are such that as the first cell matures, it is carried downstream by the upper-level winds, with a new cell forming upwind of the previous cell to take its place. Sometimes the atmospheric conditions encourage vigorous new cell growth – they form so fast that each new cell develops further and further upstream. Tremendous rainfall amounts can be produced over very small areas by back-building thunderstorms.
Multi-cell Line (Squall Line)	Thunderstorms that form in a line and can extend laterally for hundreds of miles. These "squall lines" can persist for many hours and produce damaging winds and hail. Updrafts, and therefore new cells, continually re-form at the leading edge of the system, with rain and hail following behind. Individual thunderstorm updrafts and downdrafts along the line can become quite strong, resulting in episodes of large hail and strong outflow winds that move rapidly ahead of the system. While the leading edge of squall lines occasionally form tornadoes, they primarily produce "straight-line" wind damage, a result of the force of the downdraft spreading horizontally as it reaches the Earth's surface.
Supercell Thunderstorms	Supercell thunderstorms are a special kind of single cell thunderstorm that can persist for many hours. They are responsible for nearly all the significant tornadoes produced in the U.S. and for most of the hailstones larger than golf ball size. Supercells are also known to produce extreme winds and flash flooding.

Lightning is defined by NWS as "A visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground, or between the ground and a cloud."[58] Lightning accompanies all thunderstorms and poses a threat to lives and property. While the odds of being struck by lightning are relatively low (1/1,222,000)[59], lightning kills about 20 people per year while hundreds more are injured or suffer lifelong neurological damage.[60] There are different types of lightning with varying characteristics. Most lighting starts within a thunderstorm and travels through the cloud.[61] Descriptions of these can be found in the table below.

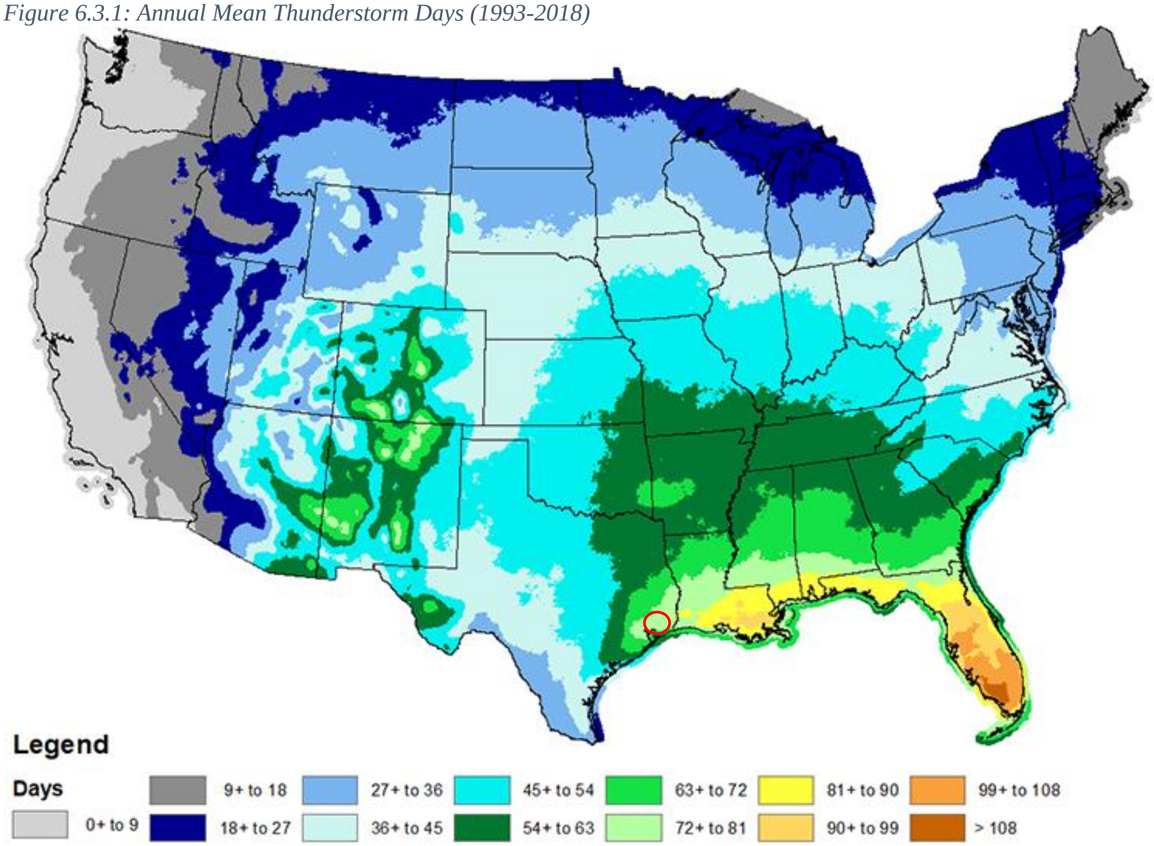
Table 6.3.2: Types of Lightning

Type of Lightning	Description
Cloud-to-Ground Flashes (Cloud-to-Ground Lightning)	A channel of negative charge, called a stepped leader, will zigzag downward in roughly 50-yard segments in a forked pattern. This stepped leader is invisible to the human eye, and shoots to the ground in less time than it takes to blink. As it nears the ground, the negatively charged stepped leader causes streamer channels of positive charge to reach upward, normally from taller objects in the area, such as a tree, house, or telephone pole. When the oppositely charged leader and streamer connect, a powerful electrical current begins flowing. This return stroke current of bright luminosity travels about 60,000 miles per second back towards the cloud.
	A "**bolt from the blue**" is Cloud-to-Ground lightning which starts inside a cloud, goes out the side of the storm, then travels horizontally away from the cloud before going to ground. A bolt from the blue can strike ground at a spot with "blue sky" above it. *Even a storm that is 6 miles away can be dangerous.*
Cloud Flashes (Intra-Cloud Lightning)	Many flashes of lightning within a cloud that do not reach the ground. Cloud flashes sometimes have visible channels that extend out into the air around the storm

Location

Thunderstorms, and the accompanying lightning, are not confined to any geographic boundaries. These hazards can happen anywhere, at any time of the year. However, typically thunderstorms will occur in warmer months such as Summer and Spring, and during the warmest parts of the day. Figure 6.3.1 shows the average number of thunderstorm days each year throughout the U.S. (defined as two lightning flashes within 10 nautical miles (nmi) radius). The most frequent occurrence is in the southeastern states due to warm, moist air from the Gulf of Mexico and Atlantic Ocean readily available to fuel atmospheric conditions that produce thunderstorms.[62] Liberty County is in an area that can see anywhere from 72-81 thunderstorm days per year as indicated by the red-circled area on the figure below.

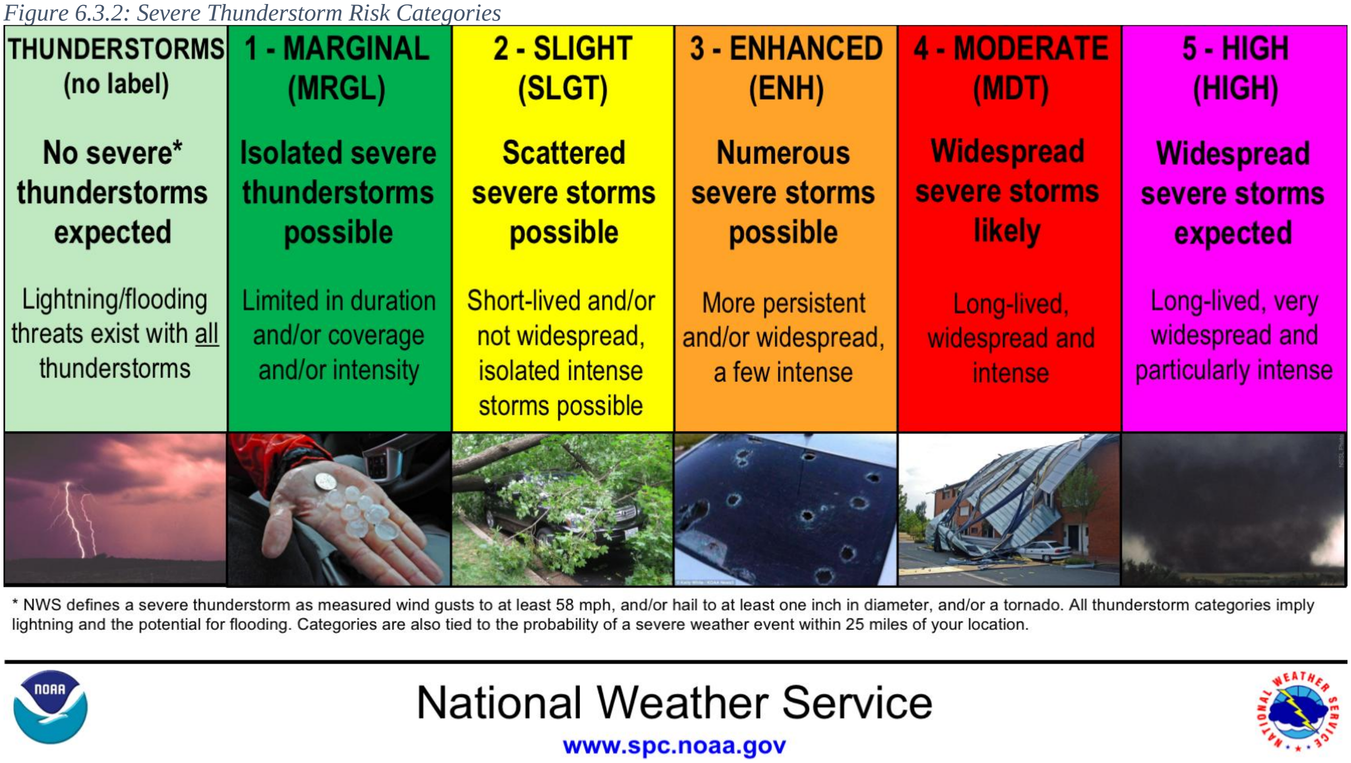
Figure 6.3.1: Annual Mean Thunderstorm Days (1993-2018)



Extent

Thunderstorm intensity can be measured by NWS and the Storm Prediction Center (SPC) of the NWS risk categories. The SPC issues Convective Outlooks that depict non-severe thunderstorm areas and severe thunderstorm threats across the contiguous United States, along with a text narrative. The categorical forecast specifies the level of the overall severe weather threat via numbers, descriptive labeling, and colors, as seen in the figure below. The probabilistic forecast directly expresses the best estimate of a severe weather event occurring within 25 miles of a given point.[63]

Figure 6.3.2: Severe Thunderstorm Risk Categories



Likewise, lightning intensity is measured by the NWS and defined as Lightning Threat Level. The NWS's "Lightning Hazard Map" depicts the local threat of lightning for specified areas. It is largely based on the likelihood that cloud-to-ground (CG) lightning from thunderstorms will occur combined with the anticipated flash rate. The hazard map depicts these likelihoods with varying colors along with a text narrative, as depicted in the table below[64].

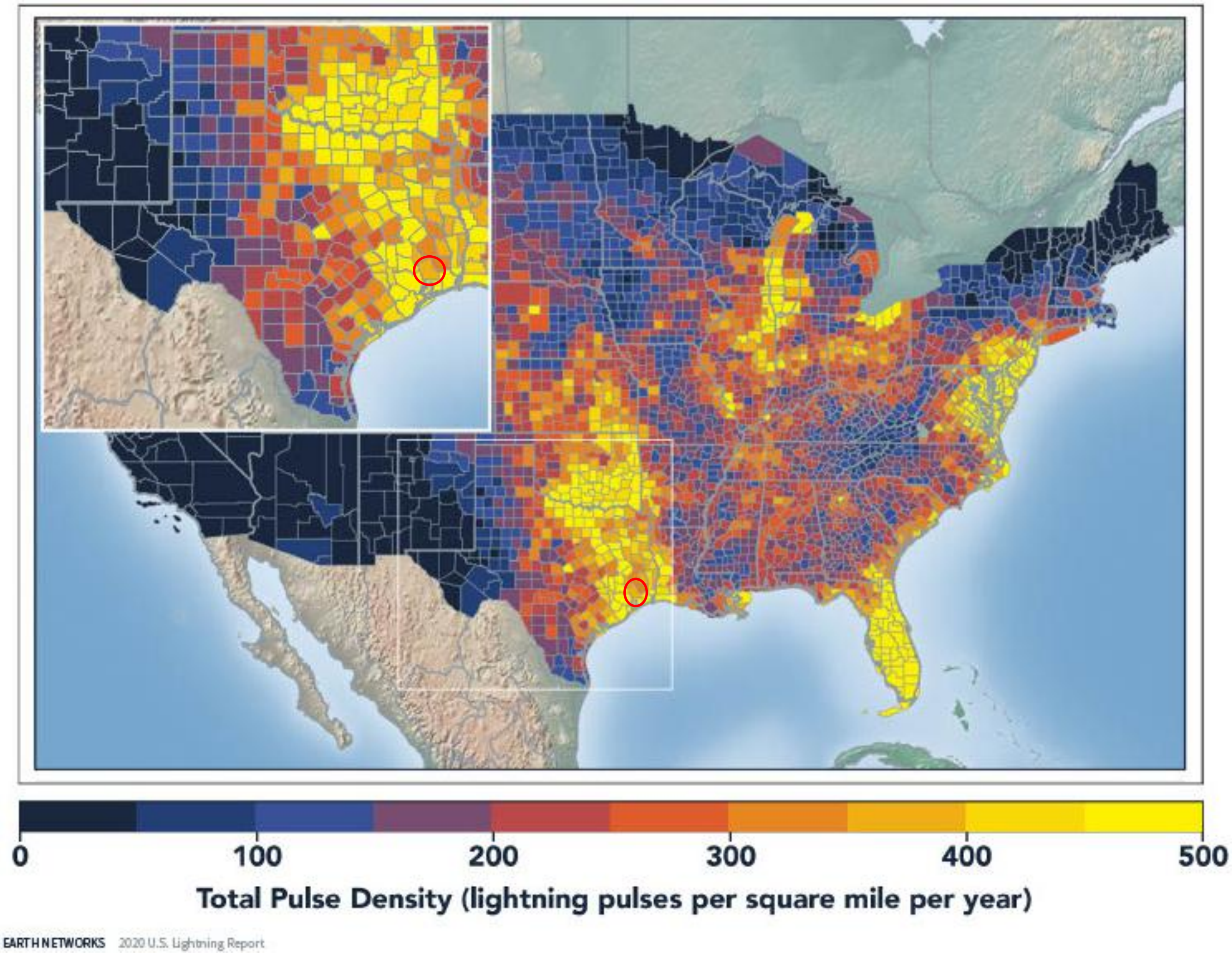
Table 6.3.3: NWS Lightning Threat Levels

Lightning Threat Level	Description
Extreme	**"An Extreme Threat to Life and Property from Lightning."** Within 12 miles of a location, a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of excessive CG lightning. AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a very high likelihood of CG lightning (or 80% to 90% thunderstorm probability), with storms capable of occasional CG lightning.
High	**"A High Threat to Life and Property from Lightning."** Within 12 miles of a location, a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of excessive CG lightning.

Lightning Threat Level	Description
	AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a high likelihood of CG lightning (or 60% to 70% thunderstorm probability), with storms capable of occasional CG lightning.
Moderate	**"A Moderate Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of excessive CG lightning. AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a moderate likelihood of CG lightning (or 50% thunderstorm probability), with storms capable of occasional CG lightning.
Low	**"A Low Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of frequent CG lightning. AND/OR...a low likelihood of CG lightning (or 30% to 40% thunderstorm probability), with storms capable of occasional CG lightning.
Very Low	**"A Very Low Threat to Life and Property from Lightning."** Within 12 miles of a location, a very low likelihood of CG lightning (or 10% to 20% thunderstorm probability), with storms capable of occasional CG lightning.
Non-Threatening	**"No Discernable Threat to Life and Property from Lightning."** Within 12 miles of a location, environmental conditions do not support CG lightning.
Note: With cloud-to-ground (CG) lightning, every strike is potentially lethal. • **Occasional- CG lightning at the rate of 1 to 3 flashes per minute (about 5 to 15 flashes per 5 minutes) associated with a given lightning storm.** • **Frequent- CG lightning at the rate of 4 to 11 flashes per minute (about 20 to 55 flashes per 5 minutes) associated with a given lightning storm.** • **Excessive- CG lightning rate of 12 flashes or more per minute (about 60 flashes or more per 5 minutes) and is nearly** continuously **associated with a given lightning storm.**	

According to Earth Networks 2020 Texas Lightning Report[65], Texas ranked #1 in total lightning pulses for 2020. Liberty County ranked 21 in lightning counts, with over 451,000 total for the year from both CG and intra-cloud pulses. This lightning report outlines pulse density (the total lightning divided by the area of the county in square miles), a better indicator of lightning activity than total lightning counts because it allows the comparison of different-sized areas (like states and counties). Pulses are clustered together into flashes. With every pulse detected, there is a more precise measure of lightning activity. In the figure below, areas in bright yellow experienced the highest lightning pulse density per square mile in 2020.[cx] Liberty County is outlined by the red circle. The county is ranked as one of the top 20 within Texas for the highest amount of thunder days (the total number of days in the year when lightning was detected by Earth Network's Total Lightning Network) at 119, with Harris County having the most thunder days, at 125 per year on average.

Figure 6.3.3: Total Pulse Density Map, Earth Networks



Previous occurrences of severe thunderstorms & lightning within the county and participating jurisdictions have seen long-lived and intense thunderstorms in the severe risk category with lightning threat levels of extreme, including frequent CG lightning at the rate of 4 to 11 flashes per minute. This is similar to what occurred during Hurricane Harvey in 2017. This event resulted in up to 14" of flooding, high-water rescues of stranded residents, dangerous outdoor conditions, roads and railroads washed out, and the destruction of critical facilities and infrastructure. A worst-case scenario for this hazard within Liberty County would include a prolonged heavy or excessive severe thunderstorm event that could produce straight-line winds up to 100 mph, strong F4 tornadoes, large baseball sized hail, and a lightning threat level of extreme with a very high likelihood of CG lightning (or 80% to 90% thunderstorm probability). This could result in dangerous and life-threatening record-level flooding, inundated roadways cutting off access to neighborhoods and critical facilities, debris cutting off access to utilities, wind gusts knocking down trees and powerlines, frequent or extreme CG lightning, and flood waters receding slowly exacerbating rescue and recovery efforts. These storms could damage critical infrastructure leading to a prolonged power outage and even result in a loss of communications within the county if a radio or cell tower is destroyed. If such a storm event occurs during an excessive heat event or a drought and disrupts power supply in the area for a prolonged amount of time, secondary hazards will pose increased risks to citizens due to the heat and inability to keep homes and buildings cool. This scenario is similar to what occurred within the region during the 2024 derecho that saw wind gusts of 100 mph within the City of Houston and 74+ mph near Liberty County. Similarly, during

Hurricane Beryl the maximum sustained winds were measured at 65 knots (74 mph) with gusts up to at least 84 knots (97 mph) and led to intense infrastructure damage; power lines were destroyed by winds and tree debris, in July, when the region was under an excessive heat advisory. Power restoration and infrastructure repairs took over 10+ days to restore in certain areas. This led to the multi-day activation of cooling centers across the county and the region.

Historic Occurrences

NOAA collects historic climate data for the nation. NOAA's storm event data can be accessed on the National Centers for Environmental Information (NCEI) Storm Events Database. A condensed version of the Liberty County severe thunderstorm & lightning events data from 2018-2023 is provided in the table below. In total, there were 131 reported thunderstorm events and 1 reported lightning event for Liberty County, per the NCEI Storm Events Database.[39]

Table 6.3.4: Liberty County Severe Thunderstorm and Lightning Events (2018-2023)

Date	Location	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)	Wind Speed (knots/mph)
4/18/2019	LIBERTY	Thunderstorm Wind	0	0	$4,000	$500	53/61
4/18/2019	DAISETTA	Thunderstorm Wind	0	0	15,000	0	54/62
7/30/2019	MOSS BLUFF	Thunderstorm Wind	0	0	0	$500	52/60
7/30/2019	CLEVELAND	Thunderstorm Wind	0	0	$10,000	0	52/60
4/19/2020	CLEVELAND	Thunderstorm Wind	0	0	$1,000	$3,000	56/64
5/18/2021	DEVERS	Thunderstorm Wind	0	0	0	0	50/57.5
6/8/2023	CLEVELAND MUNI ARPT	Thunderstorm Wind	0	0	0	0	50/57.5
3/21/2024	KENEFICK	Thunderstorm Wind	0	0	0	0	52/60
6/1/2024	DAYTON	Thunderstorm Wind	0	0	0	0	51/58
6/5/2024	DAYTON	Thunderstorm Wind	0	0	0	0	50/57.5
		TOTALS:	**0**	**0**	**$30,000**	**$4,000**	N/A

$- No dollar amount ($0.00).

Presidential Disaster Declarations

There have been 8 disaster declarations for severe storms within Liberty County as depicted in the table below. There were 0 disaster declarations for lightning.[2]

Table 6.3.5: Federal Disaster Declarations, Severe Thunderstorm

Declaration Date	Incident Type	Title	Disaster Number	Declaration Type
4/26/1979	Severe Storm	Severe Storms, Tornadoes & Flooding	580	Major Disaster Declaration
5/19/1989	Severe Storm	Severe Storms, Tornadoes & Flooding	828	Major Disaster Declaration
5/2/1990	Severe Storm	Severe Storms, Tornadoes & Flooding	863	Major Disaster Declaration
8/26/1998	Severe Storm	Tropical Storm Charley	1239	Major Disaster Declaration
11/5/2002	Severe Storm	Severe Storms, Tornadoes & Flooding	1439	Major Disaster Declaration
6/29/2007	Severe Storm	Severe Storms, Tornadoes & Flooding	1709	Major Disaster Declaration

Declaration Date	Incident Type	Title	Disaster Number	Declaration Type
5/29/2015	Severe Storm	Severe storms, tornadoes, straight-line winds, and flooding	4223	Major Disaster Declaration
11/25/2015	Severe Storm	Severe storms, tornadoes, straight-line winds, and flooding	4245	Major Disaster Declaration

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below. These declarations included USDA declarations for excessive rain. There was one USDA disaster declaration categorized under excessive rain, moisture, humidity.[40]

Table 6.3.6: USDA Declared Disasters (2018-2023), Severe Thunderstorm and Lightning

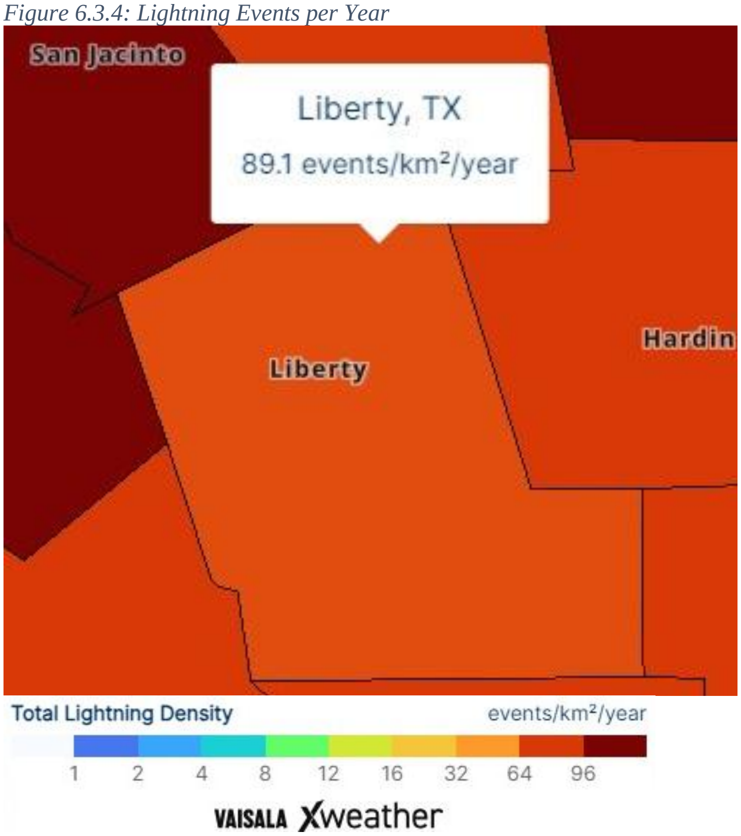
Crop Disaster Year	Disaster Description	Designation Number
2021	Excessive moisture	S5088

Probability of Future Occurrences

Severe thunderstorms and lightning are more likely to occur in summer months when temperatures are higher and moisture from the gulf helps to fuel thunderstorm development. According to the FEMA NRI, annualized frequency values for lightning in Liberty County are 111.3 events per year over a 22-year period of record (1991-2012), with 2,448 events on record for this timeframe. Severe thunderstorm is not included in the FEMA NRI, but it can be inferred that the probability of future occurrences will be the same as lightning.[43]

Additionally, the National Lightning Detection Network (NLDN) consists of over 100 remote, ground-based sensing stations located across the United States that instantaneously detect the electromagnetic signals given off when lightning strikes the earth's surface. These remote sensors send the raw data via a satellite-based communications network to the Network Control Center (NCC) operated by Vaisala Inc. in Tucson, Arizona. Within seconds of a lightning strike, the NCC's central analyzers process information on the location, time, and polarity, and communicate to users across the country. Through a partnership with Vaisala and a cooperative effort with the U.S. Air Force 14th Weather Squadron, summarized daily files from 1986 to the present are archived at the NOAA National Center for Environmental Information (NCEI). Through a contract with Vaisala, the raw data from NCEI is available only to government and military users. [66] Through the use of Vaisala's Interactive Global Lightning Density Map, Figure 6.3.3 shows the average number of lightning events per km2 per year for Liberty County. This interactive map utilizes data from 2016 to 2023.[67]

Figure 6.3.4: Lightning Events per Year



Populations at Risk

Populations at risk for severe thunderstorms and lightning include similar groups to those listed under Section 6.2 (Hurricanes, Tropical Storms, and Tropical Depressions) can bring some of the same hazards to vulnerable populations. Severe storms and lightning can cause property damage, flooding, lack of access to critical facilities that provide food, water, medications, or other forms of medical assistance, and lack of utilities such as electricity and clean water, which can increase the risk of illness. According to the NCHH, those at a greater risk from these hazards include older adults, children, people experiencing homelessness, people with disabilities, and people with chronic health conditions. Older adults, in addition to the dangers listed above, can also face social isolation, lack of electricity needed to run medical equipment, and lack of access to other critical supplies. In younger populations, such as children, severe storms can disrupt schooling via power outages, the need to shelter in place during the school-day, or even necessary evacuation or early-release days due to inclement weather. This can not only jeopardize their academic success, but it can also cause mental and emotional stress, as well as add stress to adults who work full-time and rely on schooling during normal work hours to keep children occupied and safe. Children are more vulnerable to certain medical conditions like asthma, lead poisoning, allergies, and bacterial infections which can be caused by the resulting flood damage and increased moisture of severe storms. For people experiencing homelessness, housing and adequate shelter are critical in keeping populations safe during these types of hazard events. People with disabilities may require additional assistance to stay safe and prepare for these hazards such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment.

Likewise, those with chronic health conditions may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to diseases or illnesses from standing water and increased exposure to these illnesses when utilizing a shelter or evacuation centers due to power outages or the resulting flooding.[44] People living in mobile homes are also at greater risk of injury and death from these hazards as even anchored mobile homes can be seriously damaged or destroyed when winds gust over 80 mph. [55]. Despite mobile homes providing a form of shelter, severe storms are the catalyst for strong winds and tornadoes.

Any areas of growth or future development within the county will increase the vulnerability of lives and property impacted by this hazard as it has no set geographic boundary. As mentioned above, those living in mobile/manufactured housing are at greater risk from this hazard. As the population within the county increases, so does the vulnerability of its residents.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below. The FEMA NRI does not include severe storms in its analysis.[44]

Table 6.3.7: Expected Annual Loss Exposure Values, Lightning

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Lightning	$10,266,884,211	$1,061,307,200,000/ 91,492	N/A	$1,071,574,084,211

Table 6.3.8: Expected Annual Loss Values, Lightning

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Lightning	$802	$1,153,075/ 0.10	N/A

N/A- Not Applicable

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.

Risk Index Ratings according to the FEMA NRI for lightning for these census tracts is listed as very high for 16 tracts and relatively high for 1 tract.[46] EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLR for lightning events within Liberty County is listed as relatively moderate.[45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.3.5: Risk Index Rating, Lightning

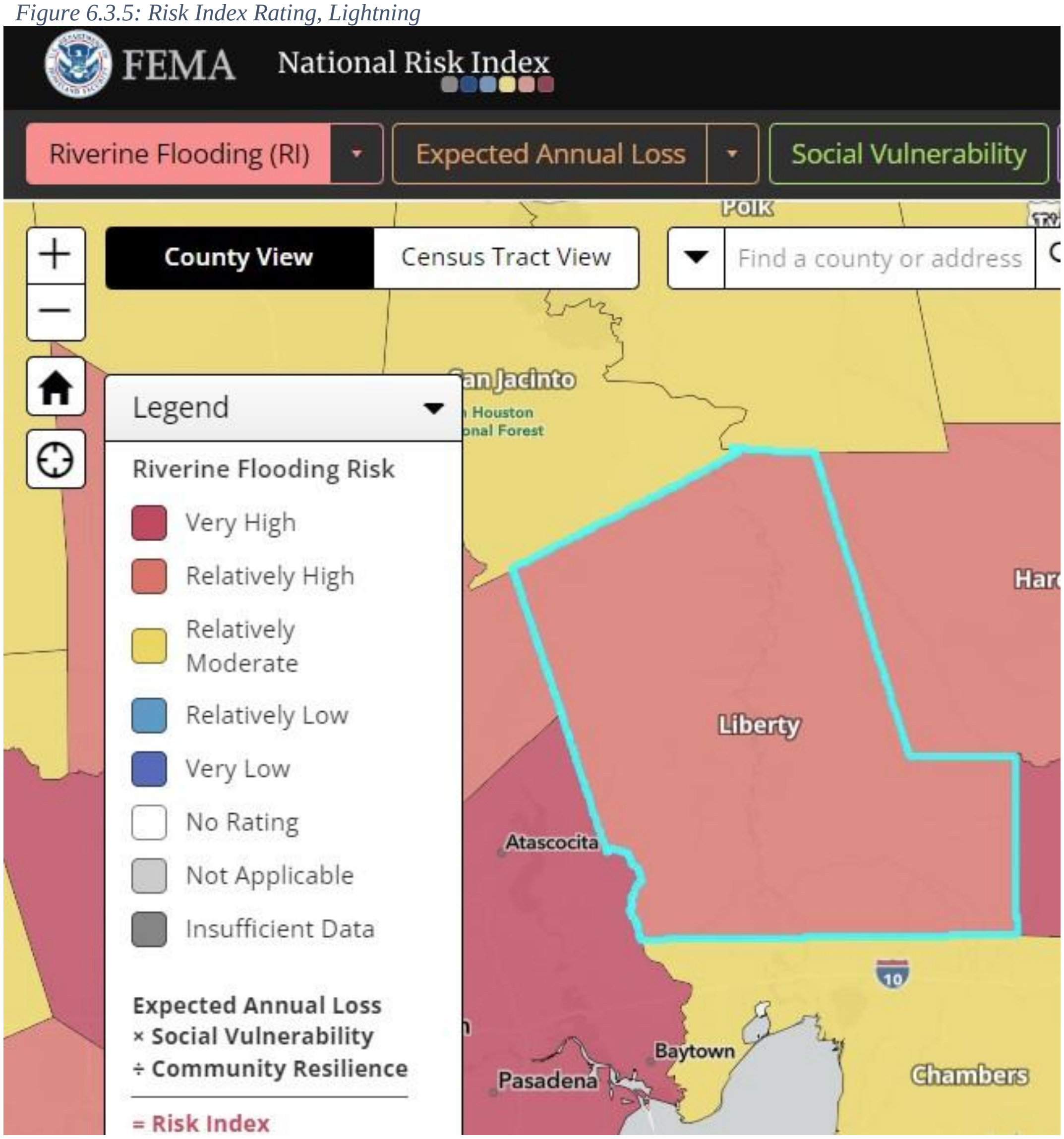


Figure 6.3.6: Risk Index by Census Tract, Liberty County, Lightning

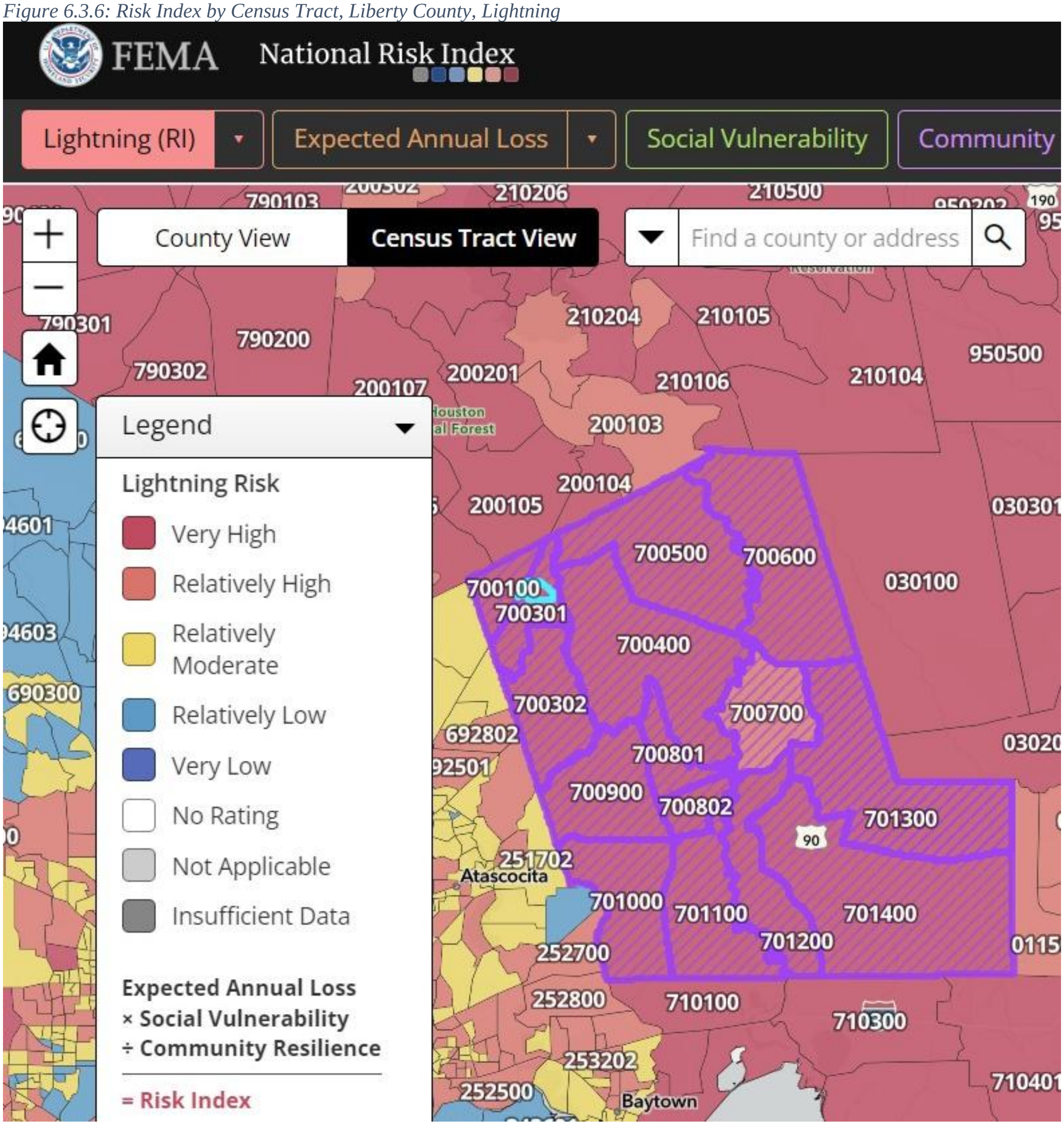


Figure 6.3.7: Social Vulnerability by Census Tract, Liberty County

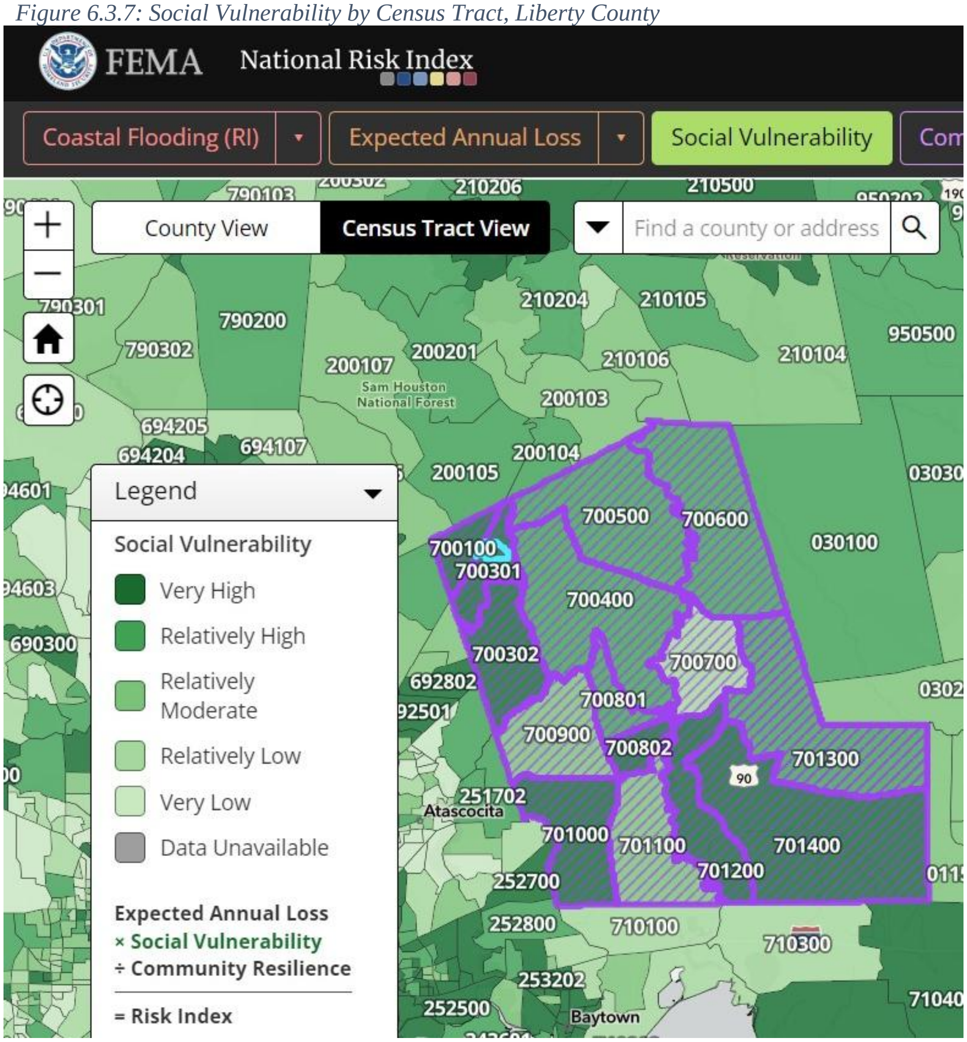


Figure 6.3.8: Social Vulnerability, Liberty County

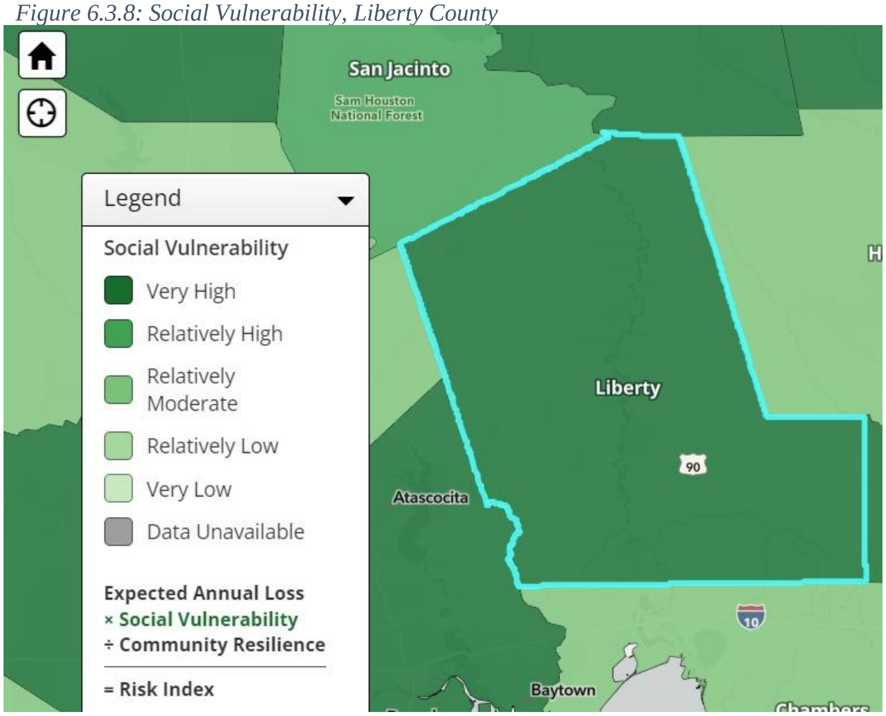


Figure 6.3.9: Community Resilience by Census Tract, Liberty County

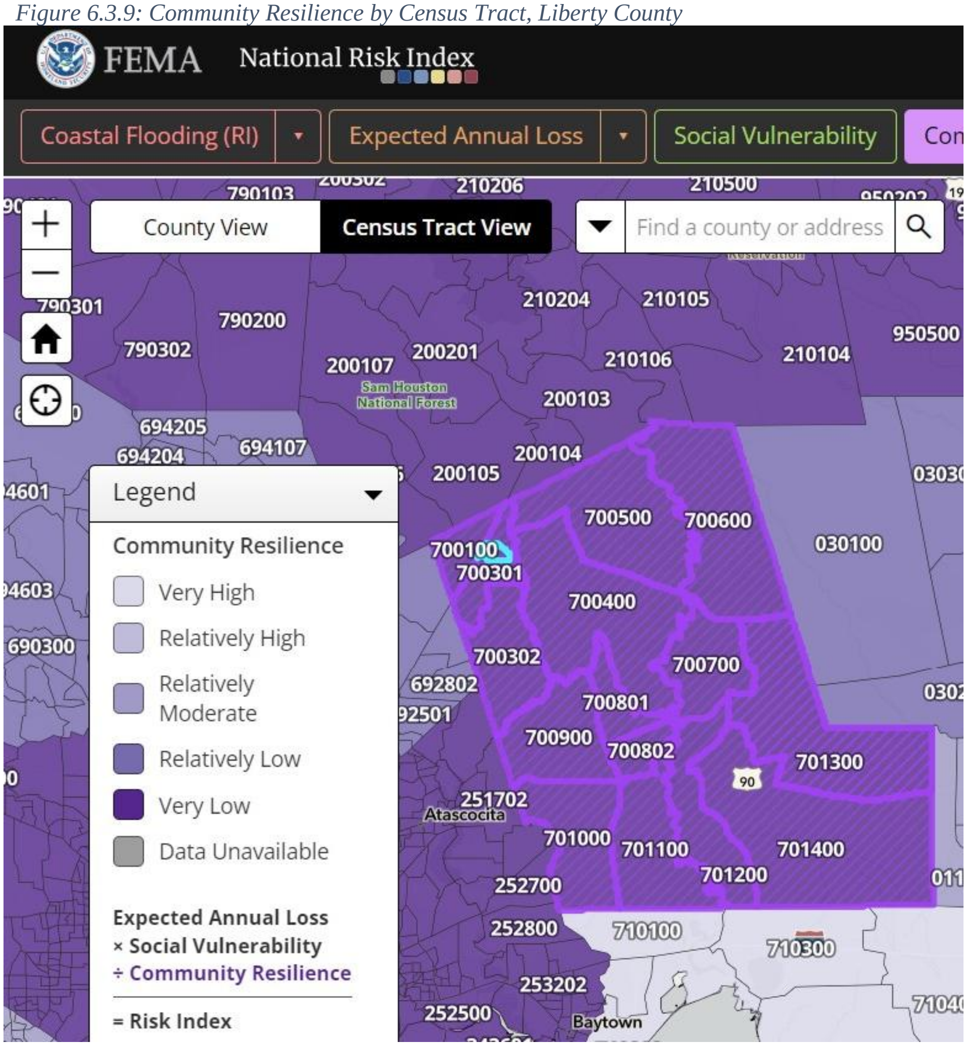


Figure 6.3.10: Community Resilience, Liberty County

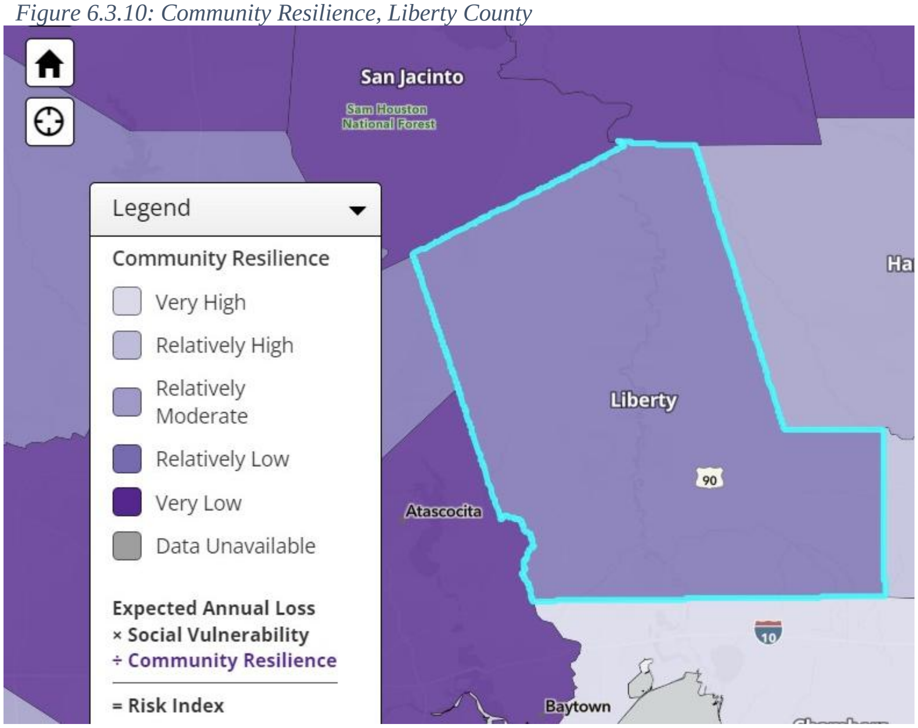


Figure 6.3.11: FEMA NRI Summary by Census Tract, Liberty County, Lightning

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Very High	99.99	0 100
2	Census tract 48291701000	TX	Very High	99.95	0 100
3	Census tract 48291701400	TX	Very High	99.9	0 100
4	Census tract 48291701200	TX	Very High	99.86	0 100
5	Census tract 48291700802	TX	Very High	99.84	0 100
6	Census tract 48291700400	TX	Very High	99.83	0 100
7	Census tract 48291701100	TX	Very High	99.76	0 100
8	Census tract 48291700900	TX	Very High	99.64	0 100
9	Census tract 48291700100	TX	Very High	99.59	0 100
10	Census tract 48291700301	TX	Very High	99.59	0 100
11	Census tract 48291700303	TX	Very High	98.96	0 100
12	Census tract 48291700801	TX	Very High	98.78	0 100
13	Census tract 48291700200	TX	Very High	98.48	0 100
14	Census tract 48291701300	TX	Very High	98.13	0 100
15	Census tract 48291700600	TX	Very High	95.83	0 100
16	Census tract 48291700500	TX	Very High	95.46	0 100
17	Census tract 48291700700	TX	Relatively High	91.96	0 100

Figure 6.3.12: FEMA NRI EAL Summary by Census Tract, Liberty County, Lightning

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$164,879	Very High	Very Low	1.53	$252,941	99.99
2	Census tract 48291701000	TX	$102,488	Very High	Very Low	1.64	$167,613	99.95
3	Census tract 48291701400	TX	$80,674	Very High	Very Low	1.72	$138,940	99.9
4	Census tract 48291701200	TX	$74,452	Very High	Very Low	1.75	$130,180	99.86
5	Census tract 48291700802	TX	$80,801	Very High	Very Low	1.55	$125,436	99.84
6	Census tract 48291700400	TX	$92,255	Relatively High	Very Low	1.35	$124,564	99.83
7	Census tract 48291701100	TX	$94,202	Relatively Moderate	Very Low	1.2	$112,683	99.76
8	Census tract 48291700900	TX	$84,837	Relatively Moderate	Very Low	1.19	$100,620	99.64
9	Census tract 48291700100	TX	$57,885	Very High	Very Low	1.65	$95,594	99.59
10	Census tract 48291700301	TX	$54,356	Very High	Very Low	1.75	$95,354	99.59
11	Census tract 48291700303	TX	$40,331	Very High	Very Low	1.81	$72,846	98.96
12	Census tract 48291700801	TX	$52,717	Relatively High	Very Low	1.3	$68,599	98.78
13	Census tract 48291700200	TX	$39,133	Very High	Very Low	1.63	$63,686	98.48
14	Census tract 48291701300	TX	$40,861	Relatively High	Very Low	1.45	$59,148	98.13
15	Census tract 48291700600	TX	$29,741	Relatively High	Very Low	1.43	$42,657	95.83
16	Census tract 48291700500	TX	$32,157	Relatively High	Very Low	1.27	$40,995	95.46
17	Census tract 48291700700	TX	$32,106	Relatively Low	Very Low	0.97	$31,189	91.96

Climate Change Impacts

According to the Office of the Texas State Climatologist, the climate data record for severe thunderstorms is poor and severe thunderstorms are too small to be simulated directly by present-day climate models. Over the past few decades, the severe storm environment over Texas has changed in complex and opposing ways. The amount of energy available for convection has decreased, and the amount of energy needed to initiate convection has increased at the same time. This suggests that environmental conditions have become less favorable for the occurrence of thunderstorms. However, the amount of low-level shear has increased, which would be expected to make thunderstorms more likely to become severe once they develop.

Changes in severe storm environments have not been uniform throughout the year, with environments becoming more favorable for severe thunderstorms and significant hail in Texas early in the spring and less favorable later in the spring. Lightning occurs most often during the months of May and June. Climate model simulations imply different prospects going forward. As temperatures increase, the amount of energy available to fuel these storms is simulated to increase as temperature and low-level moisture increase. This results in an overall increase in the number of days capable of producing severe thunderstorms. With these complex trends and partially contradictory information between models and observations, there is low confidence in any ongoing trend in the overall frequency and severity of severe thunderstorms.[47]

Table 6.3.9: Climate Change Impacts, Severe Thunderstorm and Lightning

Location	The location of severe thunderstorms and lightning is not expected to change.
Extent/Intensity	The extent and intensity of severe thunderstorms and lightning within the county may change (increase) due to increased temperatures and energy available to fuel severe thunderstorm development and the accompanying lightning.
Frequency	There are no clear trends in severe thunderstorms and lightning frequency due to considerable variability in conditions that lead to them occurring. However, these hazards occur most frequently in warmer months, around May and June.
Duration	The duration of severe thunderstorms and lightning events is not likely to change, however the intensity of them is expected to increase due to rising temperatures and the proximity of the County to the Gulf of Mexico.

Section 6.4: Extreme Heat

6.4 Extreme Heat

Heat events, or extreme heat, are defined by the CDC as summertime temperatures that are much hotter and/or humid than average.[68] The US Department of Homeland Security's Ready.gov website takes this definition a step further by defining extreme heat as "a period of high heat and humidity with temperatures above 90°F for at least two to three days." Among all weather-related hazards, extreme heat is responsible for the highest annual deaths as the body must work extra hard to maintain a normal temperature.[69] Heat-related illnesses, like heat exhaustion or heat stroke, happen when the body is not able to properly cool itself. While the body normally cools itself by sweating, during extreme heat, this might not be enough. In these cases, a person's body temperature rises faster than it can cool down. This can cause damage to the brain and other vital organs. The table below provides classifications of various heat-related NWS warnings and watches for extreme heat.[70]

Table 6.4.1: NWS Heat-Related Watches and Warnings

Name	Definition
Excessive Heat Outlook	**Be Aware!** The outlooks are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead-time to prepare for the event.
Excessive Heat Watch	**Be Prepared!** Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
Excessive Heat Warning	**Take Action!** An Excessive Heat Warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Warning is when the maximum heat index temperature is expected to be 105°F or higher for at least 2 days and nighttime air temperatures will not drop below 75°F; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. If you don't take precautions immediately when conditions are extreme, you may become seriously ill or even die.
Heat Advisory	**Take Action!** A Heat Advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Advisory is when the maximum heat index temperature is expected to be 100°F or higher for at least 2 days, and nighttime air temperatures will not drop below 75°F; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. If you don't take precautions, you may become seriously ill or even die.

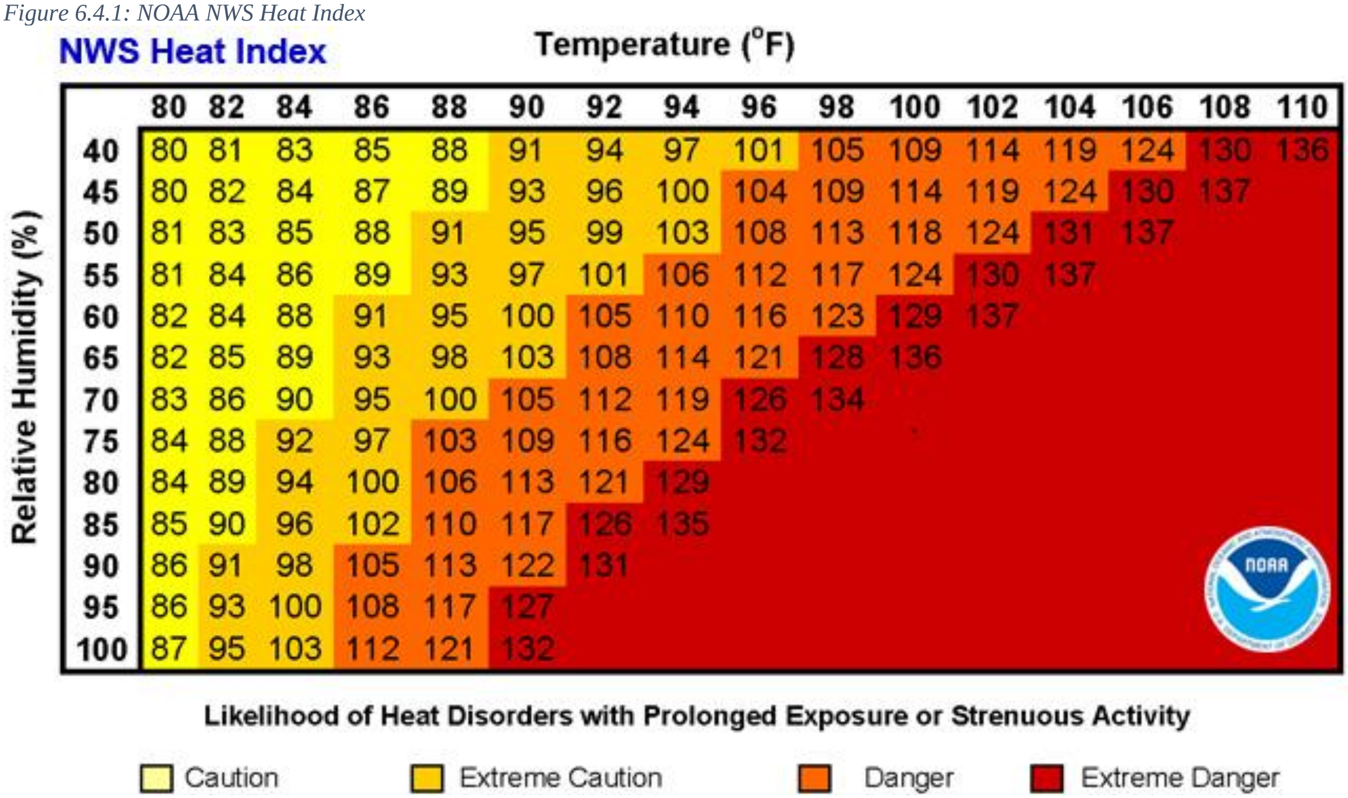
Location

The risk of an extreme heat event occurring applies the same to the entire county. Liberty County experiences the highest temperatures in the months of June to August, with average temperatures between 90°F and 100°F degrees. In more developed areas, the "urban heat island" effect (increased air temperatures in urban areas in contrast to cooler surrounding rural areas.) can occur due to higher concentrations of buildings and pavement. These materials absorb more heat during the day and radiate it at night, prohibiting temperatures from cooling as much compared to rural areas.[71]

Extent

The intensity of heat and extreme heat events are measured by temperature and humidity. NOAA's heat index or the "Apparent Temperature" is an accurate measure of how hot it feels when the relative humidity is added to the actual air temperature. The figure below outlines the NOAA NWS heat index for shaded areas. In direct sunlight, these heat index values can be increased by up to 15°F. At temperatures over 103°F dangerous heat disorders can begin with prolonged exposure to the heat or increased physical activity in the heat.[72] Hazards from extreme heat are made worse when accompanied by high levels of humidity. As the temperature rises, the air can hold more moisture. High humidity hinders a person's body from cooling down naturally, leading people to perceive that the temperature feels hotter. This combination of temperature and humidity is known as the heat index. The figure below outlines the NOAA NWS heat index for shaded areas. In direct sunlight, these heat index values can be increased by up to 15°F. At temperatures over 103°F dangerous heat disorders can begin with prolonged exposure to the heat or increased physical activity in the heat.79F[lxxix]

Figure 6.4.1: NOAA NWS Heat Index



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

The table below outlines various effects on the body in relation to the heat index and associated temperature from the figure above.

Table 6.4.2: Heat Index

Color	Heat Index	Classification	Effect on the body
	Caution	80°F - 90°F	Fatigue possible with prolonged exposure and/or physical activity
	Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
	Danger	103°F - 124°F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
	Extreme Danger	125°F or higher	Heat stroke highly likely

A worst-case scenario for this hazard would include prolonged periods of increased temperatures and humidity resulting in a heat index rating of danger or extreme danger, and excessive heat warnings being issued (maximum heat index values of 113F or above or maximum temperatures of 105 or above). A loss of power from the increased demands placed on the power grid due to increased usage of air conditioning as people attempt to stay cool. If the heat event lasts several days or more, secondary hazards associated with extreme heat can also become a concern, such as poor air quality, loss of life, and drought.

Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCDC storm events database. Liberty County heat events data from 1950-2023 is provided in the table below. There are 20 events in total, with the earliest event recorded taking place in 1999.[39] The previous *14* occurrences of heat or excessive heat all occurred within the last year, 2023.

Table 6.4.3: Heat Events (1950-2023)

Event Date	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
6/26/1999	Heat	0	0	$-	$-
8/1/1999	Heat	0	0	$-	$-
7/6/2000	Heat	0	0	$-	$-
8/29/2000	Heat	0	0	$-	$-
9/1/2000	Heat	0	0	$-	$-
6/24/2009	Heat	0	0	$-	$-
6/16/2023	Excessive Heat	0	0	$-	$-
6/16/2023	Excessive Heat	0	0	$-	$-
6/25/2023	Excessive Heat	0	0	$-	$-
6/25/2023	Excessive Heat	0	0	$-	$-
7/12/2023	Excessive Heat	0	0	$-	$-
7/12/2023	Excessive Heat	0	0	$-	$-
7/31/2023	Excessive Heat	0	0	$-	$-
7/31/2023	Excessive Heat	0	0	$-	$-
8/5/2023	Excessive Heat	0	0	$-	$-
8/5/2023	Excessive Heat	0	0	$-	$-
8/23/2023	Excessive Heat	0	0	$-	$-
8/23/2023	Excessive Heat	0	0	$-	$-
9/5/2023	Heat	0	0	$-	$-
9/5/2023	Heat	0	0	$-	$-

$- No dollar amount ($0.00)

Presidential Disaster Declarations

There have been no federally declared heat or extreme heat disaster declarations in Liberty County since 1950.[2]

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor’s authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below.[40]

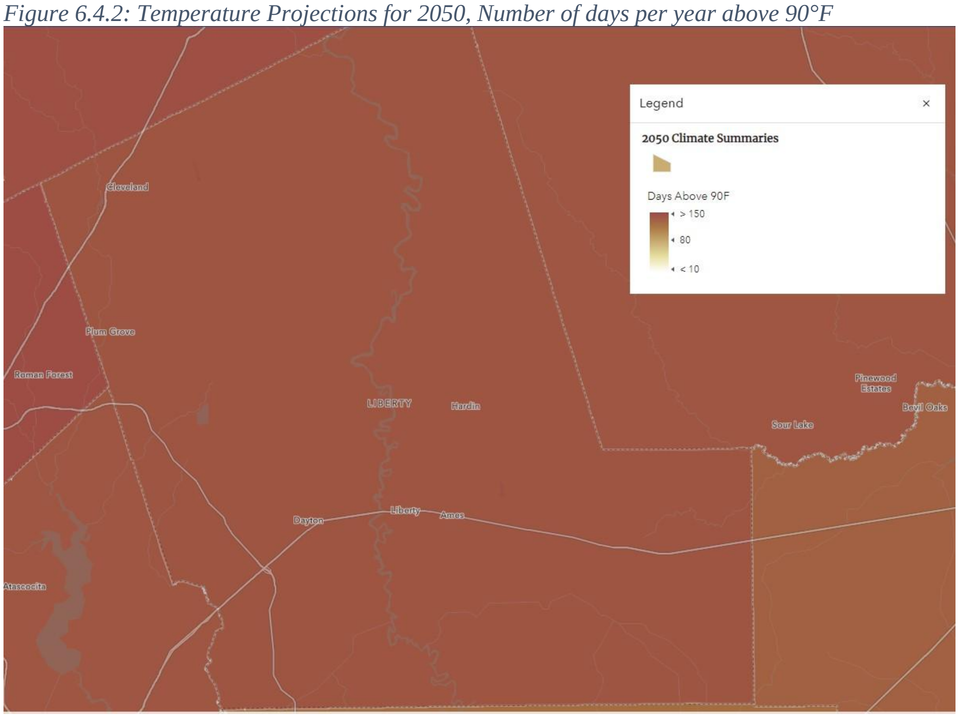
Table 6.4.4: USDA Declared Disasters (2018-2023), Extreme Heat

Crop Disaster Year	Disaster Description	Designation Number
2023	Excessive Heat and Drought	S5569

Probability of Future Occurrences

The State of Texas HMP estimates the occurrence of extreme heat and heat events is trending upward, with a 600.5% increase in the 5-year planning cycle between 2017-2021.[40] According to the FEMA NRI for heat waves in Liberty County annualized frequency values are 0.0 events per year over a 16-year period of record (2005-2021), with 0 events on record for this timeframe.[43,75] This may change in the near future as NRI data is updated and more recent heat events that have occurred within the county occurred after the reporting period used by the NRI. Additionally, as seen in the figures below, projections for the number of days per year above 90°F, and the number of days per year warmer than the top 1% historically, have both increased since previous reporting periods. These projections are expected to increase further by 2050.[73]

Figure 6.4.2: Temperature Projections for 2050, Number of days per year above 90°F



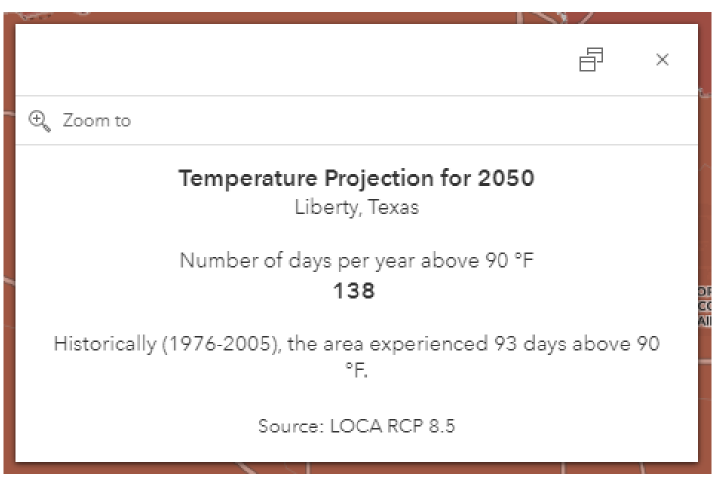
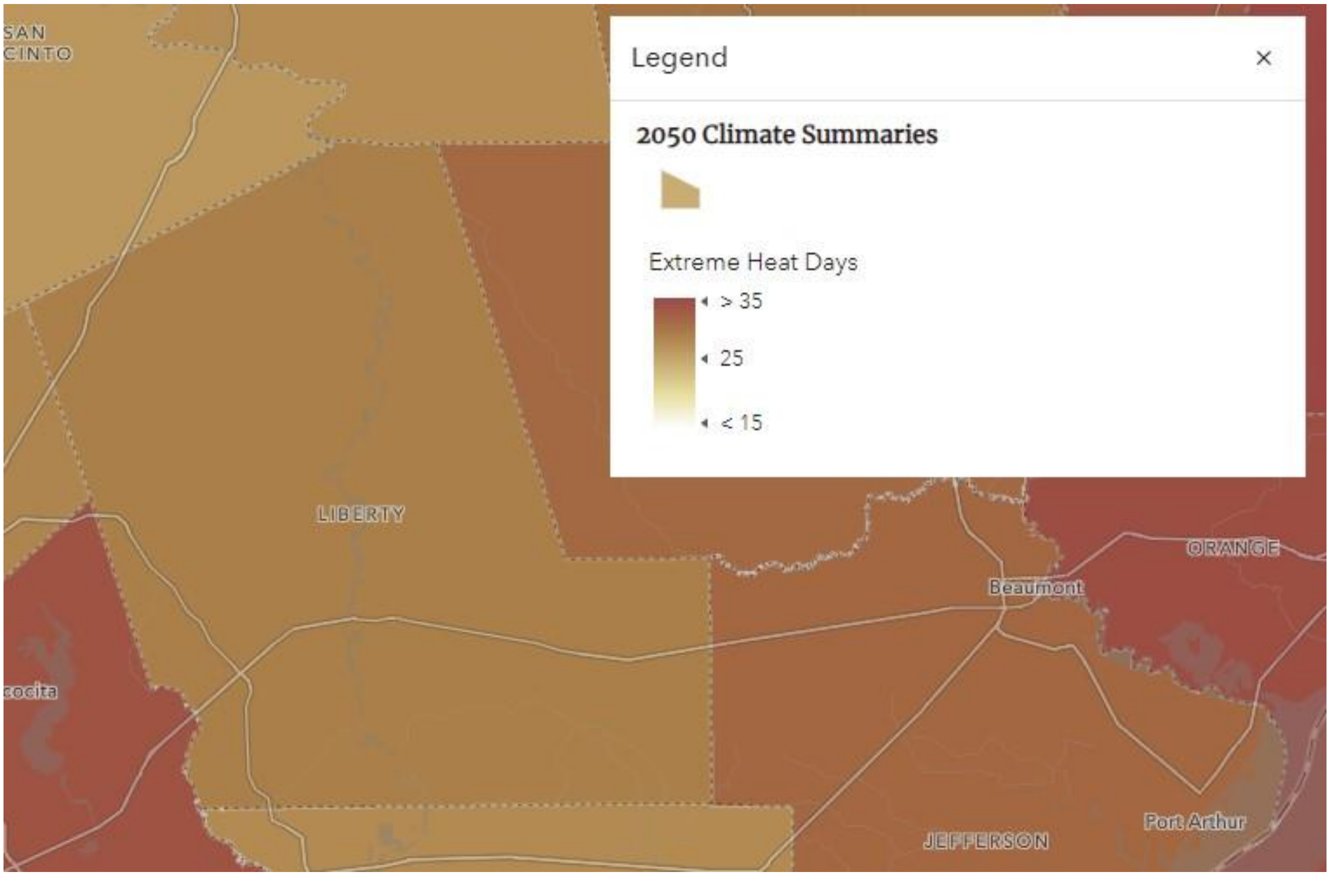
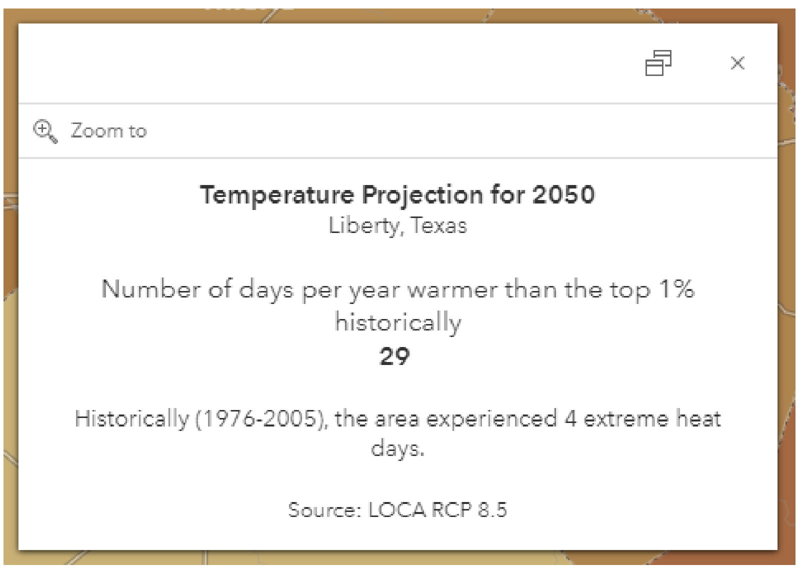


Figure 6.4.3: Temperature Projection for 2050, Number of days per year warmer than the top 1% historically


SAN
CINTO
LIBERTY
cocita
Beaumont
ORANGE
JEFFERSON
Port Arthur
Legend
2050 Climate Summaries
Extreme Heat Days
> 35
25
< 15


Zoom to
Temperature Projection for 2050
Liberty, Texas
Number of days per year warmer than the top 1% historically
29
Historically (1976-2005), the area experienced 4 extreme heat days.
Source: LOCA RCP 8.5

Populations at Risk

While heat events have the potential to damage buildings and crops, vulnerable populations are most at risk in the county during these events. The National Integrated Heat Health Information System lists those most at risk for extreme heat as older/elderly adults, children, athletes, pregnant people, people with disabilities, people with chronic health conditions/pre-existing conditions, homeless populations, emergency responders, pets and service animals, and outdoor/indoor workers. High temperatures can cause stress on the body which exacerbates respiratory and cardiovascular diseases, diabetes, and renal disease. Some medical conditions, such as obesity and heart disease, increase people's sensitivity to heat, putting them at greater risk of heat illnesses. In addition, some medications (such as some antidepressants, diuretics, and beta-blockers) taken for a chronic illness may increase an individual's sensitivity to heat by interfering with the body's ability to regulate temperature, fluids, or electrolytes.

In older populations, health conditions like cardiovascular issues can be exacerbated by extreme heat. During power outages that may occur during peak heat hours of the day, older populations may be disproportionately affected if they require access to life-sustaining devices. Older adults and children are more vulnerable to this hazard because they are unable to thermoregulate. Children also play outside often which exposes them to the same risks due to the combination of exposure and exertion. Athletes are similar in their risk as outdoor activities, sometimes while wearing protective gear, in combination with exposure and exertion will trap heat. As athletes are expected to push themselves physically, the line between acceptable levels of exertion and dangerous levels of exertion during heat may be blurred. Those who are pregnant are more vulnerable to this hazard due to a general increase in their core body temperature regardless of the air temperature, but also because extreme heat events can increase the likelihood of common challenges during pregnancy (excessive sweating and heat rash). Extreme heat also poses health risks for pregnant people and the developing fetus. There is increasing evidence that extreme heat can increase the risk of preterm birth, low birth weight, fetal death, and infant mortality.

Homeless populations are more at risk of this hazard as they may face significant stress due to their living conditions, insomnia due to poor sleeping arrangements, and lack of food or spoiled food, which also contributes to a higher risk for heat-related illness and death. Additionally, they may not seek medical treatment during a heat event due to distance, lack of access to transportation, and lack of financial resources. Their access to cooling centers or shelters may be limited due to distance and lack of transportation, building hours of access, stigma, and several other factors. People who live in rural areas may have even less access to these resources and services. If the temperature at night remains high, homeless populations are further at risk as the body will be unable to cool itself off. Emergency responders are at a greater risk due to their often heavy and bulky equipment that can trap heat it, like firefighters. Pets and service animals have differing thermoneutral zones depending on their age, size, and breed. Pets and service animals have a higher metabolic rate which makes them more vulnerable to this hazard. Service animals also face the added risk of burning their paw pads as paved surfaces become hot during a heat wave. Those who work outdoors, or indoors without access to air conditioning are also at a higher risk for heat-related illnesses. Most often these jobs require a level of physical exertion and exposure and can also require personal protective clothing that can trap heat and prevent cooling. Workers may also not have access to water and shade.[74]

The vulnerability of communities to this hazard increases with the addition of impervious pavement from any future developments, especially new developments or impervious surface areas occurring in urban areas. The heat island effect will become more prominent in these areas of the county.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below.[45]

Table 6.4.5: Expected Annual Loss Exposure Values, Heat Wave

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Heat Wave	N/A	N/A	N/A	N/A

Table 6.4.6: Expected Annual Loss Values, Heat Wave

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Heat Wave	N/A	N/A	N/A

N/A- Not Applicable (No Rating)

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.

EAL according to the FEMA NRI for heat events within these census tracts is listed as very low for the 4 most southern census tracts. All remaining census tracts have no rating for this hazard.[46] Within the FEMA NRI Technical Documentation it is noted that the periods of record vary across hazard types and risk components with the most recent source datasets including a period of record up to 2022.[75] Since a majority of recent drought and heat-related risks to the county and participating jurisdictions took place in 2023, these ratings, EAL values, and risk scores may increase as data is updated within the NRI.

EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for heat events within Liberty County the HLR is listed as relatively high.

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[45]

Figure 6.4.4: Risk Index, Liberty County, Heat Wave

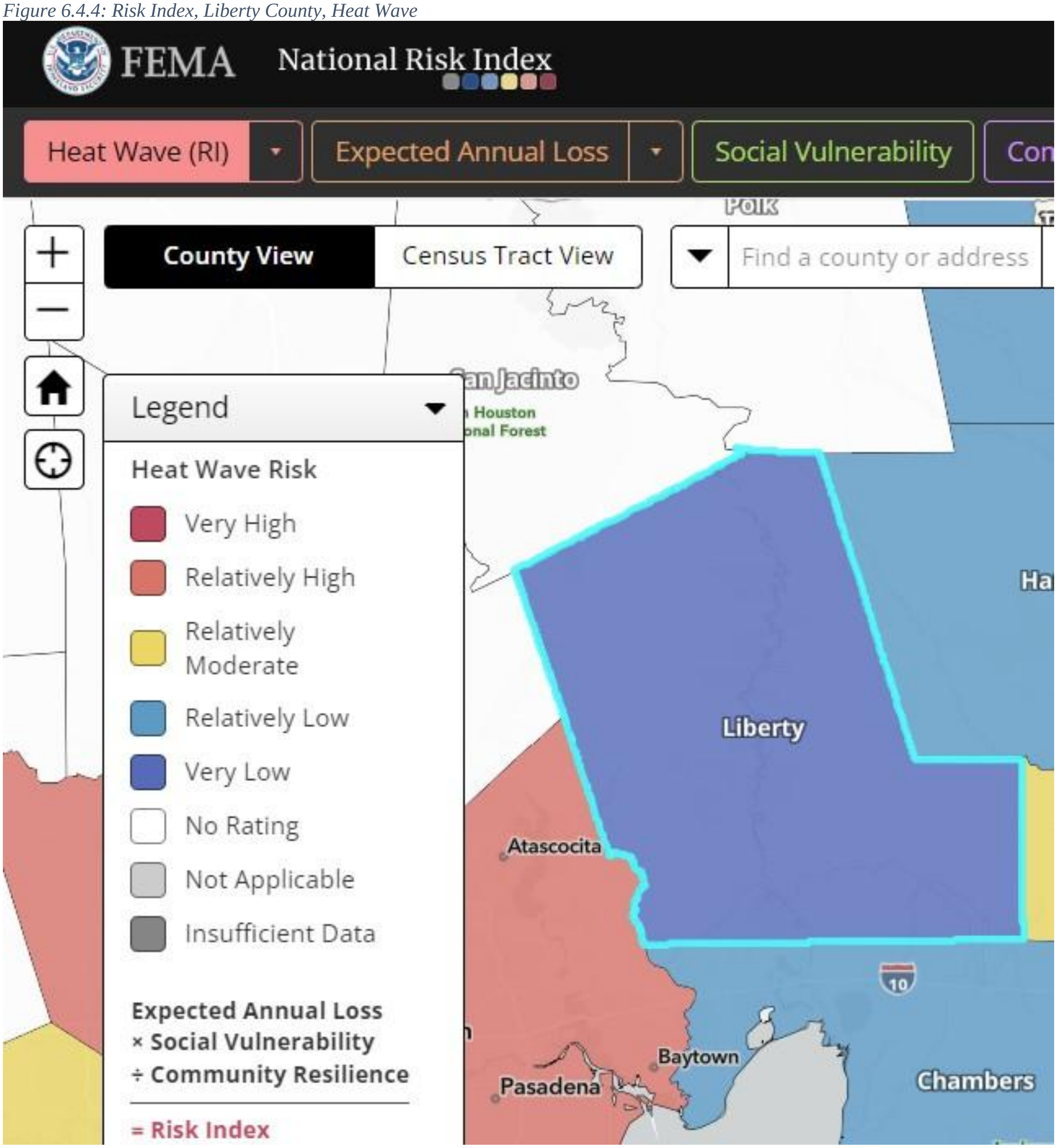


Figure 6.4.5: Risk Index by Census Tract, Liberty County, Heat Wave

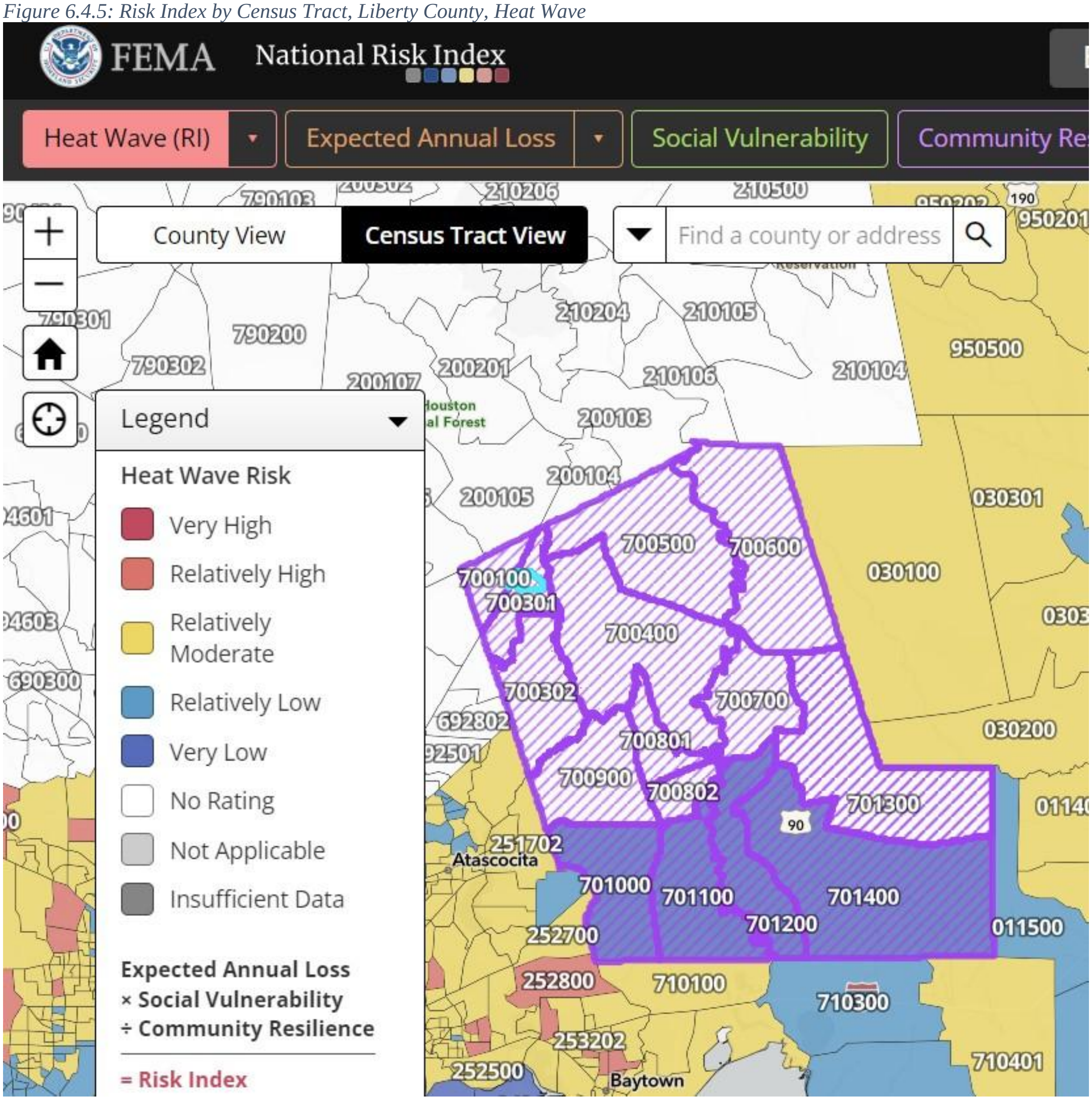


Figure 6.4.6: Social Vulnerability by Census Tract, Liberty County

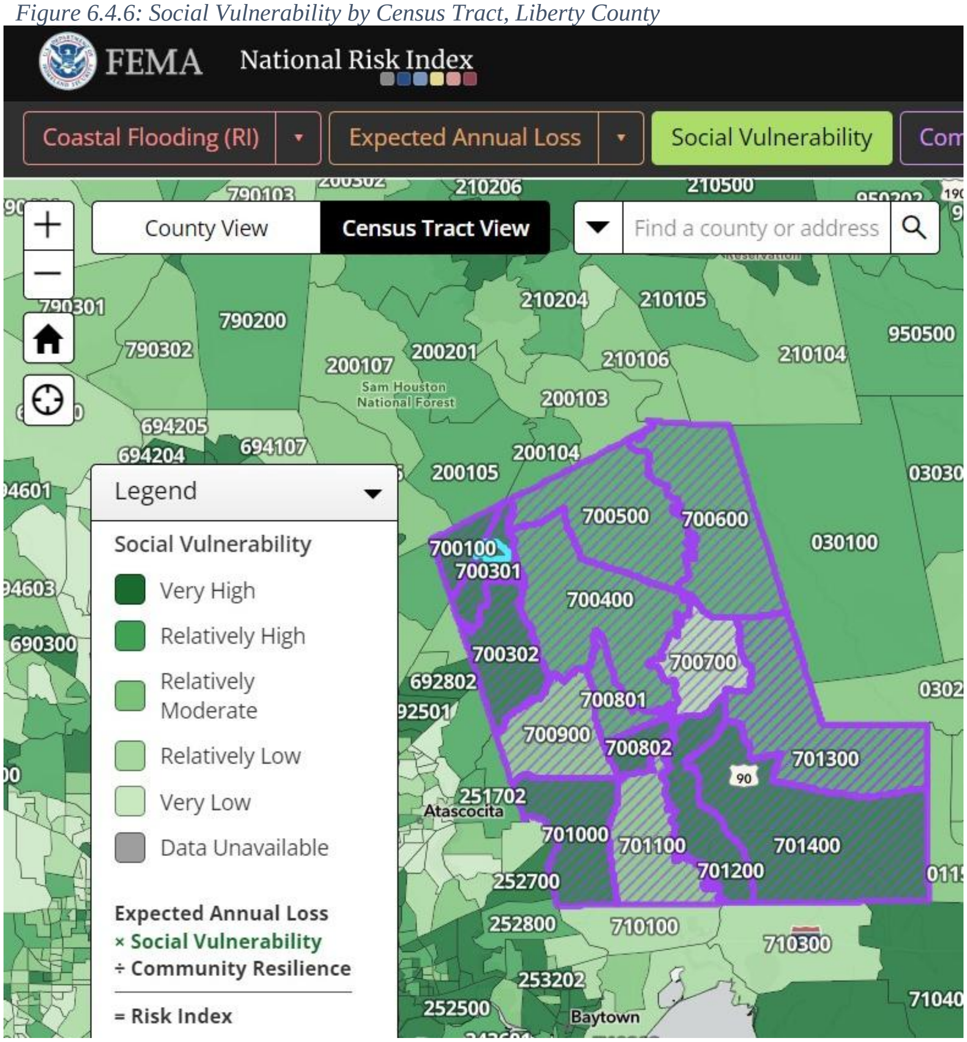


Figure 6.4.7: Social Vulnerability, Liberty County

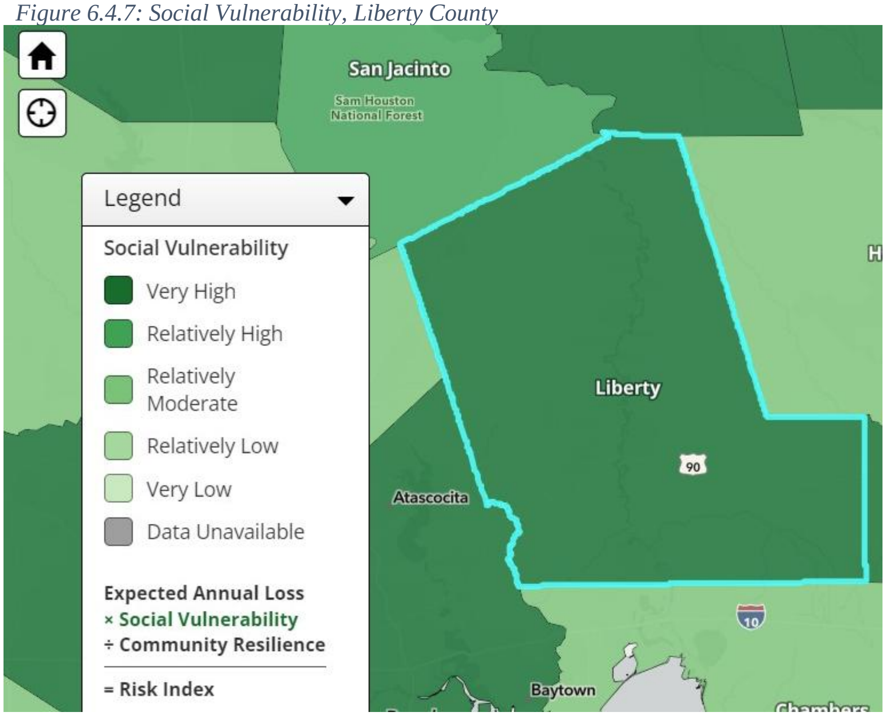


Figure 6.4.8: Community Resilience by Census Tract, Liberty County

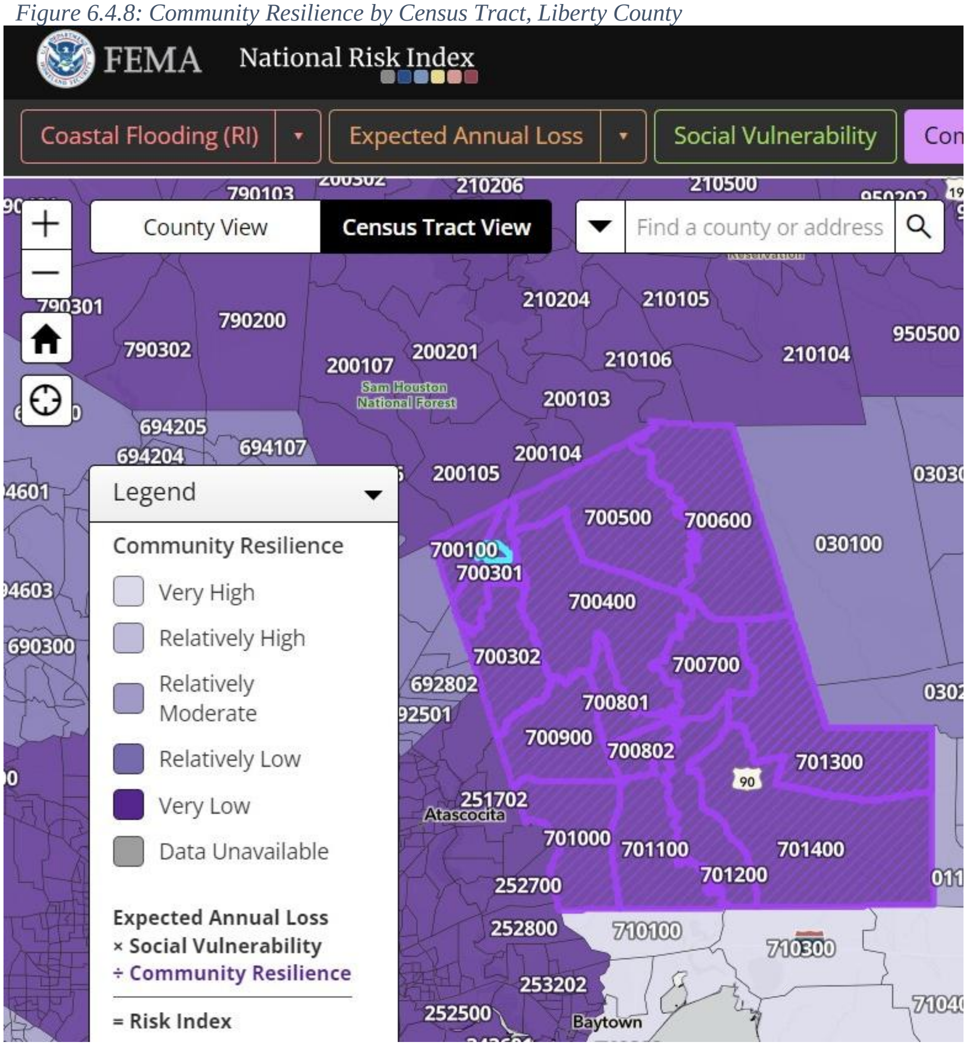


Figure 6.4.9: Community Resilience, Liberty County

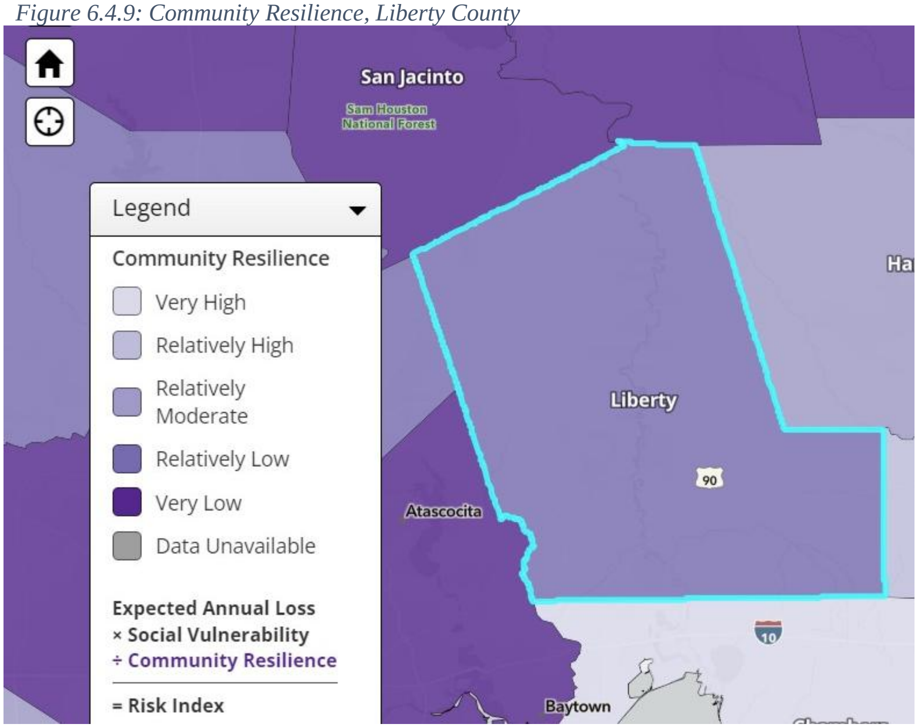


Figure 6.4.10: FEMA NRI Summary by Census Tract, Liberty County, Heat Wave

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291701000	TX	Very Low	15.76	0 100
2	Census tract 48291701100	TX	Very Low	15.51	0 100
3	Census tract 48291701400	TX	Very Low	15.5	0 100
4	Census tract 48291701200	TX	Very Low	15.41	0 100
	Census tract 48291700100	TX	No Rating	0	0 100
	Census tract 48291700200	TX	No Rating	0	0 100
	Census tract 48291700301	TX	No Rating	0	0 100
	Census tract 48291700302	TX	No Rating	0	0 100
	Census tract 48291700303	TX	No Rating	0	0 100
	Census tract 48291700400	TX	No Rating	0	0 100
	Census tract 48291700500	TX	No Rating	0	0 100
	Census tract 48291700600	TX	No Rating	0	0 100
	Census tract 48291700700	TX	No Rating	0	0 100
	Census tract 48291700801	TX	No Rating	0	0 100
	Census tract 48291700802	TX	No Rating	0	0 100
	Census tract 48291700900	TX	No Rating	0	0 100
	Census tract 48291701300	TX	No Rating	0	0 100

Figure 6.4.11: FEMA NRI EAL Summary by Census Tract, Liberty County, Heat Wave

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291701000	TX	$4	Very High	Very Low	1.64	$6	15.76
2	Census tract 48291701100	TX	$0	Relatively Moderate	Very Low	1.2	$0	15.51
3	Census tract 48291701400	TX	$0	Very High	Very Low	1.72	$0	15.5
4	Census tract 48291701200	TX	$0	Very High	Very Low	1.75	$0	15.41
	Census tract 48291700100	TX	$0	Very High	Very Low	1.65	$0	0
	Census tract 48291700200	TX	$0	Very High	Very Low	1.63	$0	0
	Census tract 48291700301	TX	$0	Very High	Very Low	1.75	$0	0
	Census tract 48291700302	TX	$0	Very High	Very Low	1.53	$0	0
	Census tract 48291700303	TX	$0	Very High	Very Low	1.81	$0	0
	Census tract 48291700400	TX	$0	Relatively High	Very Low	1.35	$0	0
	Census tract 48291700500	TX	$0	Relatively High	Very Low	1.27	$0	0
	Census tract 48291700600	TX	$0	Relatively High	Very Low	1.43	$0	0
	Census tract 48291700700	TX	$0	Relatively Low	Very Low	0.97	$0	0
	Census tract 48291700801	TX	$0	Relatively High	Very Low	1.3	$0	0
	Census tract 48291700802	TX	$0	Very High	Very Low	1.55	$0	0
	Census tract 48291700900	TX	$0	Relatively Moderate	Very Low	1.19	$0	0
	Census tract 48291701300	TX	$0	Relatively High	Very Low	1.45	$0	0

Climate Change Impacts

According to the Office of the Texas State Climatologist, extreme heat has recently become more frequent and more severe. For example, extreme summer heat is approaching values not seen since the early part of the 20th Century and is likely to surpass those numbers by 2036. The typical number of triple-digit days by 2036 is projected to be substantially larger, about 40%, than typical values so far in the 21st Century.[47] Additionally, with an increase in development and impervious pavement in areas the heat island effect will become more prominent in urban areas of the county. The fourth national climate assessment, an authoritative assessment of the science of climate change with a focus on the United States, notes that the annual average temperature over the contiguous U.S. increased by 1.2°F over the period 1986–2016 relative to 1901–1960. The frequency of heat waves has increased since the mid-1960s. Climate projections indicate that extreme heat events will be more frequent and intense in the coming decades.[75]

Table 6.4.7: Climate Change Impacts Summary, Extreme Heat

Location	The location of extreme heat and heat events are expected to increase in urban areas of the county.
Extent/Intensity	The extent and intensity of extreme heat and heat events are expected to increase.
Frequency	The frequency of extreme heat and heat events is expected to increase.
Duration	The duration of extreme heat and heat events is expected to increase.

Section 6.5: Dam/Levee Failure

6.5 Dam/Levee Failure

A dam failure is defined as the systematic failure of a dam structure resulting in the uncontrolled release of water, often resulting in floods that could exceed the 100-year floodplain boundaries. Dam failures can be catastrophic due to the energy of the water stored behind the dam being capable of causing rapid and unexpected flooding downstream and immense destruction resulting in loss of life and substantial property damage. There are four major causes of dam failures, as outlined in Table 6.5.1 below.[76]

Table 6.5.1: Dam Failure Causes

Dam Failure Cause	Description
Overtopping	These failures occur because of poor spillway design, leading to a reservoir filling too high with water, especially in times of heavy rainfall.
Foundation Defects	These failures occur because of settling in the foundation of the dam, instability of slopes surrounding the dam, uplift pressures, and seepage around the foundation. All of these failures result in structural instability and potential dam failure.
Piping and Seepage Failures	These failures occur because of internal erosion caused by seepage and erosion along hydraulic structures such as the spillways. Erosion due to animal burrows and/or cracks in the dam structure contribute to these types of failures.
Conduit and Valve Failures	These failures occur as a result of problems with values and conduits.

A levee is a human-made barrier with the primary purpose of reducing the frequency of flooding to a portion of the floodplain, sometimes referred to as a levee system.[77] A levee breach occurs when a storm or heavy rain event drops more water than the levee is designed to handle, leading to water flowing over the top of the levee and flooding the areas they were built to protect. A levee breach can occur gradually or suddenly. The most dangerous breaches happen quickly during periods of high water.

Table 6.5.2: Levee Failure Causes

Levee Failure Cause	Description
Overtopping	Water can rise high enough that it begins to flow over the top of the levee. Over time, water flowing over the top of a levee can cause it to soften, weaken, and give way.
Seepage	Water may seep into, under, or through parts of a levee. Water seeping through or under a levee can cause parts of it to erode over time. This can cause portions of a levee or its foundation to sink, weaken, or break.

Location

Figure 6.5.1 shows dam locations and dam owner types across Liberty County and highlights those with high or significant hazard potentials. Figure 6.5.2 shows the location of the singular levee within Liberty County, located within the City of Liberty. Figure 6.5.3 outlines levee information and depicts the protected (leveed) area and floodwalls, embankments, pump stations, and closure structures.

Figure 6.5.1: Dam Locations in Liberty County

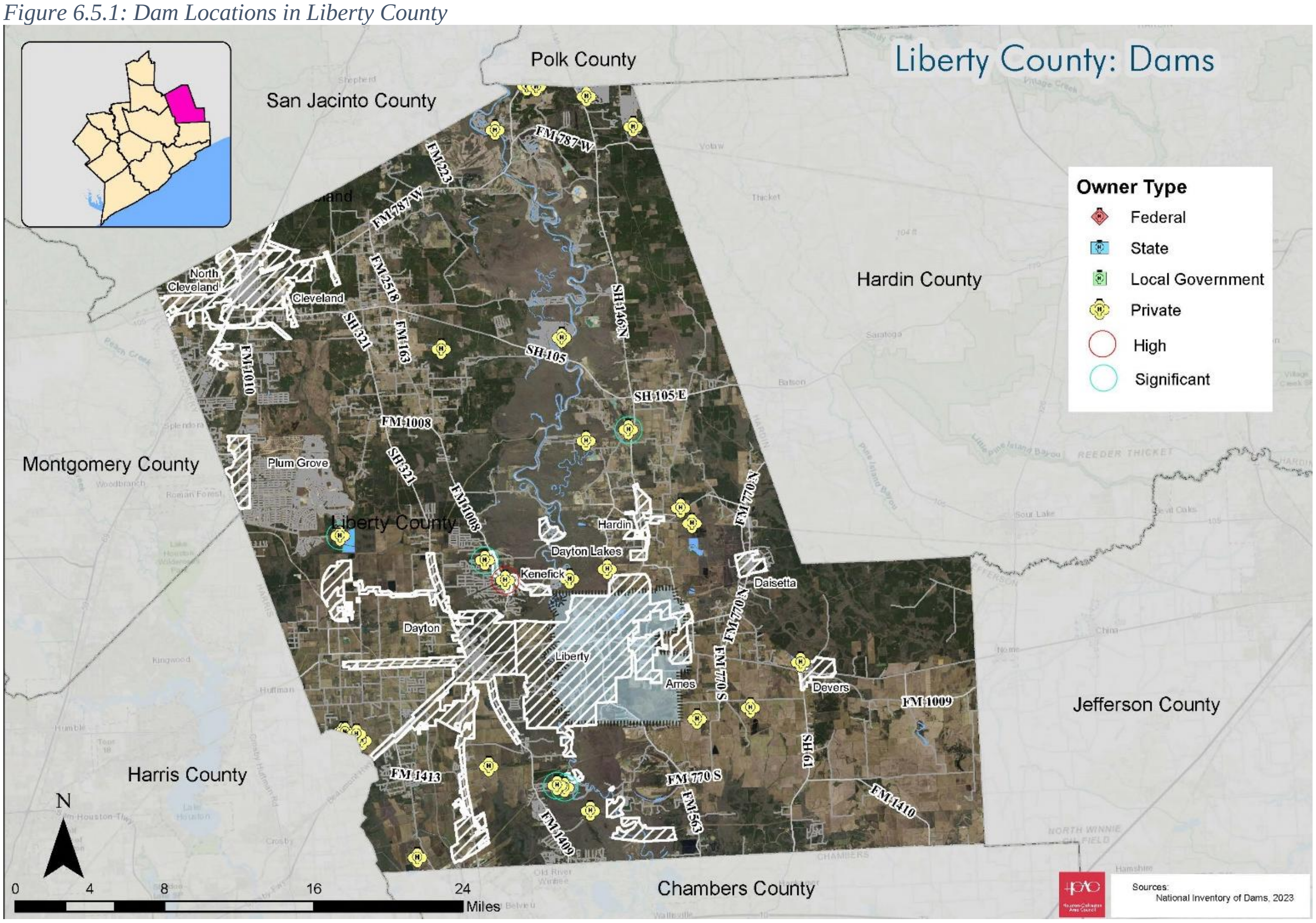


Figure 6.5.2: Levee Locations in Liberty County

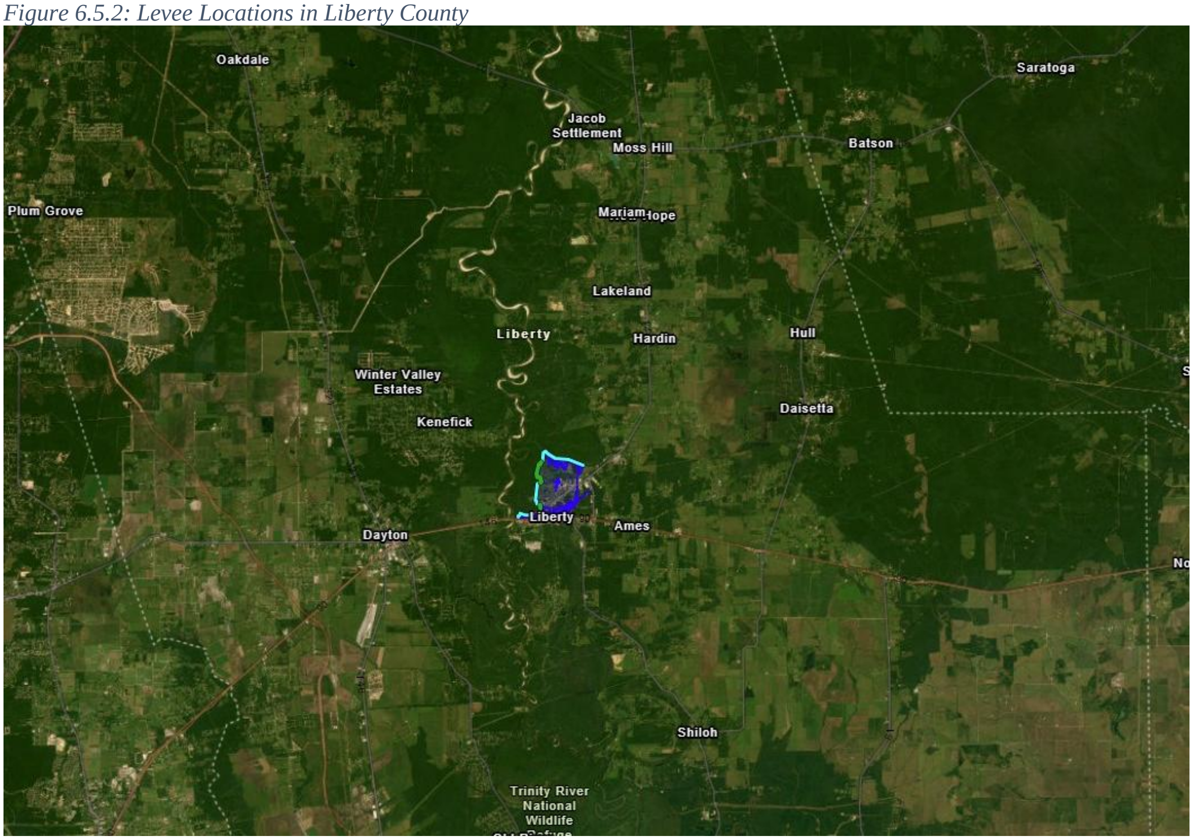
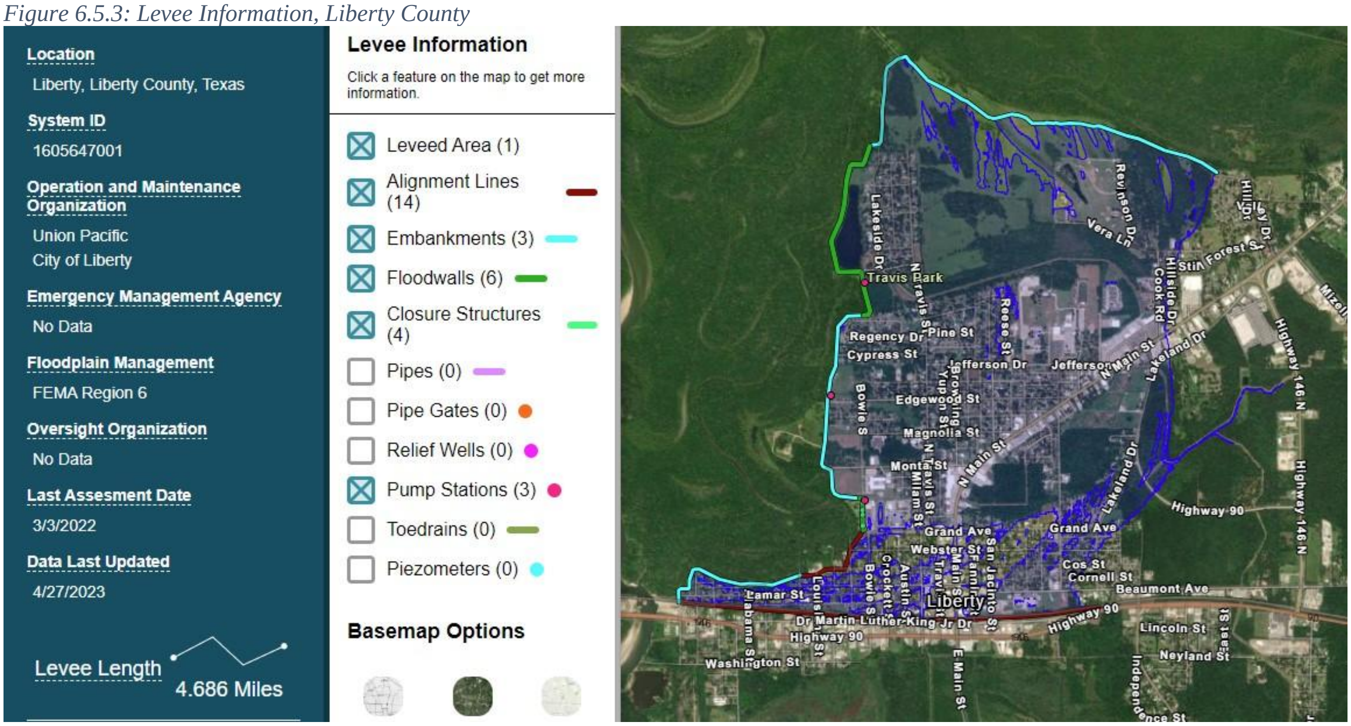


Figure 6.5.3: Levee Information, Liberty County



Extent

The United States Army Corps of Engineers (USACE) keeps a database of dams, the National Inventory of Dams, and levees, The National Levee Database. Among the many attributes recorded for dams is downstream hazard potential. Ratings of high, significant, or low are given to each dam depending on the potential hazard to the downstream area resulting from failure or maloperation. If it is estimated that there will be any probable loss of any human life this automatically puts the dam in the high hazard category. If there are any estimated economic, environmental, or lifeline losses this places a dam in the significant hazard category. If these losses are low and generally limited to the dam owner, a dam will be categorized as low hazard. The hazard potential rating does not reflect the current condition of the dam or the likelihood of the dam failing.[78] The TCEQ Dam Safety program also determines the hazard classification of dams based on the criteria in 30 Texas Administrative Code 299.14, as seen in the Table below.[79]

Table 6.5.3: Dam Hazard Classifications

Hazard Classification	Loss of Life	Economic Loss
Low	No loss of life	Minimal (located primarily in rural areas where failure may damage occasional farm buildings, limited agricultural improvements, and minor highways.)
Significant	Loss of human life possible (1-6 lives or 1-2 habitable structures in the breach inundation area downstream of the dam.)	Appreciable (located primarily in rural areas where failure may cause damage to isolated homes, damage to secondary highways, damage to minor railroads, or interruption of service or use of public utilities.)
High	Loss of life expected (7+ lives or 3+ habitable structures in the breach inundation area downstream of the dam.)	Excessive (located primarily in or near urban areas where failure would be expected to cause extensive damage to public facilities, agricultural, industrial, or commercial facilities, public utilities, including the design purpose of the utility, main highways, or railroads used as a major transportation system.)

According to the USACE National Inventory of Dams, there are 24 total dams in the county with 1 being categorized as having a high hazard potential, and 5 being categorized as having a significant hazard potential. Table 6.5.4 outlines dam classifications by hazard potential and Table 6.5.5 provides additional details for those dams with both high and significant hazard potentials. A dam is exempt from safety requirements, such as having an Emergency Action Plan on file if it has a maximum impoundment capacity of less than 500 ac-ft. and is either classified as low or significant hazard, on private property, in a county with a population of less than 350,000 (as per 2010 census), and not within the corporate limits of a municipality.[80]

While the probability of a dam or levee failure is low, a worst-case scenario for the county would be a heavy rainfall event (hurricane, tropical storm, severe thunderstorm, etc.) causing a dam/ levee failure or breech which would impact areas downstream. If a dam failure were to occur, especially in urban areas or where dams are rated as having a significant or high hazard potential, loss of life and property, including extensive damage to critical facilities and public infrastructure, can be expected. The dams listed in Table 6.5.5 are those that the county and participating jurisdictions are most concerned with due to their significant or high hazard potential rating.

Table 6.5.4: Liberty County Dams and Hazard Potential Total

High Hazard Potential Dams	Significant Hazard Potential Dams	Low Hazard Potential Dams	Total Dams	Total Dams of Concern:
1	5	18	24	6

Table 6.5.5: High and Significant Hazard Potential Dam Details, Liberty County

Dam Name	Dam ID	Hazard Potential	Distance to Nearest City (miles)	Last Inspection Date	Emergency Action Plan, Last Revision Date
Ap Parker Dam	TX09018	High	.25 miles, City of Kenefick	4/20/2023	Yes, 5/13/2011
Winter Valley Estates Dam	TX04873	Significant	No data, northwest of the City of Kenefick and west of FM 1008	4/27/2011	No, N/A
Talley Lake Dam	TX03919	Significant	No data	1/11/2012	No, N/A
Timber Lake Dam	TX04816	Significant	No data	1/11/2012	No, N/A
Pin Oak Reservoir Levee	TX0	Significant	No data, Located off Luce Bayou	2/18/2010	No, N/A
Lake Forest Dam	TX0	Significant	No data	4/27/2011	No, N/A

The AP Parker Dam is a privately owned recreational dam that was built in 1953 and is rated in fair condition as of its last inspection date on April 20, 2023. It is located within the City of Kenefick less than 300 feet away from the volunteer fire department, and less than 1,000 feet away from a place of worship and the police department. There is no dam inundation map available for this dam, nor is there data available regarding potential impacts in the event of a dam breech, such as the distance water may travel and the depth of that water. This is noted as a data deficiency to this HMP update and is addressed by an action item in Section 7: Mitigation Action Plan for all plan participants.

The Levee Safety Action Classification is one of the used to communicate the residual risk within communities. It is a classification system designed to take into account the probability of the levees being loaded, the existing condition of the levee, the current and future maintenance of the levee, and the consequences if a levee were to fail or be overwhelmed. Levee risk classifications are used to help the USACE prioritize, evaluate, and justify levee safety decisions. [81] The table below outlines these classifications and their associated characteristics.

Table 6.5.6: Levee Risk Classifications

Risk Classification	Risk Characteristics
Very Low (5)	The likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in very low risk.
Low (4)	The likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in low risk.
Moderate (3)	The likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in moderate risk.
High (2)	The likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in high risk.
Very High (1)	The likelihood of inundation due to breach and/or system component malfunction in combination with loss of life, economic, or environmental consequences results in very high risk.

According to the USACE National Levee Database, there is one levee within Liberty County that is located in and protects areas within the City of Liberty. The levee has a total length of 4.686 miles and protects 1,796 buildings, 4,798 people, 13.3 acres of farmland, 10 critical facilities, and an estimated $800 million in property value. The levee is also listed as having one occurrence where water levels reached 25% of the levee capacity and zero occurrences where a failure has occurred, and the levee was overtopped.[82]

Table 6.5.7: Levee Details, Liberty County

Levee System ID	Flood Source	FEMA Accreditation	Last Assessment Date
1605647001	Trinity River	Non-Accredited Levee System	3/3/2022

While the probability of dam/levee failure is low, a worst-case scenario for this hazard would be a heavy rain event, such as a hurricane or tropical storm similar to Hurricane Harvey, that stalls over the county causing a failure or breach within one of the significant or high hazard potential dams or the levee within the county. This could result in loss of life as well as extensive property damage, including to critical facilities, public infrastructure, and roadways.

Historic Occurrences

The Association of State Dam Safety Officials (ASDSO) Dam Incident Database provides basic information on dam safety incidents to ASDSO members, dam safety stakeholders, the media, and the public. According to the ASDSO, there have been no historical occurrences of dam failures within Liberty County.[83] There are no reported levee failures for Liberty County per the National Levee Database.

Probability of Future Occurrences

The State of Texas has not experienced loss of life or extensive economic damage due to a dam failure since the City of Austin dam failure of April 7, 1900, which was caused by heavy rainfall and faulty construction.[84] The risk of dam failure is monitored closely by TCEQ and local emergency management staff. The probability of a future dam/levee failure within Liberty County is low. However, it is important to note that increases in the amount and intensity of rainfall will lead to additional pressures being placed on these systems. Additionally, as these dams/levees age, and as development increases in areas that are downstream of dam/levee inundation zones, the risk becomes higher. Likely, dams within the county that are rated as low-hazard potential structures today may have a different classification in the future. TCEQ administers the High Hazard Potential Dam (HHPD) Grant Program, which provides technical, planning, design, and construction assistance in the form of grants for the rehabilitation of eligible high-hazard potential dams.[85]

Populations at Risk

Vulnerable populations for this hazard include those that are located within the inundation zones, and areas downstream of the dam that would be flooded in the event of a failure. Areas of growth and future development within the county could be potentially impacted by this hazard, especially if they are downstream of dams rated as significant or high hazard. The county has experienced a steady increase in population, which is expected to reach 155,000 people by 2040. Increases in population in dam/ levee failure inundation areas will result in increased risk to life and property from this hazard. Typically, flood inundation maps that are created by the USACE show how water might behave and how the dam might react in the event of a breech or failure. Areas on the map can show where water may go upstream and downstream of dams, including how far it may extend past the banks of a river or waterway and how deep it may be. These maps aid in identifying populations at risk (who and what could be damaged) within dam inundation zones and how much time there might be to give evacuation notice in an area that may flood. These maps are important for the development of emergency action plans, evacuation plans, and other emergency response activities. However, the USACE does not have dam inundation maps available for Liberty County. This has been noted as a data deficiency for this hazard and is addressed within Section 7: Mitigation Action Plan as an action item for all plan participants.

Climate Change Impacts

Temperatures and precipitation totals are expected to increase due to climate change, leading to more frequent or intense periods of rainfall and flooding. These increased volumes could potentially cause more pressure on aging dam infrastructure.

Table 6.5.8: Climate Change Impacts Summary, Dam/Levee Failure

Location	The location of dam/levee failures is not expected to change.
Extent/Intensity	The extent and intensity of dam/levee failure is not expected to change.
Frequency	There are no clear trends in the frequency of dam/levee failures within the county.
Duration	The duration of dam/levee failures is not expected to change.

Section 6.6: Severe Winter Storm

6.6 Severe Winter Storm

Winter weather is defined by NWS as "a winter weather phenomenon (such as snow, sleet, ice, wind chill) that impacts public safety, transportation, and/or commerce. It typically occurs during the climatological winter season between October 15 and April 15."[86]

Location

Winter weather occurs on a regional scale and can happen anywhere within the state or the county.

Extent

The Winter Storm Severity Index (WSSI) is a new product (released in 2022) of the NWS that forecasts the potential impacts of winter storms. NWS has implemented the WSSI to provide the public with a tool that attempts to convey the complexities and hazards associated with winter storms as they relate to potential societal impacts. The WSSI is created using Geographic Information Systems (GIS) by screening the official NWS gridded forecasts from the National Digital Forecast Database (NDFD) for winter weather elements and combining those data with non-meteorological or static information datasets such as land use, climatology, urban areas, etc. The outcome is a graphical depiction of anticipated overall impacts on society due to winter weather. There are numerous datasets used or derived as part of calculating the WSSI.

Table 6.6.1: Winter Storm Severity Index Datasets

Data Source	Dataset
Official NWS Forecast datasets from NDFD	• 6-hour snow accumulation • 6-hour ice accumulation • 6-hour precipitation accumulation (Quantitative Precipitation Forecasts) • Wind speed (hourly time steps) • Temperature (hourly time steps)
Additional derived forecast parameters from other official NWS NDFD	• Total snowfall • Total ice accumulation • Maximum wind speed within each 6-hour period • 6-hourly snowfall accumulation rate • 6-hourly snow-liquid ratio • Average snow-liquid ratio
Daily National Snow Analyses are obtained from the NWS National Operational Hydrologic Remote Sensing Center	• Snow depth • Snowpack temperature • Snow water equivalent
Non-forecast datasets	• Urban area designation • Land-use designations • NOAA/NCEI gridded annual snowfall climatology

The WSSI consists of a series of component algorithms, each of which uses meteorological and non-meteorological data to model the predicted severity of specific characteristics of winter weather. Each of the components produces a 0 to 5 output scale value that equates to the potential severity based on the winter weather hazards. The final WSSI value is the maximum value from all the sub-components. The 4 impact levels are given the following descriptors: Minor, Moderate, Major, and Extreme. In addition to the impact levels, a Winter Weather Area is also shown to depict the extent of the winter weather conditions. The WSSI output provides colors, impact classifications, and definitions of the overall expected severity of winter weather, as depicted in the table below.

Table 6.6.2: Winter Storm Severity Index Impact Classifications and Definitions

Map Color	Associated Impacts	WSSI Definition
	No Impacts	N/A
	Limited Impacts, Winter Weather Area	**Expect winter weather.** Winter driving conditions: **Drive carefully.**
	Minor Impacts	**Expect a few inconveniences to daily life.** Winter driving conditions: **Use caution while driving.**
	Moderate Impacts	**Expect disruptions to daily life.** Winter driving conditions: Hazardous driving conditions. **Use extra caution while driving**. Closures and disruptions to infrastructure may occur.
	Major Impacts	**Expect considerable disruptions to daily life.** Winter driving conditions: Dangerous or impossible driving conditions. **Avoid travel if possible.** Widespread closures and disruptions to infrastructure may occur.
	Extreme Impacts	**Expect substantial disruptions to daily life.** Winter driving conditions: Extremely dangerous or impossible driving conditions. **Travel is not advised.** Extensive and widespread closures and disruptions to infrastructure may occur. Life-saving actions may be needed.

The specific sub-components of the WSSI are:

- **Snow Load Index**- Indicates potential infrastructure impacts due to the weight of the snow. This index accounts for the land cover type. For example, more forested and urban areas will show increased severity versus the same snow conditions in grasslands.

- **Snow Amount Index**- Indicates potential impacts due to the total amount of snow or the snow accumulation rate. This index also normalizes for climatology, such that regions of the country that experience, on average, less snowfall will show a higher level of severity for the same amount of snow that is forecast across a region that experiences more snowfall on average. Designated urban areas are also weighted a little more than non-urban areas.

- **Ice Accumulation**- Indicates potential infrastructure impacts (e.g., roads/bridges) due to combined effects and severity of ice and wind. Designated urban areas are also weighted a little more than non-urban areas. Please note that not all NWS offices provide ice accumulation information in the NDFD. In those areas, the ice accumulation is not calculated.

- **Blowing Snow Index**- Indicates the potential disruption due to blowing and drifting snow. This index accounts for land use type. For example, more densely forested areas will show less blowing snow than open grassland areas.

- **Flash Freeze Index**- Indicates the potential impacts of flash freezing (temperatures starting above freezing and quickly dropping below freezing) during or after precipitation events.

- **Ground Blizzard**- Indicates the potential travel-related impacts of strong winds interacting with pre-existing snow cover. This is the only sub-component that does not require snow to be forecast for calculations to be made. The NOHRSC snow cover data along with forecast winds are used to model the ground blizzard. Adjustments are made based on the land cover type. For example, heavily forested areas will have a lower ground blizzard severity than the same conditions occurring across open areas.[87]

Anticipated intensities for the WSSI sub-components mentioned above within the planning area, per the American Society of Civil Engineers, for determining loads for structures with a risk category of 4 (those that have the greatest impact on life, health, and welfare)[88][89] include:

- Snow Load Index-
  - Ground Snow Load, p_g: 11 lb./ft^2
  - 20-year MRI Value: 1.33 lb./ft^2
  - Winter Wind Parameter: 0.45
  - Mapped Elevation: 30.0 ft
- Ice Accumulation- Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values. Values provided are equivalent radial ice thicknesses due to freezing rain for 250, 500, 1,000, and 1,400-year mean recurrence intervals along with concurrent 3-s gust speeds and concurrent air temperatures.
  - Ice Thickness: 1.50 in.
  - Concurrent Temperature: 15 F
  - 3-s Gust Speed 32 mph

A worst-case scenario for this hazard within Liberty County would be similar to that of Winter Storm Uri which occurred in February 2021. This historic winter storm brought snow, sleet, freezing rain, and extreme cold temperatures that lasted for several days. The HMC discussed Uri as being the worst the county has ever experienced; with ice accumulations of 2", temperatures of 7°F with windchill, and snow/sleet accumulations up to 3". This resulted in multiday road closures (5+ days within Liberty County) as roads throughout the county were covered with snow and ice from the previous night's freezing rain and plummeting temperatures. This resulted in power outages, loss of heat, broken pipes, and other societal impacts for the region. Winter Storm Uri was the largest and most costly winter weather event in Liberty County's history, causing $30,000 in reported property damage. Another winter storm event of this magnitude could, again, result in risks to life and property as well as secondary hazards from prolonged power outages, closure of roads, and the inability of residents to access critical facilities or resources.

NOAA and the NWS also have a variety of watches, warnings, and advisories for freeze, frost, wind, and ice events. A watch is generally issued in the 24 to 72-hour forecast time frame when the risk of a hazardous winter weather event has increased (50 to 80% certainty that warning thresholds will be met). It is intended to provide enough lead time so those who need to set their plans in motion can do so. Warnings are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). A warning is used for conditions posing a threat to life or property. Advisories are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). An advisory is for less serious conditions that cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life and/or property. 2021 Winter Storm Uri resulted in a total of 8 days, 23 hours, and 23 minutes of winter highlights between the first Winter Weather Advisory issued on Thursday, February 11th, 2021, at 9:37 am, to when the last Hard Freeze Warning expired at 9 am on Saturday, February 20th, 2021. The table below describes the various winter weather warnings, watches, and advisories below.[90]

Table 6.6.3: Winter Weather-Related Warnings, Watches, and Advisories

Watch/ Warning/ Advisory	Description
Winter Storm Watch	Issued when conditions are favorable for a significant winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow, or a combination of events.)
Wind Chill Watch	Issued when there is the potential for a combination of extremely cold air and strong winds to create dangerously low wind chill values.
Freeze Watch	Issued when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours.
Winter Storm Warning	Issued for a significant winter weather event including snow, ice, sleet, blowing snow, or a combination of these hazards. Travel will become difficult or impossible in some situations. Delay your travel plans until conditions improve.
Wind Chill Warning	Issued for a combination of very cold air and strong winds that will create dangerously low wind chill values. This level of wind chill will result in frostbite and lead to hypothermia if precautions are not taken. Avoid going outdoors and wear warm protective clothing if you must venture outside.
Freeze Warning	Issued when significant, widespread freezing temperatures are expected.
Ice Storm Warning	Are usually issued for ice accumulation of around 1/4 inch or more. This amount of ice accumulation will make travel dangerous or impossible and likely lead to snapped power lines and falling tree branches. Travel is strongly discouraged.
Blizzard Warning	Issued for frequent gusts greater than or equal to 35 mph accompanied by falling and/or blowing snow, frequently reducing visibility to less than 1/4 mile for three hours or more. A Blizzard Warning means severe winter weather conditions are expected or occurring. Falling and blowing snow with strong winds and poor visibilities are likely, leading to whiteout conditions making travel extremely difficult. Do not travel. If you must travel, have a winter survival kit with you. If you get stranded, stay with your vehicle, and wait for help to arrive.
Winter Weather Advisory	Issued for any amount of freezing rain, or when 2 to 4 inches of snow (alone or in combination with sleet and freezing rain) is expected to cause a significant inconvenience, but not serious enough to warrant a warning.
Wind Chill Advisory	Issued when wind chills of -5F to -19F are expected east of the Blue Ridge Mountains and when wind chills of -10 to -24F are expected along and west of the Blue Ridge Mountains and in Frederick and Carroll Counties in Maryland.
Frost Advisory	Issued when the minimum temperature is forecast to be 33 to 36 degrees on clear and calm nights during the growing season.

Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCDC storm events database. Winter weather-related events data for the city from 1950-2023 is provided in the table below.[39]

Table 6.6.4: Historic Occurrences, Winter Weather

Event Date	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
1/12/1997	Ice Storm	0	0	$-	$-
1/16/2007	Ice Storm	0	0	$2,000	$-
12/10/2008	Heavy Snow	0	0	$-	$-
2/4/2011	Winter Storm	0	0	$-	$-
1/23/2014	Winter Storm	0	0	$-	$-
3/3/2014	Winter Storm	0	0	$-	$-
2/15/2021	Extreme Cold/Wind Chill	0	0	$30,000	$-

$- No dollar amount ($0.00)

Presidential Disaster Declarations

There have been 2 disaster declarations for winter weather within Liberty County since 1953.[2]

Table 6.6.5: Federal Disaster Declarations, Winter Weather

Declaration Date	Incident Type	Title	Disaster Number	Declaration Type
2/14/2021	Severe Ice Storm	Severe Winter Storm	3554	Emergency Declaration
2/19/2021	Severe Ice Storms	Severe Winer Storms	4586	Major Disaster Declaration

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below.[40]

Table 6.6.6: USDA Disaster Declarations (2018-2023), Winter Weather

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

The table below shows FEMA NRI annualized frequency values for winter weather and related hazards.

Table 6.6.7: Annualized Frequency Values, Cold Wave, Ice Storm, and Winter Weather

Hazard Type	Annualized Frequency	Events on Record	Period of Record
Cold Wave	0.2 events per year	3	2005-2021 (16 years)
Ice Storm	0.8 events per year	57	1949-2021 (73 years)
Winter Weather	0.6 events per year	10	2005-2021 (16 years)

Populations at Risk

The Gulf Coast and Southeast Texas region are generally not used to snow, ice, and freezing temperatures. When cold air penetrates south across Texas and Florida, into the Gulf of Mexico, temperatures fall below freezing. This can kill vulnerable vegetation, such as flowering plants and the citrus fruit crop. Wet snow and ice rapidly accumulate on trees with leaves, causing the branches to snap under the load. Motorists are generally unaccustomed to driving on slick roads and traffic accidents increase. Some buildings are poorly insulated or lack heat altogether. Local towns may not have snow removal equipment or treatments available, such as sand or salt for icy roads.[91] Populations at risk include adults over 65 years of age and children, who according to the CDC are the most vulnerable populations to winter weather-related illnesses. Winter weather and ice storms can cause dangerous driving conditions, falling trees, and power outages in homes. The most notable vulnerabilities throughout the county to this hazard are the dangerous driving conditions and power outages.

The NCHH summarizes at-risk populations for several hazards. These include older adults, children, people experiencing homelessness, people with disabilities, and people with chronic health conditions. In addition to the dangers listed above, older adults can face social isolation, lack of electricity needed to run medical equipment, lack of access to a vehicle for evacuation, and lack of access to other critical supplies. In younger populations, such as children, winter weather and related hazard events can disrupt schooling and the normal day-to-day routines they thrive on. This can not only jeopardize their academic success but can also cause mental and emotional stress. Children are more at risk when their exposure to these extreme temperatures is prolonged. For people experiencing homelessness, adequate shelter is critical in keeping populations safe during winter weather and related events. People with disabilities may require additional assistance to stay safe and prepare for these hazards such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment. Likewise, those with chronic health conditions may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to diseases or illnesses from prolonged exposure to extreme temperatures and increased exposure to these illnesses when utilizing a shelter, warming center, or evacuation center.

Additionally, freezing temperatures can cause damage to homes and businesses in the form of burst pipes, which can cause mold to thrive if not treated promptly. This can exacerbate illness among the general population but especially among those with chronic health conditions. When heating systems or power outages can't adequately maintain safe temperatures, households may turn to using space heaters, fireplaces, or appliances that aren't meant for heating (such as ovens or stoves) for warmth. This increases the risk of fires and negatively impacts indoor air quality. Additionally, carbon monoxide poisoning can be a risk for those who utilize generators too close to the home or indoors. These issues disproportionately affect low-income communities and families who may lack the resources to pay for safe heating in their homes.[44]

Any areas of growth or future development within the county could be potentially impacted by this hazard as the level of vulnerability is the same throughout Liberty County. Similarly, as the population within the county increases more people are at risk and vulnerable to winter weather impacts.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

The FEMA NRI accounts for winter weather in various formats, these are cold waves, ice storms, and winter weather. EAL Exposure and EAL Values for Liberty County for these hazards can be found in the tables and figures below.[44]

Table 6.6.8: Expected Annual Loss Exposure Values, Cold Wave, Ice Storm, and Winter Weather

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Cold Wave, Ice Storm, and Winter Weather	$10,266,884,211	$1,061,307,200,000/ 91,492	$34,324,047	$1,071,608,408,258

Table 6.6.9: Expected Annual Loss Values, Cold Wave, Ice Storm, and Winter Weather

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Cold Wave	$1,970	$282,637 0.02	$21,936
Ice Storm	$3,904	$76,694/ 0.01	N/A
Winter Weather	$2,413	$1146,316/ 0.01	$629

N/A- Not Applicable

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802. Risk Index Ratings according to the FEMA NRI for Cold Wave, Ice Storm, and Winter Weather events within these census tracts are[46]:

Table 6.6.10: Risk Index Rating Summary, Cold Wave, Ice Storm, and Winter Weather

Hazard Type	Risk Index Rating Summary
Cold Wave	5 census tracts- Relatively High, 12 census tracts- Relatively Moderate
Ice Storm	8 census tracts- Relatively Moderate, 9 census tracts- Relatively Low
Winter Weather	10 census tracts- Relatively High, 7 census tracts- Relatively Moderate

EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for Cold Wave, Ice Storm, and Winter Weather events within Liberty County as very low, very low, and relatively moderate, respectively.

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map..[46]

Figure 6.6.1: Risk Index Rating, Cold Wave

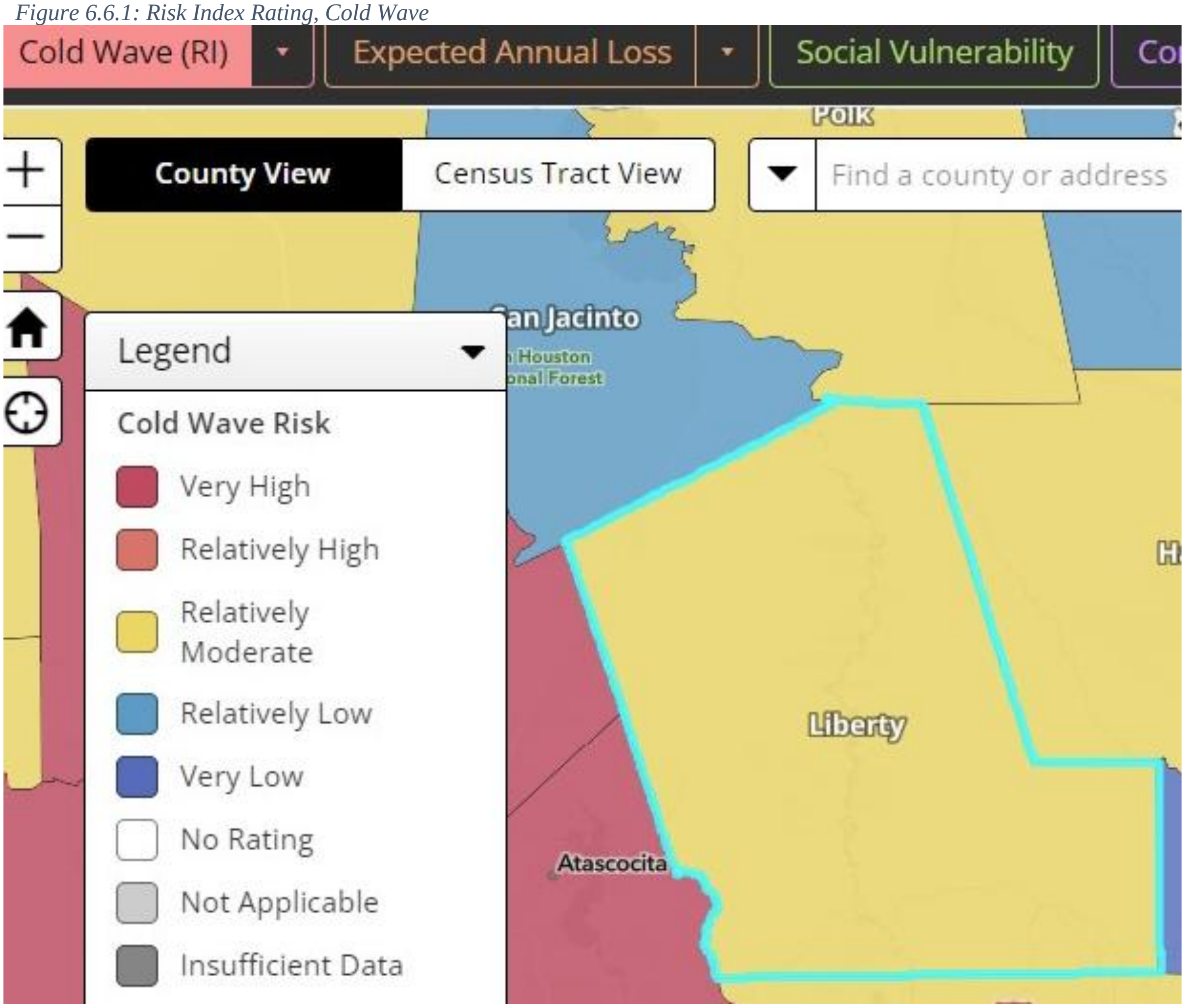


Figure 6.6.2: Risk Index by Census Tract, Liberty County, Cold Wave

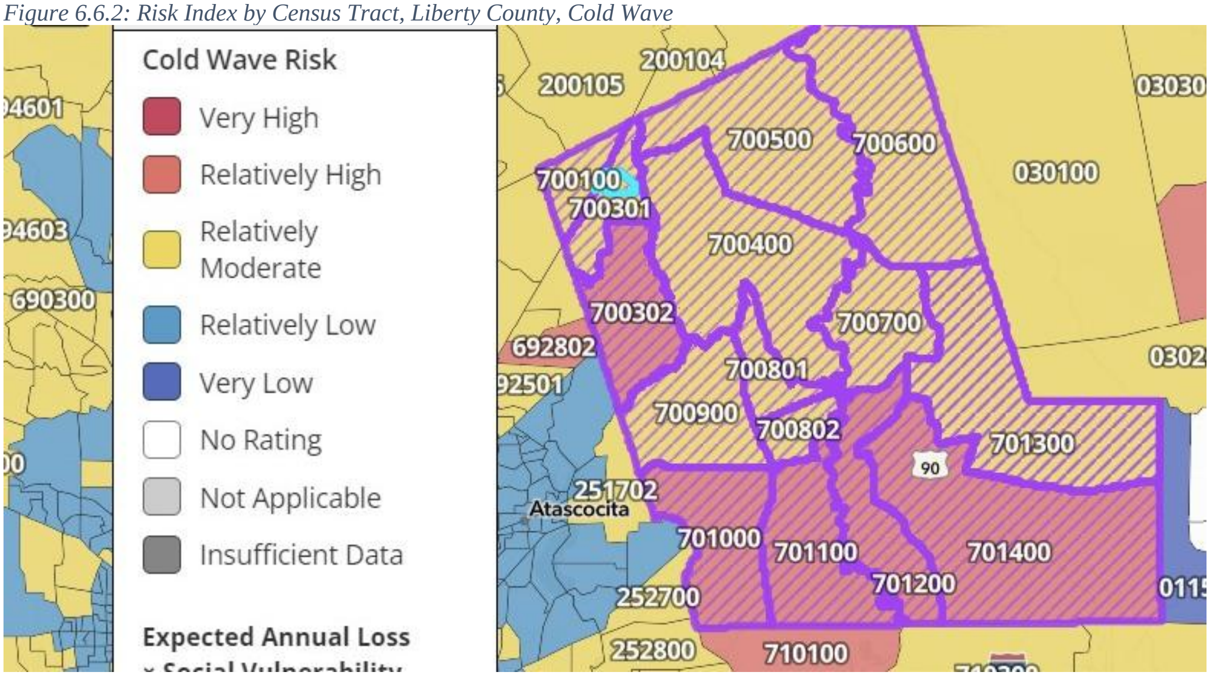


Figure 6.6.3: Risk Index Rating, Ice Storm

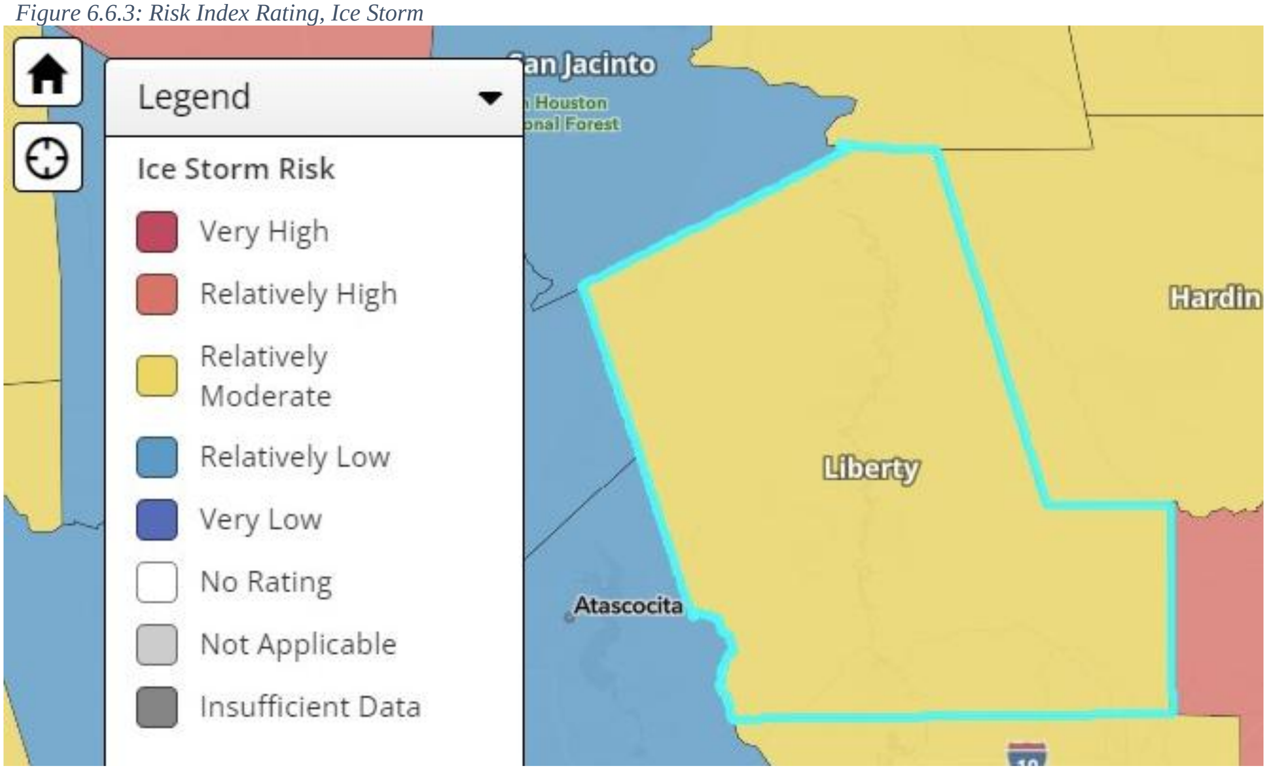


Figure 6.6.4: Risk Index by Census Tract, Liberty County, Ice Storm

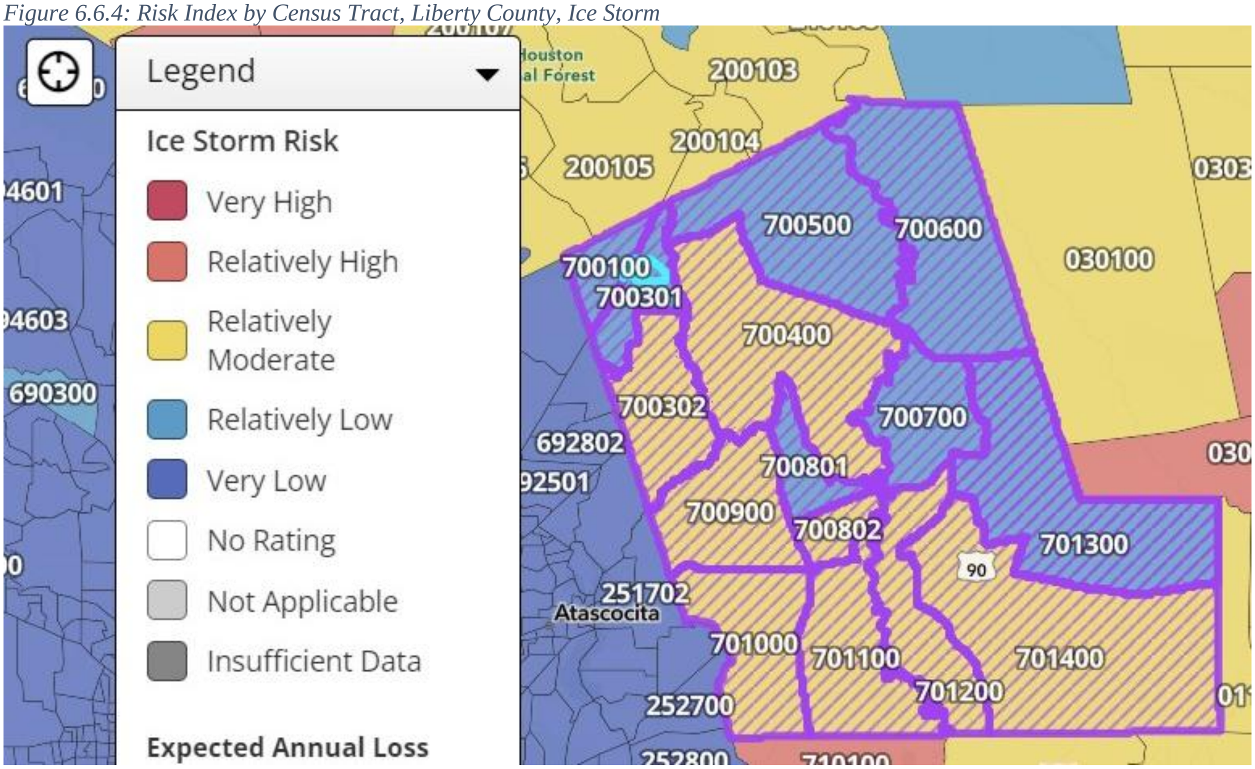


Figure 6.6.5: Risk Index Rating, Winter Weather

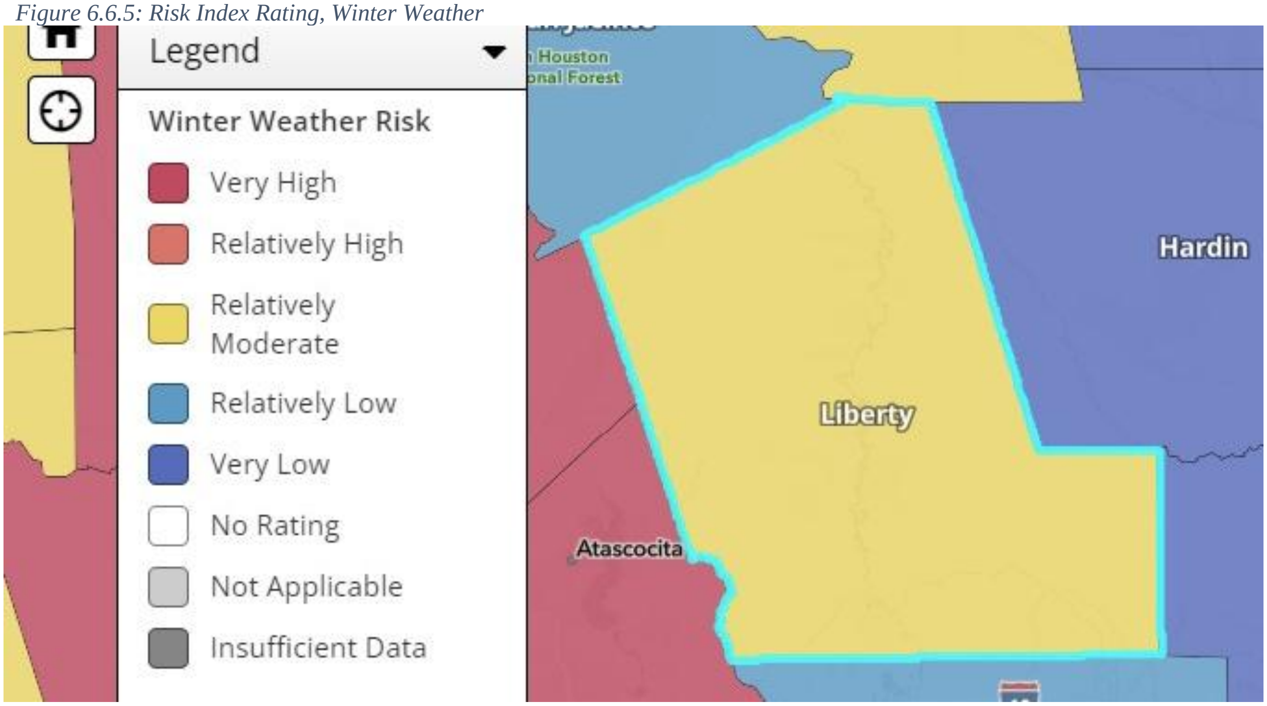


Figure 6.6.6: Risk Index by Census Tract, Liberty County, Winter Weather

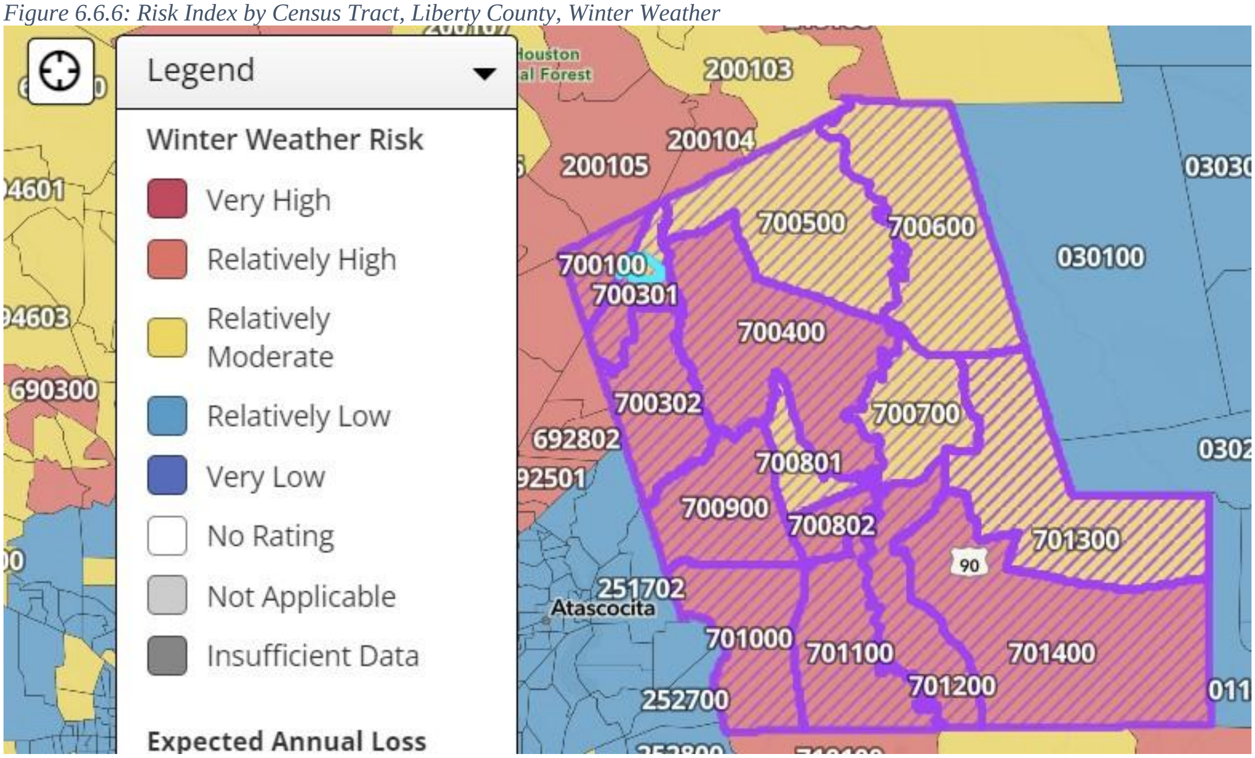


Figure 6.6.7: Social Vulnerability by Census Tract, Liberty County

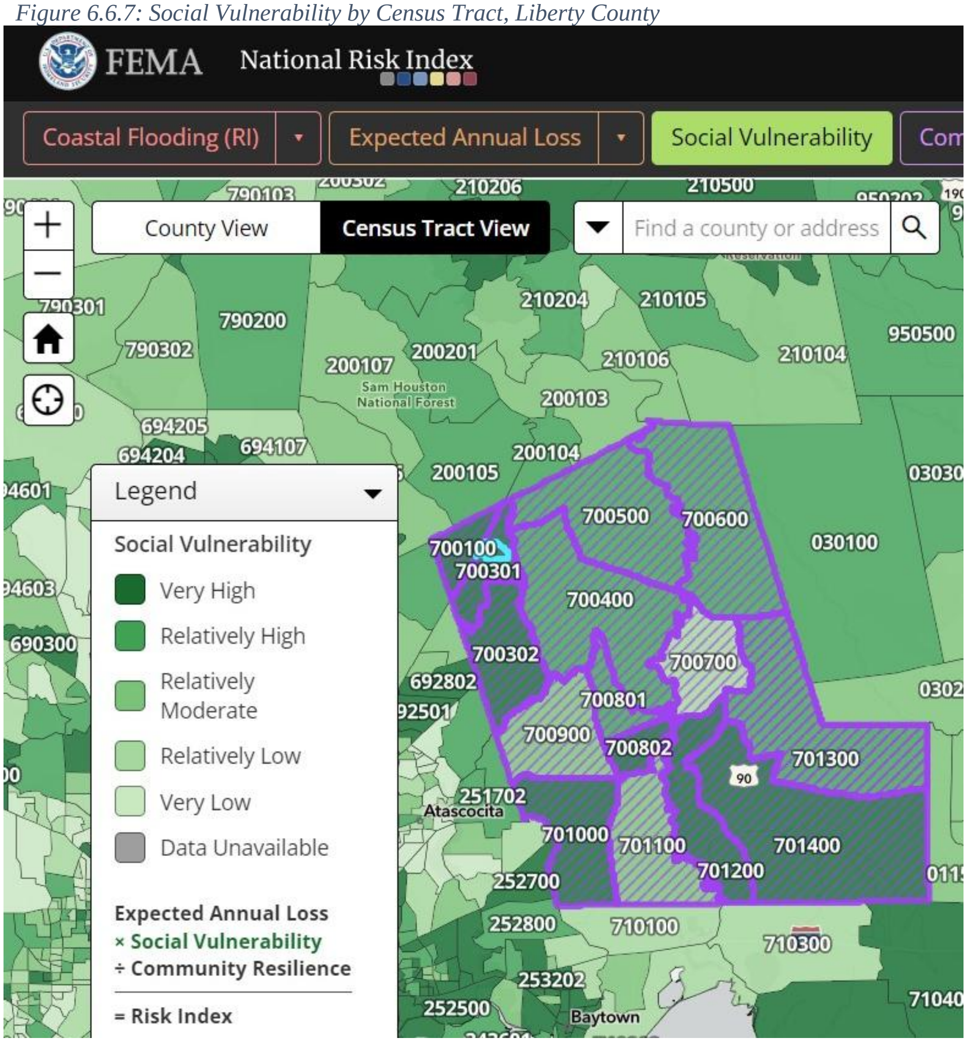


Figure 6.6.8: Social Vulnerability, Liberty County

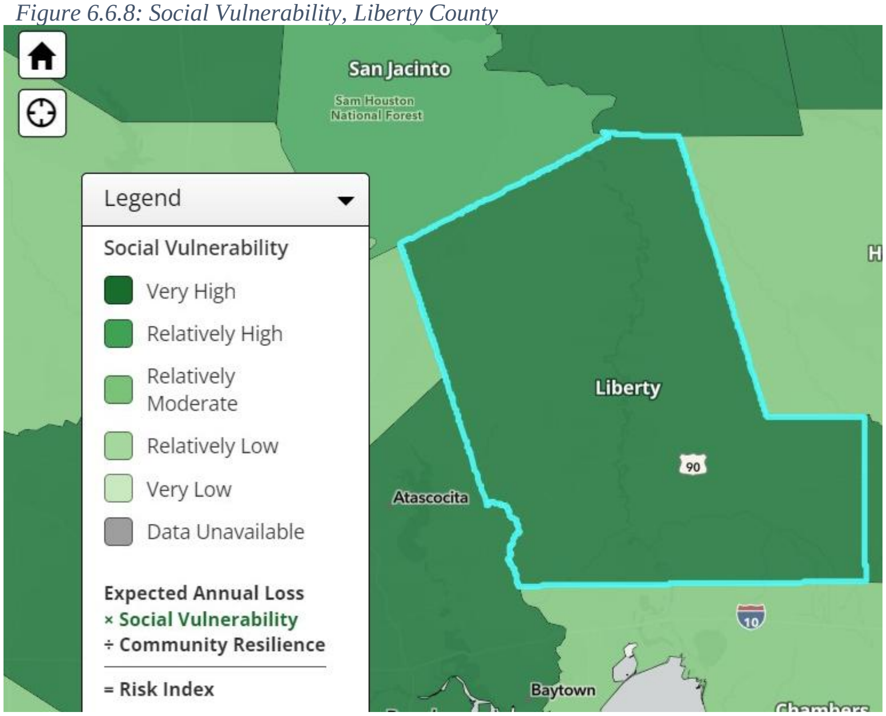


Figure 6.6.9: Community Resilience by Census Tract, Liberty County

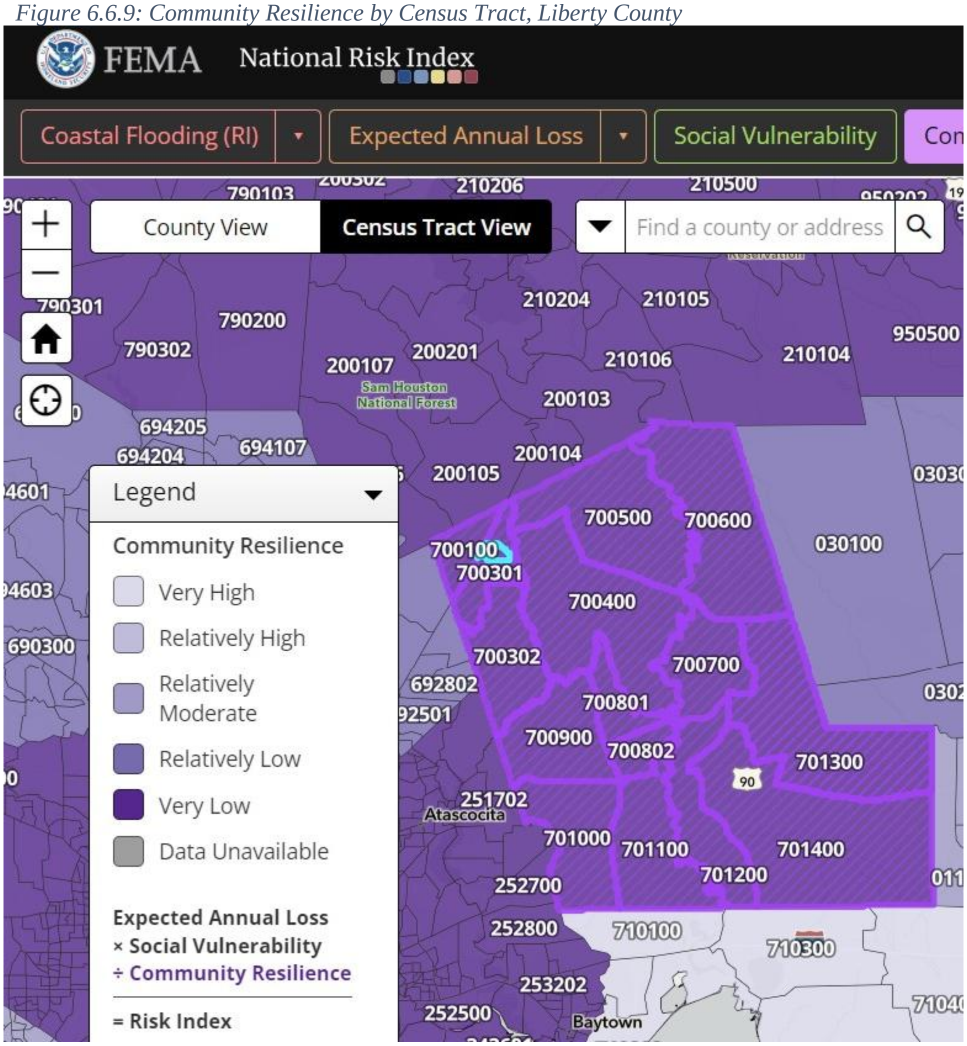


Figure 6.6.10: Community Resilience, Liberty County

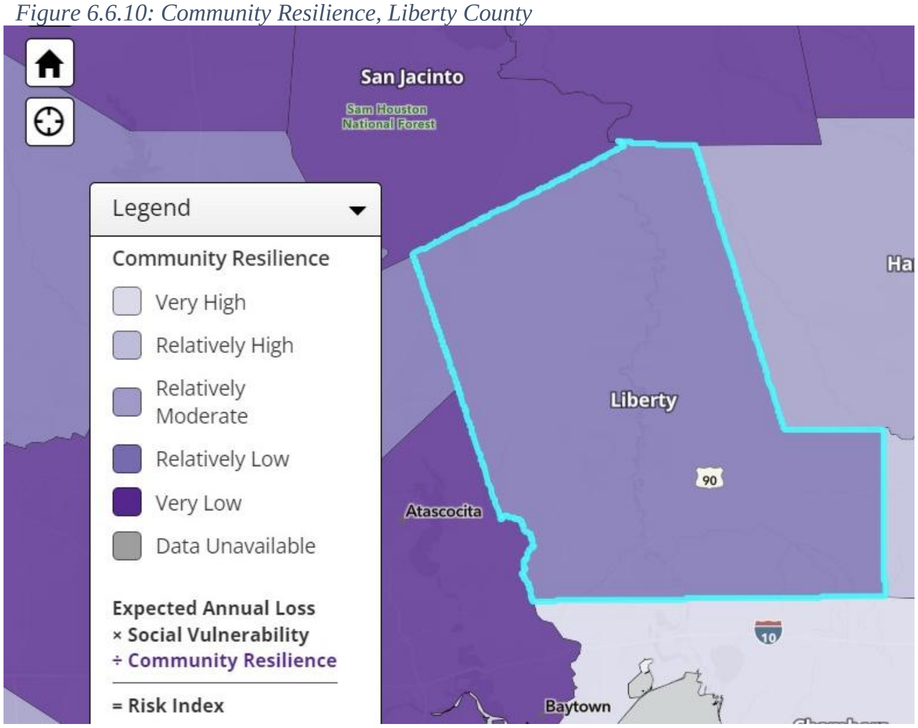


Figure 6.6.11: FEMA NRI Summary by Census Tract, Liberty County, Cold Wave

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Relatively High	95.26	0 100
2	Census tract 48291701400	TX	Relatively High	95.14	0 100
3	Census tract 48291701000	TX	Relatively High	94.89	0 100
4	Census tract 48291701100	TX	Relatively High	93.74	0 100
5	Census tract 48291701200	TX	Relatively High	92.2	0 100
6	Census tract 48291700400	TX	Relatively Moderate	89.4	0 100
7	Census tract 48291700802	TX	Relatively Moderate	88.95	0 100
8	Census tract 48291700900	TX	Relatively Moderate	87.37	0 100
9	Census tract 48291700301	TX	Relatively Moderate	86.21	0 100
10	Census tract 48291700100	TX	Relatively Moderate	85.95	0 100
11	Census tract 48291701300	TX	Relatively Moderate	82.53	0 100
12	Census tract 48291700303	TX	Relatively Moderate	82.34	0 100
13	Census tract 48291700801	TX	Relatively Moderate	81.28	0 100
14	Census tract 48291700200	TX	Relatively Moderate	80.46	0 100
15	Census tract 48291700600	TX	Relatively Moderate	77.96	0 100
16	Census tract 48291700500	TX	Relatively Moderate	76.57	0 100
17	Census tract 48291700700	TX	Relatively Moderate	72.74	0 100

Figure 6.6.12: FEMA NRI EAL Summary by Census Tract, Liberty County, Cold Wave

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$37,499	Very High	Very Low	1.53	$57,528	95.26
2	Census tract 48291701400	TX	$32,740	Very High	Very Low	1.72	$56,386	95.14
3	Census tract 48291701000	TX	$33,186	Very High	Very Low	1.64	$54,274	94.89
4	Census tract 48291701100	TX	$38,485	Relatively Moderate	Very Low	1.2	$46,035	93.74
5	Census tract 48291701200	TX	$21,556	Very High	Very Low	1.75	$37,690	92.2
6	Census tract 48291700400	TX	$20,658	Relatively High	Very Low	1.35	$27,893	89.4
7	Census tract 48291700802	TX	$17,207	Very High	Very Low	1.55	$26,713	88.95
8	Census tract 48291700900	TX	$19,459	Relatively Moderate	Very Low	1.19	$23,079	87.37
9	Census tract 48291700301	TX	$11,925	Very High	Very Low	1.75	$20,919	86.21
10	Census tract 48291700100	TX	$12,370	Very High	Very Low	1.65	$20,429	85.95
11	Census tract 48291701300	TX	$10,817	Relatively High	Very Low	1.45	$15,657	82.53
12	Census tract 48291700303	TX	$8,534	Very High	Very Low	1.81	$15,413	82.34
13	Census tract 48291700801	TX	$10,918	Relatively High	Very Low	1.3	$14,207	81.28
14	Census tract 48291700200	TX	$8,189	Very High	Very Low	1.63	$13,328	80.46
15	Census tract 48291700600	TX	$7,694	Relatively High	Very Low	1.43	$11,035	77.96
16	Census tract 48291700500	TX	$7,760	Relatively High	Very Low	1.27	$9,893	76.57
17	Census tract 48291700700	TX	$7,547	Relatively Low	Very Low	0.97	$7,331	72.74

Figure 6.6.13: FEMA NRI Summary by Census Tract, Liberty County, Ice Storm

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Relatively Moderate	82.39	0 100
2	Census tract 48291701000	TX	Relatively Moderate	79.31	0 100
3	Census tract 48291701400	TX	Relatively Moderate	78.45	0 100
4	Census tract 48291701200	TX	Relatively Moderate	77.45	0 100
5	Census tract 48291700400	TX	Relatively Moderate	75.15	0 100
6	Census tract 48291700802	TX	Relatively Moderate	75.14	0 100
7	Census tract 48291701100	TX	Relatively Moderate	74.64	0 100
8	Census tract 48291700900	TX	Relatively Moderate	70.59	0 100
9	Census tract 48291700100	TX	Relatively Low	66.61	0 100
10	Census tract 48291700301	TX	Relatively Low	66.3	0 100
11	Census tract 48291700801	TX	Relatively Low	64.04	0 100
12	Census tract 48291701300	TX	Relatively Low	63.25	0 100
13	Census tract 48291700303	TX	Relatively Low	60.82	0 100
14	Census tract 48291700600	TX	Relatively Low	59.24	0 100
15	Census tract 48291700200	TX	Relatively Low	57.59	0 100
16	Census tract 48291700500	TX	Relatively Low	56.56	0 100
17	Census tract 48291700700	TX	Relatively Low	49.25	0 100

Figure 6.6.14: FEMA NRI EAL Summary by Census Tract, Liberty County, Ice Storm

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$9,685	Very High	Very Low	1.53	$14,858	82.39
2	Census tract 48291701000	TX	$7,251	Very High	Very Low	1.64	$11,859	79.31
3	Census tract 48291701400	TX	$6,493	Very High	Very Low	1.72	$11,182	78.45
4	Census tract 48291701200	TX	$5,991	Very High	Very Low	1.75	$10,475	77.45
5	Census tract 48291700400	TX	$6,642	Relatively High	Very Low	1.35	$8,969	75.15
6	Census tract 48291700802	TX	$5,775	Very High	Very Low	1.55	$8,965	75.14
7	Census tract 48291701100	TX	$7,259	Relatively Moderate	Very Low	1.2	$8,683	74.64
8	Census tract 48291700900	TX	$5,735	Relatively Moderate	Very Low	1.19	$6,802	70.59
9	Census tract 48291700100	TX	$3,330	Very High	Very Low	1.65	$5,500	66.61
10	Census tract 48291700301	TX	$3,083	Very High	Very Low	1.75	$5,408	66.3
11	Census tract 48291700801	TX	$3,702	Relatively High	Very Low	1.3	$4,817	64.04
12	Census tract 48291701300	TX	$3,200	Relatively High	Very Low	1.45	$4,633	63.25
13	Census tract 48291700303	TX	$2,287	Very High	Very Low	1.81	$4,131	60.82
14	Census tract 48291700600	TX	$2,675	Relatively High	Very Low	1.43	$3,836	59.24
15	Census tract 48291700200	TX	$2,198	Very High	Very Low	1.63	$3,578	57.59
16	Census tract 48291700500	TX	$2,678	Relatively High	Very Low	1.27	$3,414	56.56
17	Census tract 48291700700	TX	$2,613	Relatively Low	Very Low	0.97	$2,538	49.25

Figure 6.6.15: FEMA NRI Summary by Census Tract, Liberty County, Winter Weather

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Relatively High	96.17	0 100
2	Census tract 48291701000	TX	Relatively High	93.62	0 100
3	Census tract 48291701400	TX	Relatively High	93.2	0 100
4	Census tract 48291701200	TX	Relatively High	92.31	0 100
5	Census tract 48291701100	TX	Relatively High	91.66	0 100
6	Census tract 48291700400	TX	Relatively High	90.71	0 100
7	Census tract 48291700802	TX	Relatively High	90.56	0 100
8	Census tract 48291700301	TX	Relatively High	87.73	0 100
9	Census tract 48291700900	TX	Relatively High	87.56	0 100
10	Census tract 48291700100	TX	Relatively High	87.55	0 100
11	Census tract 48291700303	TX	Relatively Moderate	83.78	0 100
12	Census tract 48291700801	TX	Relatively Moderate	82.38	0 100
13	Census tract 48291701300	TX	Relatively Moderate	81.61	0 100
14	Census tract 48291700200	TX	Relatively Moderate	81.6	0 100
15	Census tract 48291700600	TX	Relatively Moderate	77.45	0 100
16	Census tract 48291700500	TX	Relatively Moderate	75.51	0 100
17	Census tract 48291700700	TX	Relatively Moderate	69.59	0 100

Figure 6.6.16: FEMA NRI EAL Summary by Census Tract, Liberty County, Winter Weather

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$21,284	Very High	Very Low	1.53	$32,652	96.17
2	Census tract 48291701000	TX	$13,146	Very High	Very Low	1.64	$21,500	93.62
3	Census tract 48291701400	TX	$11,773	Very High	Very Low	1.72	$20,277	93.2
4	Census tract 48291701200	TX	$10,461	Very High	Very Low	1.75	$18,291	92.31
5	Census tract 48291701100	TX	$14,254	Relatively Moderate	Very Low	1.2	$17,050	91.66
6	Census tract 48291700400	TX	$11,434	Relatively High	Very Low	1.35	$15,438	90.71
7	Census tract 48291700802	TX	$9,807	Very High	Very Low	1.55	$15,224	90.56
8	Census tract 48291700301	TX	$6,758	Very High	Very Low	1.75	$11,855	87.73
9	Census tract 48291700900	TX	$9,864	Relatively Moderate	Very Low	1.19	$11,699	87.56
10	Census tract 48291700100	TX	$7,076	Very High	Very Low	1.65	$11,686	87.55
11	Census tract 48291700303	TX	$4,887	Very High	Very Low	1.81	$8,827	83.78
12	Census tract 48291700801	TX	$6,169	Relatively High	Very Low	1.3	$8,028	82.38
13	Census tract 48291701300	TX	$5,279	Relatively High	Very Low	1.45	$7,642	81.61
14	Census tract 48291700200	TX	$4,694	Very High	Very Low	1.63	$7,639	81.6
15	Census tract 48291700600	TX	$4,177	Relatively High	Very Low	1.43	$5,991	77.45
16	Census tract 48291700500	TX	$4,236	Relatively High	Very Low	1.27	$5,401	75.51
17	Census tract 48291700700	TX	$4,058	Relatively Low	Very Low	0.97	$3,942	69.59

Climate Change Impacts

As stated above, the Gulf Coast and Southeast Texas region are generally not used to snow, ice, and freezing temperatures. According to the Office of the Texas State Climatologist, in the southern part of the state and in coastal regions, snow is rare, but large accumulations of snow are possible. Climate model projections have shown the risk of snowfall consistently decreases in climates like that of Texas.[47]

Table 6.6.11: Climate Change Impacts, Winter Weather

Location	The location of winter weather is not expected to change.
Extent/Intensity	The extent of winter weather is not expected to change.
Frequency	The frequency of winter weather is expected to decrease.
Duration	The duration of winter weather is expected to decrease.

Section 6.7: Wildfire

6.7 Wildfire

Wildfire refers to any non-structure fire that occurs in the wildland, an area in which development is essentially nonexistent except for roads, railroads, power lines, and similar transportation or utility structures. This definition does not refer to fires that are conducted via prescribed burns.[92] Wildfires typically occur more often in the summer during dry months and can be exacerbated by droughts or drought-like conditions when plants and other brush contain less moisture and easily ignite. In Texas, nearly 85 percent of wildfires occur within two miles of a community. Wildfires can be ignited by a variety of causes from lightning strikes, downed powerlines, smoking (or improper disposal of cigarettes), debris burning, and fireworks.

Location

This is a reoccurring natural hazard in every Texas county and has no geographic boundary. The Texas Wildfire Risk Assessment (TWRA) Explorer is the primary mechanism for the Texas A&M Forest Service to deploy wildfire risk information and create awareness about wildfire issues across the state.[93] The Texas Wildfire Risk Assessment Portal (TxWRAP) allows users to easily view their wildfire risk online. TxWRAP uses a variety of factors such as wildfire threat, wildland urban interface, surface fuels, historic wildfire ignitions, fire behavior, and much more to determine the fire potential of specific land areas and depicts through a set of rating areas that are most prone to wildfires.[94] Particularly vulnerable are the Wildland Urban Interface (WUI) areas. The WUI is the area where development, people, and homes, mix with areas of wildland or other vegetation. It is within these areas that wildfire risks substantially increase. With continued population growth throughout the county, the WUI zones will become more abundant. Since most wildfires are caused by human activities, the intersection of WUI and drought is particularly dangerous. Wildfires and their size can vary greatly depending on a variety of factors such as location, fire intensity, and duration.

It is estimated that 66,357 people or 87.9 % percent of residents within Liberty County live within the WUI. The tables and figures below depict the population and acreage in each of the WUI zones within the county and participating jurisdictions, which closely follow housing density. Darker colors of purple depict higher housing densities. WUI housing density is categorized based on the standard Federal Register and U.S. Forest Service (USFS) SILVIS data set categories. The number of housing density categories is extended to provide a better gradation of housing distribution to meet specific requirements for fire protection planning activities. While units of the data set are in houses per sq. km., which is consistent with other data such as USFS SILVIS, the data is presented as the number of houses per acre to aid with interpretation and use in Texas. LT 1hs/40ac refers to less than 1 house per 40 acres. GT 3hs/1ac refers to greater than 3 houses per acre.[89]

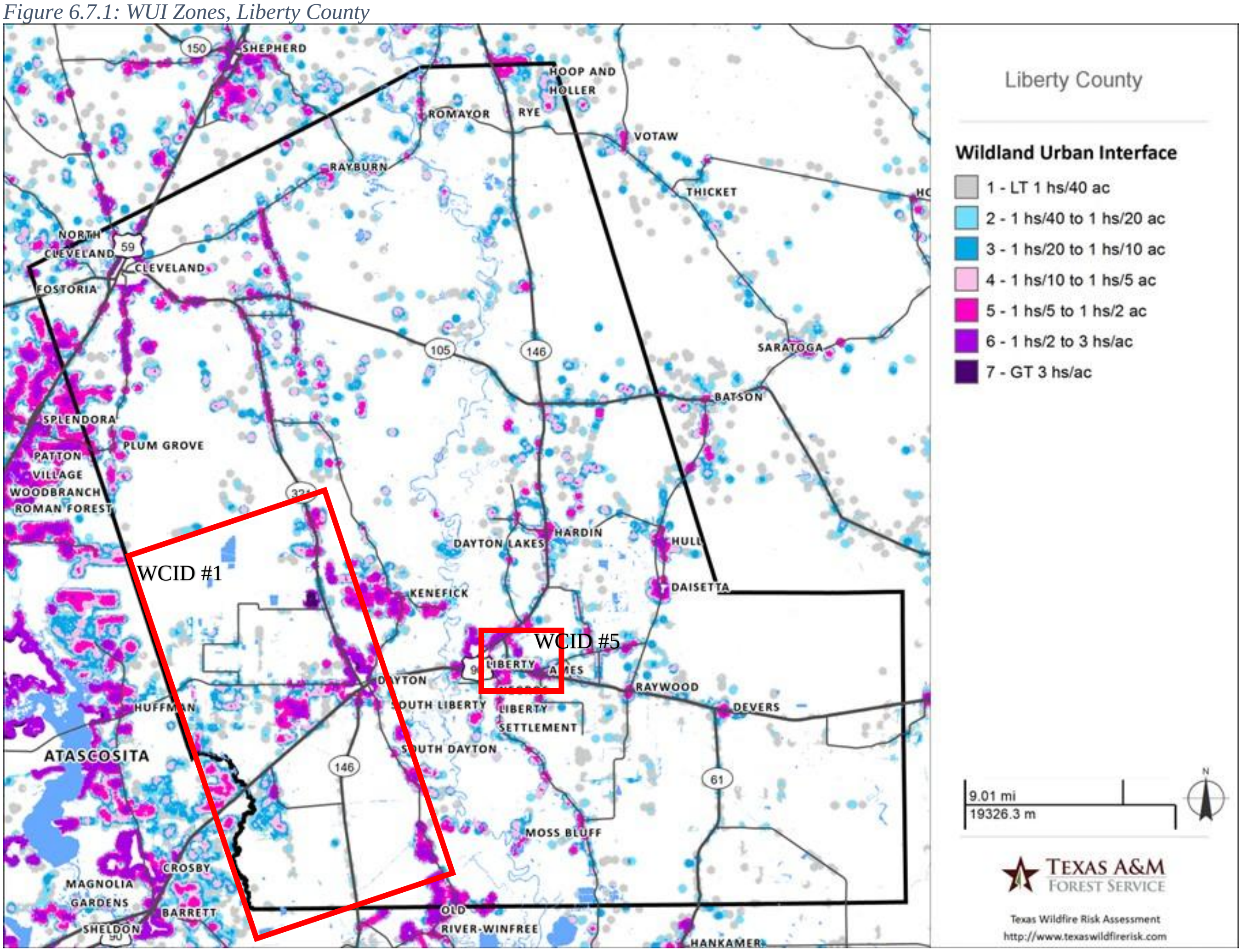
Table 6.7.1: Summary of WUI Population and Acres

Project Area	Total Population	Population in WUI	% Population in WUI
Liberty County	75,518	66,357	87.9%
City of Ames	1,061	1,061	100%
City of Cleveland	7,529	3,060	40.6%
City of Daisetta	999	813	81.4%
City of Dayton	6,621	5,156	77.9%
City of Devers	412	412	100%
City of Hardin	724	721	99.6%
City of Kenefick	760	760	100%
City of Liberty	7,634	5,453	71.4%
City of North Cleveland	319	319	100%
City of Plum Grove	959	960	99.9%

Table 6.7.2: WUI Population and Acres, Liberty County

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	1,136	1.7 %	56,535	32.5 %
	1hs/40ac to 1hs/20ac	2,020	3.0 %	26,944	15.5 %
	1hs/20ac to 1hs/10ac	4,357	6.6 %	30,446	17.5 %
	1hs/10ac to 1hs/5ac	9,671	14.6 %	27,252	15.7 %
	1hs/5ac to 1hs/2ac	18,398	27.7 %	22,310	12.8 %
	1hs/2ac to 3hs/1ac	25,190	38.0 %	10,096	5.8 %
	GT 3hs/1ac	5,585	8.4 %	266	0.2 %
	Total	**66,357**	**100.0 %**	**173,849**	**100.0 %**

Figure 6.7.1: WUI Zones, Liberty County



Liberty County WCID #1 and #5 boundaries are depicted by the red outlined areas above. Shapes are approximate and not the actual boundaries of the WCIDs.

Table 6.7.3: WUI Population and Acres, City of Ames

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	10	0.9 %	234	14.6 %
	1hs/40ac to 1hs/20ac	3	0.3 %	135	8.4 %
	1hs/20ac to 1hs/10ac	29	2.7 %	244	15.2 %
	1hs/10ac to 1hs/5ac	113	10.7 %	329	20.5 %
	1hs/5ac to 1hs/2ac	410	38.6 %	442	27.5 %
	1hs/2ac to 3hs/1ac	496	46.7 %	224	13.9 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**1,061**	**100.0 %**	**1,608**	**100.0 %**

Figure 6.7.2: WUI Zones, City of Ames

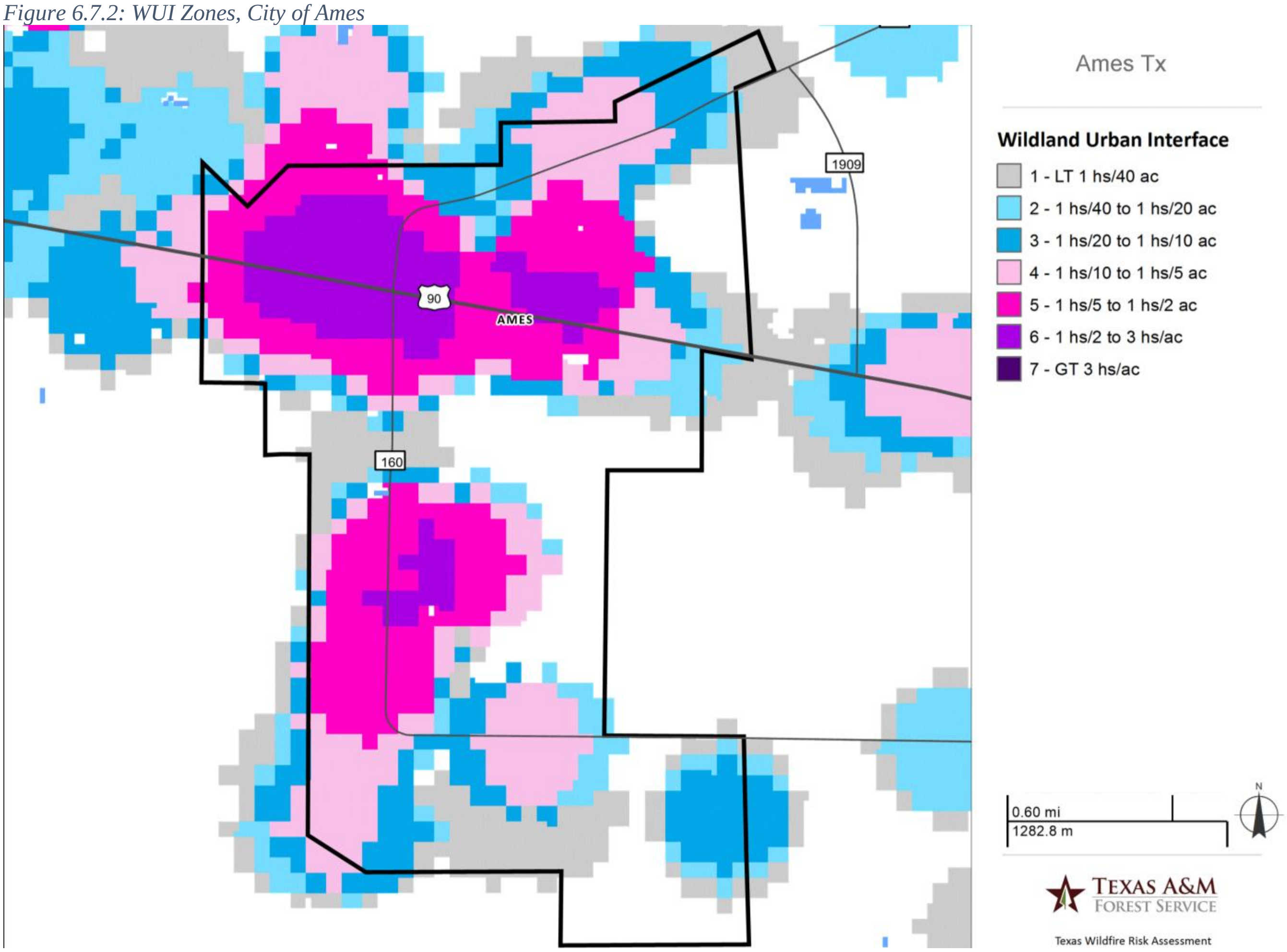


Table 6.7.4: WUI Population and Acres, City of Cleveland

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	9	0.3 %	220	14.2 %
	1hs/40ac to 1hs/20ac	0	0.0 %	72	4.6 %
	1hs/20ac to 1hs/10ac	3	0.1 %	59	3.8 %
	1hs/10ac to 1hs/5ac	20	0.7 %	121	7.8 %
	1hs/5ac to 1hs/2ac	101	3.3 %	268	17.2 %
	1hs/2ac to 3hs/1ac	2,927	95.7 %	814	52.4 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	3,060	100.0 %	1,554	100.0 %

Figure 6.7.3: WUI Zones, City of Cleveland

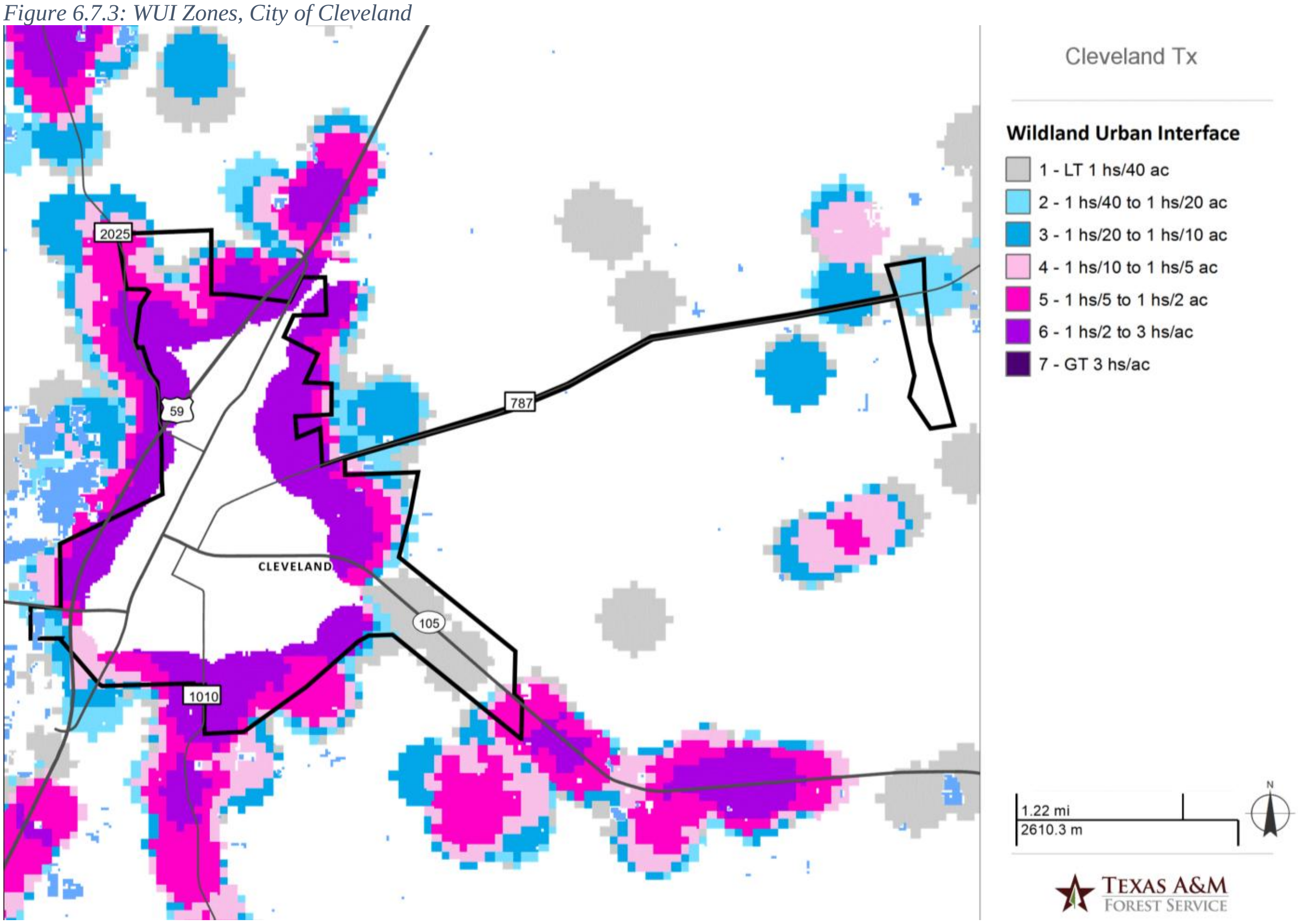


Table 6.7.5: WUI Population and Acres, City of Daisetta

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	4	0.5 %	71	9.2 %
	1hs/40ac to 1hs/20ac	7	0.9 %	48	6.2 %
	1hs/20ac to 1hs/10ac	14	1.7 %	82	10.6 %
	1hs/10ac to 1hs/5ac	38	4.7 %	124	16.1 %
	1hs/5ac to 1hs/2ac	206	25.3 %	221	28.6 %
	1hs/2ac to 3hs/1ac	544	66.9 %	226	29.3 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**813**	**100.0 %**	**772**	**100.0 %**

Figure 6.7.4: WUI Zones, City of Daisetta

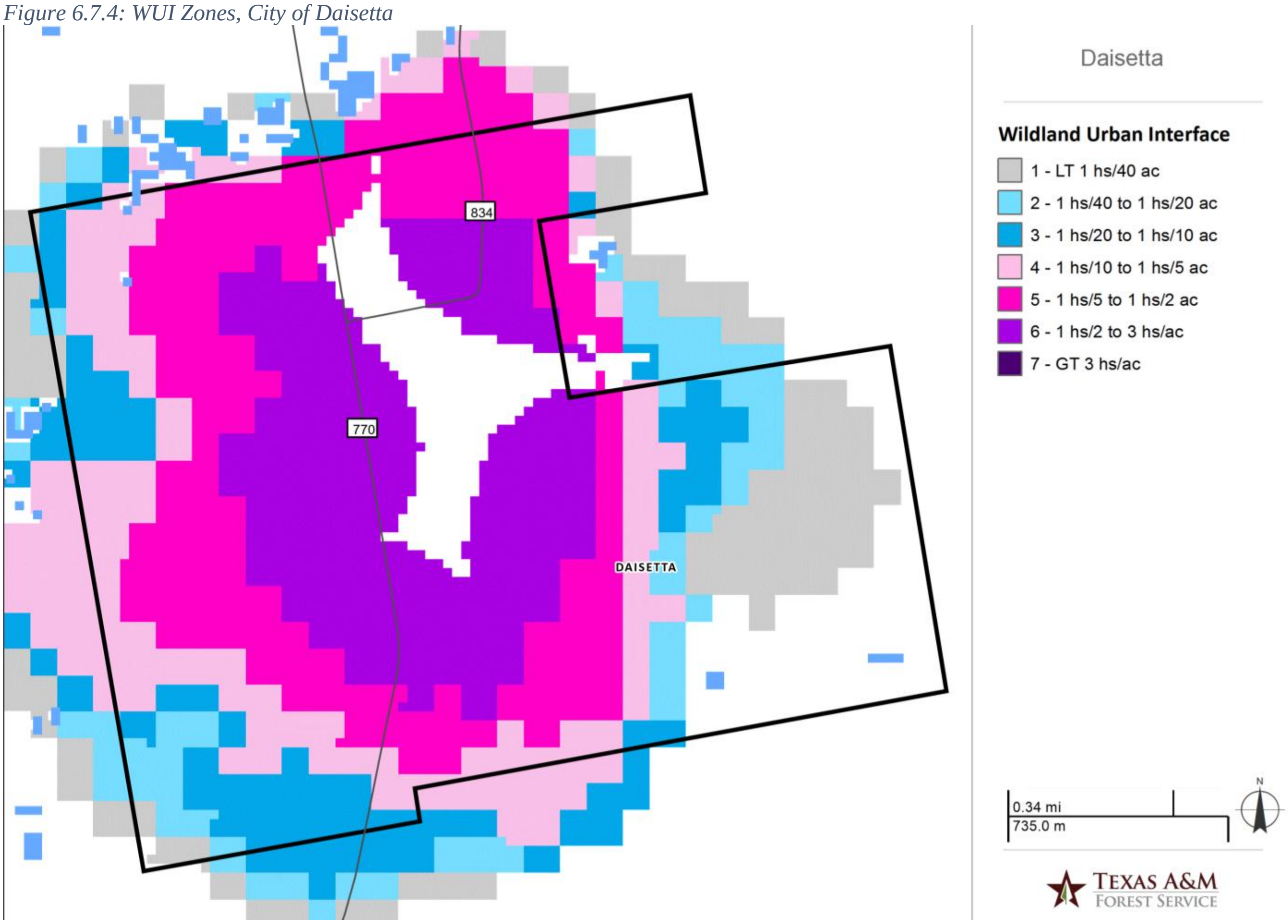


Table 6.7.6: WUI Population and Acres, City of Dayton

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	7	0.1 %	604	15.3 %
	1hs/40ac to 1hs/20ac	11	0.2 %	244	6.2 %
	1hs/20ac to 1hs/10ac	39	0.8 %	446	11.3 %
	1hs/10ac to 1hs/5ac	167	3.2 %	666	16.9 %
	1hs/5ac to 1hs/2ac	407	7.9 %	765	19.4 %
	1hs/2ac to 3hs/1ac	4,133	80.2 %	1,193	30.2 %
	GT 3hs/1ac	392	7.6 %	33	0.8 %
	Total	**5,156**	**100.0 %**	**3,951**	**100.0 %**

Figure 6.7.5: WUI Zones, City of Dayton

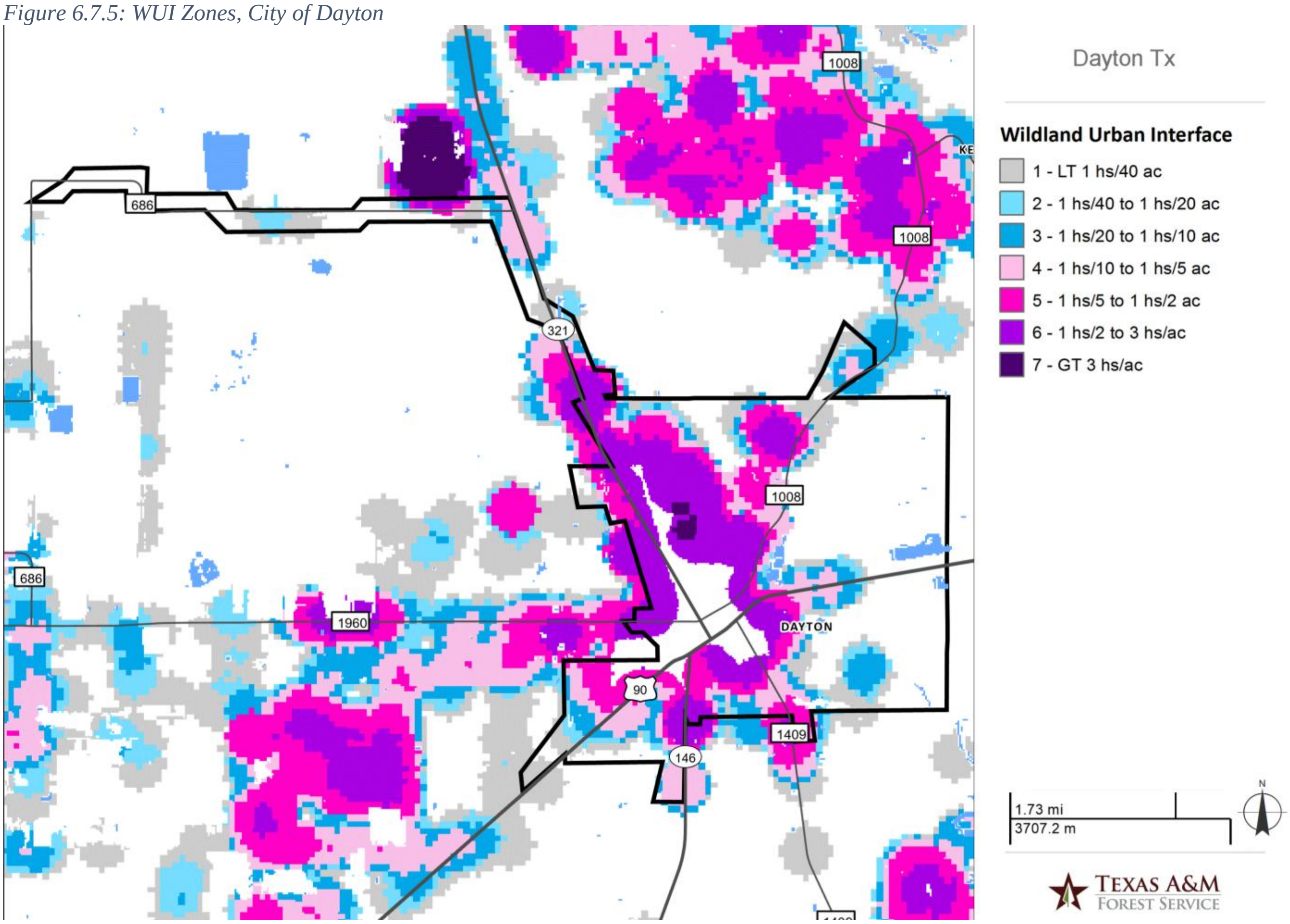


Table 6.7.7: WUI Population and Acres, City of Devers

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	2	0.5 %	56	7.5 %
	1hs/40ac to 1hs/20ac	10	2.4 %	88	11.8 %
	1hs/20ac to 1hs/10ac	54	13.1 %	241	32.2 %
	1hs/10ac to 1hs/5ac	41	10.0 %	120	16.0 %
	1hs/5ac to 1hs/2ac	99	24.0 %	174	23.3 %
	1hs/2ac to 3hs/1ac	206	50.0 %	69	9.2 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**412**	**100.0 %**	**748**	**100.0 %**

Figure 6.7.6: WUI Zones, City of Devers

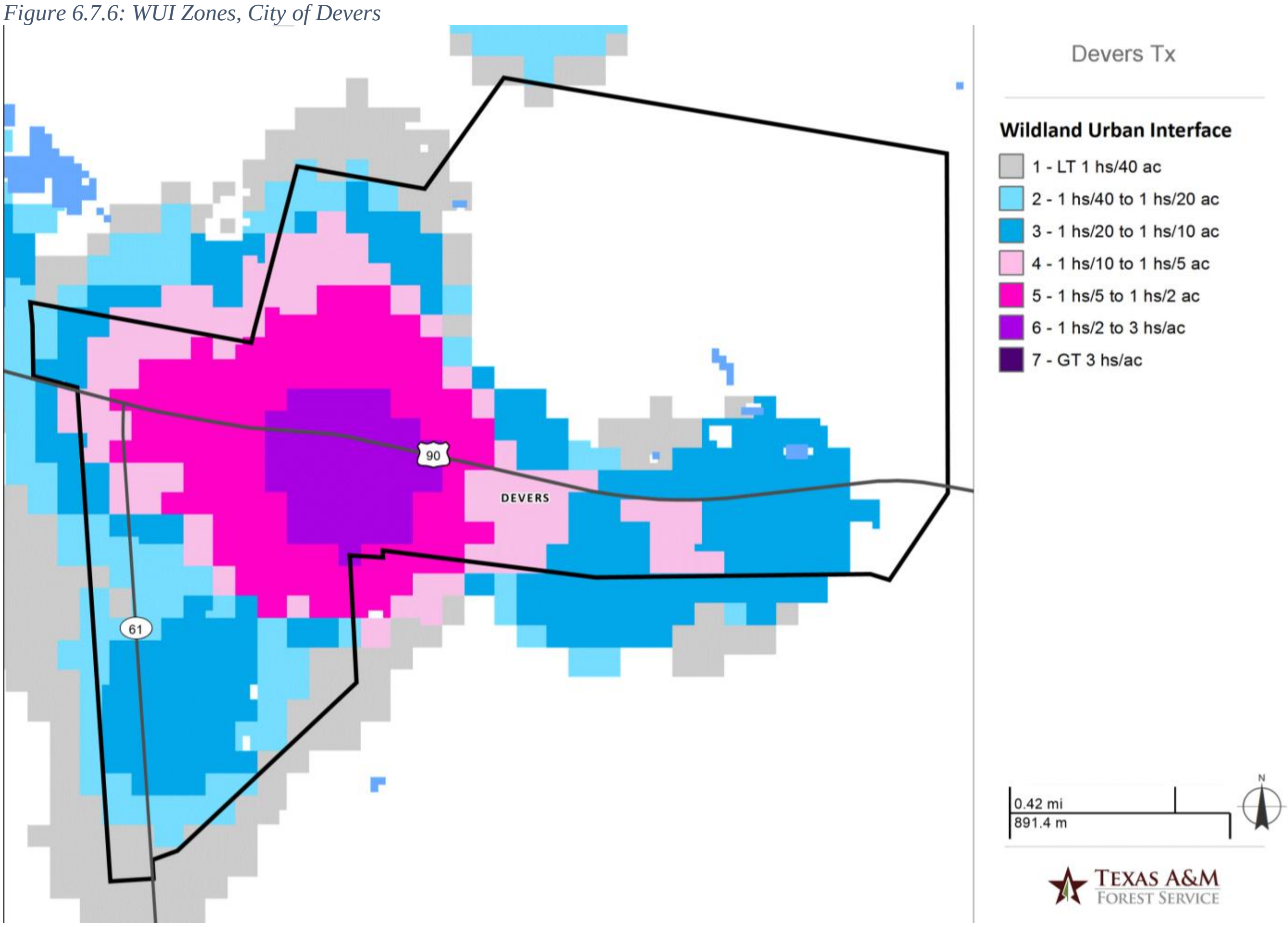


Table 6.7.8: WUI Population and Acres, City of Hardin

Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
LT 1hs/40ac	4	0.6 %	128	9.7 %
1hs/40ac to 1hs/20ac	12	1.7 %	128	9.7 %
1hs/20ac to 1hs/10ac	56	7.8 %	284	21.6 %
1hs/10ac to 1hs/5ac	179	24.8 %	390	29.7 %
1hs/5ac to 1hs/2ac	262	36.3 %	288	21.9 %
1hs/2ac to 3hs/1ac	208	28.8 %	95	7.2 %
GT 3hs/1ac	0	0.0 %	0	0.0 %
Total	**721**	**100.0 %**	**1,313**	**100.0 %**

Figure 6.7.7: WUI Zones, City of Hardin

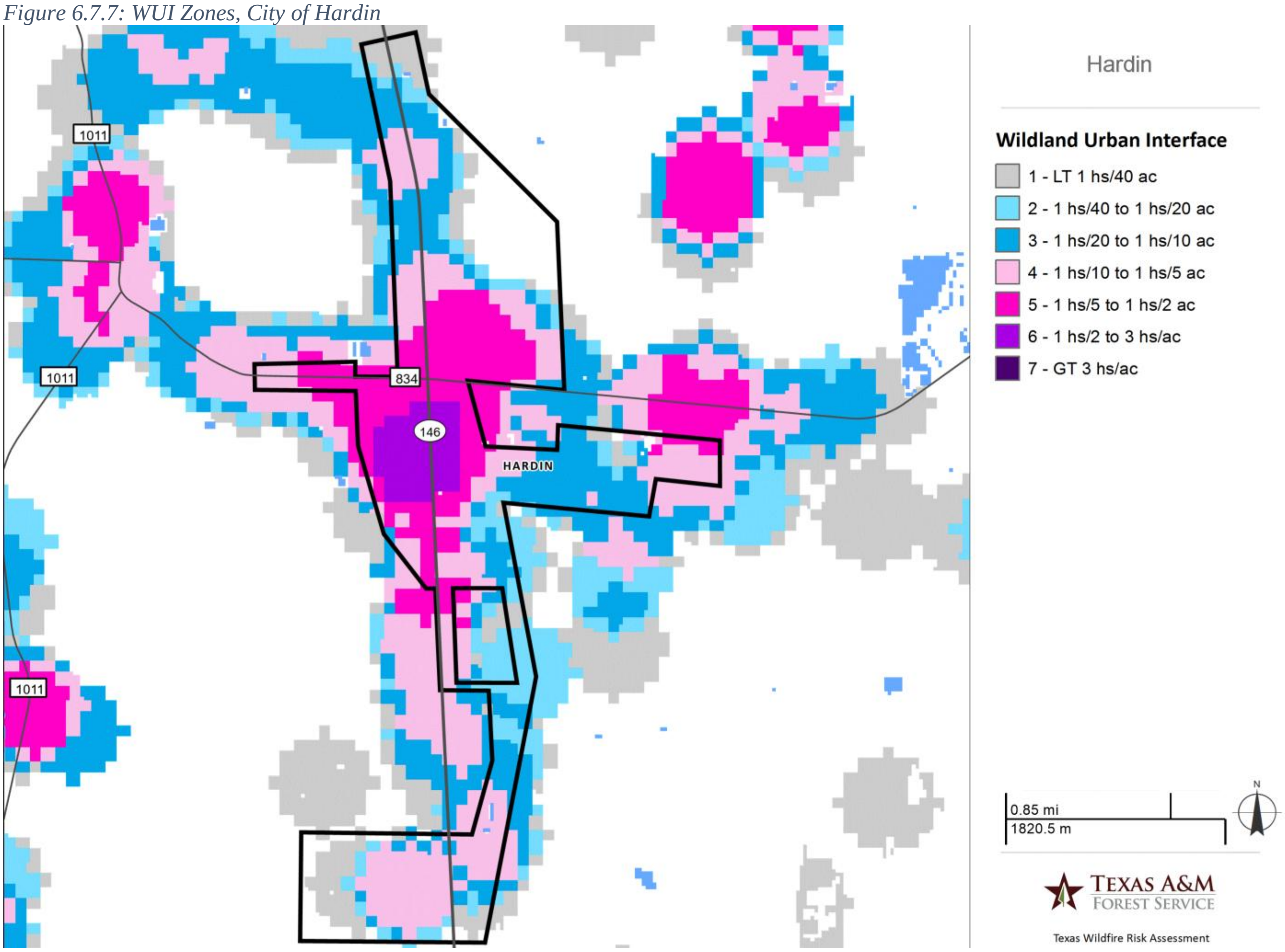


Table 6.7.9: WUI Population and Acres, City of Kenefick

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	0	0.0 %	25	2.6 %
	1hs/40ac to 1hs/20ac	12	1.6 %	42	4.4 %
	1hs/20ac to 1hs/10ac	34	4.5 %	136	14.4 %
	1hs/10ac to 1hs/5ac	42	5.5 %	169	17.9 %
	1hs/5ac to 1hs/2ac	579	76.2 %	493	52.2 %
	1hs/2ac to 3hs/1ac	93	12.2 %	80	8.5 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**760**	**100.0 %**	**945**	**100.0 %**

Figure 6.7.8: WUI Zones, City of Kenefick

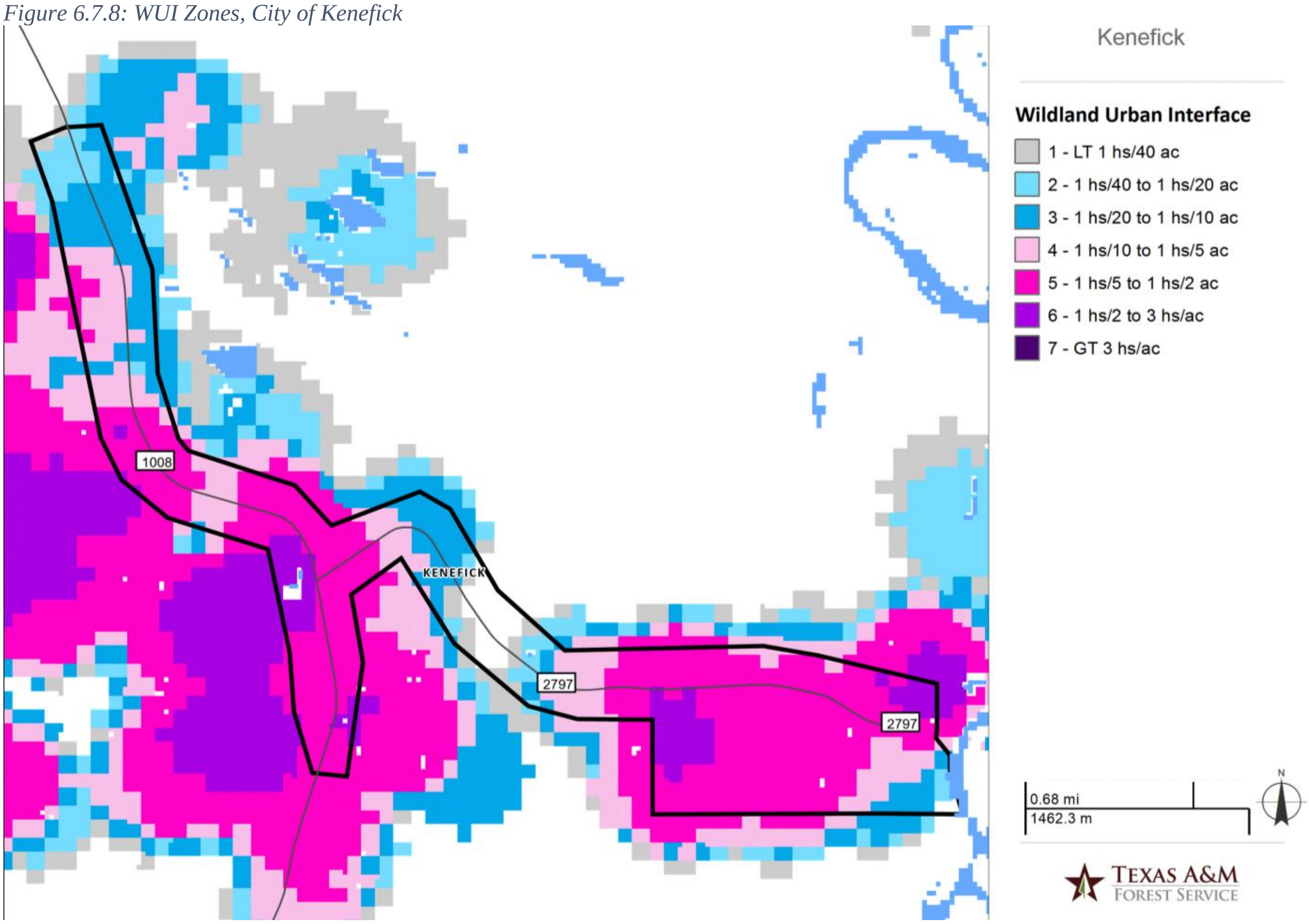


Table 6.7.10: WUI Population and Acres, City of Liberty

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	29	0.5 %	1,742	21.5 %
	1hs/40ac to 1hs/20ac	49	0.9 %	926	11.4 %
	1hs/20ac to 1hs/10ac	84	1.5 %	960	11.9 %
	1hs/10ac to 1hs/5ac	243	4.5 %	1,163	14.4 %
	1hs/5ac to 1hs/2ac	1,494	27.4 %	1,959	24.2 %
	1hs/2ac to 3hs/1ac	3,546	65.0 %	1,343	16.6 %
	GT 3hs/1ac	8	0.1 %	3	0.0 %
	Total	**5,453**	**100.0 %**	**8,096**	**100.0 %**

Figure 6.7.9: WUI Zones, City of Liberty

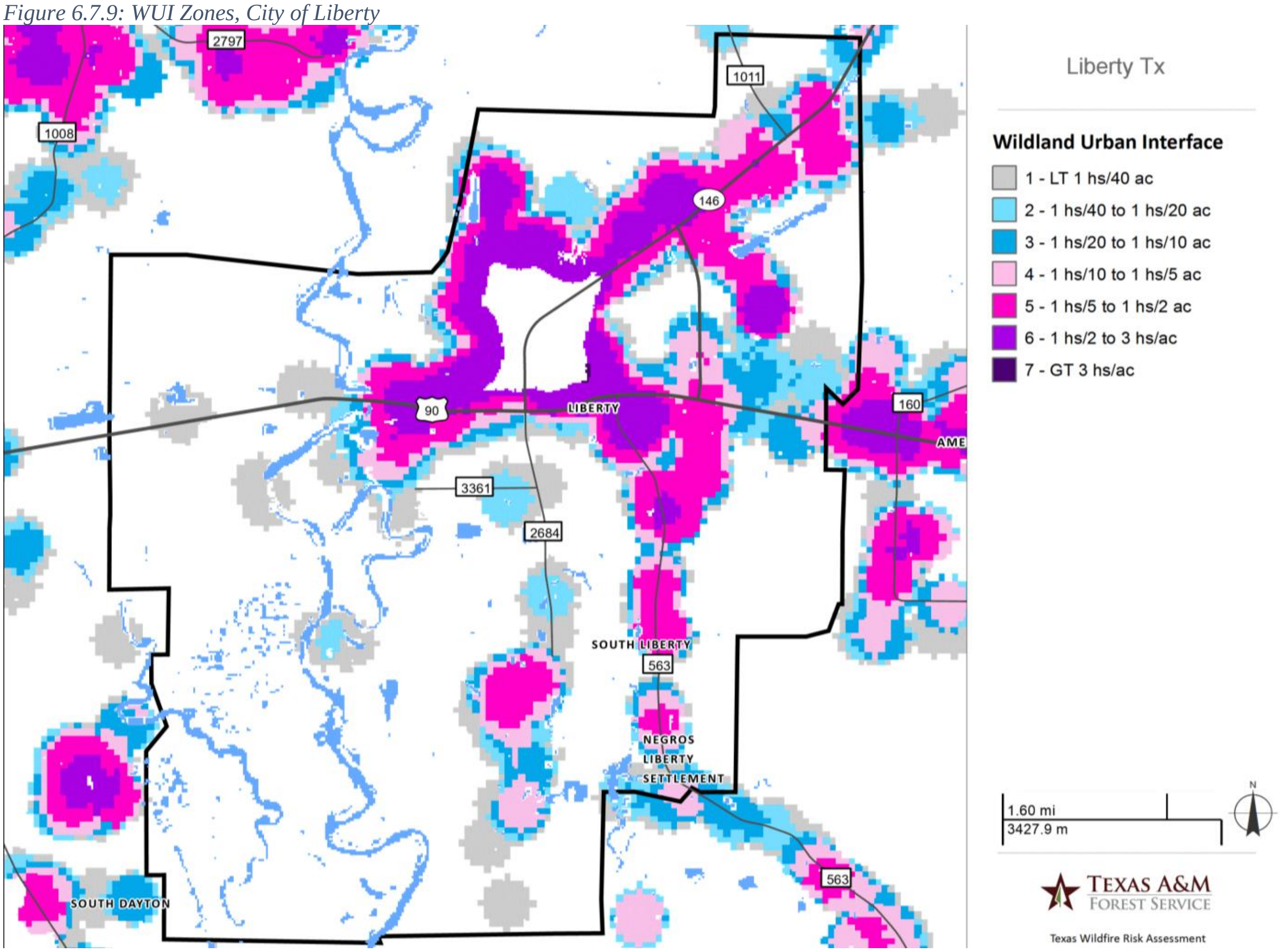


Table 6.7.11: WUI Population and Acres, City of North Cleveland

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	4	1.3 %	90	13.5 %
	1hs/40ac to 1hs/20ac	0	0.0 %	45	6.7 %
	1hs/20ac to 1hs/10ac	19	6.0 %	155	23.2 %
	1hs/10ac to 1hs/5ac	18	5.6 %	86	12.9 %
	1hs/5ac to 1hs/2ac	80	25.1 %	159	23.8 %
	1hs/2ac to 3hs/1ac	198	62.1 %	134	20.0 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**319**	**100.0 %**	**669**	**100.0 %**

Figure 6.7.10: WUI Zones, City of North Cleveland

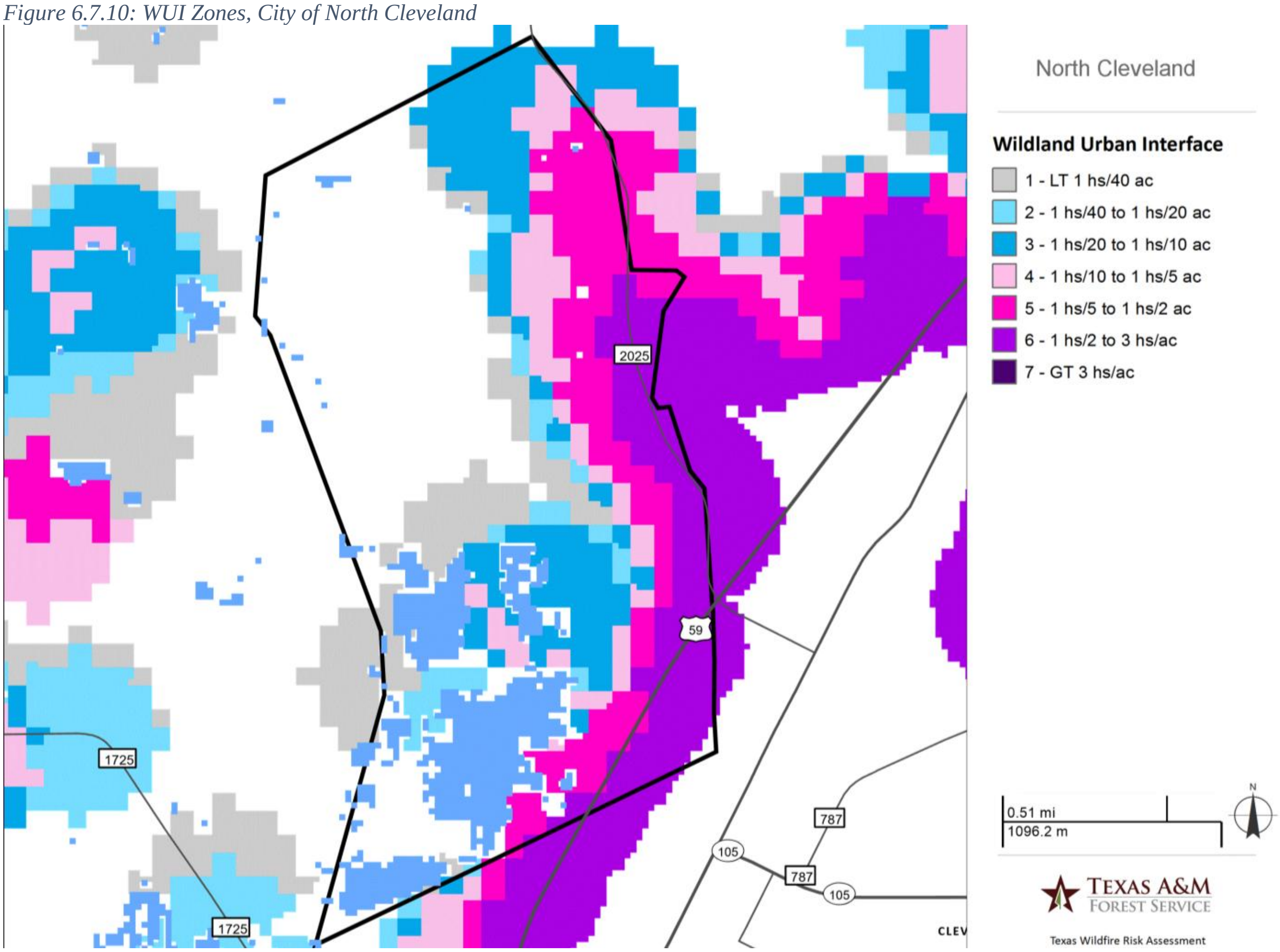


Table 6.7.12: WUI Population and Acres, City of Plum Grove

	Housing Density	WUI Population	Percent of WUI Population	WUI Acres	Percent of WUI Acres
	LT 1hs/40ac	4	0.4 %	319	13.9 %
	1hs/40ac to 1hs/20ac	2	0.2 %	234	10.2 %
	1hs/20ac to 1hs/10ac	52	5.4 %	443	19.3 %
	1hs/10ac to 1hs/5ac	182	19.0 %	577	25.1 %
	1hs/5ac to 1hs/2ac	719	75.0 %	718	31.3 %
	1hs/2ac to 3hs/1ac	0	0.0 %	4	0.2 %
	GT 3hs/1ac	0	0.0 %	0	0.0 %
	Total	**959**	**100.0 %**	**2,295**	**100.0 %**

Figure 6.7.11: WUI Zones, City of Plum Grove

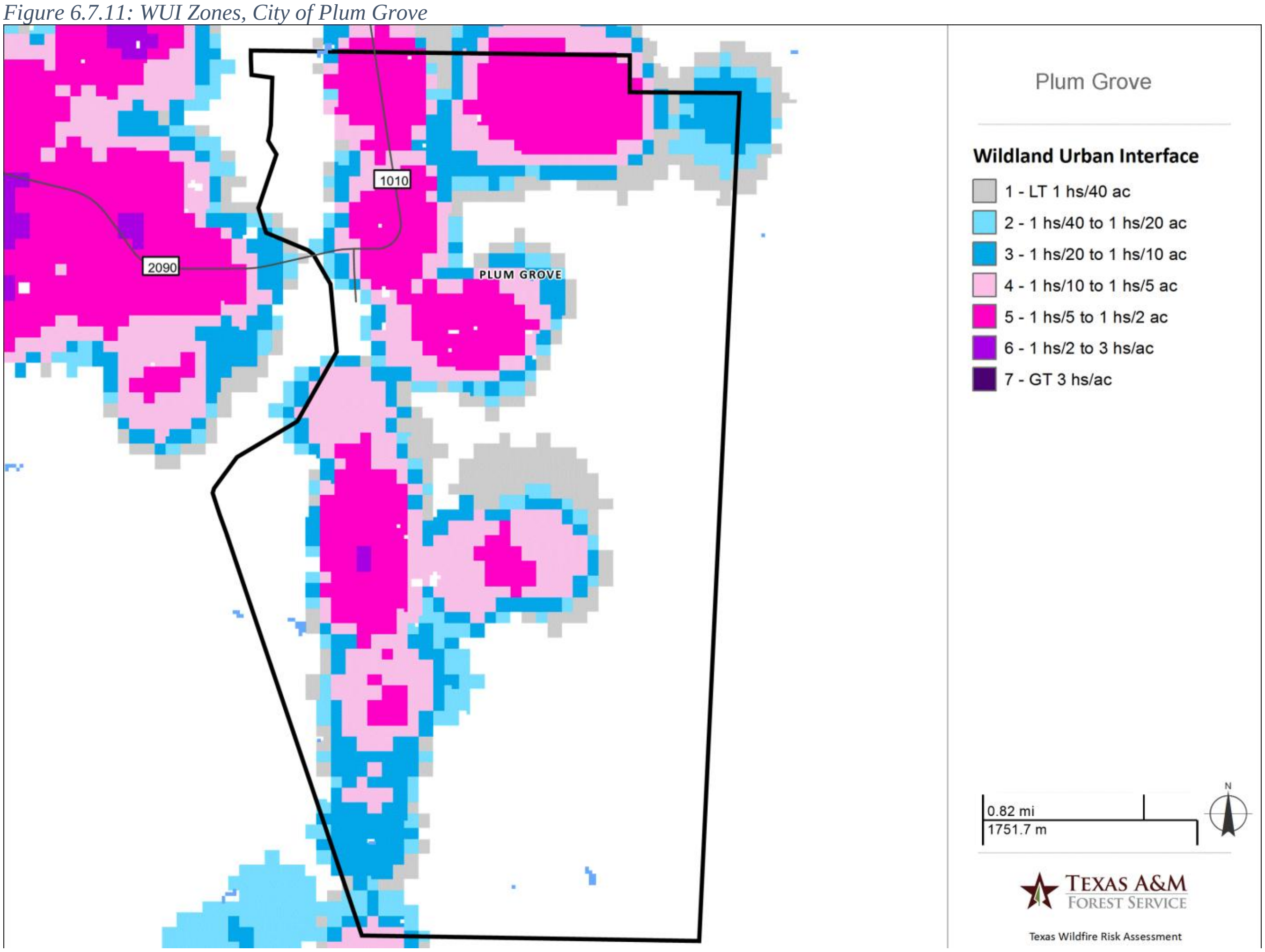
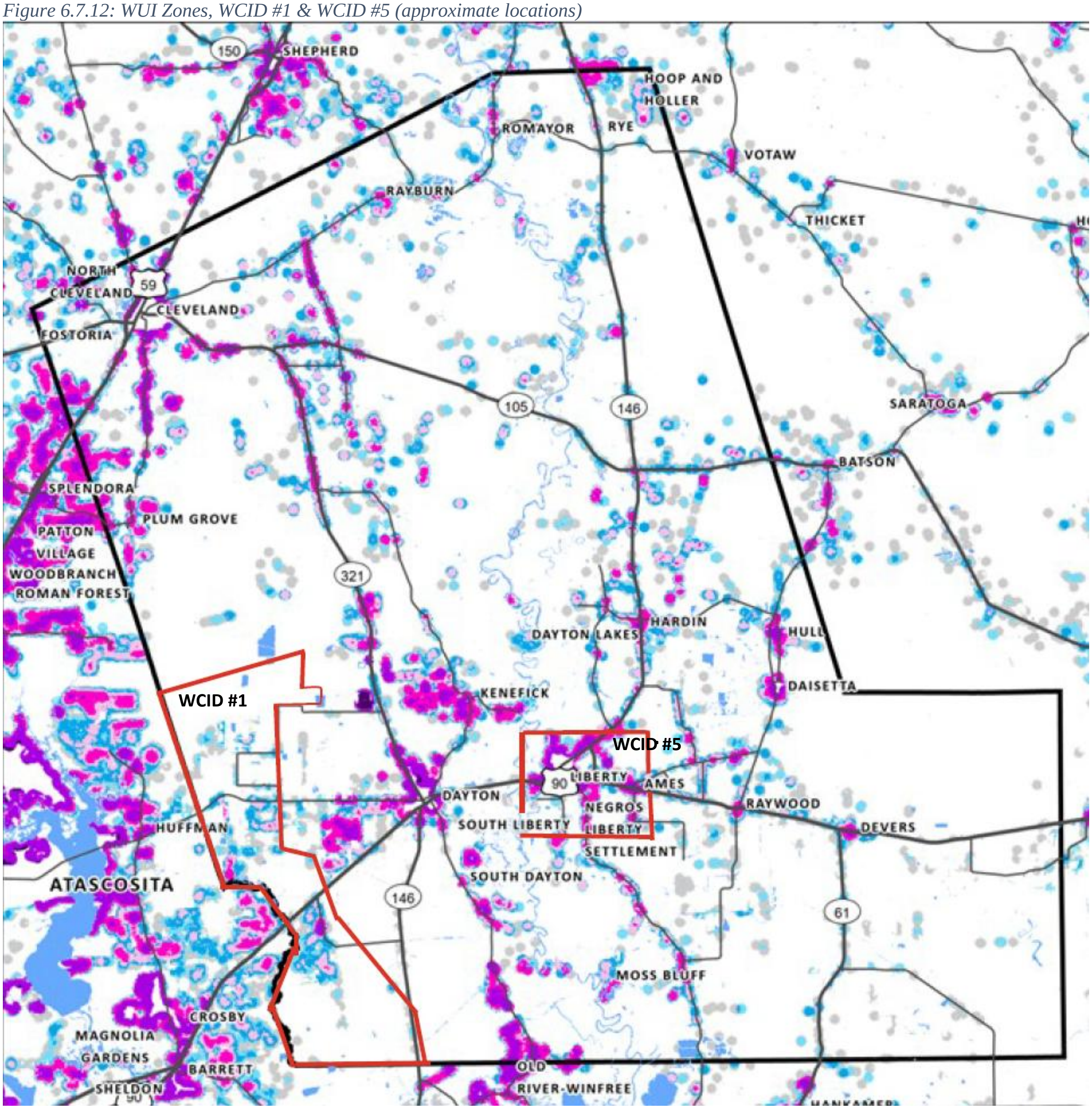


Figure 6.7.12: WUI Zones, WCID #1 & WCID #5 (approximate locations)



Extent

Characteristic Fire Intensity Scale (FIS) specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on a weighted average of four percentile weather categories. This is like the Richter scale for earthquakes. FIS provides a standard scale to measure potential wildfire intensity. FIS consists of 5 classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities, and the maximum class, Class 5, represents very high wildfire intensities. The Characteristic FIS is described in the table below.

Table 6.7.13: Characteristic FIS Descriptions

	Wildfire Intensity Class	Description
	1- Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
	2- Low	Small flames, usually less than two feet long; small amount of very short-range spotting possible. Fires are easy to suppress by trained firefighters with protective equipment and specialized tools.
	3- Moderate	Flames up to 8 feet in length; short-range spotting is possible. Trained firefighters will find these fires difficult to suppress without support from aircraft or engines, but dozer and plows are generally effective. Increasing potential for harm or damage to life and property.
	4- High	Large Flames, up to 30 feet in length; short-range spotting common; medium range spotting possible. Direct attack by trained firefighters, engines, and dozers is generally ineffective, indirect attack may be effective. Significant potential for harm or damage to life and property.
	5- Very High	Very large flames up to 150 feet in length; profuse short-range spotting, frequent long-range spotting; strong fire-induced winds. Indirect attack marginally effective at the head of the fire. Great potential for harm or damage to life and property.

The table below show the class, acreage, and percent within each class within Liberty County. The figures below shows these wildfire intensity areas from TxWrap in relation to critical facilities within the county and participating jurisdictions. For Liberty County and participating jurisdictions, a majority of land falls within the very low class, followed closely by non-burnable areas, and moderate. Less than 1.3% of the county is within the very high and high class.

Table 6.7.14: Fire Intensity Scale Acreage, Liberty County

	Class	Acres	Percent
	Non-Burnable	133,274	17.7 %
	1 (Very Low)	225,141	30.0 %
	1.5	46,792	6.2 %
	2 (Low)	107,836	14.3 %
	2.5	32,712	4.4 %
	3 (Moderate)	130,590	17.4 %
	3.5	65,236	8.7 %
	4 (High)	9,042	1.2 %
	4.5	933	0.1 %
	5 (Very High)	0	0.0 %
	Totals:	**751,556**	**100.0 %**

Figure 6.7.13: Wildfire Risk, Liberty County

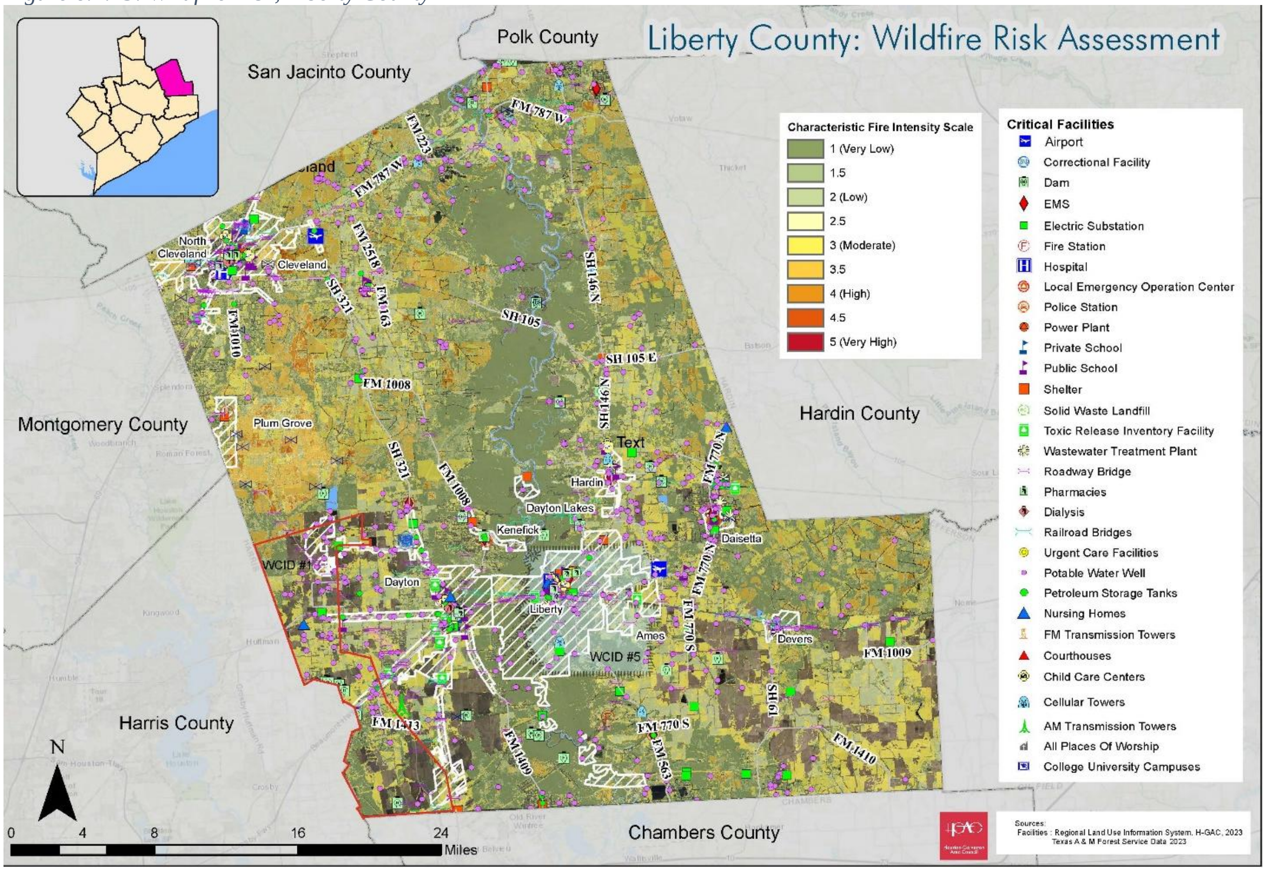


Figure 6.7.14: Wildfire Risk, City of Ames

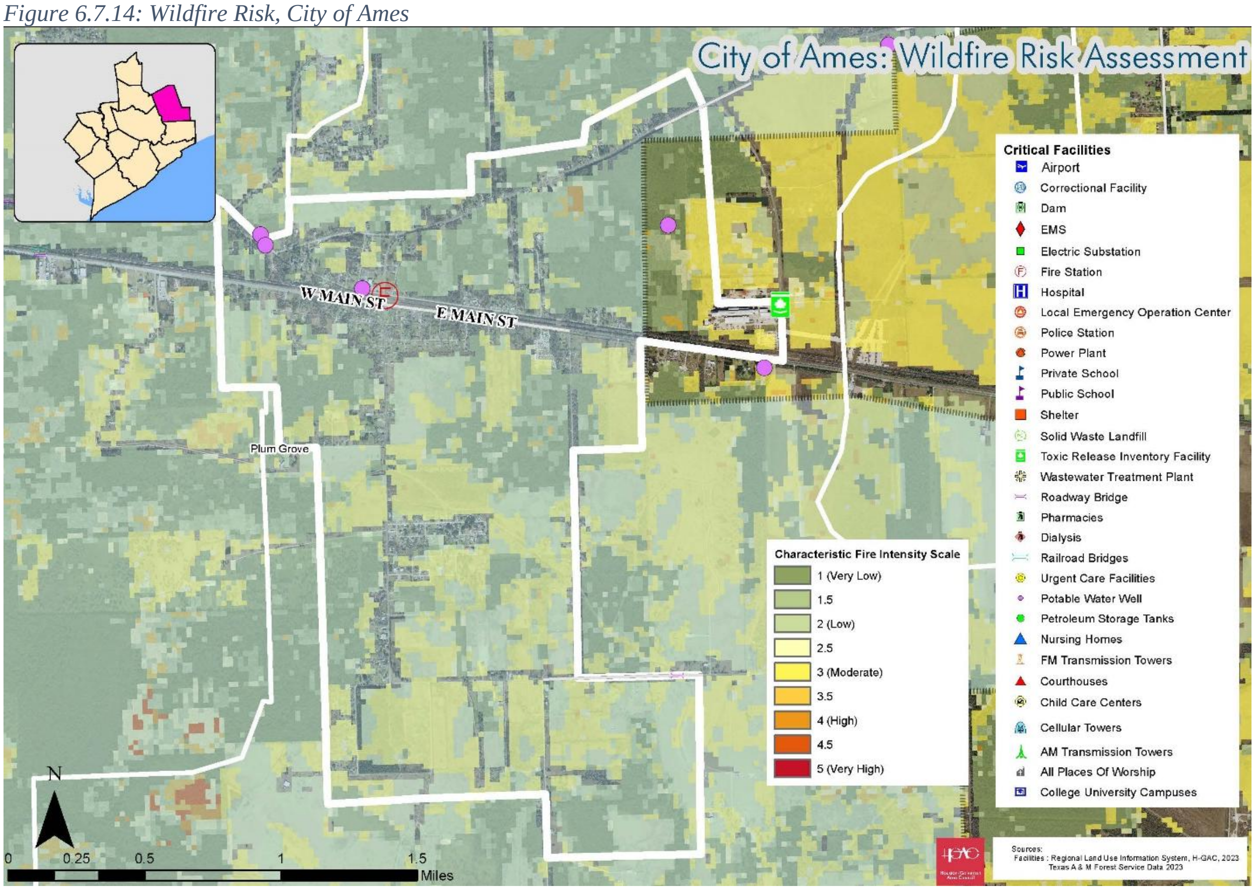


Figure 6.7.15: Wildfire Risk, City of Cleveland

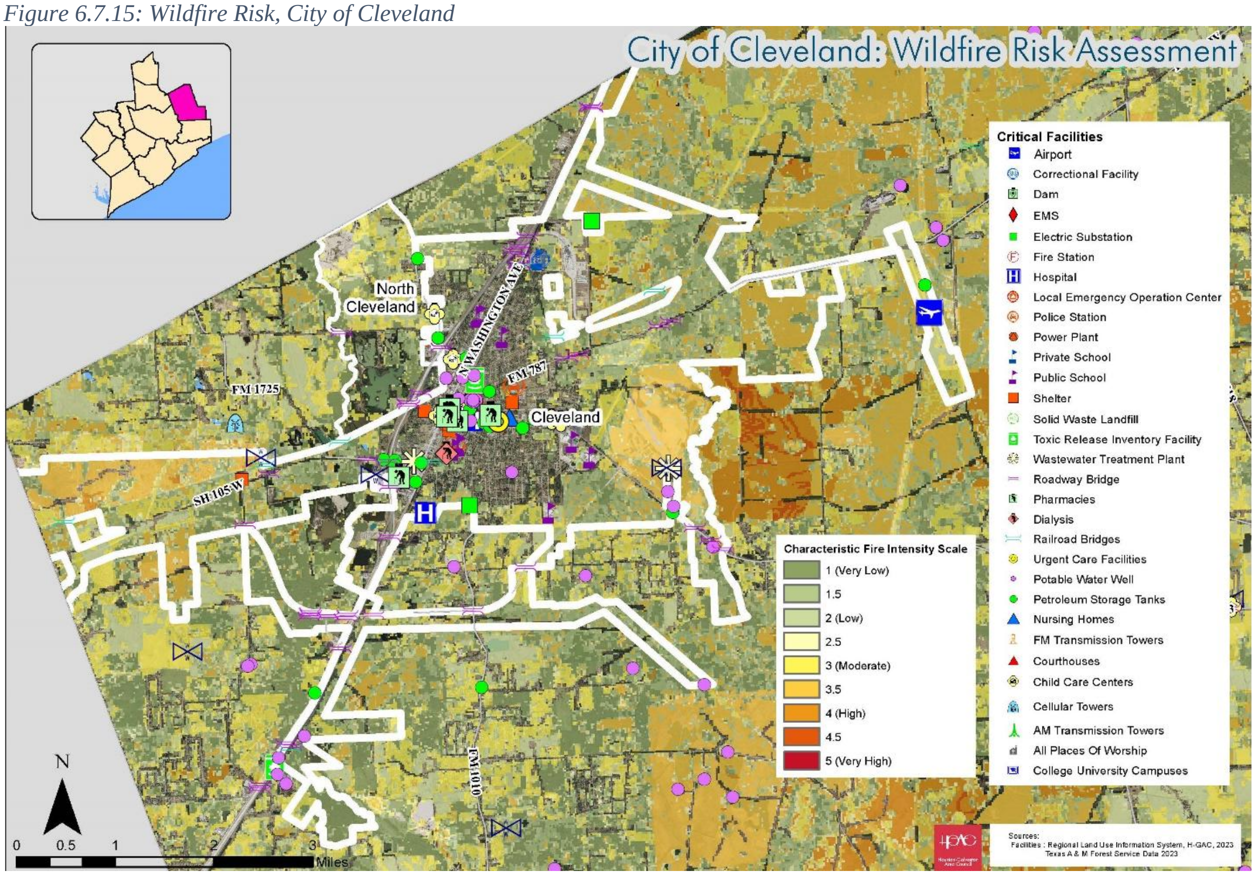


Figure 6.7.16: Wildfire Risk, City of Daisetta

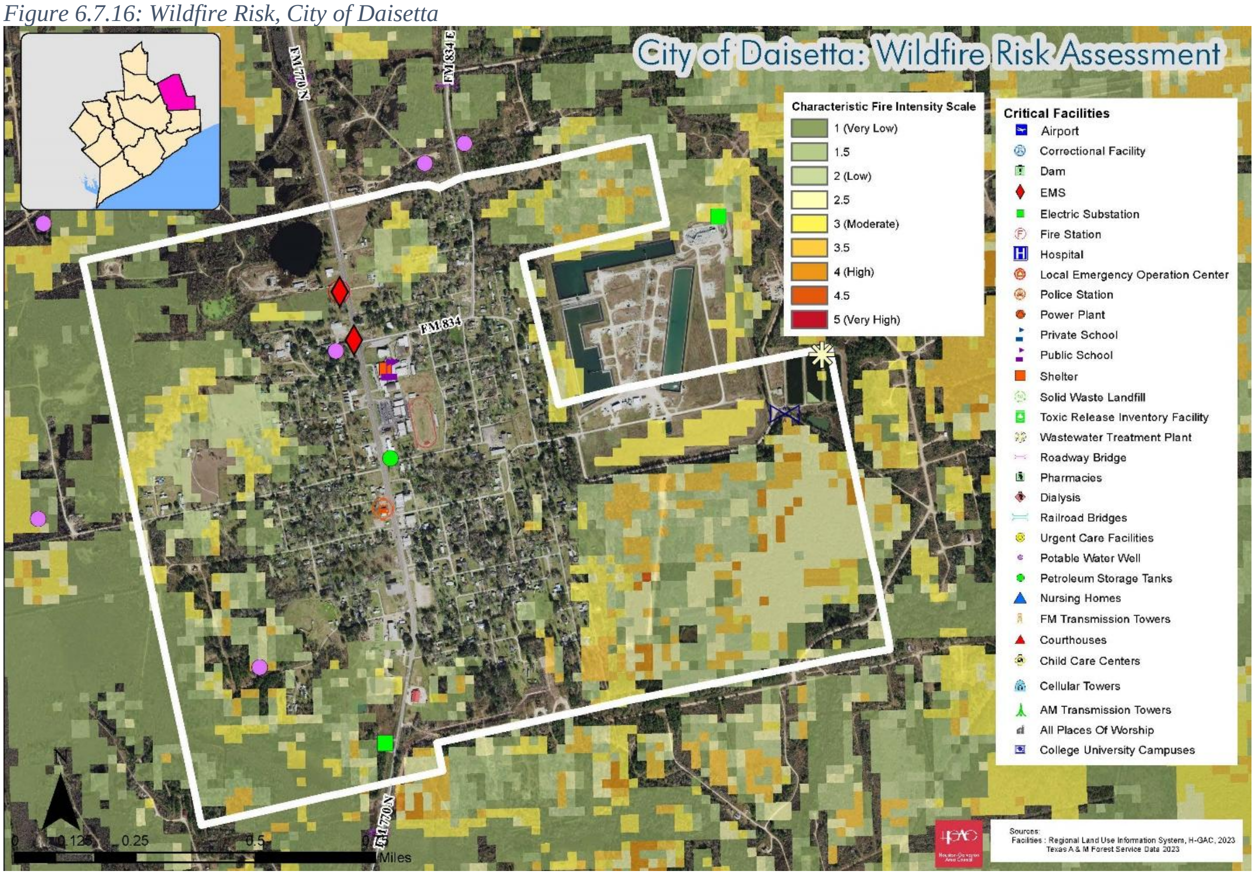


Figure 6.7.17: Wildfire Risk, City of Dayton

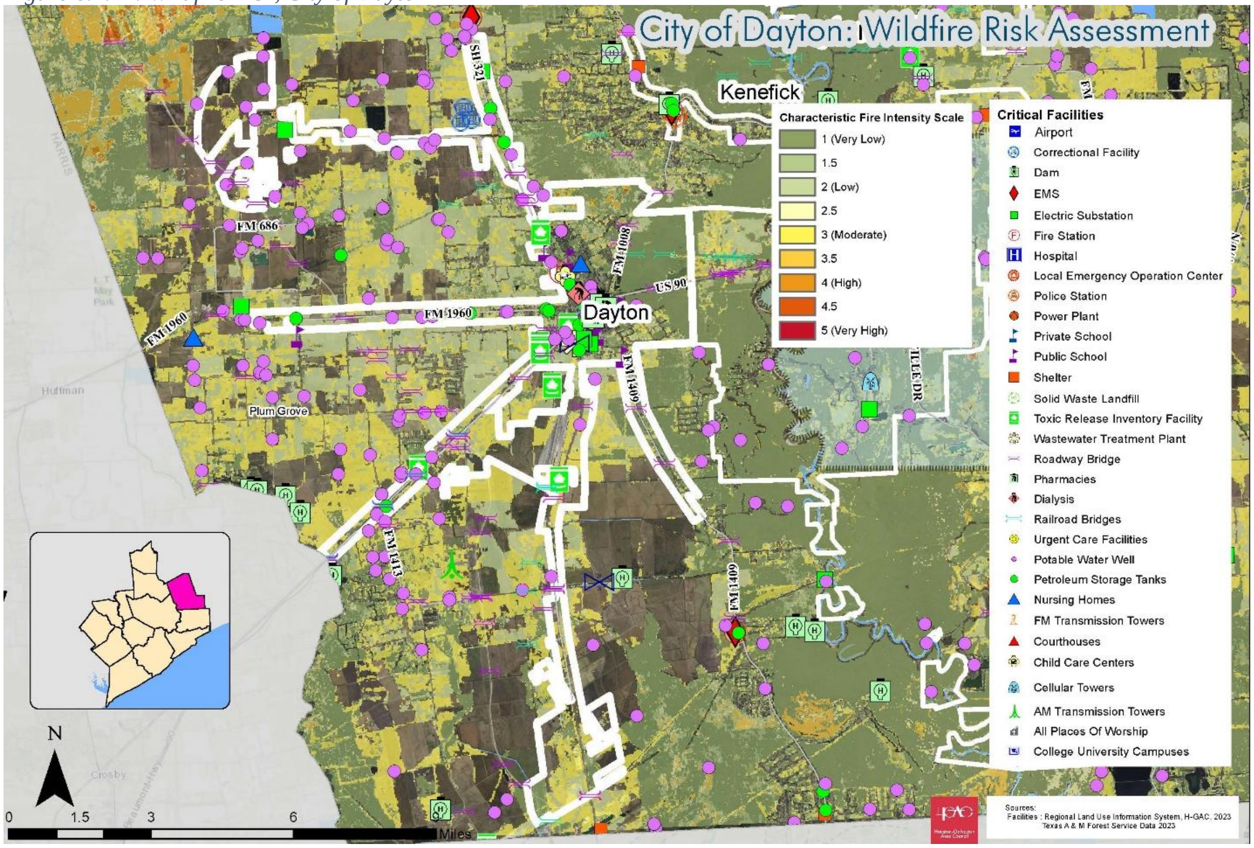


Figure 6.7.18: Wildfire Risk, City of Devers

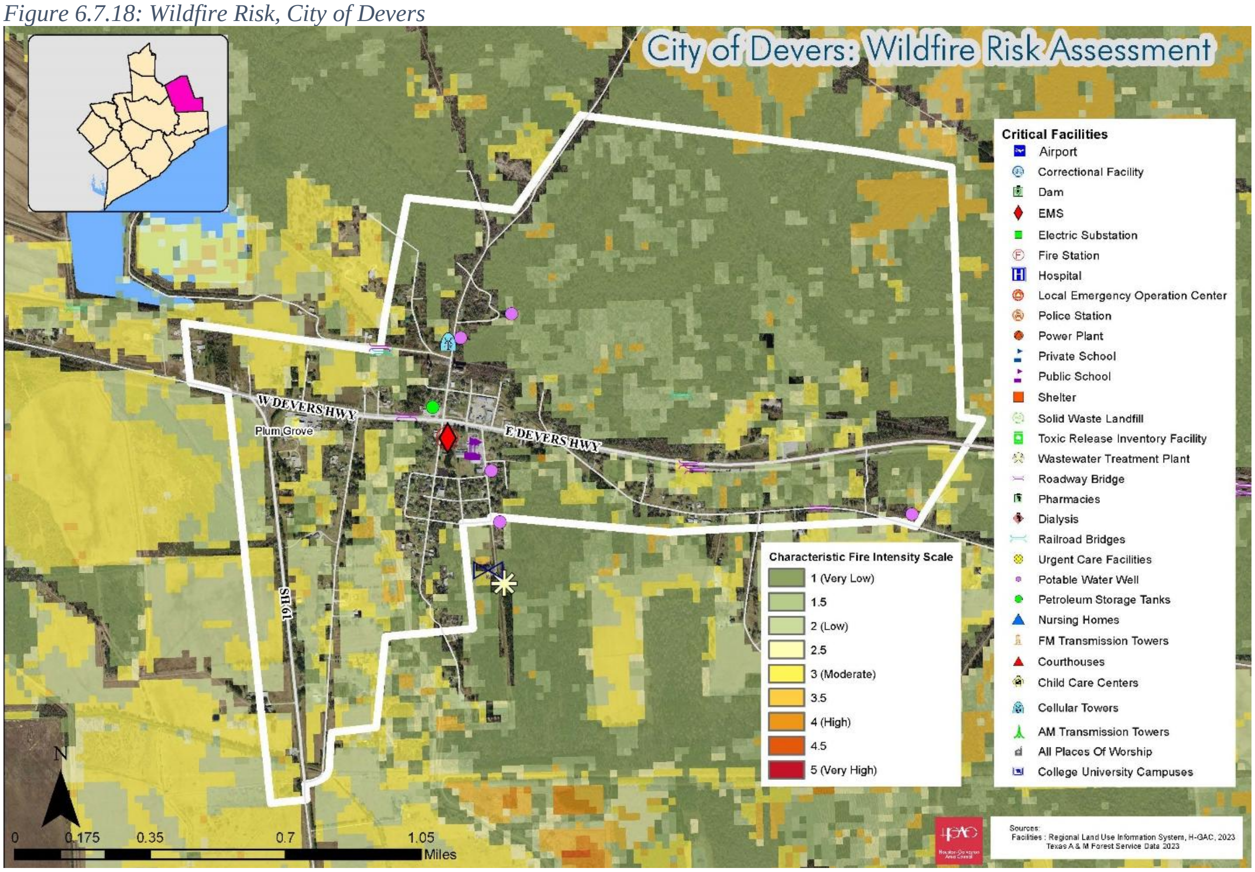


Figure 6.7.19: Wildfire Risk, City of Hardin

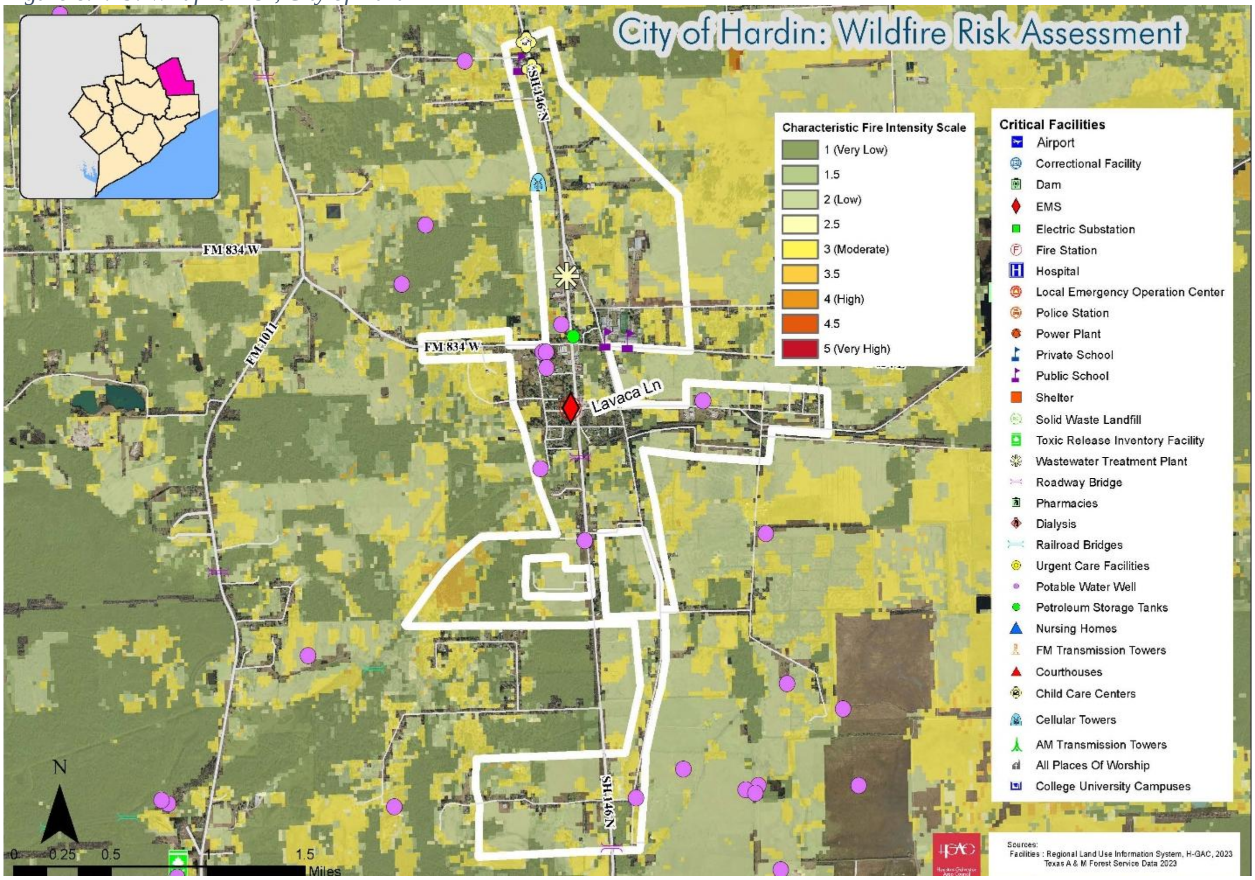


Figure 6.7.20: Wildfire Risk, City of Kenefick

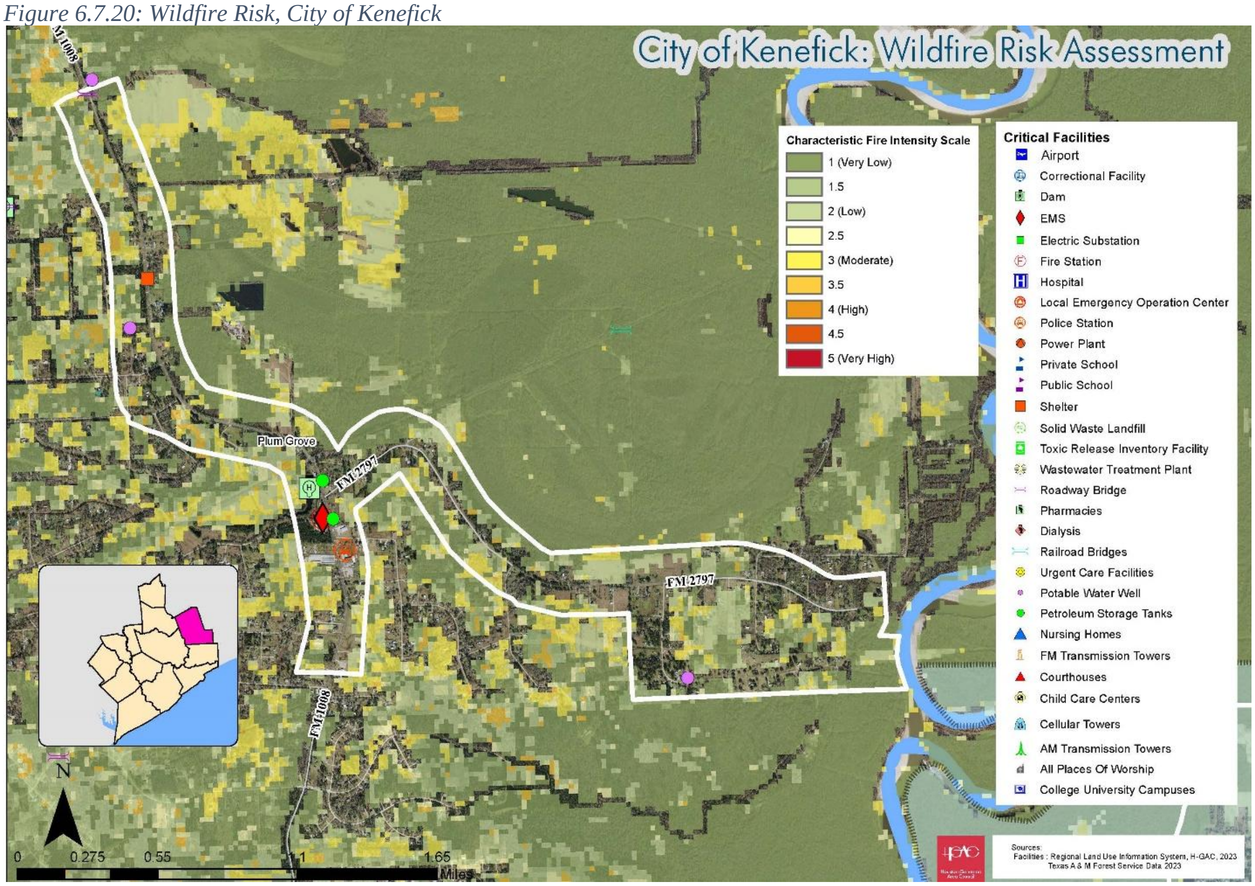


Figure 6.7.21: Wildfire Risk, City of Liberty

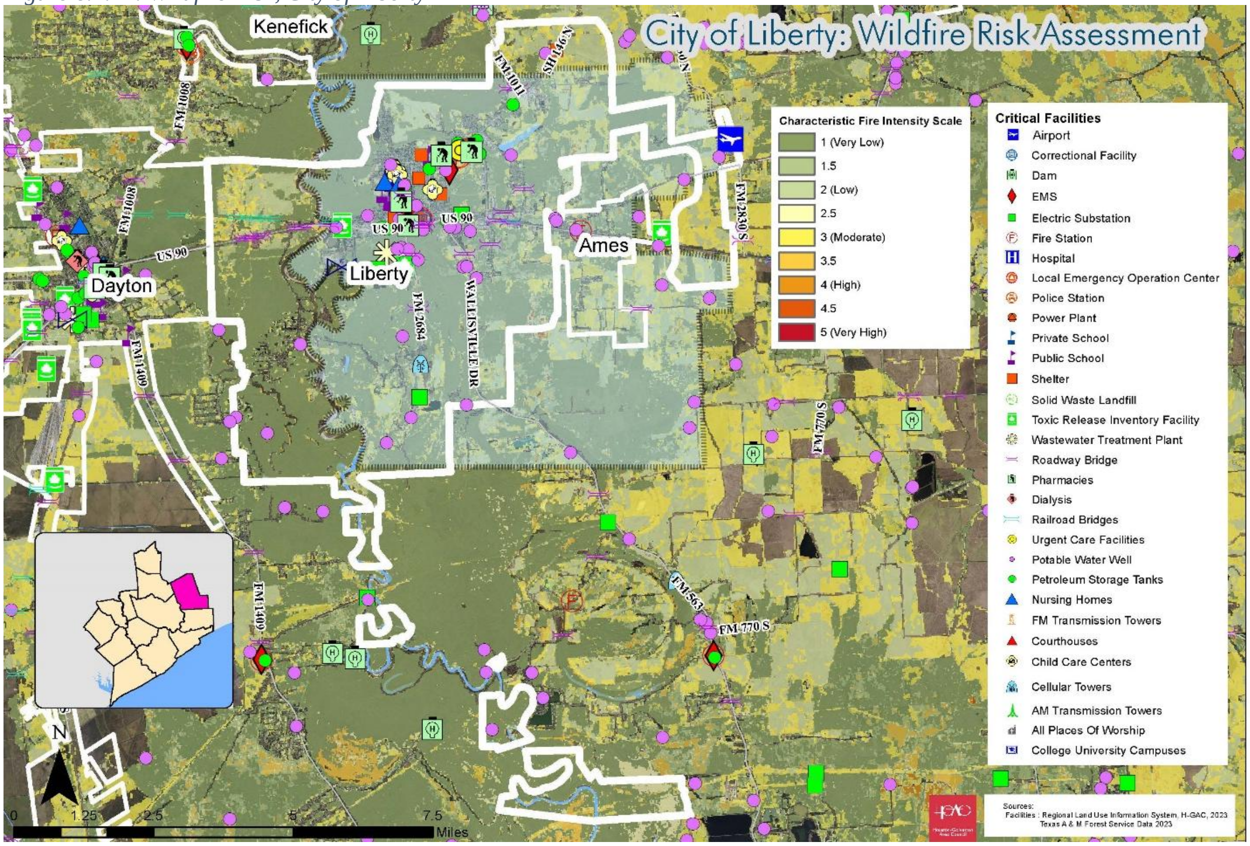


Figure 6.7.22: Wildfire Risk, City of North Cleveland

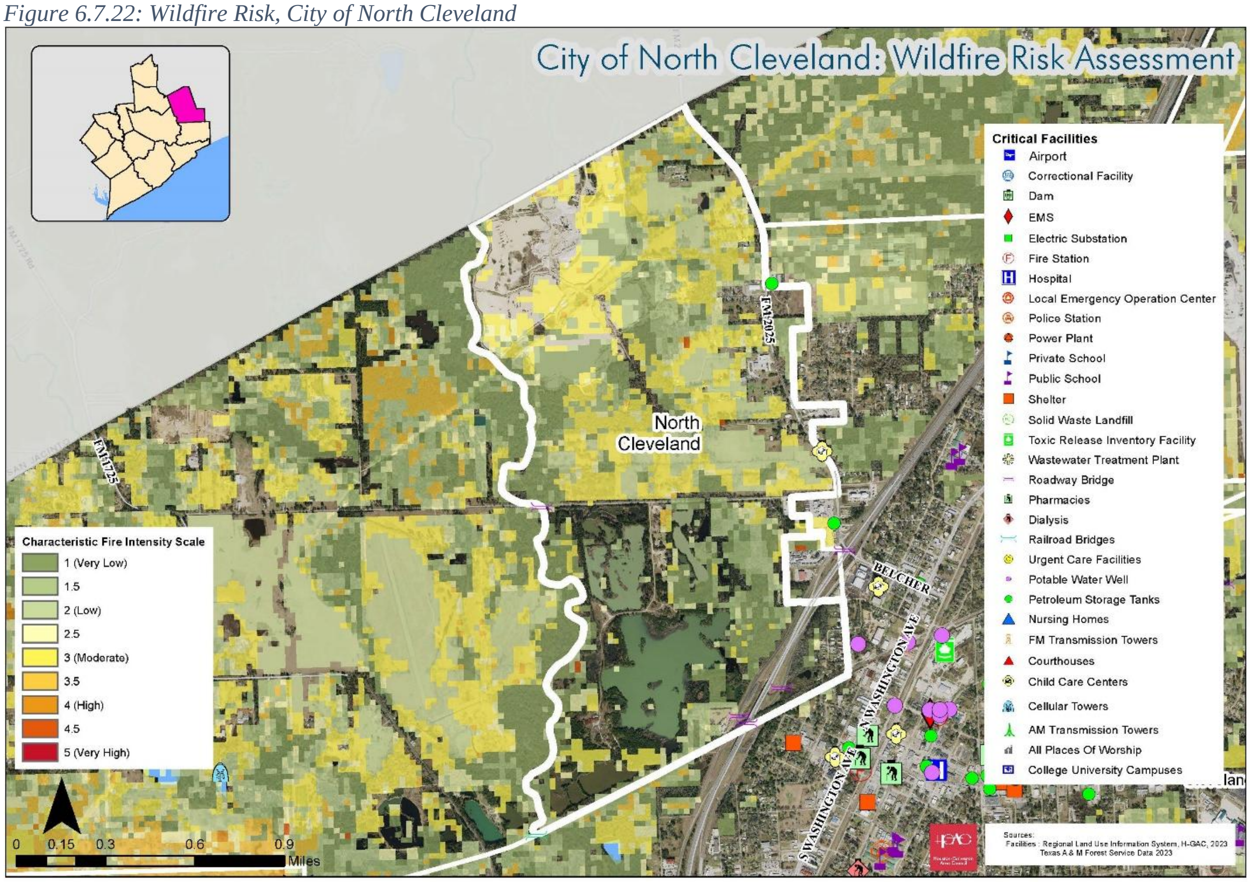


Figure 6.7.23: Wildfire Risk, City of Plum Grove

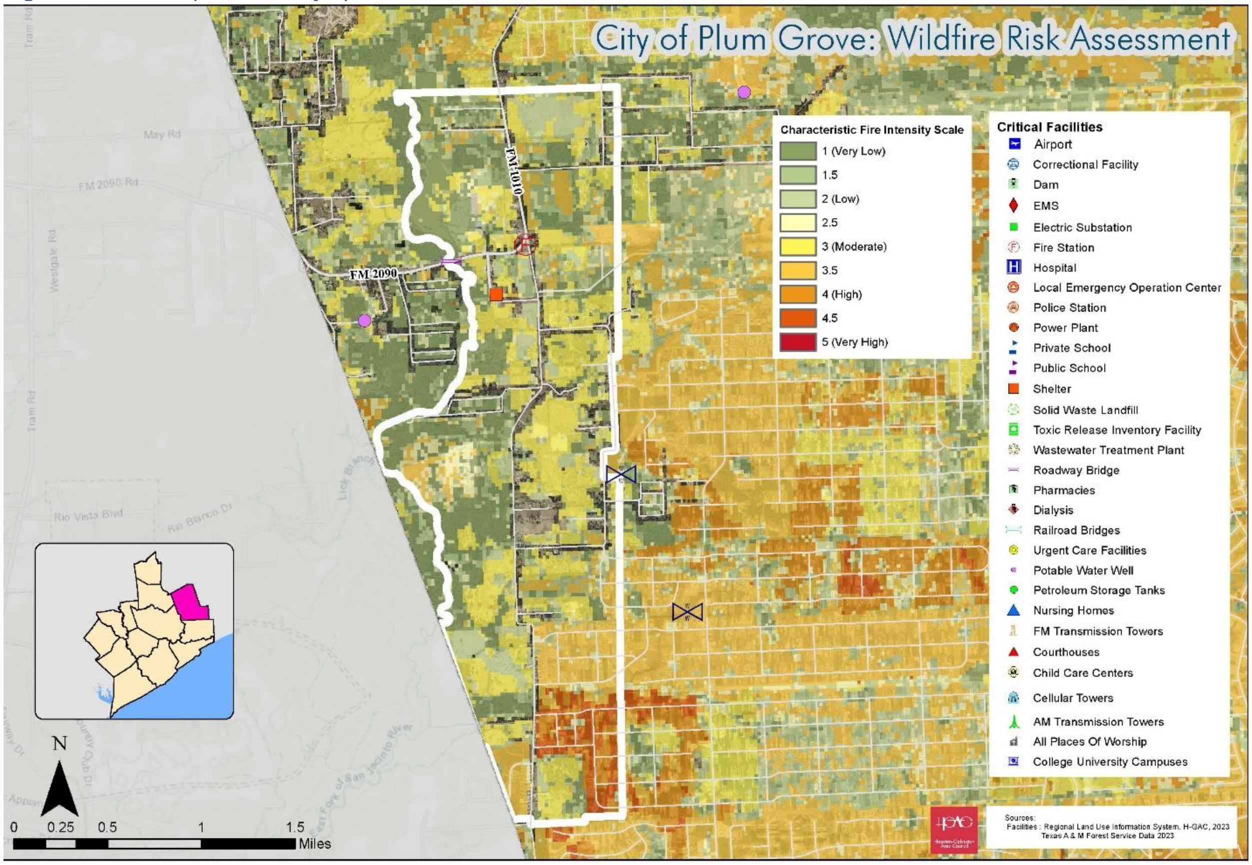
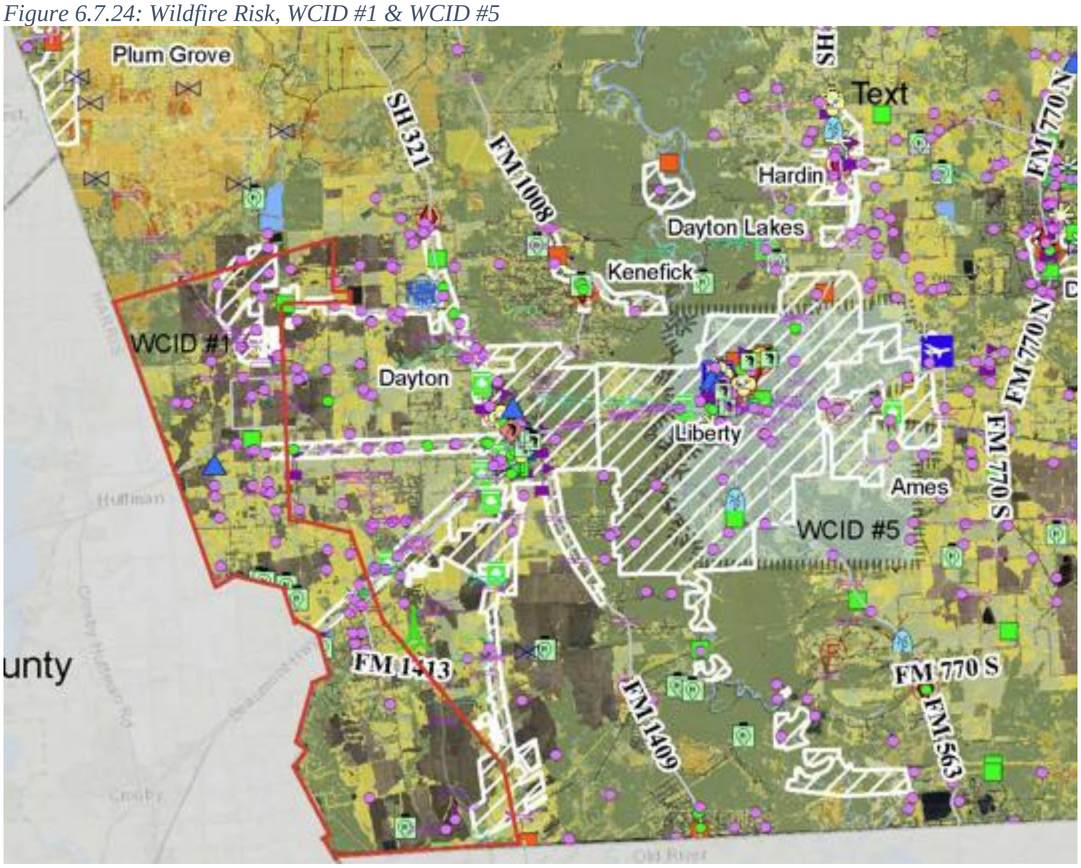


Figure 6.7.24: Wildfire Risk, WCID #1 & WCID #5



A worst-case scenario for this hazard would be a wildfire sparked during a drought or a heat event where temperatures are high, the ground and vegetation are dry, and water supplies may already be in high demand. Similar events occurring within counties bordering Liberty County or near urban areas would further exacerbate the risks to life and property. Large-scale events could also affect transportation and evacuation corridors, power supply, and access to critical facilities, and lead to degraded air quality and health impacts.

Historic Occurrences

The Texas A&M Forest Service tracks wildfire events, acres destroyed, and the initial ignition cause of the fire. The table below shows the historical data associated with burns that caused recorded damage. Data is included since the last HMP update. Figure 6.7.39 shows the point location of all fire ignitions from 2005-2021, symbolized by color to depict the cause of the fire. There are 644 individual fire ignition points shown. The table below condenses fire ignition points since the last plan update and includes those points that occurred between 2018-2021. [39]

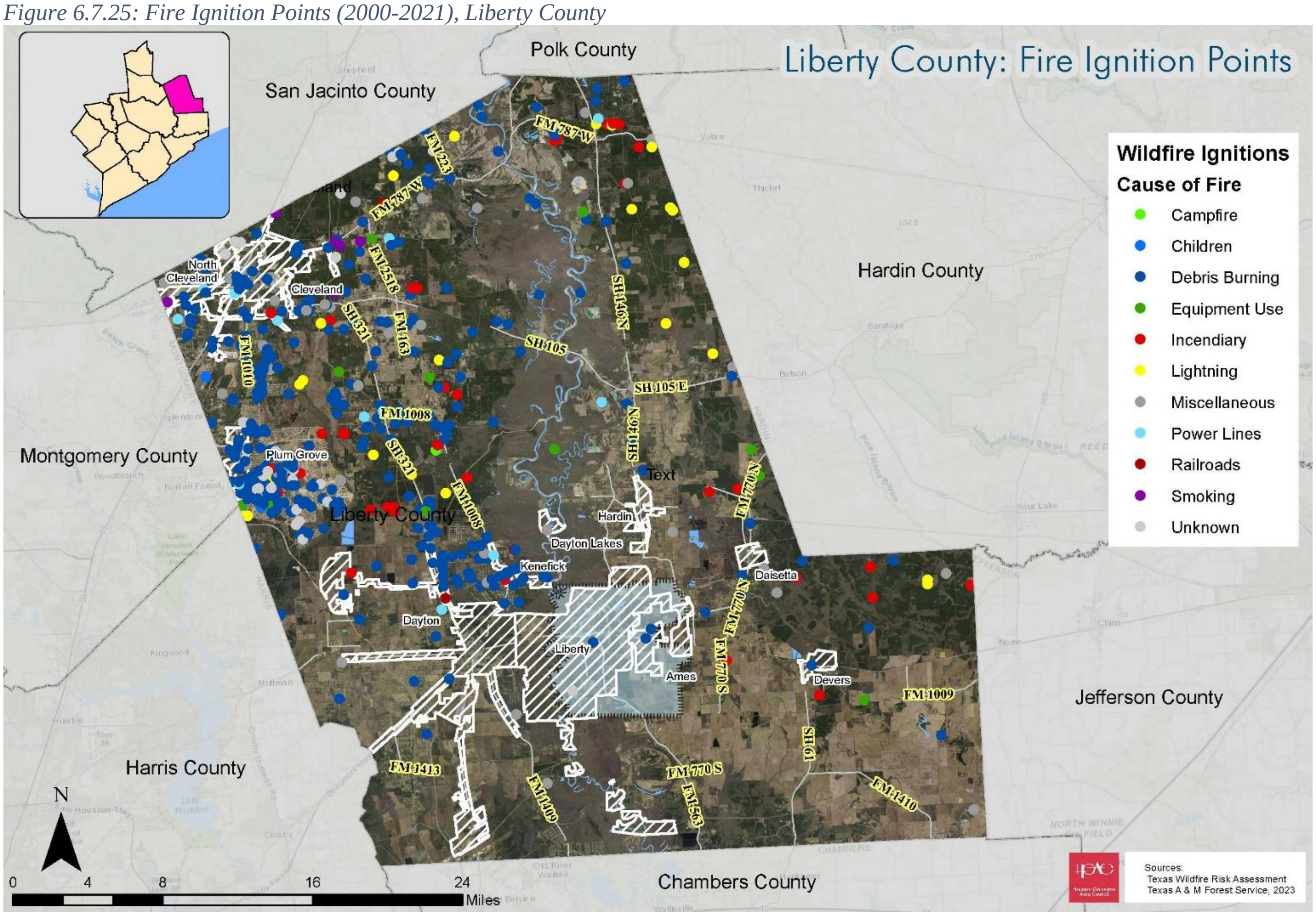
Table 6.7.15: Fire Ignition Point Causes, Liberty County (2018-2021)

Start Date	Damaged Acres	Ignition Cause	Ignition Sub Cause
1/1/2018	0.25	Debris Burning	No data
1/1/2018	0.25	Debris Burning	Brush pile burning
1/1/2018	35	Miscellaneous	Other
1/1/2018	1	Debris Burning	Pasture and field burning (including grass, crop residues)
1/1/2018	1.5	Debris Burning	Brush pile burning
1/2/2018	0.5	Debris Burning	No data
1/3/2018	0.5	Unknown	Unable to determine
1/7/2018	0.5	Debris Burning	Brush pile burning
1/7/2018	0.5	Debris Burning	No data
1/24/2018	7.5	Equipment Use	Farm equipment (hay balers, tractors, etc.)
1/24/2018	2	Debris Burning	No data
1/24/2018	2	Debris Burning	No data
1/24/2018	1.5	Debris Burning	No data
1/25/2018	157	Debris Burning	Prescribed burning (forest brush control/hazard reduction, grassland brush control)
1/25/2018	5	Debris Burning	No data
2/2/2018	0.5	Debris Burning	No data
2/8/2018	0.5	Debris Burning	No data
2/17/2018	2	Debris Burning	No data
2/18/2018	1.5	Debris Burning	No data
3/2/2018	1	Debris Burning	No data
3/8/2018	12	Debris Burning	No data
3/19/2018	12	Lightning	Origin traceable to lightning
3/19/2018	1	Debris Burning	Subdivision development, clearing
3/20/2018	7.5	Incendiary	Other
3/21/2018	0.25	Debris Burning	Subdivision development, clearing
3/23/2018	5	Debris Burning	Subdivision development, clearing
4/10/2018	4	Debris Burning	Subdivision development, clearing
4/10/2018	0.5	Debris Burning	Subdivision development, clearing
4/15/2018	8	Debris Burning	Subdivision development, clearing
4/19/2018	2	Debris Burning	Subdivision development, clearing
4/21/2018	2	Unknown	Unable to determine
5/12/2018	12	Incendiary	Other
6/9/2018	0.01	Unknown	No data
6/10/2018	0.01	Unknown	No data
6/14/2018	10.92	Children	Other
7/3/2018	0.1	Debris Burning	Pasture and field burning (including grass, crop residues)

Start Date	Damaged Acres	Ignition Cause	Ignition Sub Cause
7/26/2018	10.59	Debris Burning	Brush pile burning
8/19/2018	10	Debris Burning	Brush pile burning
12/5/2018	50	Unknown	Unable to determine
8/30/2019	8	Debris Burning	Subdivision development, clearing
9/2/2019	1.35	Debris Burning	Brush pile burning
9/8/2019	0.65	Debris Burning	Brush pile burning
9/8/2019	5.83	Debris Burning	Brush pile burning
9/8/2019	1.5	Debris Burning	Brush pile burning
1/5/2020	0.5	Unknown	Cause and Origin Not Identified
1/5/2020	3.5	Unknown	Cause and Origin Not Identified
2/4/2020	0.1	Unknown	Cause and Origin Not Identified
2/26/2020	0.3	Power Lines	Power Lines
2/29/2020	77	Debris Burning	Subdivision development, clearing
3/8/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
3/12/2020	20	Equipment Use	Farm equipment (hay balers, tractors, etc.)
4/8/2020	0.1	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
4/11/2020	0.5	Unknown	Cause and Origin Not Identified
4/16/2020	3.5	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
4/18/2020	6	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
4/23/2020	15	Debris Burning	Subdivision development, clearing
4/23/2020	1	Unknown	Cause and Origin Not Identified
4/26/2020	1	Debris Burning	Unsafe burning of household trash
5/1/2020	0.3	Debris Burning	Brush pile burning
5/3/2020	0.5	Debris Burning	Subdivision development, clearing
5/6/2020	0.5	Debris Burning	Subdivision development, clearing
5/6/2020	0.5	Debris Burning	Subdivision development, clearing
5/7/2020	1	Debris Burning	Subdivision development, clearing
5/9/2020	0.1	Debris Burning	Brush pile burning
5/10/2020	0.5	Debris Burning	Subdivision development, clearing
5/10/2020	1.5	Debris Burning	Subdivision development, clearing
5/13/2020	4	Debris Burning	Subdivision development, clearing
5/18/2020	0.5	Debris Burning	Subdivision development, clearing
5/20/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
5/20/2020	0.3	Debris Burning	Subdivision development, clearing
5/20/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
6/11/2020	0.1	Debris Burning	Subdivision development, clearing
6/11/2020	2	Debris Burning	Subdivision development, clearing
6/12/2020	1	Debris Burning	Subdivision development, clearing
6/13/2020	4	Debris Burning	Subdivision development, clearing
6/13/2020	0.3	Debris Burning	Subdivision development, clearing
6/13/2020	5	Debris Burning	Subdivision development, clearing
6/14/2020	15	Debris Burning	Subdivision development, clearing
6/18/2020	6	Unknown	Cause and Origin Not Identified
6/18/2020	10	Unknown	Cause and Origin Not Identified
6/18/2020	2	Unknown	Cause and Origin Not Identified
6/19/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
7/5/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)

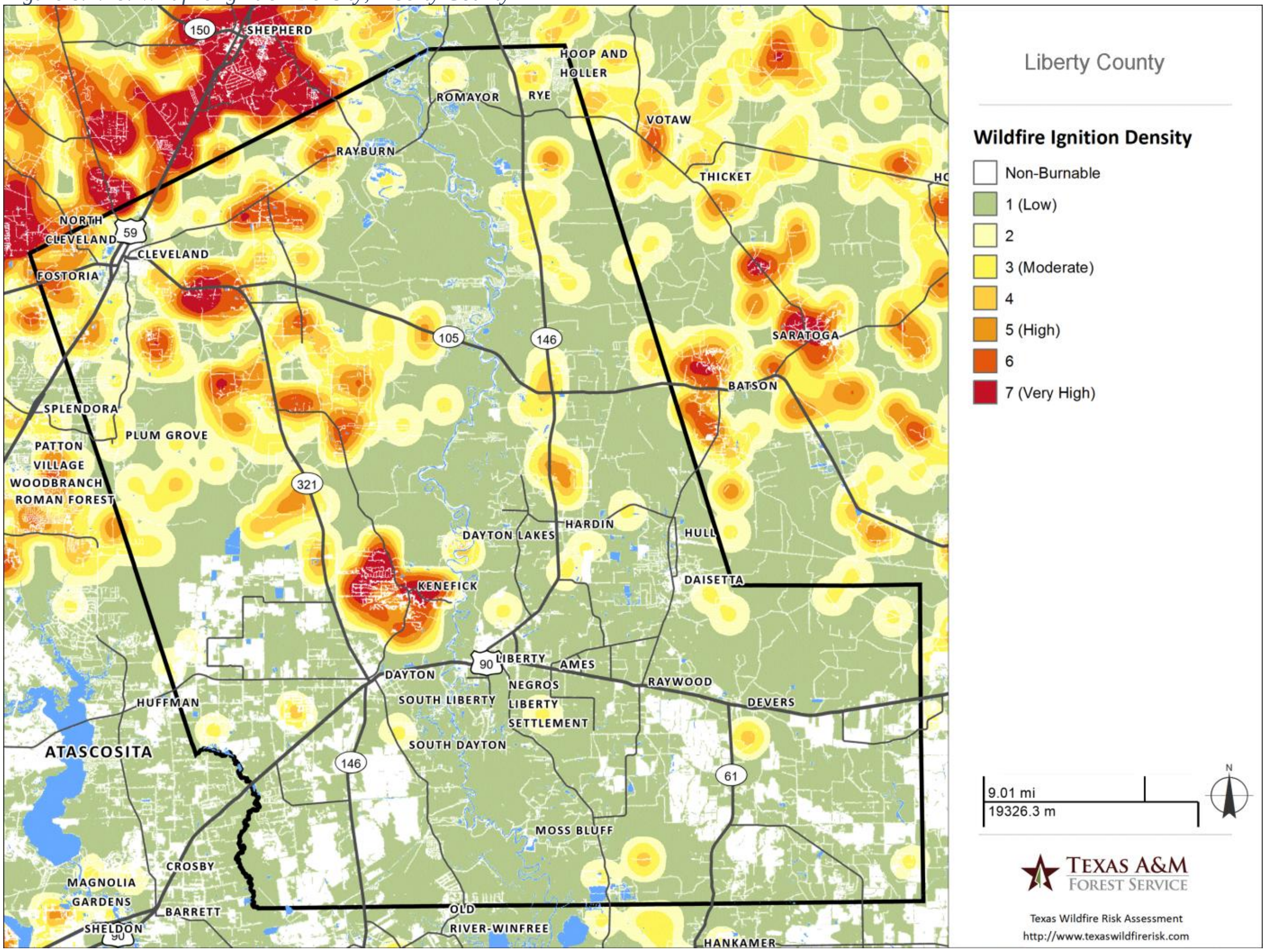
Start Date	Damaged Acres	Ignition Cause	Ignition Sub Cause
7/8/2020	0.5	Debris Burning	Burning leaves and garden spots
7/11/2020	0.5	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
7/11/2020	4	Unknown	Cause and Origin Not Identified
7/11/2020	2	Unknown	Cause and Origin Not Identified
7/19/2020	11	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/3/2020	0.3	Debris Burning	Burning leaves and garden spots
8/6/2020	0.3	Debris Burning	Burning leaves and garden spots
8/6/2020	2	Unknown	Cause and Origin Not Identified
8/15/2020	3	Unknown	Cause and Origin Not Identified
8/16/2020	5	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/23/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/25/2020	0.5	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/26/2020	8	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/26/2020	4	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
8/28/2020	0.1	Unknown	Cause and Origin Not Identified
9/2/2020	22	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
9/3/2020	15	Debris Burning	Unsafe burning of household trash
9/3/2020	2	Unknown	Cause and Origin Not Identified
9/14/2020	0.1	Unknown	Cause and Origin Not Identified
9/19/2020	2.5	Unknown	Cause and Origin Not Identified
9/20/2020	0.1	Unknown	Cause and Origin Not Identified
9/22/2020	0.5	Unknown	Cause and Origin Not Identified
9/29/2020	1	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
9/29/2020	3	Unknown	Cause and Origin Not Identified
10/1/2020	0.3	Unknown	Cause and Origin Not Identified
10/13/2020	0.3	Debris Burning	Site preparation burning (preparing previously harvested wooded areas for planting)
10/31/2020	1.5	Incendiary	Amusement
11/15/2020	222	Debris Burning	Brush pile burning
11/16/2020	53	Debris Burning	Brush pile burning
12/10/2020	222	Debris Burning	Construction debris (boards, panels, cardboard, etc.)
1/17/2021	3	Equipment Use	Vehicles (catalytic converters, faulty mufflers, dragging metal)
2/4/2021	12	Debris Burning	Brush pile burning
3/4/2021	58	Unknown	Unable to determine
3/7/2021	5	Debris Burning	Prescribed burning (forest brush control/hazard reduction, grassland brush control)
3/8/2021	22.6	Debris Burning	Brush pile burning
3/18/2021	21	Miscellaneous	Other
3/20/2021	8	Debris Burning	Brush pile burning
3/21/2021	111	Debris Burning	Pasture and field burning (including grass, crop residues)
4/10/2021	45	Unknown	Unable to determine
4/21/2021	11	Debris Burning	Brush pile burning

Figure 6.7.25: Fire Ignition Points (2000-2021), Liberty County



The measure of wildfire occurrence used in the TWRA is called the Wildfire Ignition Density. Wildfire Ignition Density is the likelihood of a wildfire starting based on historical ignition patterns. Occurrence is derived by modeling historic wildfire ignition locations to create an average ignition rate map. The ignition rate is measured in the number of fires per year per 1000 acres. Five years of historic fire report data was used to create the ignition points for all Texas fires. Data was obtained from federal, state and local fire department report data sources for the years 2005 to 2009. The compiled wildfire occurrence database was cleaned to remove duplicate records and to correct inaccurate locations. The database was then modeled to create a density map reflecting historical fire ignition rates. The Ignition Density map, below, is derived at a 30-meter resolution. This scale of data was chosen to be consistent with the accuracy of the primary surface fuels dataset used in the assessment. While not appropriate for site-specific analysis, it is appropriate for regional, county, or local planning efforts.[95]

Figure 6.7.26: Wildfire Ignition Density, Liberty County



Presidential Disaster Declarations

There have been 5 disaster declarations for fire/wildfire within Liberty County, since 1953, as depicted in the table below.[2]

Table 6.7.16: Disaster Declarations, Wildfire

Declaration Date	Incident Type	Title	Disaster Number	Declaration Type
2/23/1996	Fire	EXTREME FIRE HAZARD	3117	Emergency Declaration
9/1/1999	Fire	EXTREME FIRE HAZARDS	3142	Emergency Declaration
9/4/2000	Fire	TX - STANLEY MAINLINE FIRE	2329	Emergency Declaration
1/11/2006	Fire	EXTREME WILDFIRE THREAT	1624	Major Disaster Declaration
3/14/2008	Fire	WILDFIRES	3284	Emergency Declaration

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations caused by fires/wildfire events for Liberty County since the last HMP are listed in the table below.[38]

Table 6.7.17: USDA Declared Disasters (2018-2023), Wildfire

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

As jurisdictions across the state move into wildland and increase the WUI areas, the potential for wildfires substantially increases. Wildfire probability depends on a variety of factors such as local weather conditions, topographic factors, and existing fuels within a given area (natural vegetation or wildlands). A variety of activities can spark wildfires, most of which are human induces such as camping, debris burning, and smoking can affect the number and the extent of wildfires within a given year. Wildfires can occur at any time of the year under the right conditions. Wildfires can be exacerbated by droughts, which are more likely to occur in summer months when temperatures are higher, and precipitation is less frequent. according to the FEMA NRI for drought, annualized frequency values for drought are 14.1 events per year over a 22-year period of record for Liberty County (2000-2021), while annualized frequency values for wildfires is 0.378% chance per year based on the 2021 dataset. The probability of future occurrences of wildfires for the county, per FEMA's NRI, is relatively moderate.[46]

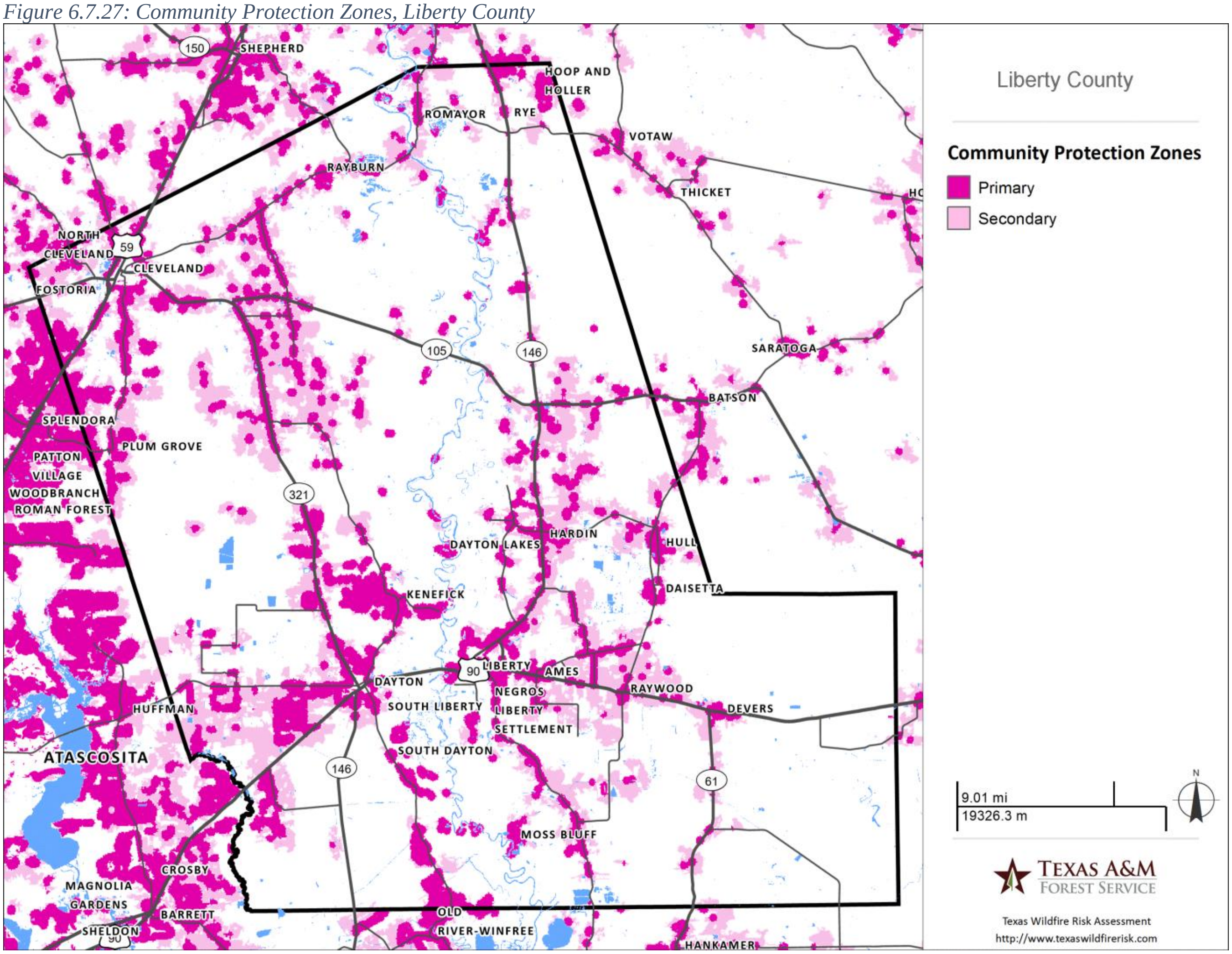
Populations at Risk

The TFS outlines Community Protection Zones (CPZ), areas that are outlined as primary and secondary and should be the highest priority for mitigation planning activities. CPZs are based on where population and housing density is highest using data regarding surrounding fire potential and fire behavior. Per the TFS "General consensus among fire planners is that for fuel mitigation treatments to be effective in reducing wildfire hazard, they must be conducted within a close distance of a community. In Texas, the WUI housing density has been used to reflect populated areas in place of community boundaries. This ensures that CPZs reflect where people are living in the wildland, not jurisdictional boundaries." [96] The table and figure below outline these primary and secondary CPZs and their acreage within the county.

Table 6.7.18: Community Protection Zones, Liberty County

	Class	Acres	Percent
	Primary	92,668	46.7 %
	Secondary	105,632	53.3 %
	Total	**198,300**	**100.0 %**

Figure 6.7.27: Community Protection Zones, Liberty County



Wildfires negatively impact air quality impacting the surrounding areas and areas further away depending on how wind direction and the fire intensity distribute the smoke. This smoke exposure can put certain vulnerable populations at greater risk of adverse effects from this hazard event. According to the Environmental Protection Agency, these vulnerable populations include People with asthma and other respiratory diseases, people with cardiovascular disease, children (18 years of age or younger), pregnant people older adults, people of low socio-economic status, and outdoor workers.

Underlying respiratory diseases result in compromised health status that can result in the triggering of severe respiratory responses by environmental irritants, such as wildfire smoke. Underlying circulatory diseases result in compromised health status that can result in the triggering of severe cardiovascular events by environmental irritants, such as wildfire smoke. In younger populations, children’s lungs are still developing, and there is a greater likelihood of increased exposure to wildfire smoke resulting from more time spent outdoors, engagement in more vigorous activity, and inhalation of more air per pound of body weight compared to adults. Pregnancy-related physiologic changes (e.g., increased breathing rates) may increase vulnerability to environmental exposures, such as wildfire smoke. In addition, during critical development periods, the fetus may experience increased vulnerability to these exposures. In older populations, there is a higher prevalence of pre-existing lung and heart disease and a decline of physiologic processes, such as defense mechanisms. This can lead to exacerbation of heart and lung diseases and can lead to emergency department visits, hospital admissions, and even death. Those of low socioeconomic status are vulnerable to these types of hazards as they have less access to health care which could lead to a higher likelihood of untreated or insufficient treatment of underlying health conditions (asthma, diabetes), and greater exposure to wildfire smoke resulting from less access to measures to reduce exposure such as air conditioning. Outdoor workers can be more vulnerable to this hazard due to increased exposure to smoke.[97]

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[44]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below.

Table 6.7.19: Expected Annual Loss Exposure Values, Wildfire

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Wildfire	$1,080,215,761	$111,515,122,302 / 9,613.37	$6,528,136	$112,601,866,199

Table 6.7.20: Expected Annual Loss Values, Wildfire

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Wildfire	$1,096,518	$151,801 / 0.01	$755

N/A- Not Applicable

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings, according to the FEMA NRI for hurricane events, for these census tracts are listed as very high for 4 census tracts, relatively high for 12 census tracts, and relatively moderate for 1 census tract. EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the historic loss ratio (HLR), a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for hurricanes within Liberty County as relatively high. [45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.7.28: Risk Index, Liberty County, Wildfire

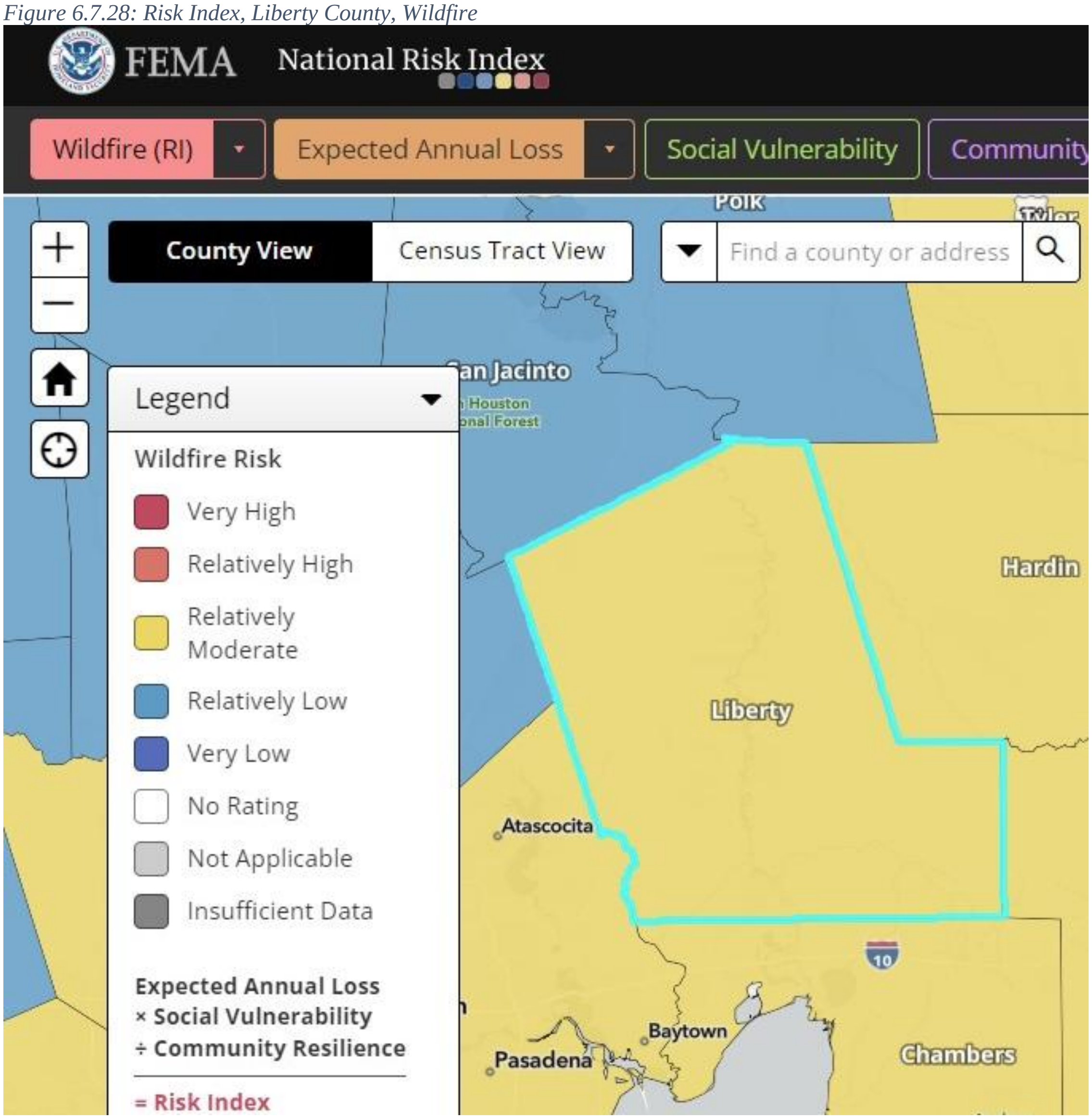


Figure 6.7.29: Risk Index by Census Tract, Liberty County, Wildfire

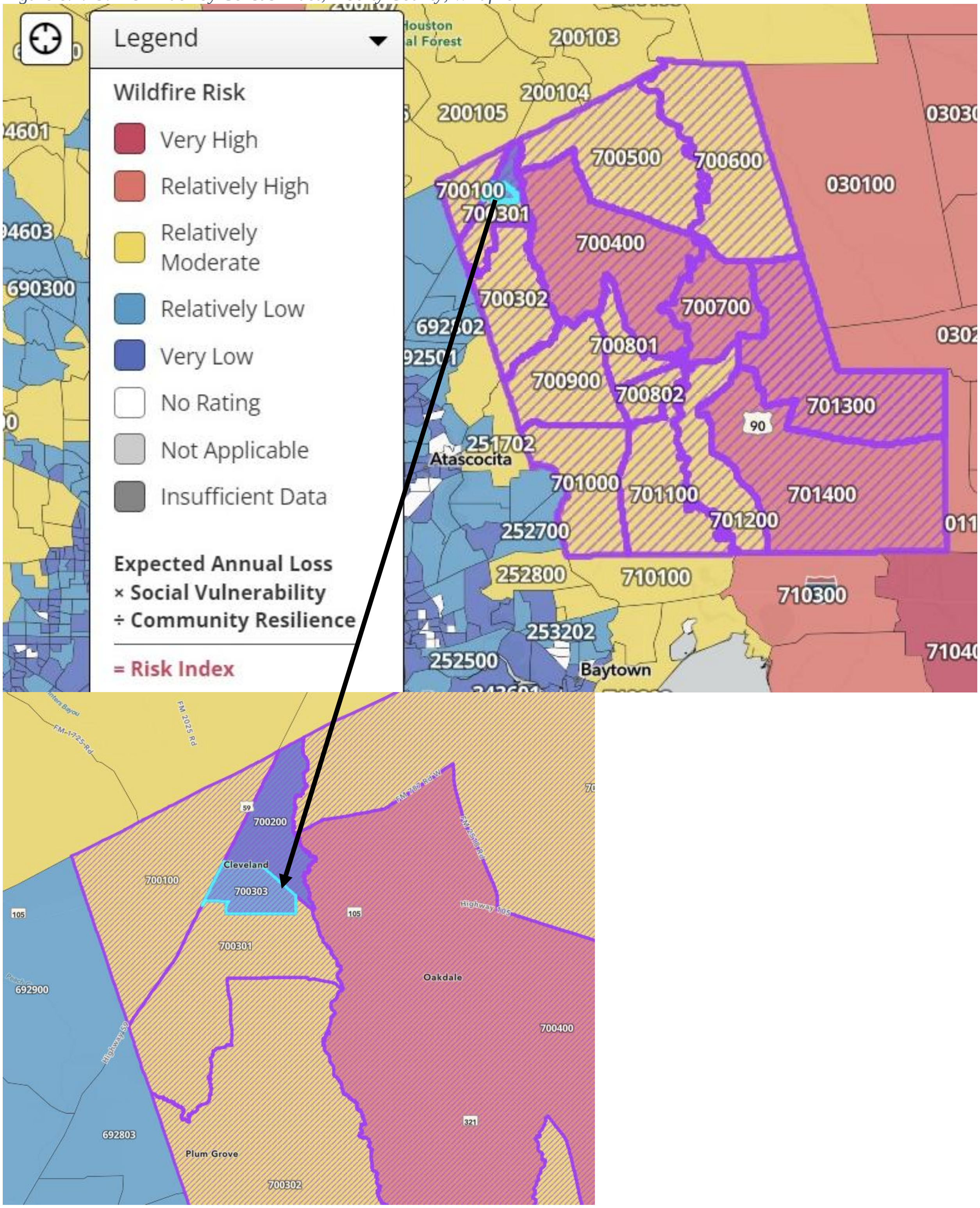


Figure 6.7.30: Social Vulnerability by Census Tract, Liberty County

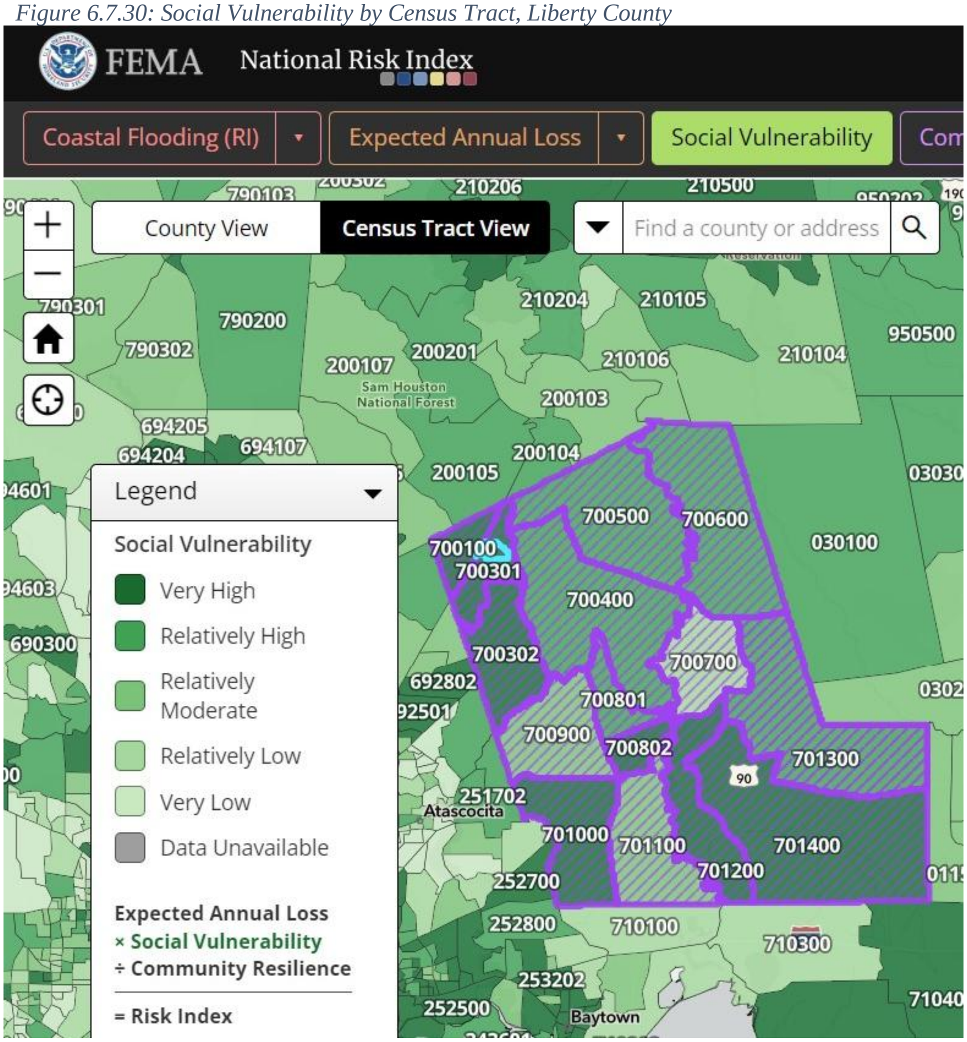


Figure 6.7.31: Social Vulnerability, Liberty County

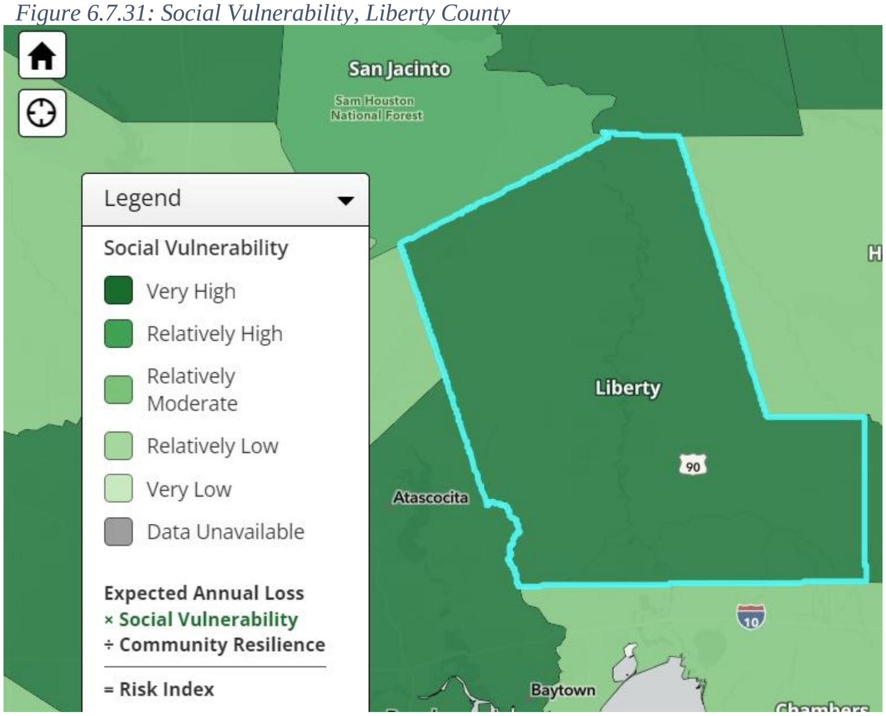


Figure 6.7.32: Community Resilience by Census Tract, Liberty County

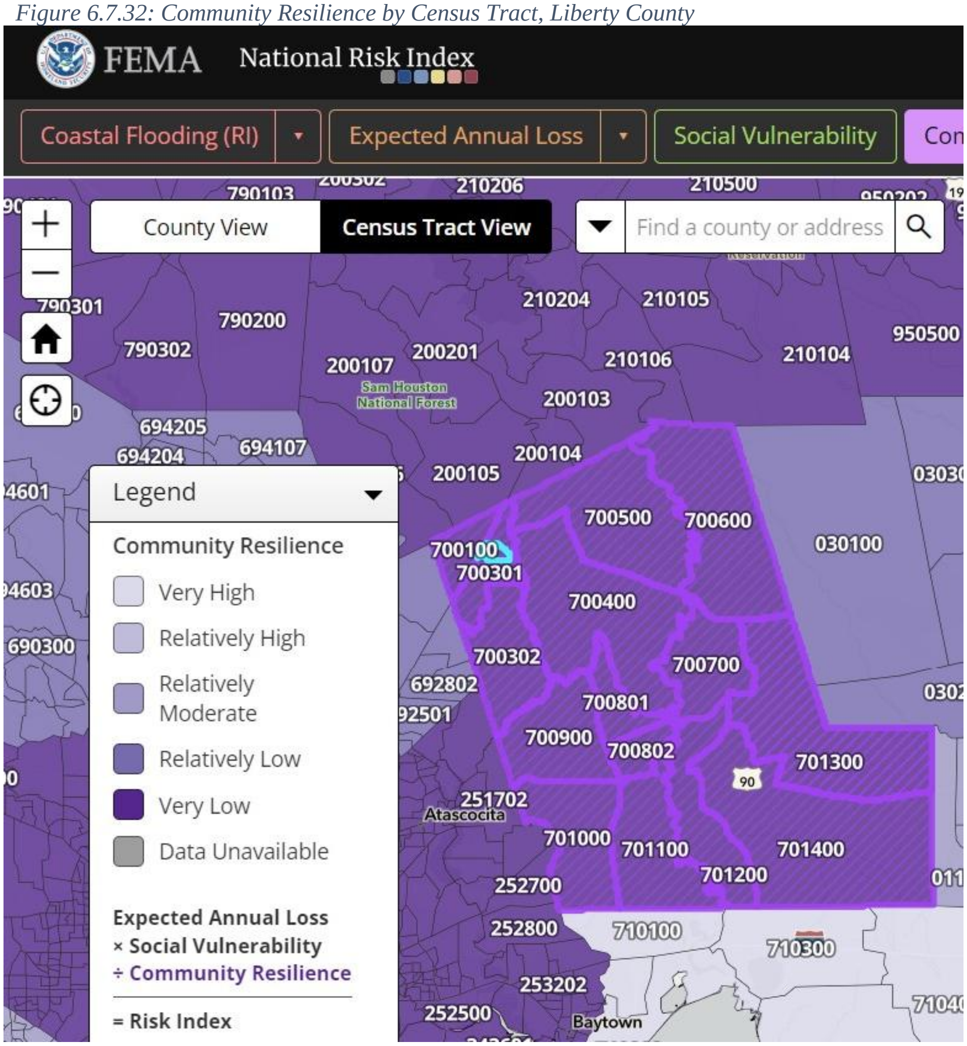


Figure 6.7.33: Community Resilience, Liberty County

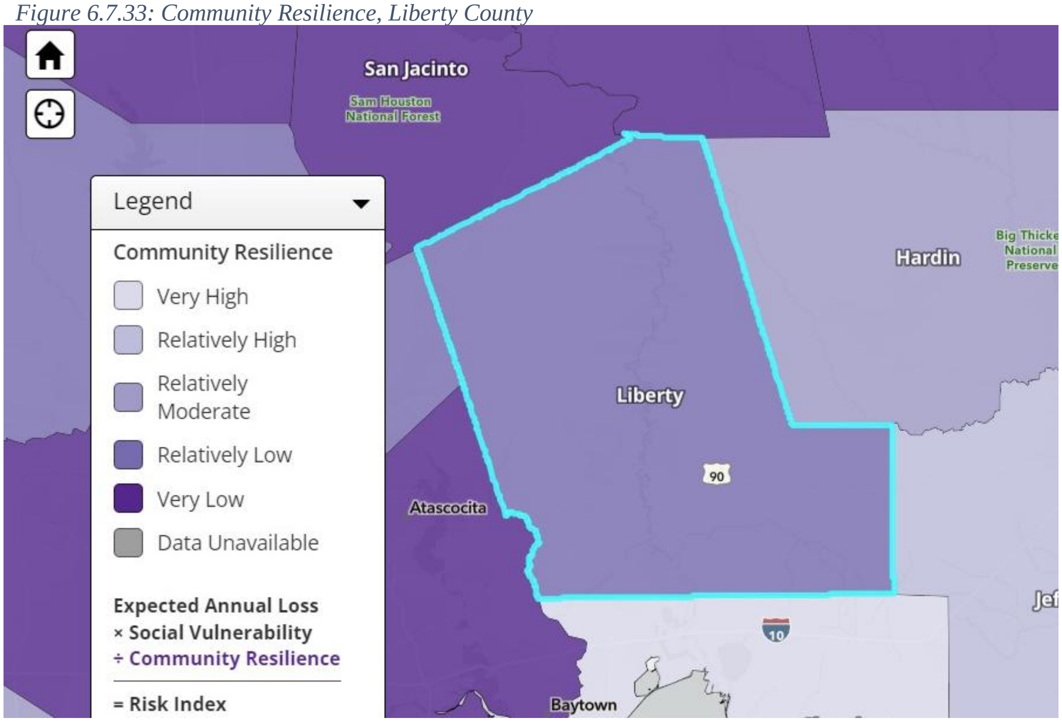


Figure 6.7.34: FEMA NRI Summary by Census Tract, Liberty County, Wildfire

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700400	TX	Relatively High	97.78	0 100
2	Census tract 48291701400	TX	Relatively High	97.44	0 100
3	Census tract 48291701300	TX	Relatively High	96.2	0 100
4	Census tract 48291700700	TX	Relatively High	95.73	0 100
5	Census tract 48291701200	TX	Relatively Moderate	94.12	0 100
6	Census tract 48291701100	TX	Relatively Moderate	93.62	0 100
7	Census tract 48291700500	TX	Relatively Moderate	92.9	0 100
8	Census tract 48291701000	TX	Relatively Moderate	92.47	0 100
9	Census tract 48291700600	TX	Relatively Moderate	91.57	0 100
10	Census tract 48291700302	TX	Relatively Moderate	91.05	0 100
11	Census tract 48291700900	TX	Relatively Moderate	89.64	0 100
12	Census tract 48291700301	TX	Relatively Moderate	88.66	0 100
13	Census tract 48291700802	TX	Relatively Moderate	87.98	0 100
14	Census tract 48291700100	TX	Relatively Moderate	87.19	0 100
15	Census tract 48291700801	TX	Relatively Moderate	86.76	0 100
16	Census tract 48291700303	TX	Relatively Low	61.36	0 100
17	Census tract 48291700200	TX	Very Low	45.3	0 100

Figure 6.7.35: FEMA NRI EAL Summary by Census Tract, Liberty County, Wildfire

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700400	TX	$308,567	Relatively High	Very Low	1.35	$416,631	97.78
2	Census tract 48291701400	TX	$205,369	Very High	Very Low	1.72	$353,697	97.44
3	Census tract 48291701300	TX	$147,345	Relatively High	Very Low	1.45	$213,285	96.2
4	Census tract 48291700700	TX	$185,521	Relatively Low	Very Low	0.97	$180,218	95.73
5	Census tract 48291701200	TX	$62,066	Very High	Very Low	1.75	$108,522	94.12
6	Census tract 48291701100	TX	$78,930	Relatively Moderate	Very Low	1.2	$94,415	93.62
7	Census tract 48291700500	TX	$60,681	Relatively High	Very Low	1.27	$77,360	92.9
8	Census tract 48291701000	TX	$42,637	Very High	Very Low	1.64	$69,730	92.47
9	Census tract 48291700600	TX	$38,603	Relatively High	Very Low	1.43	$55,366	91.57
10	Census tract 48291700302	TX	$31,749	Very High	Very Low	1.53	$48,706	91.05
11	Census tract 48291700900	TX	$29,190	Relatively Moderate	Very Low	1.19	$34,620	89.64
12	Census tract 48291700301	TX	$15,757	Very High	Very Low	1.75	$27,642	88.66
13	Census tract 48291700802	TX	$15,529	Very High	Very Low	1.55	$24,108	87.98
14	Census tract 48291700100	TX	$12,270	Very High	Very Low	1.65	$20,263	87.19
15	Census tract 48291700801	TX	$14,283	Relatively High	Very Low	1.3	$18,586	86.76
16	Census tract 48291700303	TX	$430	Very High	Very Low	1.81	$776	61.36
17	Census tract 48291700200	TX	$146	Very High	Very Low	1.63	$237	45.3

Climate Change Impacts

Wildfires are often a natural phenomenon and part of the normal cycle of the natural environment that helps keep ecosystems healthy. Weather conditions often affect the duration of a wildfire and how it will grow. These factors are lower precipitation, high temperatures, wind, and more.[98] Wildfires are more likely to occur during summer months and periods of drought. According to the Office of the Texas State Climatologist, drivers of wildfire risk are projected to increase the risk of wildfires throughout the state, primarily due to increased rates of drying and increased fuel load.[47]

Table 6.7.21: Climate Change Impacts, Wildfire

Location	The location of wildfires is not expected to change. Areas within or near the WUI are at the greatest risk.
Extent/Intensity	The extent and intensity of wildfires within the county may change (increase) due to rising surface temperatures, heat events, and increases in drought severity.
Frequency	Weather and other factors that lead to wildfires are expected to increase throughout the state, thus the frequency of wildfires is expected to increase.
Duration	There is no clear trend regarding the duration of wildfire events.

Section 6.8: Windstorm

6.8 Windstorm

Damaging winds are often called straight-line winds to differentiate the damage they cause from tornadoes or other hazards. Winds that cause damage at the ground are a result of outflows generated by a thunderstorm downdraft. Damaging winds are classified as those exceeding 50-60 mph. Damage from severe winds accounts for half of all damage reports and is more common than damage from tornadoes. Wind speeds can reach over 100 mph and can produce a damage path extending for hundreds of miles. These damaging winds are often associated with other hazards such as thunderstorms, tornadoes, hurricanes, tropical storms, and tropical depressions.[99] Windstorms, or damaging winds, include many different variations. These damaging wind types and their definitions from NOAA can be seen in the table below.[100]

Table 6.8.1: Types of Damaging Winds

Damaging Wind Type	Description
Straight-line Wind	Used to define thunderstorm wind, which is not linked with rotation and is mainly used to differentiate from tornadic winds
Down Draft	A small-scale column of air that sinks toward the ground
Macroburst	An outward burst of strong winds that are more than 2.5 miles in diameter, occurs when a strong downdraft reaches the surface
Microburst	A small, concentrated downburst that produces an outward burst of relatively strong winds near the surface. Microbursts are less than 4 km in diameter and short-lived, lasting only five to 10 minutes. Maximum wind speeds sometimes exceed 100 mph. There are two kinds of microbursts: wet and dry. • A wet microburst is accompanied by heavy precipitation at the surface. • A dry microburst is common in places like the high plains and occur with little or no precipitation reaching the ground.
Downburst	A general term to describe macro and microbursts
Gust Front	The leading edge of rain-cooled air that clashes with a warm thunderstorm inflow
Derecho	A widespread and long-lived windstorm is associated with rapidly moving showers or thunderstorms. A typical derecho consists of numerous microbursts, downbursts, and downburst clusters. If the wind damage swath extends more than 240 miles and includes wind gusts of at least 58 mph or greater along most of its length, then the event may be classified as a derecho.

Location

Similar to the Severe Thunderstorms & Lightning (Section 6.3), Hurricane, Tropical Storms, and Tropical Depressions (Section 6.2), and Tornado (Section 6.10) hazard profiles, windstorms/ damaging winds are not confined to any geographic boundaries and can occur anywhere within the county if the right conditions are present. The entire county is at risk for this hazard. Thunderstorms and tropical storms that can lead to a tornado or hurricane will typically occur in warmer months such as Summer and Spring, and during the warmest parts of the day. Warm, moist air from the Gulf of Mexico is readily available to help fuel atmospheric conditions that produce thunderstorms/ tropical storms, and the damaging winds associated with them.

Extent

Wind intensity is measured by the NWS through the Beaufort Wind Scale. One of the first scales to estimate wind speeds and their effects was created by Britain's Admiral Sir Francis Beaufort (1774-1857). He developed the scale in 1805 to help sailors estimate the winds via visual observations. The scale starts with 0 and goes to a force of 12. The Beaufort scale is still used today to estimate wind strengths.[101] The table below outlines the measurements used by the Beaufort Wind Scale for use on land. Tornadoes are measured by the damage that they cause at specific 3-second wind gust speeds, of which the worst the planning area has seen was an F4 tornado that crossed through areas within the City of Dayton in 1992 with 3 second wind gusts between 166-200 mph. The intensity of a tropical storm or hurricane is measured by its 1-minute sustained wind speed. The higher the wind speed, the higher the categorization of the storm. While the categorization of a storm is often used as a proxy for its destructive capability, it is the 3-second wind gusts that actually cause the most damage to properties and infrastructure. [102]

Table 6.8.2: Beaufort Wind Scale

Force	Speed (mph)	Description	Specifications for use on land
0	0-1	Calm	Calm; smoke rises vertically.
1	1-3	Light Air	Direction of wind shown by smoke drift, but not by wind vanes.
2	4-7	Light Breeze	Wind felt on face; leaves rustle; ordinary vanes moved by wind.
3	8-12	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag.
4	13-18	Moderate Breeze	Raises dust and loose paper; small branches are moved.
5	19-24	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	25-31	Strong Breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	32-38	Near Gale	Whole trees in motion; inconvenience felt when walking against the wind.
8	39-46	Gale	Breaks twigs off trees; generally impedes progress.
9	47-54	Severe Gale	Slight structural damage occurs (chimneypots and slates removed)
10	55-63	Storm	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
11	64-72	Violent Storm	Very rarely experienced; accompanied by wide-spread damage.
12	72-83	Hurricane	Reference the Saffir-Simpson Hurricane Scale

Additionally, NOAA and the NWS issues watches, warnings, and advisories for wind events when wind speeds can pose a hazard or are life-threatening. Table 6.8.3 describes the various wind-related warnings, watches, and advisories below.[103]

Table 6.8.3: Wind-Related Warnings, Watches, and Advisories

Watch/ Warning/ Advisory	Description
High Wind Warning	Sustained, strong winds with even stronger gusts are happening. Seek shelter. If you are driving, keep both hands on the wheels and slow down.
High Wind Watch	Sustained, strong winds are possible. Secure loose outdoor items and adjust plans as necessary so you're not caught outside.
Wind Advisories	Strong winds are occurring but are not so strong as to warrant a High Wind Warning. Objects that are outdoors should be secured and caution should be taken if driving.
Hurricane Force Wind Warning	Hurricane Force Wind Warnings are issued for locations along the water when one or both of the following conditions are expected to begin within 36 hours and are not directly associated with a tropical cyclone: sustained winds of 64 knots or greater or frequent gusts (duration of two or more hours) of 64 knots (74 mph) or greater.

A worst-case scenario for this hazard within Liberty County would include a prolonged heavy or excessive severe thunderstorm event that could produce straight-line winds up to 100 mph, strong F4 tornadoes, large baseball sized hail, and a lightning threat level of extreme with a very high likelihood of CG lightning (or 80% to 90% thunderstorm probability). This could result in dangerous and life-threatening record-level flooding, inundated roadways cutting off access to neighborhoods and critical facilities, flying debris posing threats to life and cutting off access to utilities, wind gusts flinging debris, knocking down trees and powerlines, frequent or extreme CG lightning, and flood waters receding slowly exacerbating rescue and recovery efforts. These storms could damage critical infrastructure leading to a prolonged power outage and even result in a loss of communications within the county if a radio or cell tower is destroyed. If such a storm event occurs during an excessive heat event or a drought and disrupts power supply in the area for a prolonged amount of time, secondary hazards will pose increased risks to citizens due to the heat and inability to keep homes and buildings cool. This scenario is similar to what occurred within the region during the 2024 derecho and Hurricane Beryl. This led to infrastructure damage; power lines were destroyed by winds and tree debris, in July, when the region was under an excessive heat advisory. Power restoration and infrastructure repairs took over 10+ days to restore in certain areas. This led to the multi-day activation of cooling centers across the county and the region. The strongest winds ever recorded in Liberty County were from Hurricane Ike in 2008 that saw maximum sustained winds at landfall estimated at 95 knots (110 mph) with gusts to 110 knots (127 mph).

Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCDC storm events database. A condensed version of Liberty County's strong wind events from 1950-2023 is provided in the table below. There are 130 occurrences of past events, with the earliest event on record occurring in 1963.[39]

Table 6.8.4: Liberty County, Wind Events (2018-2023)

Date	Location	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)	Wind Speed (knots/mph)
4/18/2019	LIBERTY	Thunderstorm Wind	0	0	$4,000	$500	53/61
4/18/2019	DAISETTA	Thunderstorm Wind	0	0	$15,000	$-	60/69
7/30/2019	MOSS BLUFF	Thunderstorm Wind	0	0	$-	$500	52/60
7/30/2019	CLEVELAND	Thunderstorm Wind	0	0	$10,000	$-	52/60
4/19/2020	CLEVELAND	Thunderstorm Wind	0	0	$1,000	$3,000	56/64.5
5/18/2021	DEVERS	Thunderstorm Wind	0	0	$-	$-	50/57.5
6/8/2023	CLEVELAND MUNI ARPT	Thunderstorm Wind	0	0	$-	$-	50/57.5
3/21/2024	KENEFICK	Thunderstorm Wind	0	0	0	0	52/60
6/1/2024	DAYTON	Thunderstorm Wind	0	0	0	0	51/58
6/5/2024	DAYTON	Thunderstorm Wind	0	0	0	0	50/57.5
TOTALS:			**0**	**0**	**$30,000**	**$4,000**	N/A

$- No dollar amount ($0.00).

Presidential Disaster Declarations

There have been 2 disaster declarations in which wind (straight-line winds) was included in the declaration title for Liberty County. However, the declarations are listed as severe storms for the incident type.[2]

Table 6.8.5: Federal Disaster Declarations, Windstorm

Declaration Date	Incident Type	Title	Disaster Number	Declaration Type
5/29/2015	Severe Storm	Severe storms, tornadoes, straight-line winds, and flooding	4223	Major Disaster Declaration
11/25/2015	Severe Storm	Severe storms, tornadoes, straight-line winds, and flooding	4245	Major Disaster Declaration

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below.[40]

Table 6.8.6: USDA Declared Disasters (2018-2023), Windstorm

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences
Severe thunderstorms and their associated damaging winds are more likely to occur in summer months when temperatures are higher and moisture from the gulf helps to fuel thunderstorm development. According to the FEMA NRI for strong wind events, annualized frequency values are 1.4 events per year over a 34-year period of record (1986-2021), with 48 events on record for this timeframe.[43]

Populations at Risk
Populations at risk for strong wind events include similar groups to those listed under Severe Thunderstorms & Lightning (Section 6.3) and Tornado (Section 6.10) hazard profiles. All residents within the county are exposed to this hazard. The impacts of strong winds on the life, health, and safety of Liberty County residents depend on several factors, including the severity of the event and adequate warning time being provided to residents to secure projectiles and take shelter. Strong wind events can lead to a disruption in emergency response services, loss of electricity, loss of clean water, and delayed forms of necessary medical assistance while repairs are made to critical facilities or power is being restored within the county.

The NCHH summarizes at-risk populations for several hazards. For strong wind events, these include older adults, people experiencing homelessness, people with disabilities, and people with chronic health conditions. In addition to the dangers listed above, older adults can face social isolation, lack of electricity needed to run medical equipment, lack of access to a vehicle for evacuation, and lack of access to other critical supplies. Evacuation for these events is fast-paced, and older adults may not be able to seek adequate shelter or secure dangerous projectiles on their property before a wind event impacts their area. For people experiencing homelessness, adequate shelter is critical in keeping populations safe during these events as they are heavily associated with severe thunderstorms and even tornadoes. People with disabilities may require additional assistance to stay safe and prepare for these hazards and their after-effects such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment. Likewise, those with chronic health conditions may need similar assistance as those with disabilities. Residents impacted may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings, and debris carried by the strong winds associated with severe thunderstorms or tornadoes can lead to further injury or loss of life. Socially vulnerable populations are most susceptible based on several factors, including their physical and financial ability to react or respond during or directly following a hazard event. These issues disproportionately affect low-income communities and families who may lack the resources to pay for damages to their homes, lack insurance, or lack the resources to replace home contents or personal belongings.[44]

Areas of growth or future development within the county could be impacted by this hazard because the entire county is vulnerable to strong wind events. Those living in mobile/manufactured housing are at greater risk from this hazard as even anchored mobile homes can be seriously damaged or destroyed when winds gust over 80 mph.[55] As the population within the county increases, so does the vulnerability of residents to this hazard.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below.[45]

Table 6.8.7: Expected Annual Loss Exposure Values, Strong Wind

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Strong Wind	$10,266,884,211	$1,061,307,200,000/ 91,492	$6,997,533	$34,324,048

Table 6.8.8: Expected Annual Loss Values, Strong Wind

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Strong Wind	$61,169	$75,180/ 0.01	$266

N/A- Not Applicable

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings according to the FEMA NRI for strong wind events for 7 census tracts is listed as relatively moderate and 10 tracts rating relatively low. EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below.

Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLR for strong wind events within Liberty County is listed as very low.[46]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.8.1: Risk Index Rating, Strong Wind

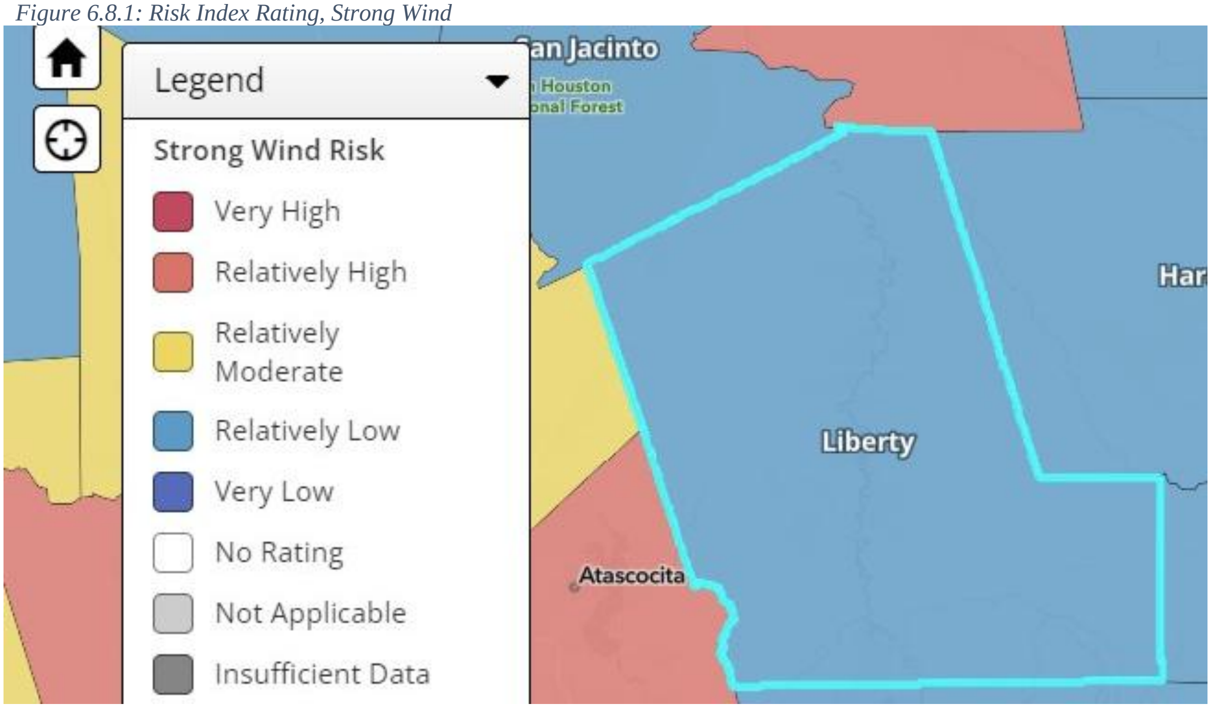


Figure 6.8.2: Risk Index by Census Tract, Liberty County, Strong Wind

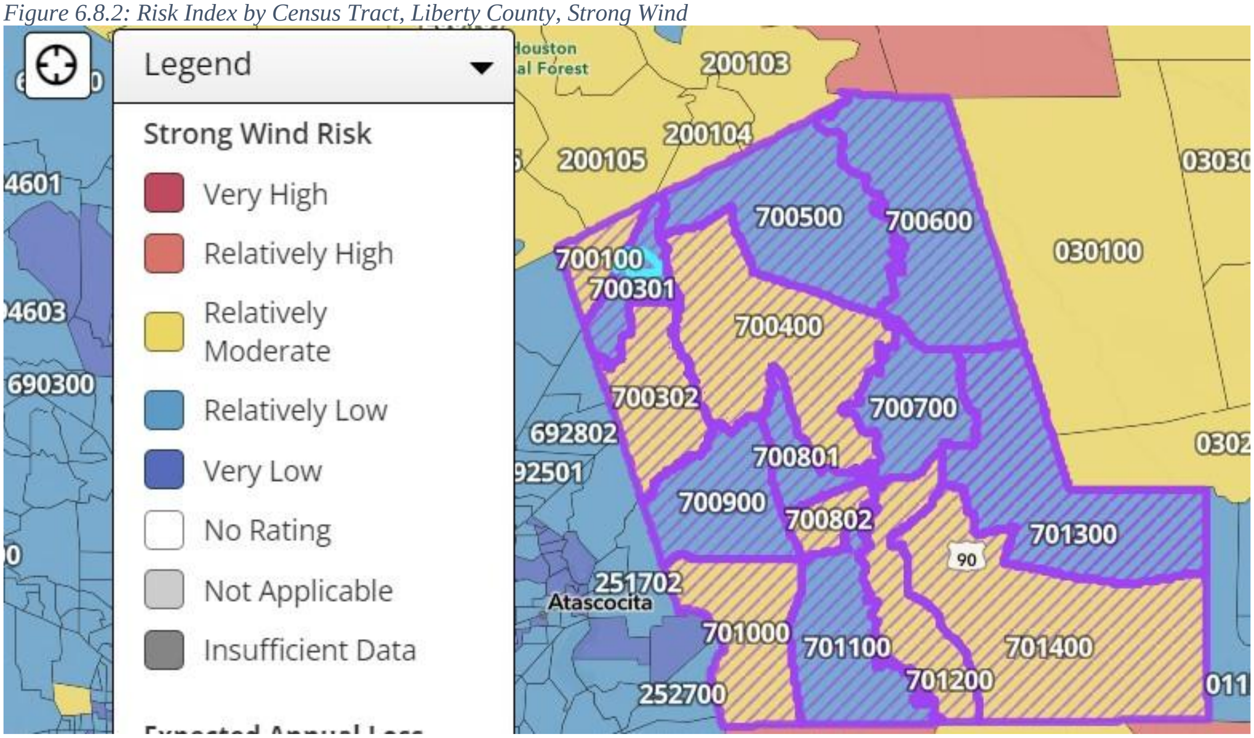


Figure 6.8.3: Social Vulnerability by Census Tract, Liberty County

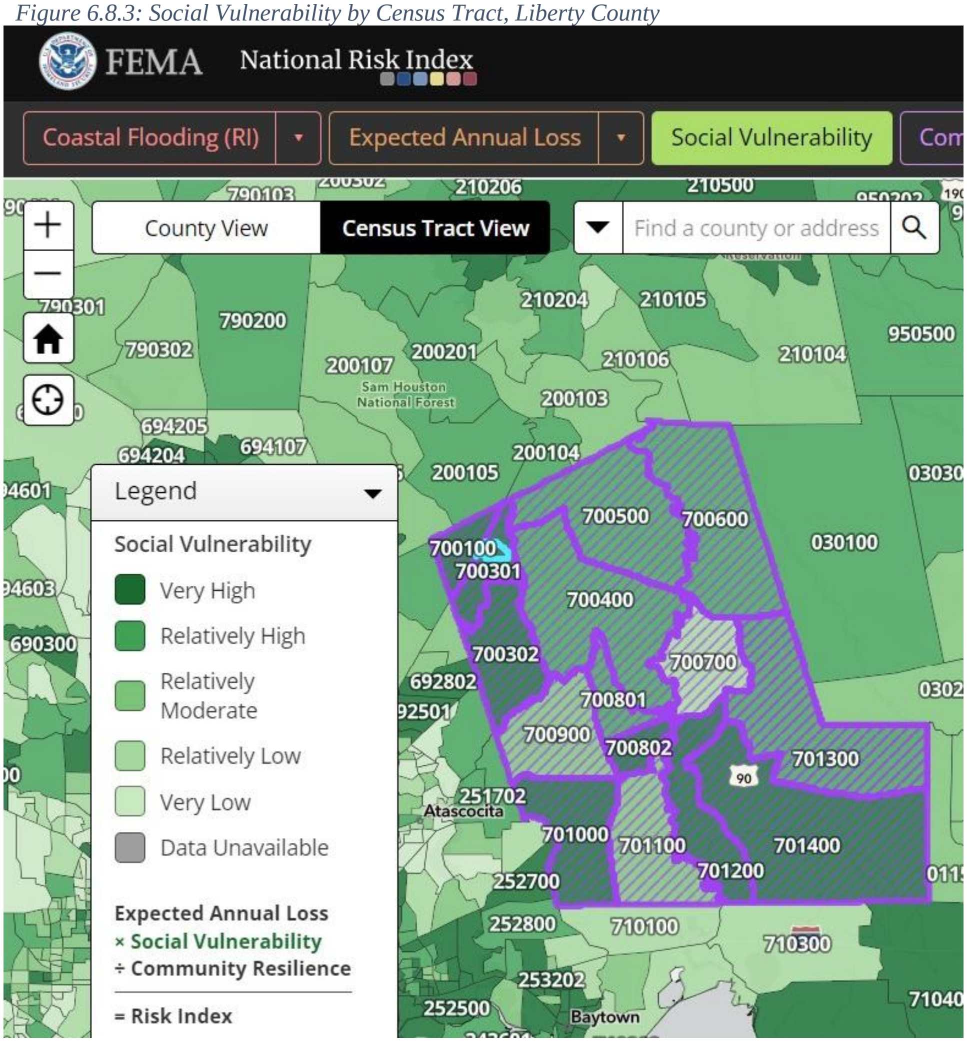


Figure 6.8.4: Social Vulnerability, Liberty County

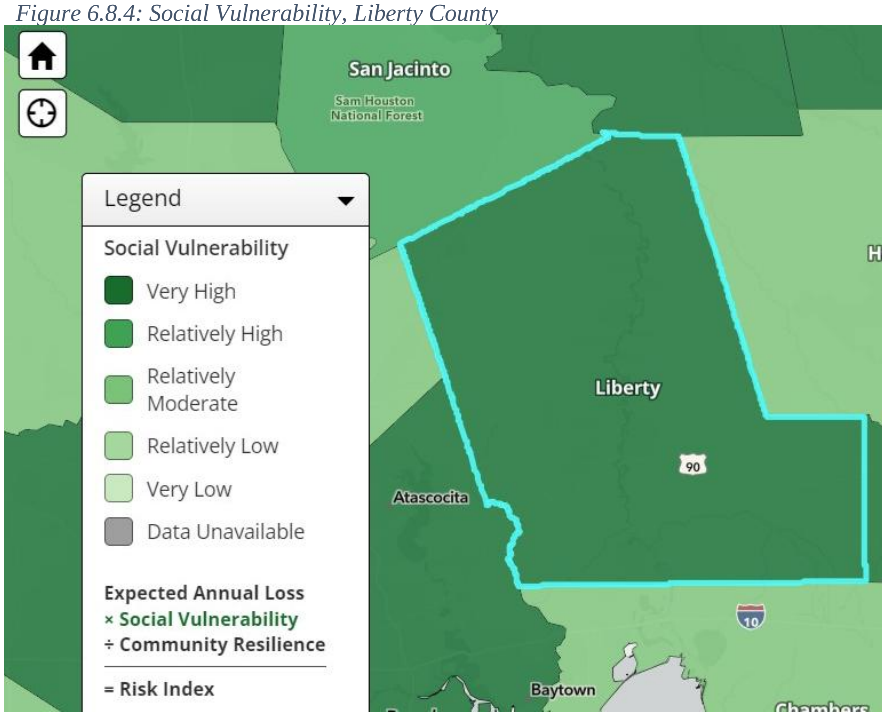


Figure 6.8.5: Community Resilience by Census Tract, Liberty County

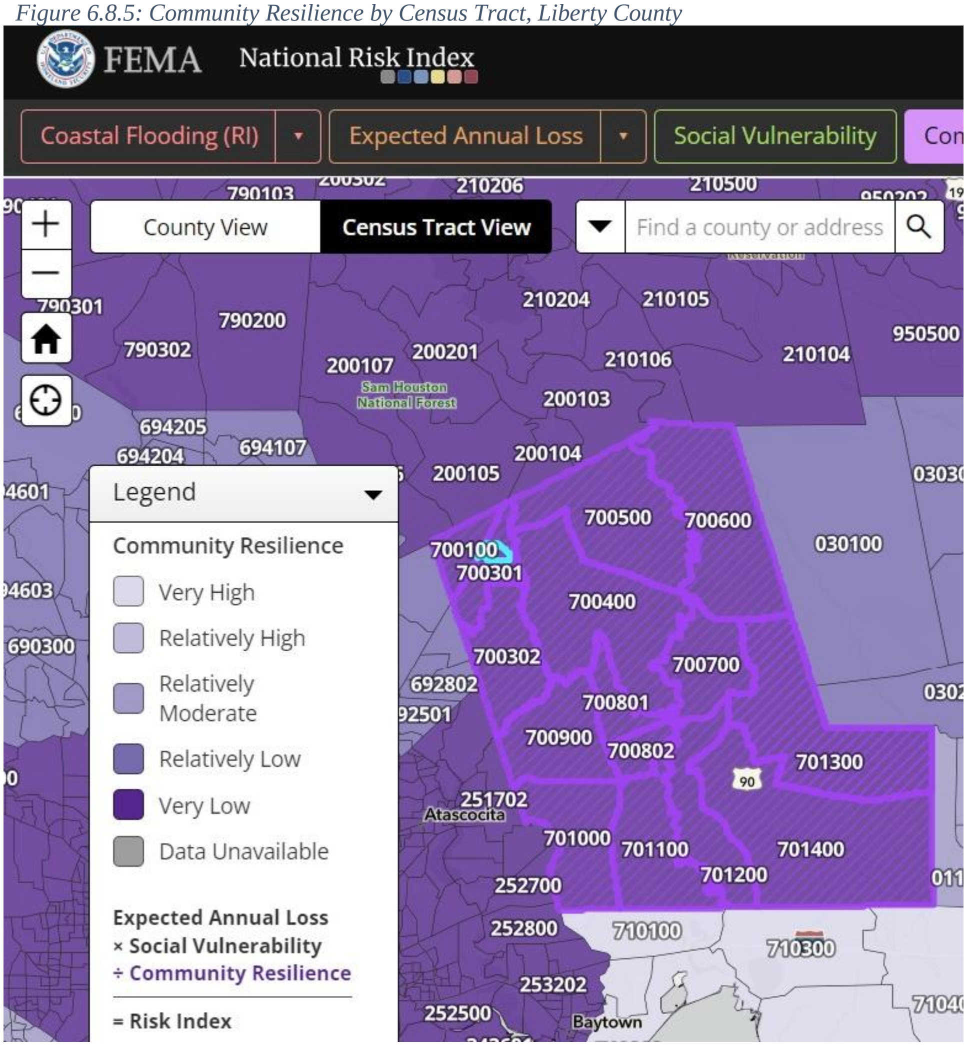


Figure 6.8.6: Community Resilience, Liberty County

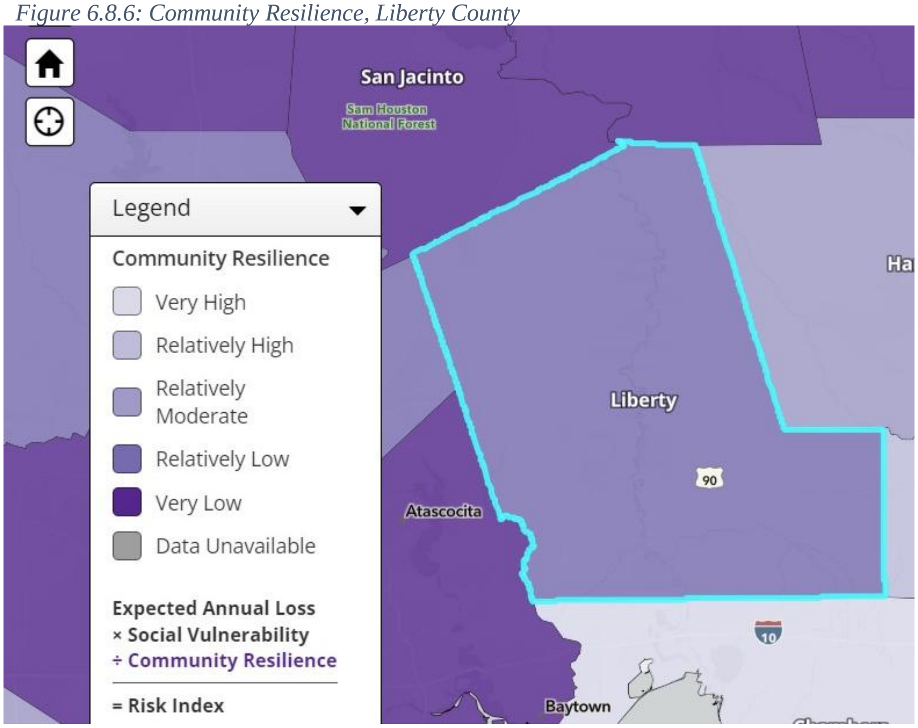


Figure 6.8.7: FEMA NRI Summary by Census Tract, Liberty County, Strong Wind

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Relatively Moderate	70.42	0 100
2	Census tract 48291701200	TX	Relatively Moderate	63.81	0 100
3	Census tract 48291701400	TX	Relatively Moderate	63.77	0 100
4	Census tract 48291701000	TX	Relatively Moderate	60.51	0 100
5	Census tract 48291700400	TX	Relatively Moderate	58.82	0 100
6	Census tract 48291700100	TX	Relatively Moderate	58.48	0 100
7	Census tract 48291700802	TX	Relatively Moderate	55.66	0 100
8	Census tract 48291701100	TX	Relatively Low	54.3	0 100
9	Census tract 48291700303	TX	Relatively Low	51.05	0 100
10	Census tract 48291700301	TX	Relatively Low	49.92	0 100
11	Census tract 48291700200	TX	Relatively Low	48.22	0 100
12	Census tract 48291700900	TX	Relatively Low	45.38	0 100
13	Census tract 48291701300	TX	Relatively Low	44.05	0 100
14	Census tract 48291700801	TX	Relatively Low	40.67	0 100
15	Census tract 48291700600	TX	Relatively Low	39.6	0 100
16	Census tract 48291700500	TX	Relatively Low	39.43	0 100
17	Census tract 48291700700	TX	Relatively Low	34.02	0 100

Figure 6.8.8: FEMA NRI EAL Summary by Census Tract, Liberty County, Strong Wind

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$16,733	Very High	Very Low	1.53	$25,670	70.42
2	Census tract 48291701200	TX	$10,985	Very High	Very Low	1.75	$19,208	63.81
3	Census tract 48291701400	TX	$11,139	Very High	Very Low	1.72	$19,184	63.77
4	Census tract 48291701000	TX	$10,224	Very High	Very Low	1.64	$16,721	60.51
5	Census tract 48291700400	TX	$11,486	Relatively High	Very Low	1.35	$15,508	58.82
6	Census tract 48291700100	TX	$9,244	Very High	Very Low	1.65	$15,266	58.48
7	Census tract 48291700802	TX	$8,656	Very High	Very Low	1.55	$13,438	55.66
8	Census tract 48291701100	TX	$10,558	Relatively Moderate	Very Low	1.2	$12,629	54.3
9	Census tract 48291700303	TX	$5,973	Very High	Very Low	1.81	$10,789	51.05
10	Census tract 48291700301	TX	$5,818	Very High	Very Low	1.75	$10,206	49.92
11	Census tract 48291700200	TX	$5,783	Very High	Very Low	1.63	$9,411	48.22
12	Census tract 48291700900	TX	$6,861	Relatively Moderate	Very Low	1.19	$8,137	45.38
13	Census tract 48291701300	TX	$5,235	Relatively High	Very Low	1.45	$7,578	44.05
14	Census tract 48291700801	TX	$4,820	Relatively High	Very Low	1.3	$6,272	40.67
15	Census tract 48291700600	TX	$4,133	Relatively High	Very Low	1.43	$5,928	39.6
16	Census tract 48291700500	TX	$4,605	Relatively High	Very Low	1.27	$5,870	39.43
17	Census tract 48291700700	TX	$4,363	Relatively Low	Very Low	0.97	$4,239	34.02

Climate Change Impacts

Since windstorms and strong winds are heavily related to severe thunderstorm development, this section will mirror that of Section 6.3 (Severe Thunderstorms & Lightning) seen previously. According to the Office of the Texas State Climatologist, the climate data record for severe thunderstorms is poor, and severe thunderstorms are too small to be simulated directly by present-day climate models. Over the past few decades, the severe storm environment over Texas has changed in complex and opposing ways. The amount of energy available for convection has decreased, and the amount of energy needed to initiate convection has increased at the same time. This suggests that environmental conditions have become less favorable for the occurrence of thunderstorms. However, the amount of low-level shear has increased, which would be expected to make thunderstorms more likely to become severe once they develop.[47]

Changes in severe storm environments have not been uniform throughout the year, with environments becoming more favorable for severe thunderstorms and significant hail in Texas early in the spring and less favorable later in the spring. Strong winds associated with severe storms occur most often during May and June. Climate model simulations imply different prospects in the future. As temperatures increase, the amount of energy available to fuel these storms is simulated to increase as temperature and low-level moisture increase. This results in an overall increase in the number of days capable of producing severe thunderstorms. With these complex trends and partially contradictory information between models and observations, there is low confidence in any ongoing trend in the overall frequency and severity of severe thunderstorms.[48]

Table 6.8.9: Climate Change Impacts Summary, Windstorm

Location	The location of windstorms is not expected to change.
Extent/Intensity	The extent and intensity of windstorms within the county may change (increase) due to increased temperatures and energy available to fuel severe thunderstorms.
Frequency	There are no clear trends in windstorm frequency just as there are no clear trends in severe thunderstorm frequency. This is due to considerable variability in conditions that lead to them occurring. However, these hazards occur most frequently in warmer months, around May and June.
Duration	The duration of windstorms is not likely to change, however, the intensity of them is expected to increase due to rising temperatures and the proximity of the county to the Gulf of Mexico which provides warm air to aid in fueling thunderstorms.

Section 6.9: Drought & Expansive Soils

6.9 Drought & Expansive Soils

The NWS defines drought as “A deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area.” The American Meteorological Survey defines drought as “A period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance.”[104] Drought can have several different classifications for monitoring purposes. Table 6.9.1 below outlines these classifications and their definitions.

Table 6.9.1: Drought Classifications

Drought Classification	Definition
Meteorological	When dry weather patterns dominate an area.
Hydrological	When low water supply becomes evident in the water system.
Agricultural	When crops become affected by drought.
Socioeconomic	When the supply and demand of various commodities is affected by drought.
Ecological	When natural ecosystems are affected by drought.

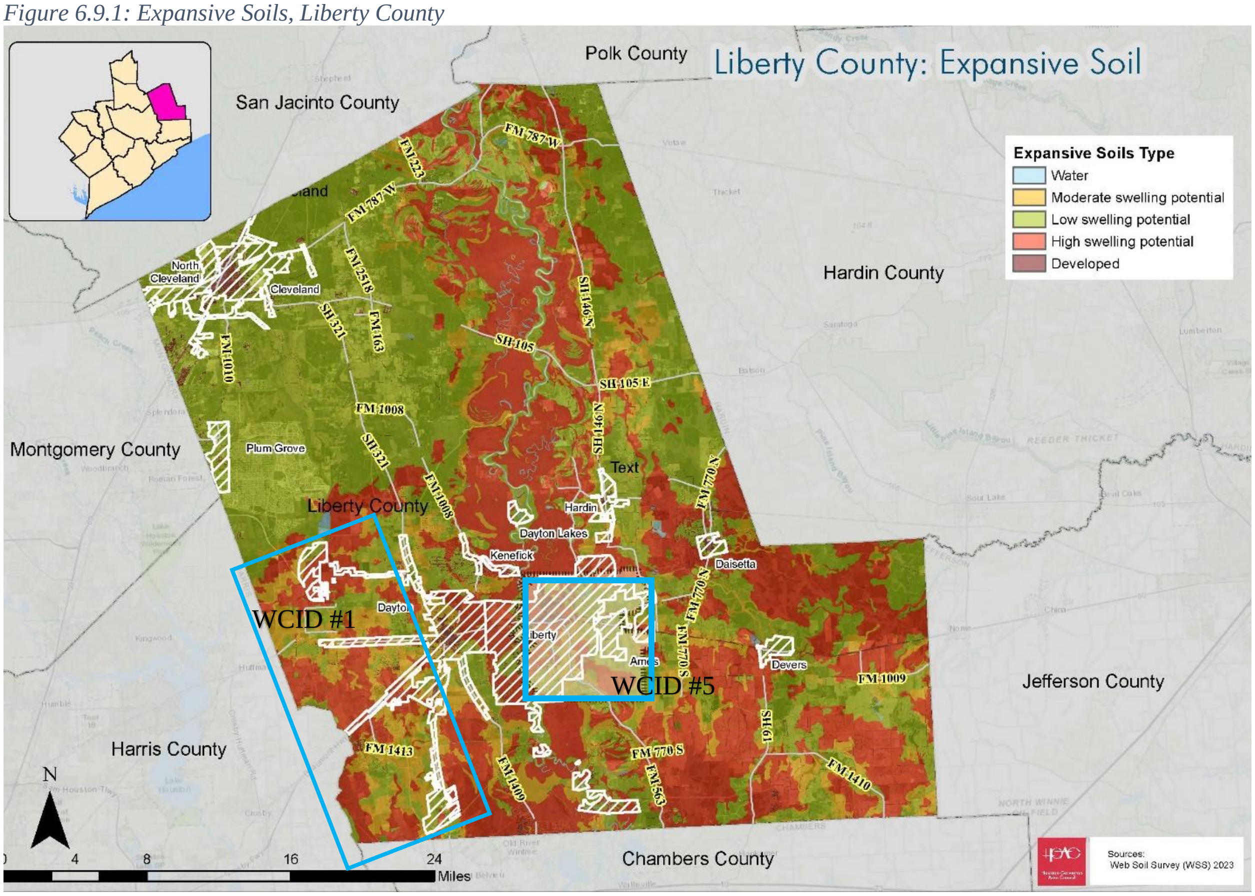
Expansive or swelling soils are soils intertwined with layers of various clay particles that can absorb large quantities of water. Changes in precipitation or other moisture conditions cause these soils to shrink and swell. They can expand up to 20% by volume when exposed to water and exert a force of up to 30,000 pounds per square foot, enough to break up any structure they encounter. Expansive soils are one of the nation’s most prevalent causes of damage to buildings and construction. Annual losses are estimated in the billions of dollars. Losses include severe structural damage, cracked driveways, cracked or upheaval in sidewalks, slab on grade foundations, roads, and highway structures, which can lead to the condemnation of buildings and disruption of pipelines and sewer lines. The destructive forces of these soils may be upward, horizontal, or both, and can be exacerbated by drought conditions.[105] For this plan update, drought & expansive soils are included in the same hazard profile as they directly correlate to greater losses and risk for the county.

Location

Drought can lead to a wide range of impacts on agriculture, public health, water quality, ecosystems, transportation, and wildfire risk. This is a reoccurring natural hazard in every Texas county and has no geographic boundary. Droughts are also difficult to predict and monitor as the effects vary from region to region.[106] All of Liberty County and participating jurisdictions are susceptible to drought and its impacts.

Similarly, expansive soils pose a greater risk during times of drought followed by heavy rainfall and periods of dryness. The figures below show expansive soil locations via their shrink-swell potentials within Liberty County and participating jurisdictions. Areas with high shrink-swell potentials are more at risk for losses and damage than those with low shrink-swell potential.

Figure 6.9.1: Expansive Soils, Liberty County



Liberty County WCID #1 and WCID #5 are depicted by the blue outline above. Location is approximate and do not reflect actual boundaries of the WCIDs.

Figure 6.9.2: Expansive Soils, City of Ames

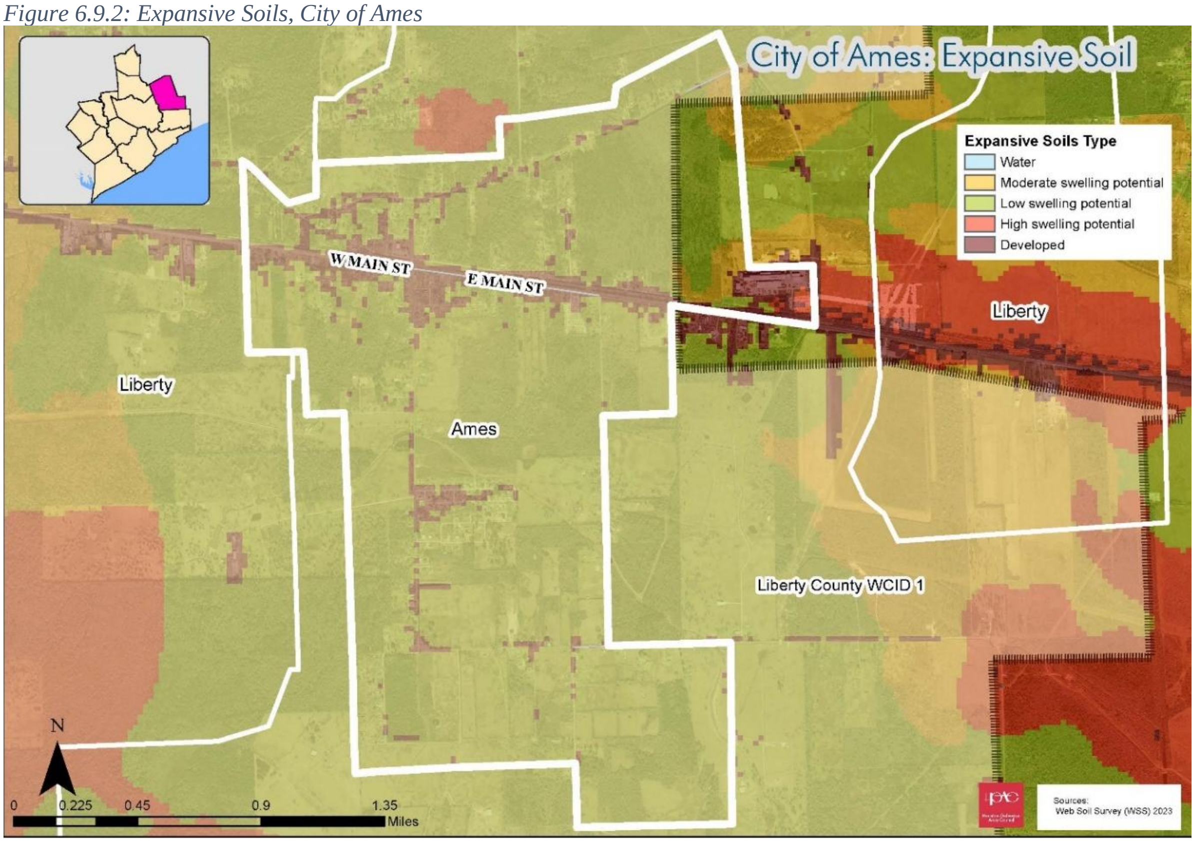


Figure 6.9.3: Expansive Soils, City of Cleveland

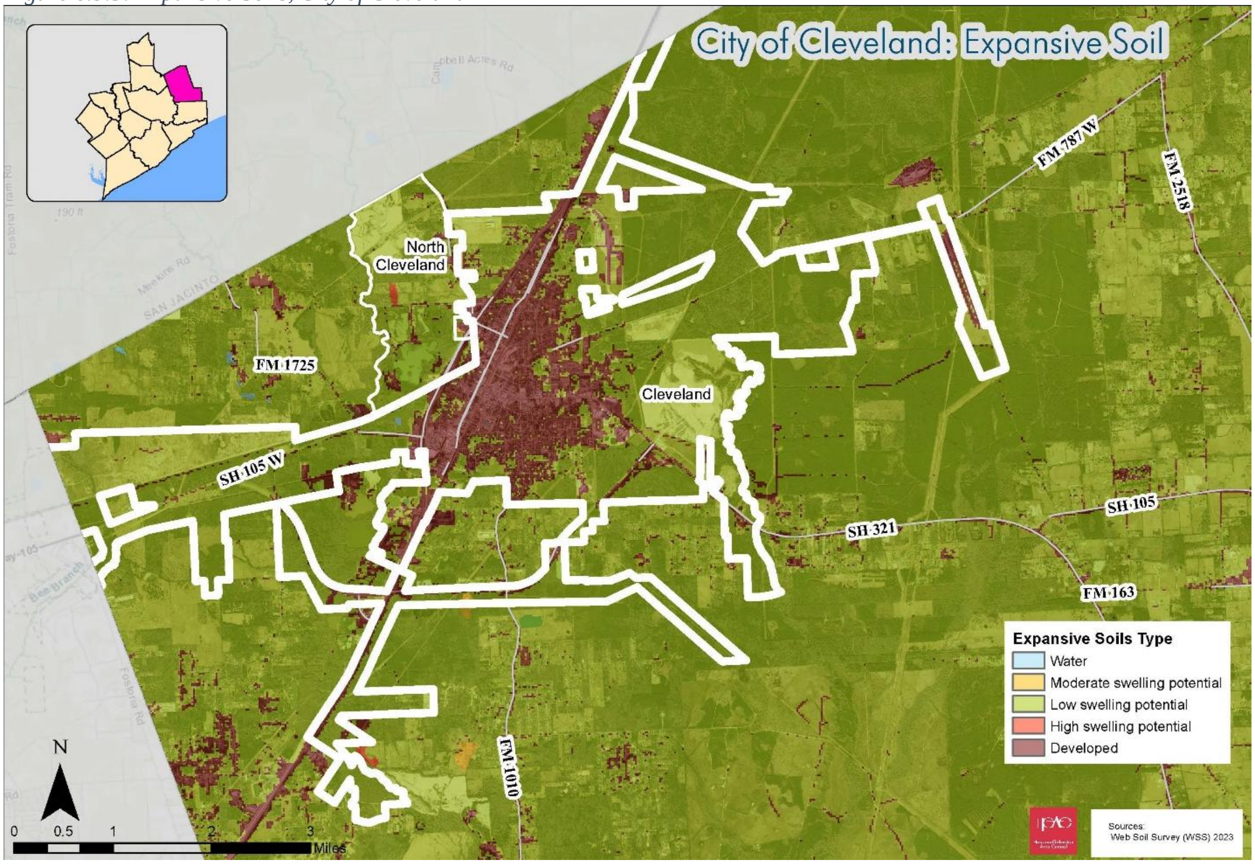


Figure 6.9.4: Expansive Soils, City of North Cleveland

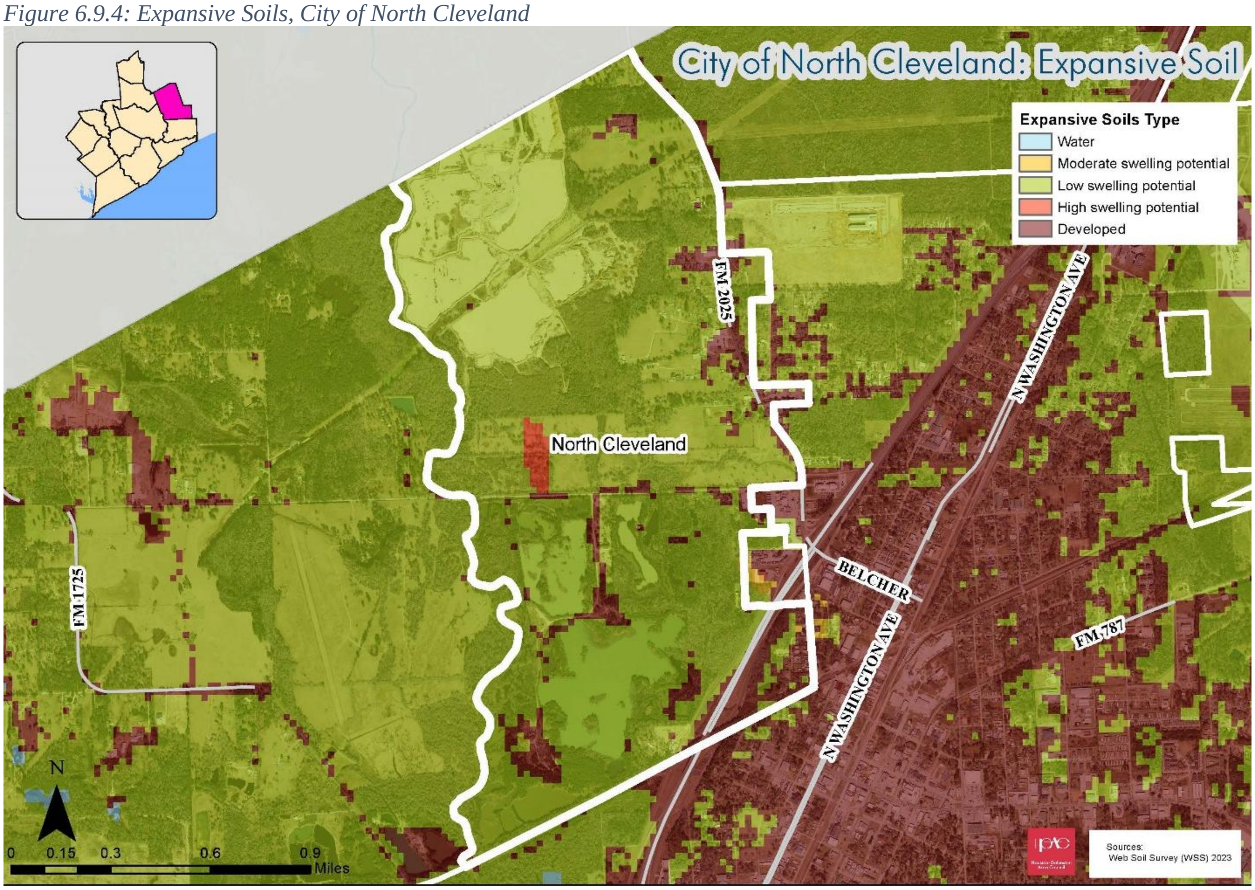


Figure 6.9.5: Expansive Soils, City of Daisetta

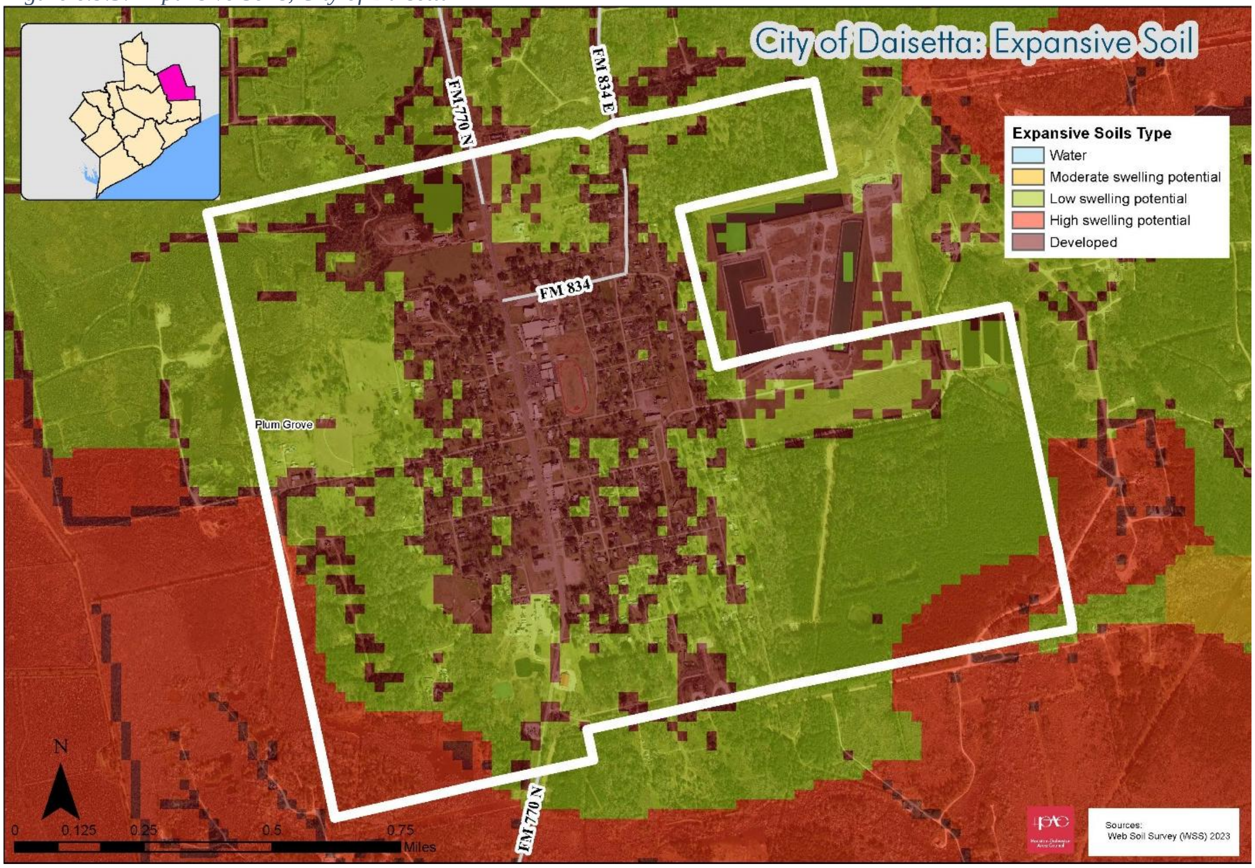


Figure 6.9.6: Expansive Soils, City of Dayton

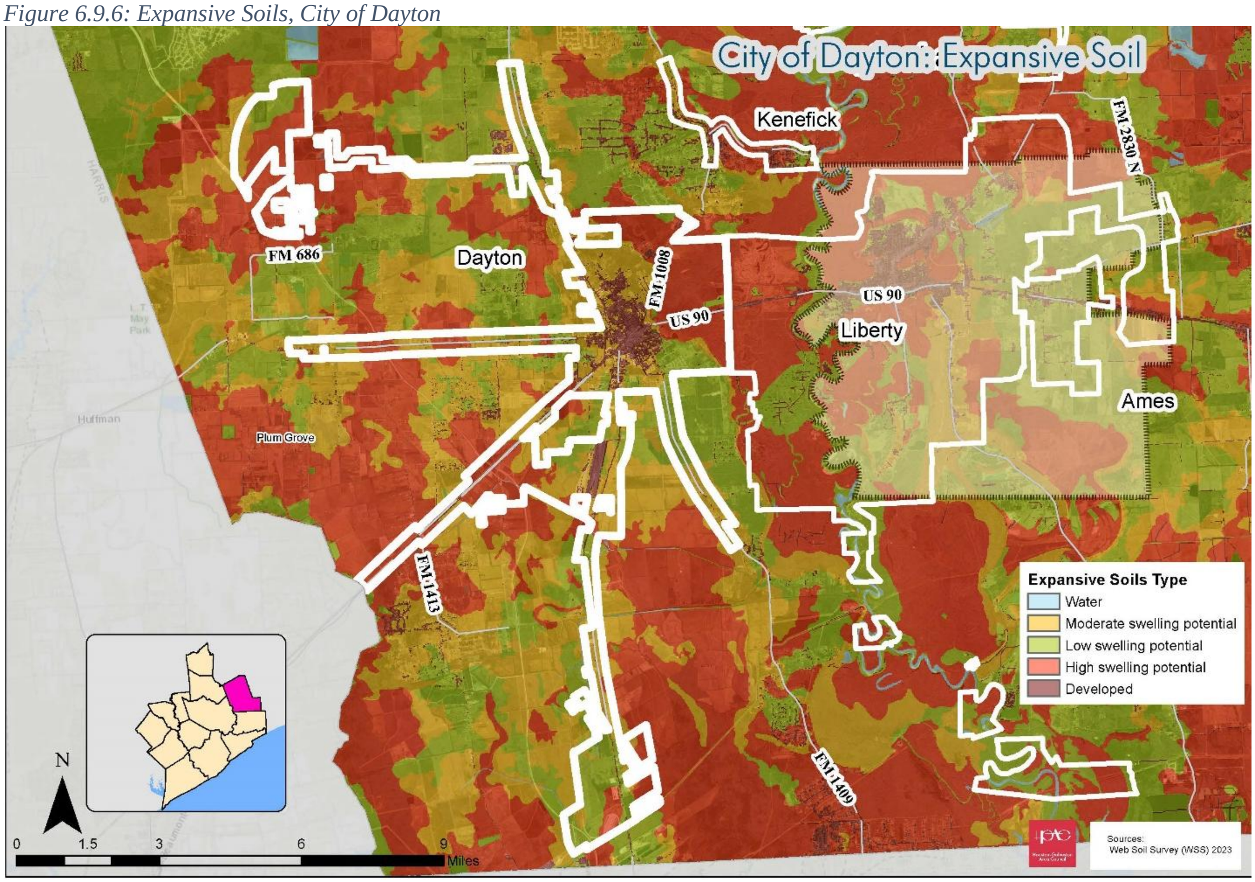


Figure 6.9.7: Expansive Soils, City of Devers

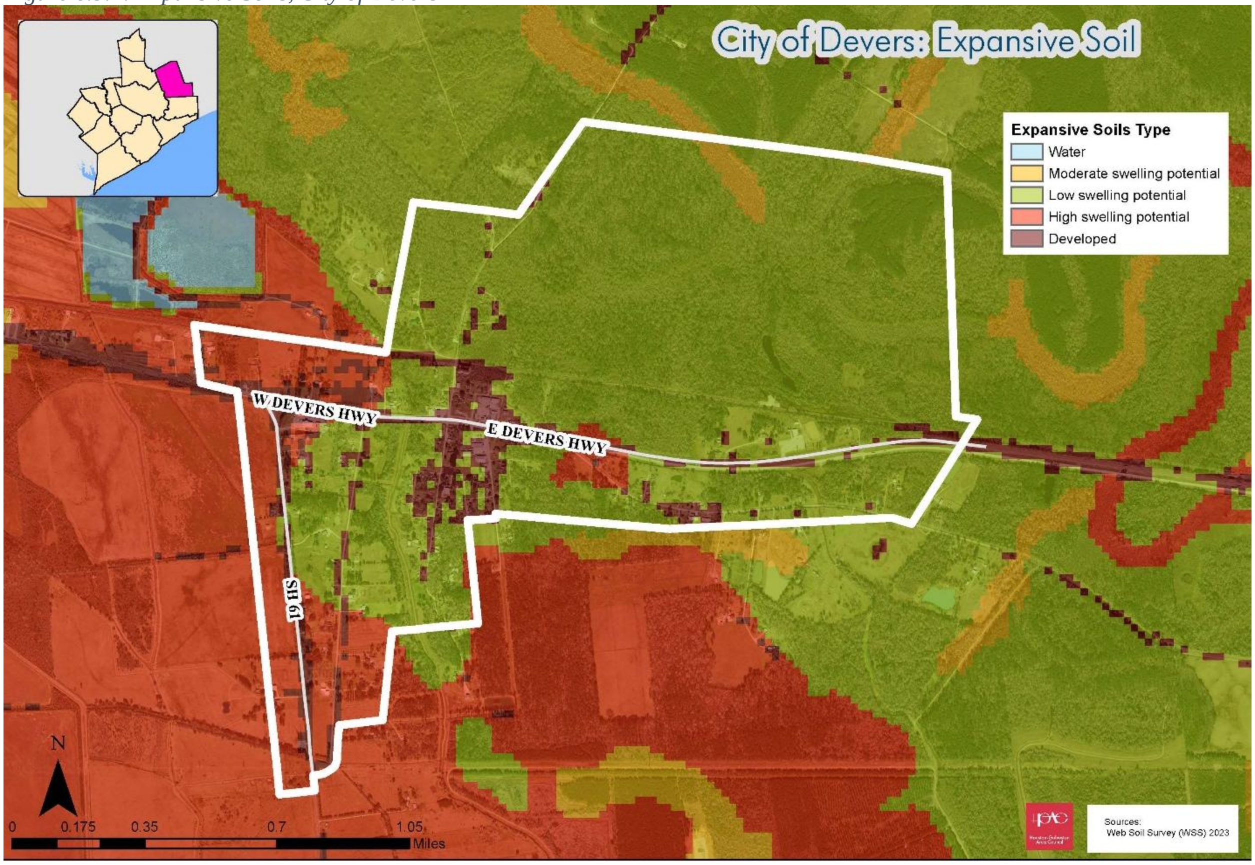


Figure 6.9.8: Expansive Soils, City of Hardin

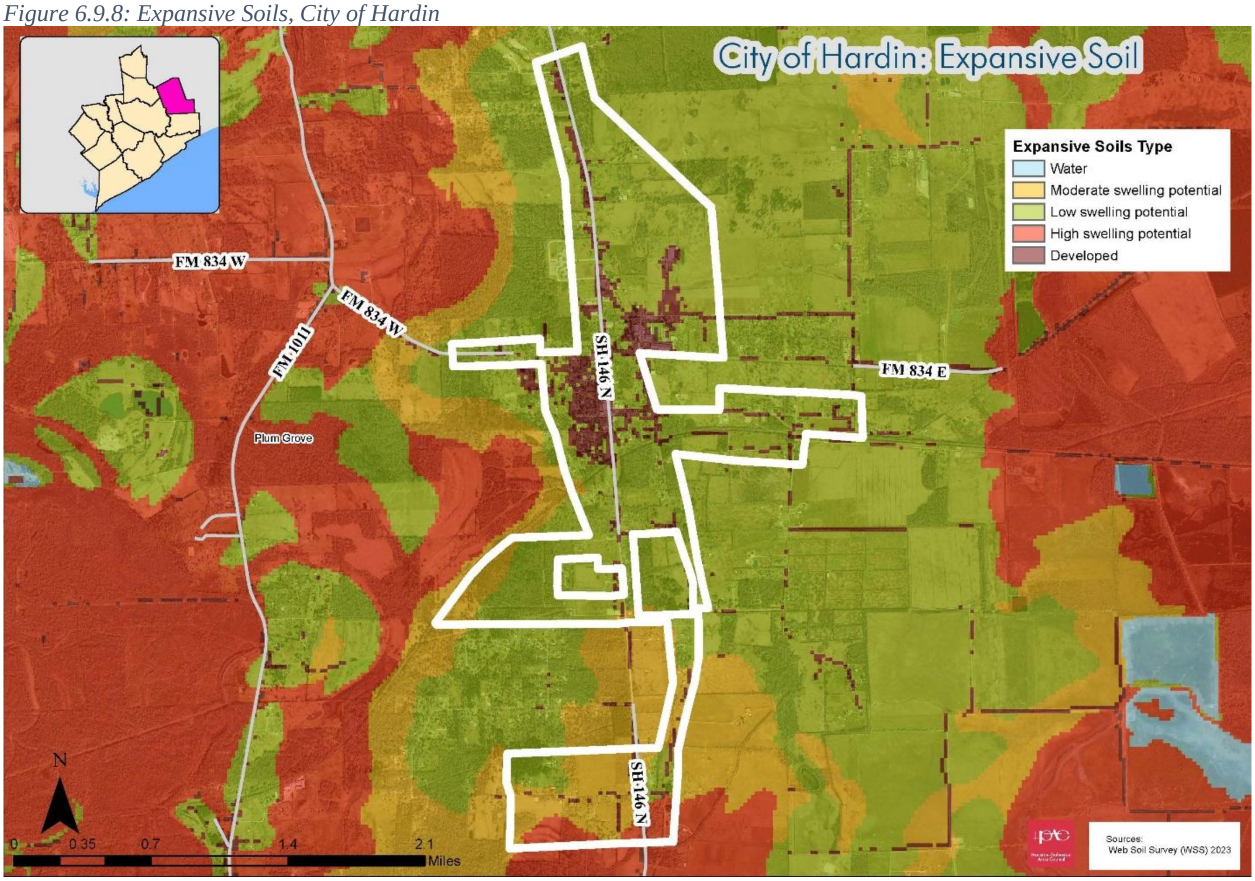


Figure 6.9.9:Expansive Soils, City of Kenefick

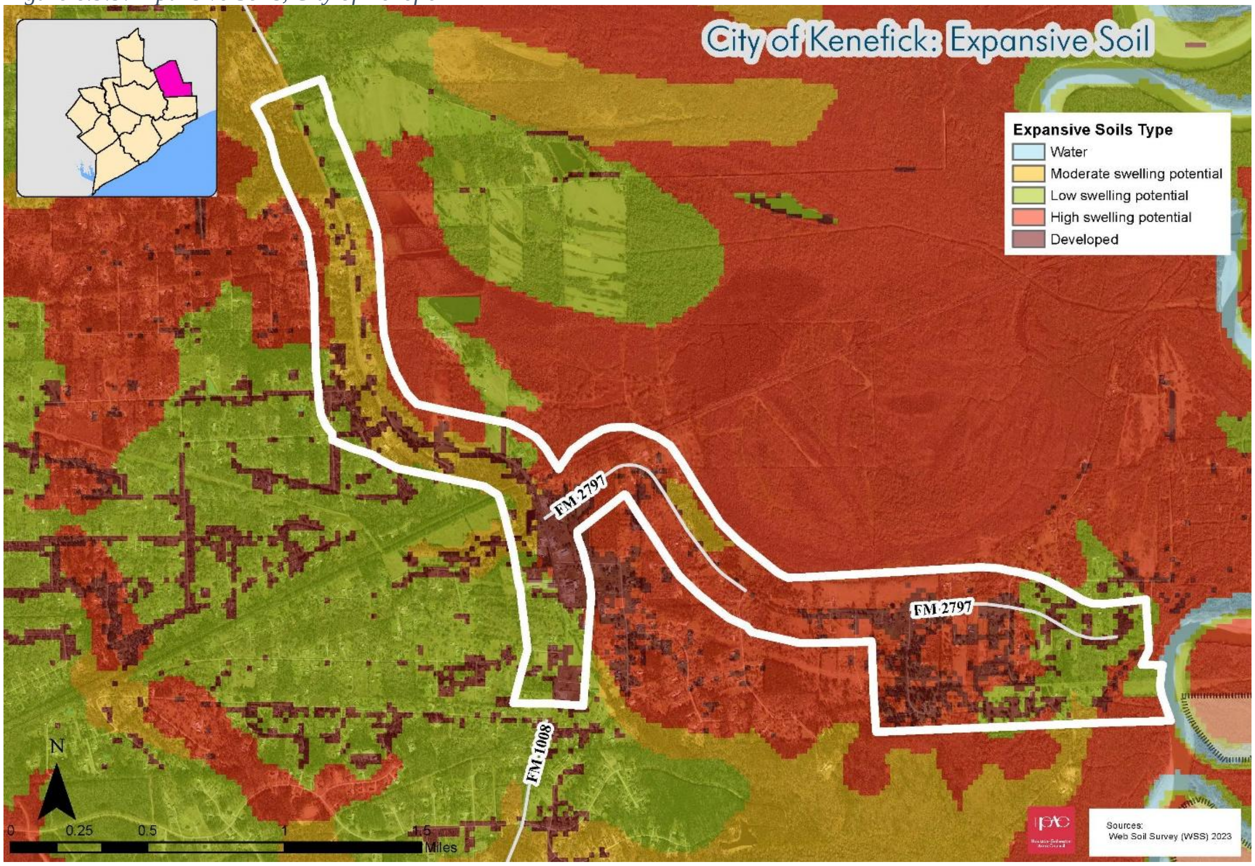


Figure 6.9.10: Expansive Soils, City of Liberty

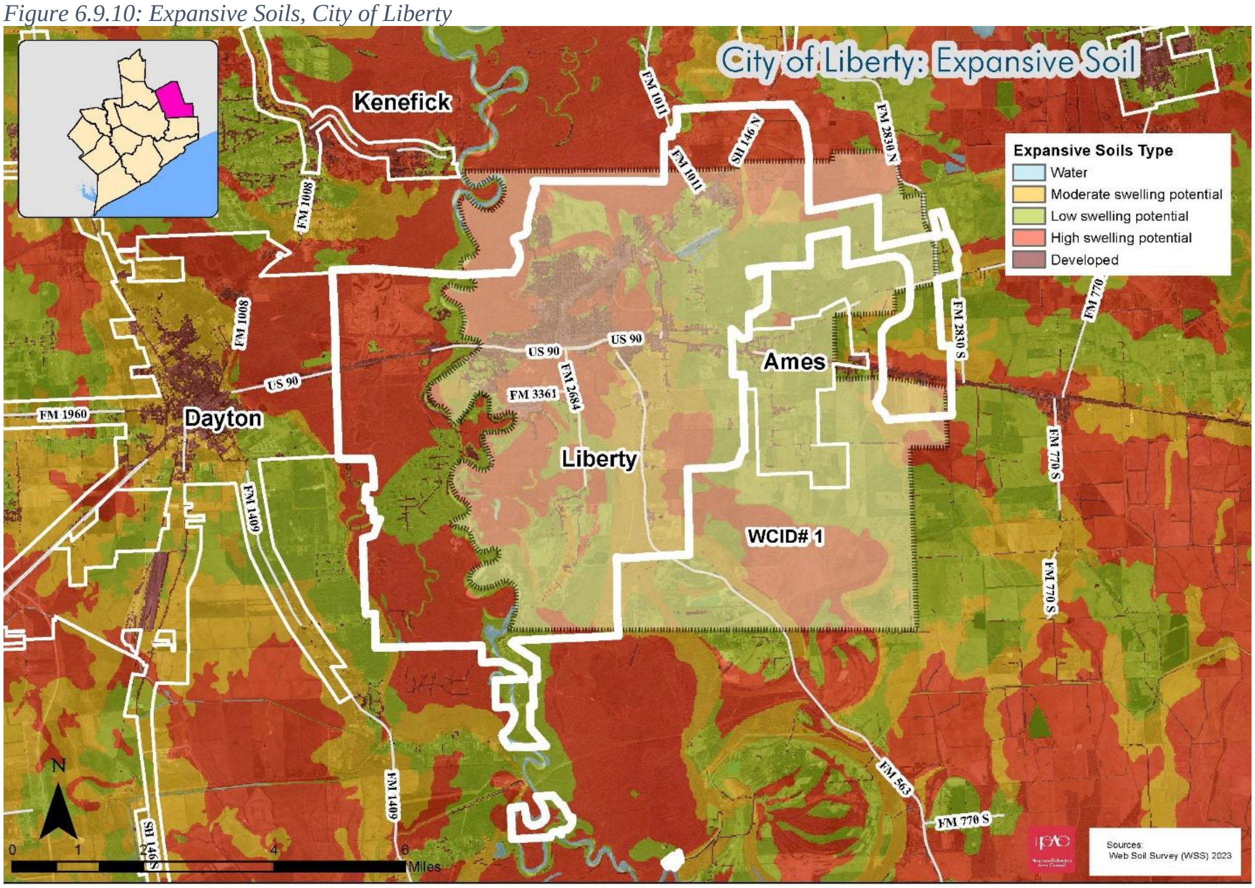
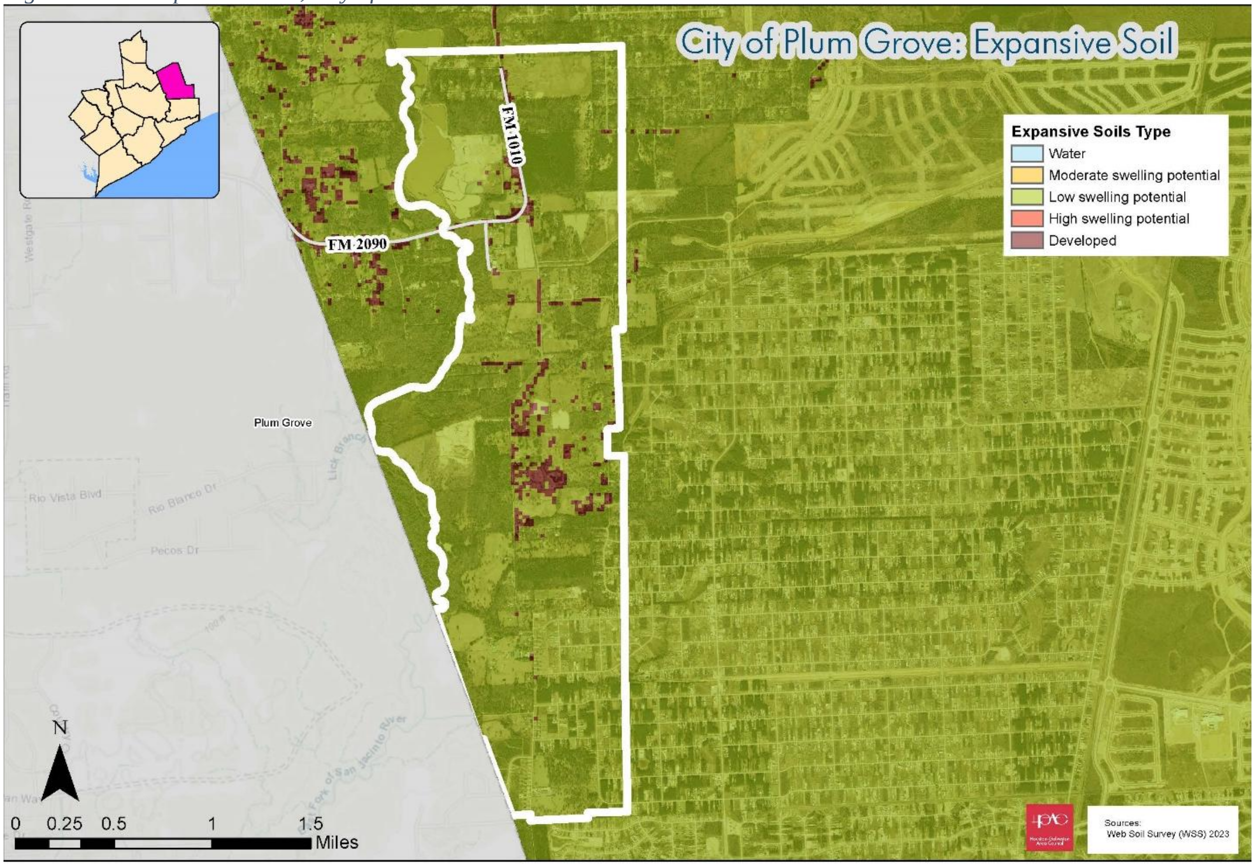


Figure 6.9.11: Expansive Soils, City of Plum Grove



The chart below shows the Linear Extensibility Percent (LEP) and Coefficient of Linear Extent (COLE) to show the Shrink-Swell Class of expansive soils, as pictured above. COLE is a test frequently used to characterize expansive soils. COLE is a measure expressed as a fraction of the change in a soil sample dimension from the moist to dry state. The LEP is a measure expressed as a percentage of the change in a soil sample dimension from the moist to dry state. The Shrink-Swell Class is found in comparing these two measurements. A Moderate to Very High rating marks soils that have the potential to contract and expand, leading to damage to critical infrastructure, foundations, and transportation structures. The city is located almost entirely within areas that have soils with moderate and high shrink-swell potentials.

Table 6.9.2: Linear Extensibility Percent & Coefficient of Linear Extent for Expansive Soils

Shrink-Swell Class	Linear Extensibility Percent	Coefficient of Linear Extent
Low	3	0.03
Moderate	3 to 6	.03-.06
High	6 to 9	.06-.09
Very High	Greater than or equal to 9	Greater than or equal to 0.09

Extent

The U.S. Drought Monitor (USDM) is a map that is updated each Thursday to show the location and intensity of drought across the country. The USDM uses a five-category system to classify levels of drought. These categories, seen in the figure below, show experts' assessments of conditions related to dryness and drought including observations of how much water is available in streams, lakes, and soils compared to usual for the same time of year. Abnormally Dry (D0) shows areas that may be going into or are coming out of drought, while the remaining four categories characterize levels of drought (D1–D4).[107]

Figure 6.9.12: Drought Monitor Categories

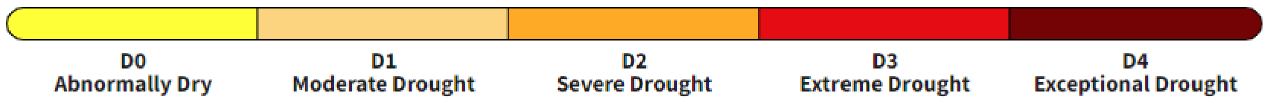
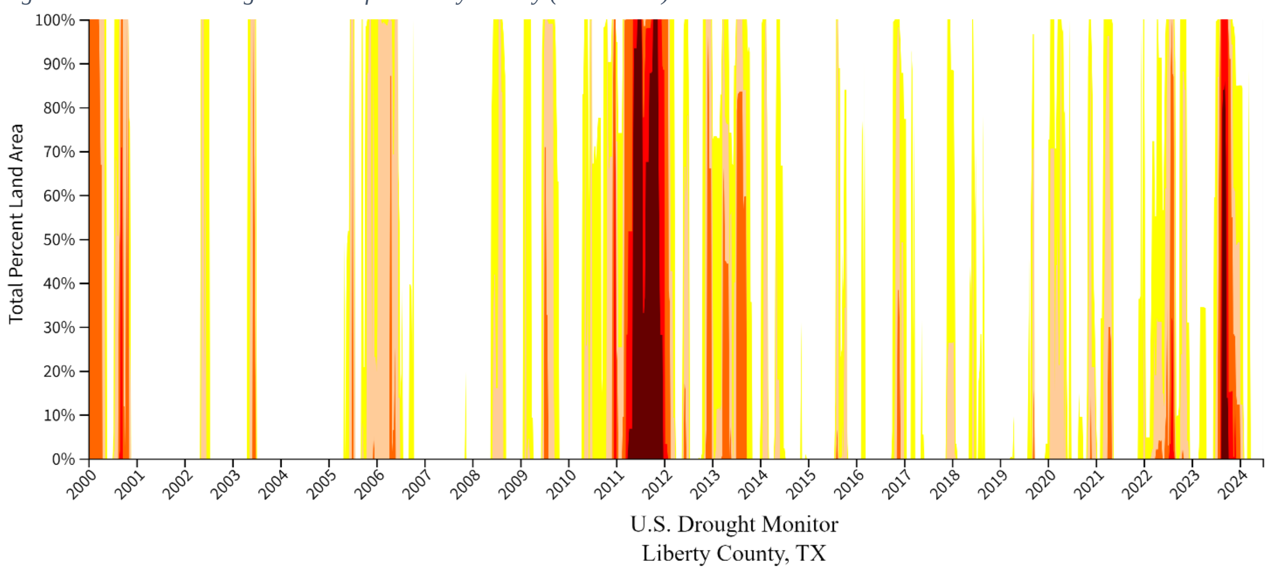


Figure 6.9.13 shows the USDM Drought Categories for Liberty County since 2000. The risk of drought occurring applies the same to the entire county. There are no known factors that make one area or community more prone to drought events than another. However, drought can adversely impact individuals employed in agriculture and natural resources over other industries. Severe droughts can lead to increased wildfire risk and poor pasture conditions that can result in crop and livestock losses, impacting the food supply and economy.[108] Extreme (D3) drought conditions result in multiple sectors of the economy experiencing some level of financial burden, dry and cracked soil that leads to greater crop and livestock losses, and severe fish, plant, and wildlife loss due to low soil moisture and surface water levels, and impacted air quality from increased dust and sand storms. Exceptional drought (D4) impacts can see water levels at historic lows leading to water shortages, exceptional and widespread crop and livestock losses, widespread tree mortality, water sanitation and water quality concerns, extreme wildfire risks, and significant financial losses within the forestry, tourism, and agricultural sectors.

For Liberty County, the worst-case scenario for drought would include a multi-year drought of D4, similar to what occurred in 2010-2014, and more recently in 2022 and 2024. Regarding expansive soils, a worst case scenario for this hazard would be soils shifting and causing foundation and infrastructure damages to underground pipes. Expansive soil risks are exacerbated during a drought, when temperatures are high and rainfall is scarce

Figure 6.9.13: U.S. Drought Monitor for Liberty County (2000-2025)



Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCDC storm events database. The table below shows Liberty County's drought events since the last plan update.[39]

Table 6.9.3: Liberty County Drought Events (1950-2023)

Event Date	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
6/14/2022	Drought	0	0	$-	$-
7/19/2022	Drought	0	0	$-	$-
8/1/2022	Drought	0	0	$-	$-
7/25/2023	Drought	0	0	$-	$-
9/1/2023	Drought	0	0	$-	$-
10/1/2023	Drought	0	0	$-	$-
	Totals:	0	0	$-	$-

$- No dollar amount ($0.00).

Presidential Disaster Declarations

Presidential major disaster declarations, which must be requested of the President by a governor, are administered through FEMA. A Presidential major disaster declaration can be made within days or hours of the initial request. There have been no federally declared drought disasters for drought within the county since 1950.[2]

USDA Disaster Declarations

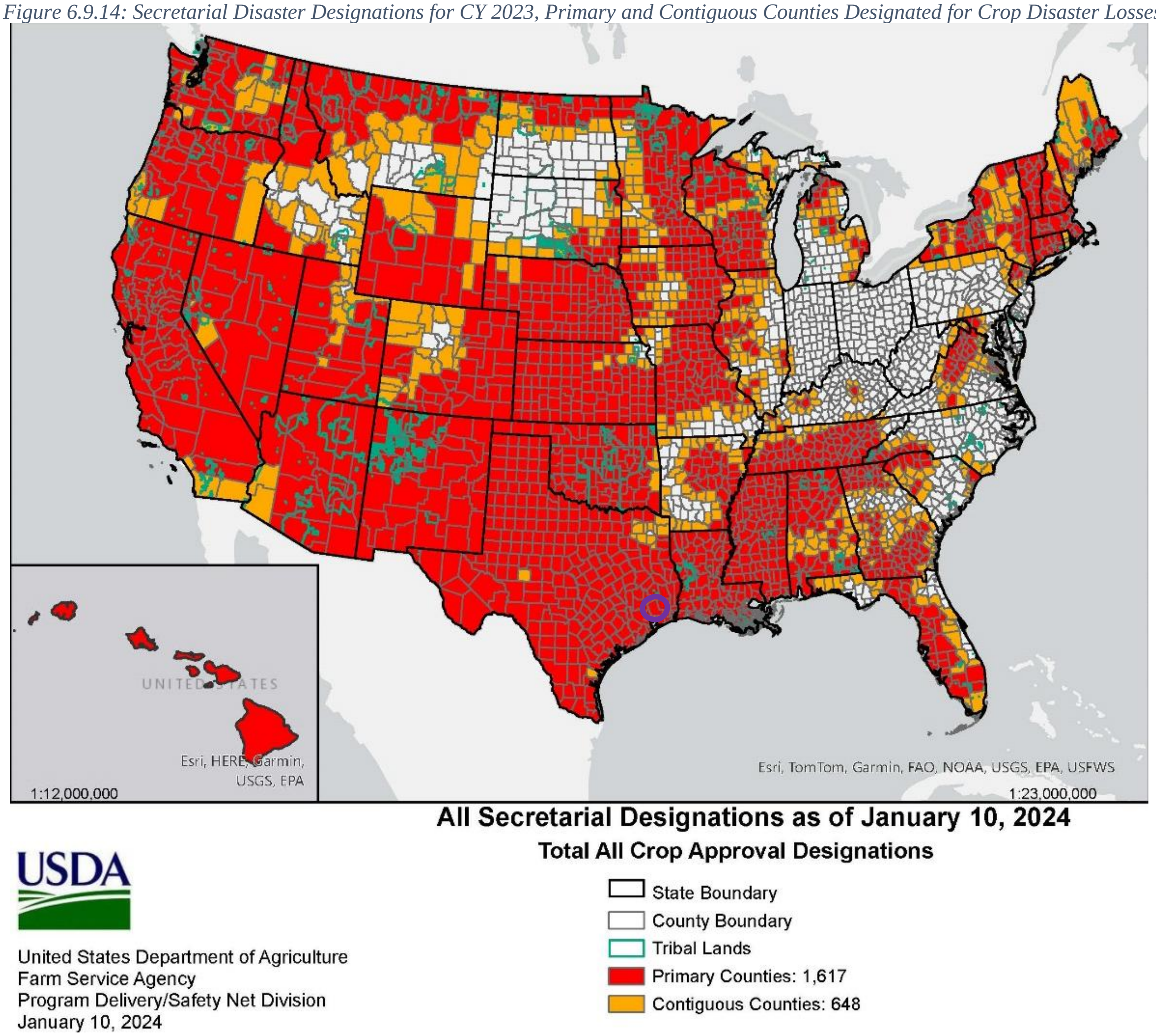
The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below.[40]

Table 6.9.4: USDA Declared Disasters (2018-2023), Drought

Crop Disaster Year	Disaster Description	Designation Number
2022	Drought-FAST TRACK	S5158
2022	Drought-FAST TRACK	S5188
2022	Drought-FAST TRACK	S5209
2022	Drought-FAST TRACK	S5240
2022	Drought-FAST TRACK	S5252
2022	Drought-FAST TRACK	S5259
2023	Drought-FAST TRACK	S5493
2023	Drought-FAST TRACK	S5499
2023	Excessive Heat and Drought	S5569

The figure below displays counties declared primary (red) or contiguous (orange) disaster counties, where producers may be eligible for emergency aid. Liberty is listed as a primary county for CY 2023 and is outlined in purple.

Figure 6.9.14: Secretarial Disaster Designations for CY 2023, Primary and Contiguous Counties Designated for Crop Disaster Losses



Historic occurrences of expansive soils and related damages are not currently tracked or documented in any dataset from local, state, or national levels. Damages to homeowners and business owners are typically shouldered by the individuals when they are discovered. Though the effects and extent of expansive soils have been studied over a great period of time, there is no system in place and no future tracking method for these damages or associated costs. Thus, there is no way to quantify or show historical occurrences of this hazard throughout the entire county. The 2017 HMP Update for Liberty County noted the City of Cleveland had underground water lines broken due to drought and soil conditions.

Probability of Future Occurrences

Droughts are more likely to occur in summer months when temperatures are higher, and precipitation is less frequent. According to the FEMA NRI for drought, annualized frequency values for drought are 14.1 events per year over a 22-year period of record (2000-2021).[43] There have been 350 reports of drought for the county during this period of record. Impacts from expansive soils are directly associated with both drought and flooding hazards. The probability of future occurrences of drought can be found above in this hazard profile. The flooding hazard profile can be found in Section 6.1: Flooding.

Populations at Risk

Populations most at risk, or that may be disproportionately affected by drought impacts according to the National Integrated Drought Information System are people with chronic health conditions or respiratory illnesses, people with compromised immune systems, and people with mental health or mood disorders. Drought impacts on public health include changes in air quality, changes in water quality and quantity, increased incidence of illness and disease, and mental health effects. Air quality can decrease during drought events because of dust storms or wildfires. Particulates in the air irritate the lungs and bronchial passages and exacerbate chronic respiratory conditions. Drought conditions can also put those with compromised immune systems at risk as drought conditions can change how often and where certain diseases occur. Mosquitoes that carry West Nile virus can move to new locations when water bodies become stagnant and create new breeding grounds. There is also a higher risk of contracting a lung infection called Valley Fever, caused by a fungus in the soil, in dry and dusty soil conditions. Complex relationships between drought and its associated economic consequences can increase mood disorders, domestic violence, and suicide.[109]

As the county continues to grow and the population increases, so does the vulnerability of residents and property to these hazards. New developments in areas where soils have medium and high shrink-swell potentials face greater vulnerability to the damage they can cause in the right conditions, especially during drought where soil moisture is low. Additionally, as more people move into the county there will be an increased demand for water resources and supplies, these increased demands can be exacerbated during a drought leading to water restrictions and water shortages.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County for drought can be found below.[45]

Table 6.9.5: Expected Annual Loss Exposure Values, Drought

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Drought	N/A	N/A	$12,671,052	$12,671,052

N/A- Not Applicable

Table 6.9.6: Expected Annual Loss Values, Drought

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Drought	N/A	N/A	$261,696

N/A- Not Applicable

Expansive soils are not included in the FEMA NRI. However, businesses and residents can be impacted by expensive financial costs to repair foundations and water lines for public facilities. School districts, homeowners, and business owners could also be impacted by broken pipes, cracked foundations, and other structural costly repairs caused by expanding and contracting soils. Pipes in critical facilities may also lead to a loss of service, or damaged roads/bridges can increase response time for emergency personnel. While newer buildings can be impacted; older buildings including critical facilities and homes are more likely to be impacted due to older buildings being exposed to numerous weather events and seasons, having building standards that do not take expansive soils into account, and the lack of engineering solutions to mitigate expansive soils used in the past.

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings, according to the FEMA NRI, for drought within these census tracts are listed as relatively moderate for 4 census tracts, and relatively low for 2 census tracts, and very low for 4 census tracts. [46] The remaining census tracts within the county are unrated for drought. EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for riverine flooding within Liberty County as relatively moderate.[45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.9.15: Risk Index, Liberty County, Drought

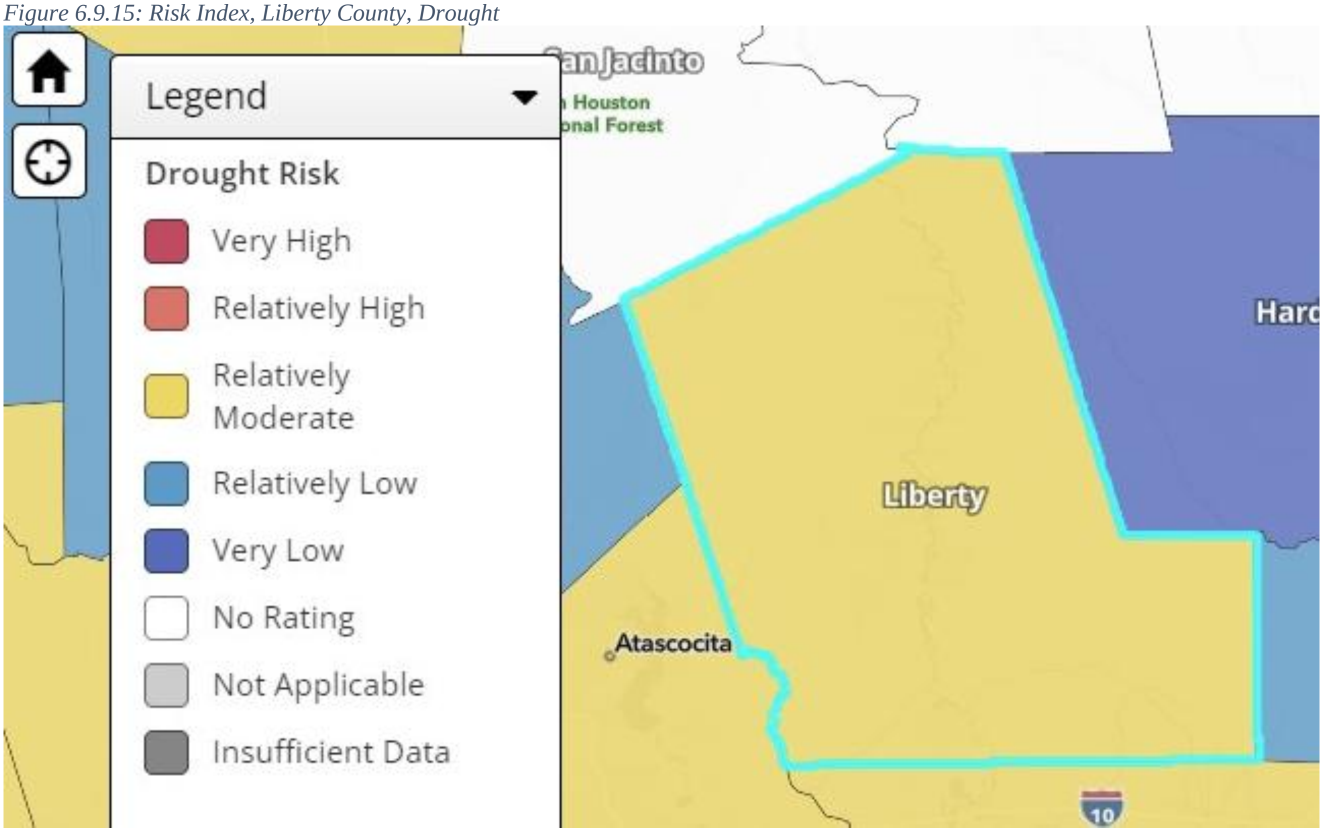


Figure 6.9.16: Risk Index by Census Tract, Liberty County, Drought

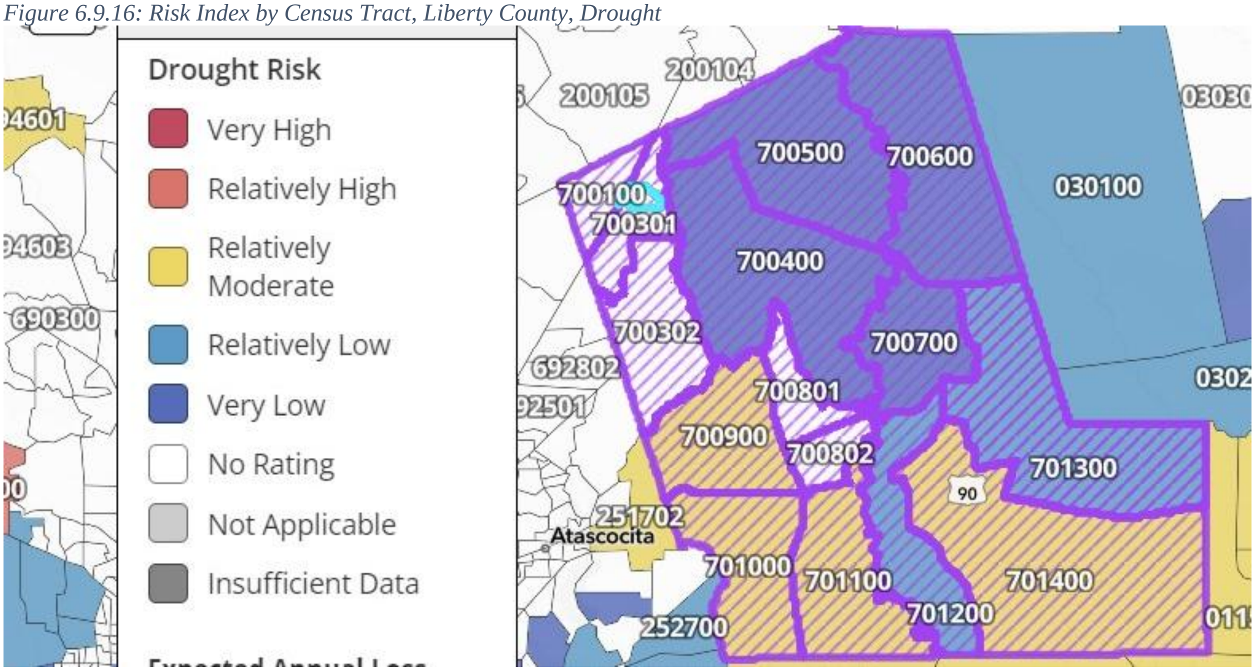


Figure 6.9.17: Social Vulnerability by Census Tract, Liberty County

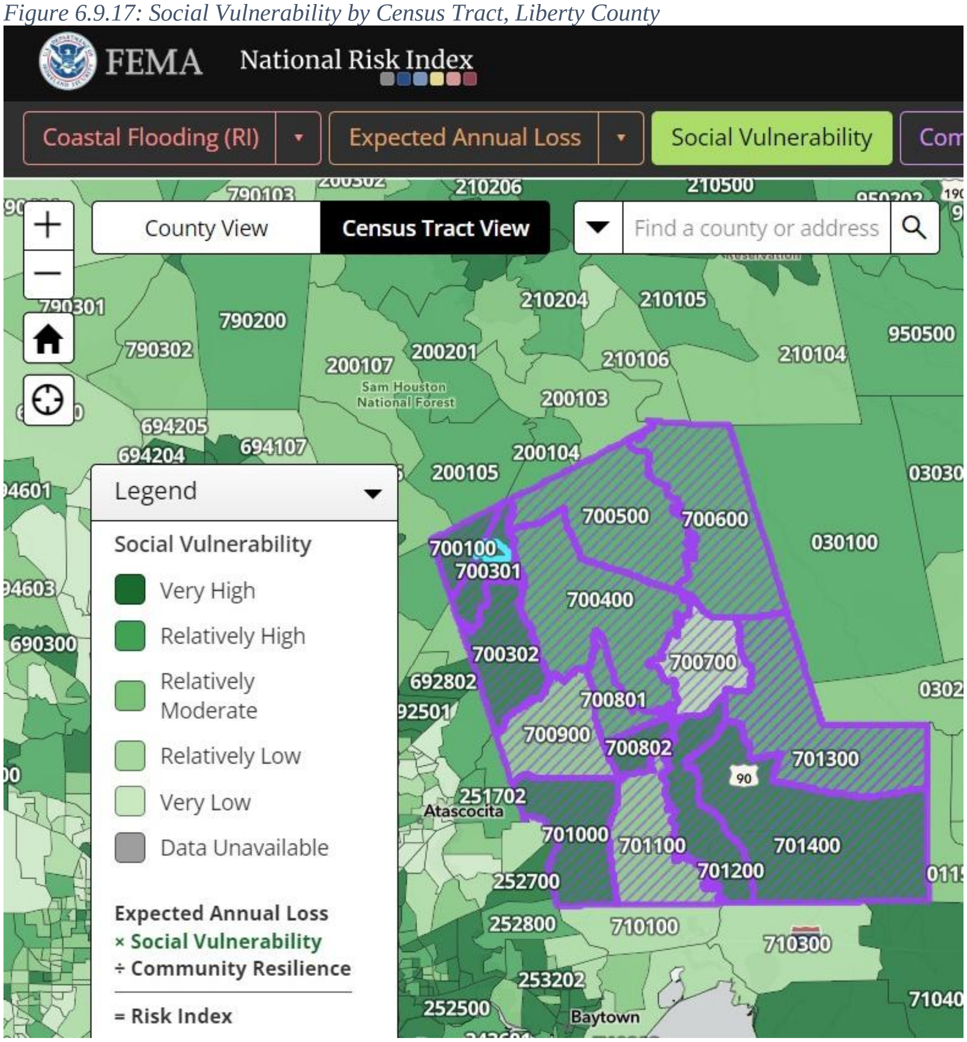


Figure 6.9.18: Social Vulnerability, Liberty County

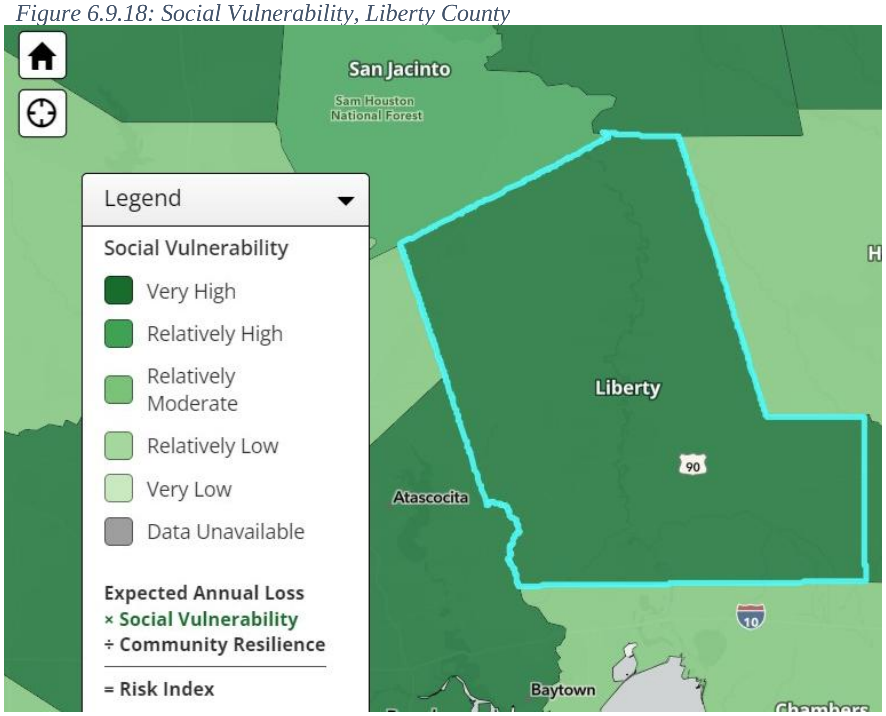


Figure 6.9.19: Community Resilience by Census Tract, Liberty County

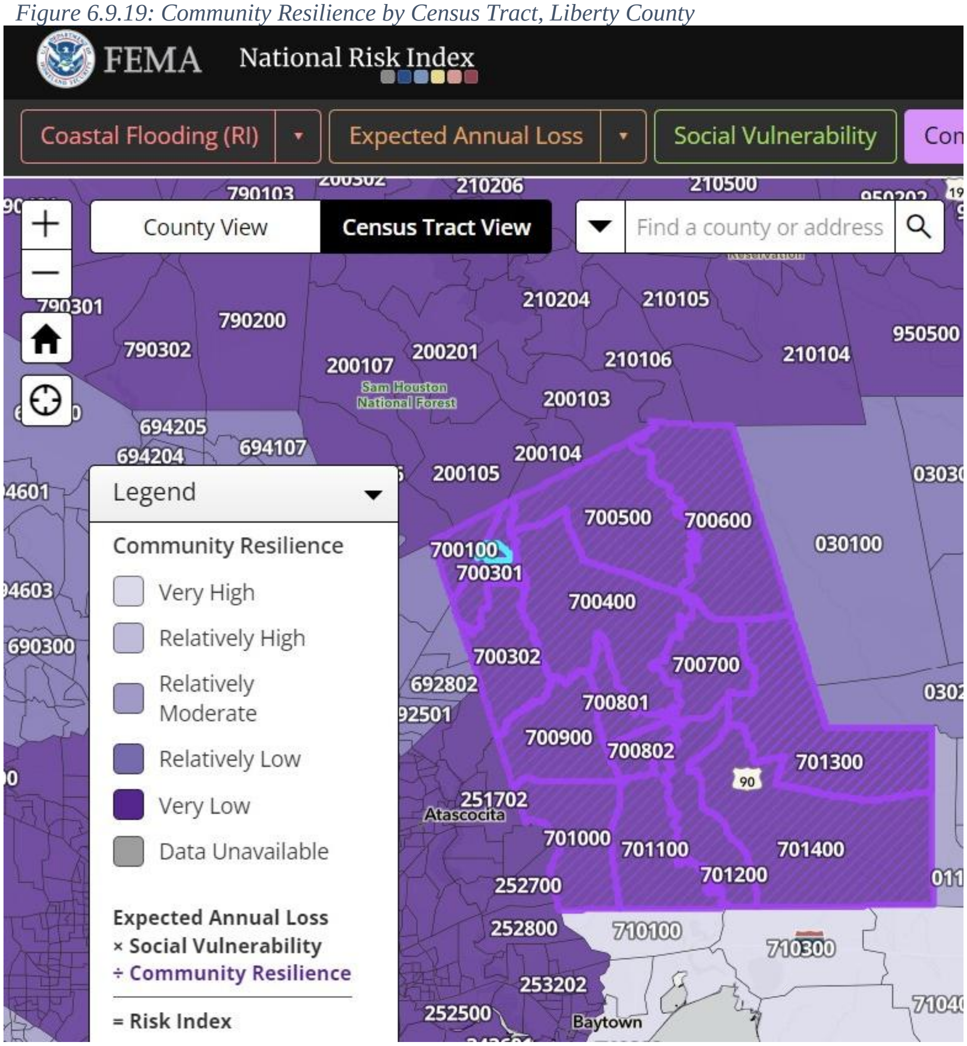


Figure 6.9.20: Community Resilience, Liberty County

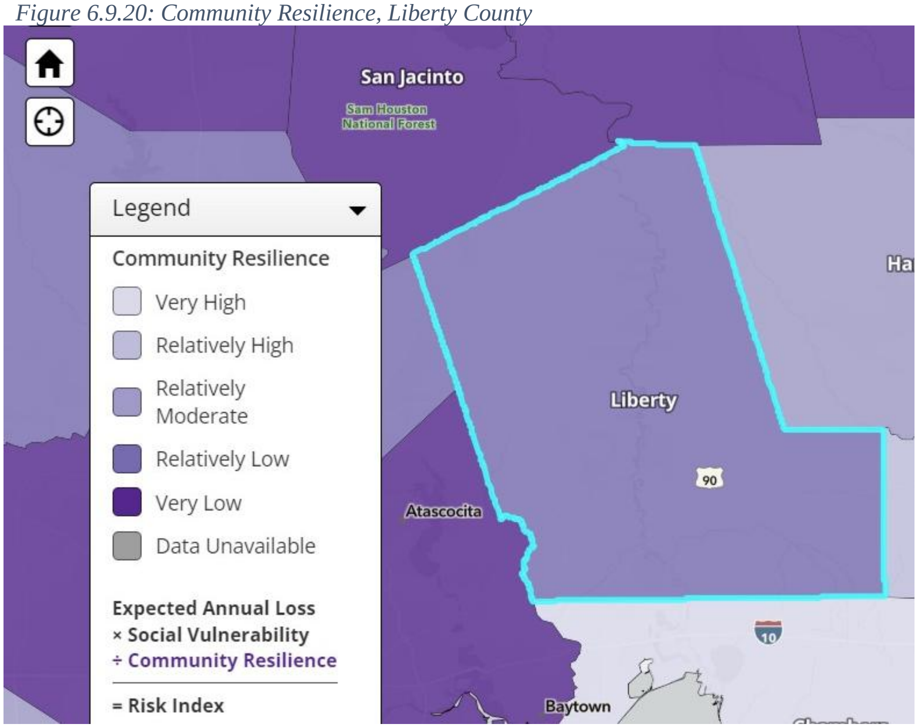


Figure 6.9.21: FEMA NRI Summary by Census Tract, Liberty County, Drought

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291701000	TX	Relatively Moderate	98.3	0 100
2	Census tract 48291701400	TX	Relatively Moderate	97.72	0 100
3	Census tract 48291700900	TX	Relatively Moderate	97.41	0 100
4	Census tract 48291701100	TX	Relatively Moderate	96.14	0 100
5	Census tract 48291701300	TX	Relatively Low	90.09	0 100
6	Census tract 48291701200	TX	Relatively Low	82.16	0 100
7	Census tract 48291700500	TX	Very Low	80.83	0 100
8	Census tract 48291700700	TX	Very Low	79.74	0 100
9	Census tract 48291700600	TX	Very Low	75.72	0 100
10	Census tract 48291700400	TX	Very Low	69.98	0 100
	Census tract 48291700100	TX	No Rating	0	0 100
	Census tract 48291700200	TX	No Rating	0	0 100
	Census tract 48291700301	TX	No Rating	0	0 100
	Census tract 48291700302	TX	No Rating	0	0 100
	Census tract 48291700303	TX	No Rating	0	0 100
	Census tract 48291700801	TX	No Rating	0	0 100
	Census tract 48291700802	TX	No Rating	0	0 100

Figure 6.9.22: FEMA NRI EAL Summary by Census Tract, Liberty County, Drought

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291701000	TX	$90,191	Very High	Very Low	1.64	$147,502	98.3
2	Census tract 48291701400	TX	$58,494	Very High	Very Low	1.72	$100,741	97.72
3	Census tract 48291700900	TX	$70,026	Relatively Moderate	Very Low	1.19	$83,053	97.41
4	Census tract 48291701100	TX	$37,841	Relatively Moderate	Very Low	1.2	$45,265	96.14
5	Census tract 48291701300	TX	$4,091	Relatively High	Very Low	1.45	$5,921	90.09
6	Census tract 48291701200	TX	$355	Very High	Very Low	1.75	$621	82.16
7	Census tract 48291700500	TX	$329	Relatively High	Very Low	1.27	$420	80.83
8	Census tract 48291700700	TX	$310	Relatively Low	Very Low	0.97	$301	79.74
9	Census tract 48291700600	TX	$57	Relatively High	Very Low	1.43	$82	75.72
10	Census tract 48291700400	TX	$2	Relatively High	Very Low	1.35	$3	69.98
	Census tract 48291700100	TX	$0	Very High	Very Low	1.65	$0	0
	Census tract 48291700200	TX	$0	Very High	Very Low	1.63	$0	0
	Census tract 48291700301	TX	$0	Very High	Very Low	1.75	$0	0
	Census tract 48291700302	TX	$0	Very High	Very Low	1.53	$0	0
	Census tract 48291700303	TX	$0	Very High	Very Low	1.81	$0	0
	Census tract 48291700801	TX	$0	Relatively High	Very Low	1.3	$0	0
	Census tract 48291700802	TX	$0	Very High	Very Low	1.55	$0	0

Climate Change Impacts

According to the Office of the Texas State Climatologist, it is impossible to make a quantitative statewide projection of drought trends. However, most factors at play point to an increase in drought severity.[47] It can be inferred that the impacts of climate change on expansive soils will grow as drought and flooding risks and associated impacts become more prevalent.

Table 6.9.7: Climate Change Impacts, Drought & Expansive Soils

Location	The location of droughts and expansive soils is not expected to change.
Extent/Intensity	The extent and intensity of drought and associated risks from expansive soils within the county may change (increase) due to increased precipitation and stronger storms which can lead to an increase in flooding events and rising surface temperatures, heat events, and increases in drought severity.
Frequency	There are no clear trends in drought frequency due to considerable variability in conditions that lead to droughts. Since expansive soils pose the most risk during periods of drought and flooding, and there is no way to data to track losses due to expansive soils, the frequency of expansive soil impacts also shows no clear trends.
Duration	The duration of drought events is not likely to change, however the intensity of droughts is expected to increase.

Section 6.10: Tornado

6.10 Tornado

A Tornado is defined by the NWS as "a violently rotating column of air touching the ground, usually attached to the base of a thunderstorm." [110] Tornados are one of the most violent storms, with the strongest tornados being capable of massive destruction. In extreme cases, winds from a tornado may approach 300 miles per hour, with damage paths that can be more than one mile wide and 50 miles long. These catastrophic tornados are often produced by supercell thunderstorms.[32]

Location

Tornadoes do not have any specific geographic boundary and can occur anywhere if the right conditions are present. From 1951-2011, nearly 62.7 percent of all Texas tornadoes occurred within the three months of April, May, and June, with almost one-third of the total tornadoes occurring in May.[111] The State of Texas has the highest average annual number of tornadoes per state, with an average of 136 tornadoes per year over 30 years, as seen in Figure 6.10.1.[112] Figure 6.10.2 depicts Liberty County's total number of tornadoes from 1950-2022 between 61-80 instances.[113]

Figure 6.10.1: Annual Tornadoes per State, 1993-2022

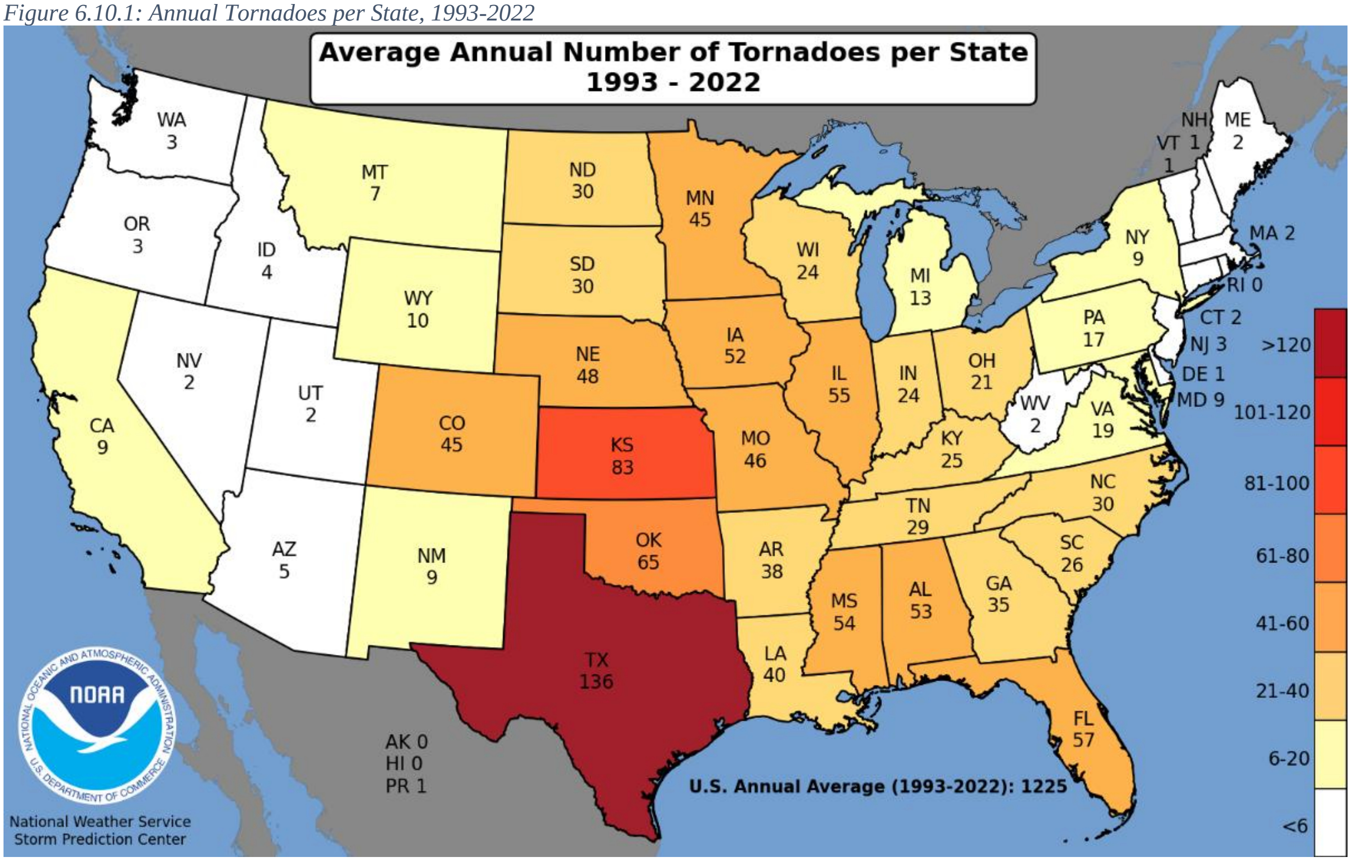
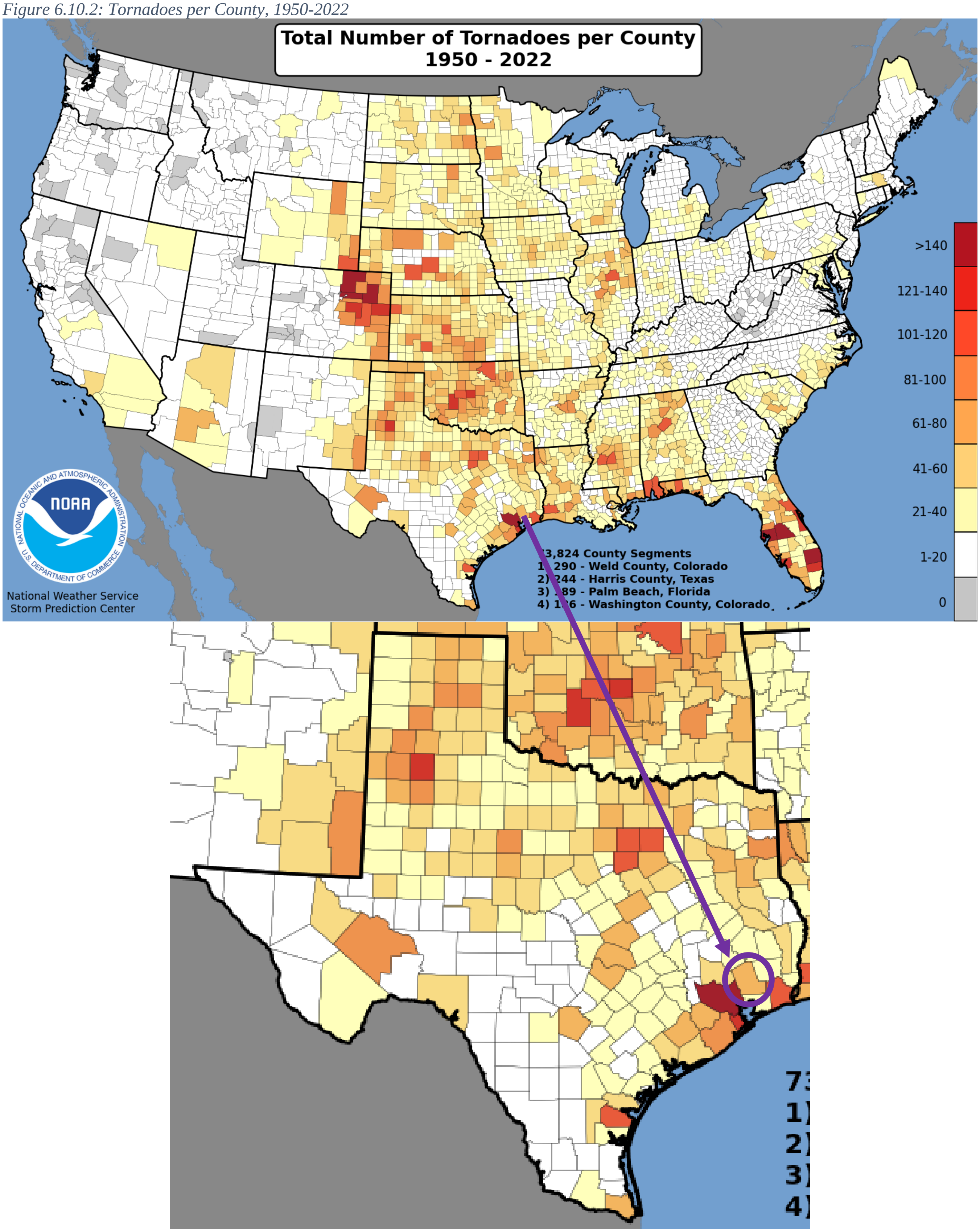


Figure 6.10.2: Tornadoes per County, 1950-2022



Extent

Tornado intensity is ranked using the Enhanced Fujita Scale (EF- Scale), a rating of how strong a tornado was. It is calculated by surveying the damage and comparing it with damage to similar objects at certain wind speeds. The EF-Scale is not meant to be used as a measure of how strong a tornado currently on the ground is. The EF-Scale incorporates 28 damage indicators such as building type, structures, and trees. For each damage indicator, there are 8 degrees of damage ranging from the beginning of visible damage to complete destruction of the damage indicator.[114]

Table 6.10.1: Enhanced Fujita Scale Descriptions

EF Rating	Wind Speed	Typical Damage
0	65-85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
1	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
2	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
4	166-200	Devastating damage. Whole frame houses Well-constructed houses and whole frame houses completely leveled; cars thrown, and small missiles generated.
5	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly more than 109 yards; high-rise buildings have significant structural deformation; incredible phenomena will occur.

Table 6.10.2: EF-Scale Damage Indicators

Number (Details Linked)	Damage indicator	Abbreviation
1	Small barns, farm outbuildings	SBO
2	One- or two-family residences	FR12
3	Single-wide mobile home (MHSW)	MHSW
4	Double-wide mobile home	MHDW
5	Apt, condo, townhouse (3 stories or less)	ACT
6	Motel	M
7	Masonry apt. or motel	MAM
8	Small retail bldg. (fast food)	SRB
9	Small professional (doctor office, branch bank)	SPB
10	Strip mall	SM
11	Large shopping mall	LSM
12	Large, isolated ("big box") retail bldg.	LIRB
13	Automobile showroom	ASR
14	Automotive service building	ASB
15	School - 1-story elementary (interior or exterior halls)	ES
16	School - jr. or sr. high school	JHSH
17	Low-rise (1-4 story) bldg.	LRB
18	Mid-rise (5-20 story) bldg.	MRB
19	High-rise (over 20 stories)	HRB
20	Institutional bldg. (hospital, govt. or university)	IB
21	Metal building system	MBS
22	Service station canopy	SSC
23	Warehouse (tilt-up walls or heavy timber)	WHB
24	Transmission line tower	TLT

Number (Details Linked)	Damage indicator	Abbreviation
25	Free-standing tower	FST
26	Free-standing pole (light, flag, luminary)	FSP
27	Tree - hardwood	TH
28	Tree - softwood	TS

For this hazard, a worst-case scenario within Liberty County would be an EF-5 tornado crossing through the county. This would be a catastrophic event with buildings and homes leveled, vehicles becoming airborne missiles, downed trees and power lines, debris on roadways, and critical facilities damaged or experiencing a service disruption to residents due to damages or lack of power. This scenario is based on previous occurrences of tornadoes that have crossed through the county, with the strongest being an EF4, The Channelview Tornado, that crossed through areas within the City of Dayton in 1992 and saw wind speeds of 166-200 mph (see Figure 6.10.3 below).

Historic Occurrences

There have been 18 tornadoes, and 4 funnel cloud sightings within Liberty County since 1950.[39] Figure 6.10.3 below depicts historic tornado occurrences and their tracks within Liberty County and participating jurisdictions, while the table below lists tornado and funnel cloud occurrences within the county since 2018.

Figure 6.10.3: Tornado Paths, Liberty County

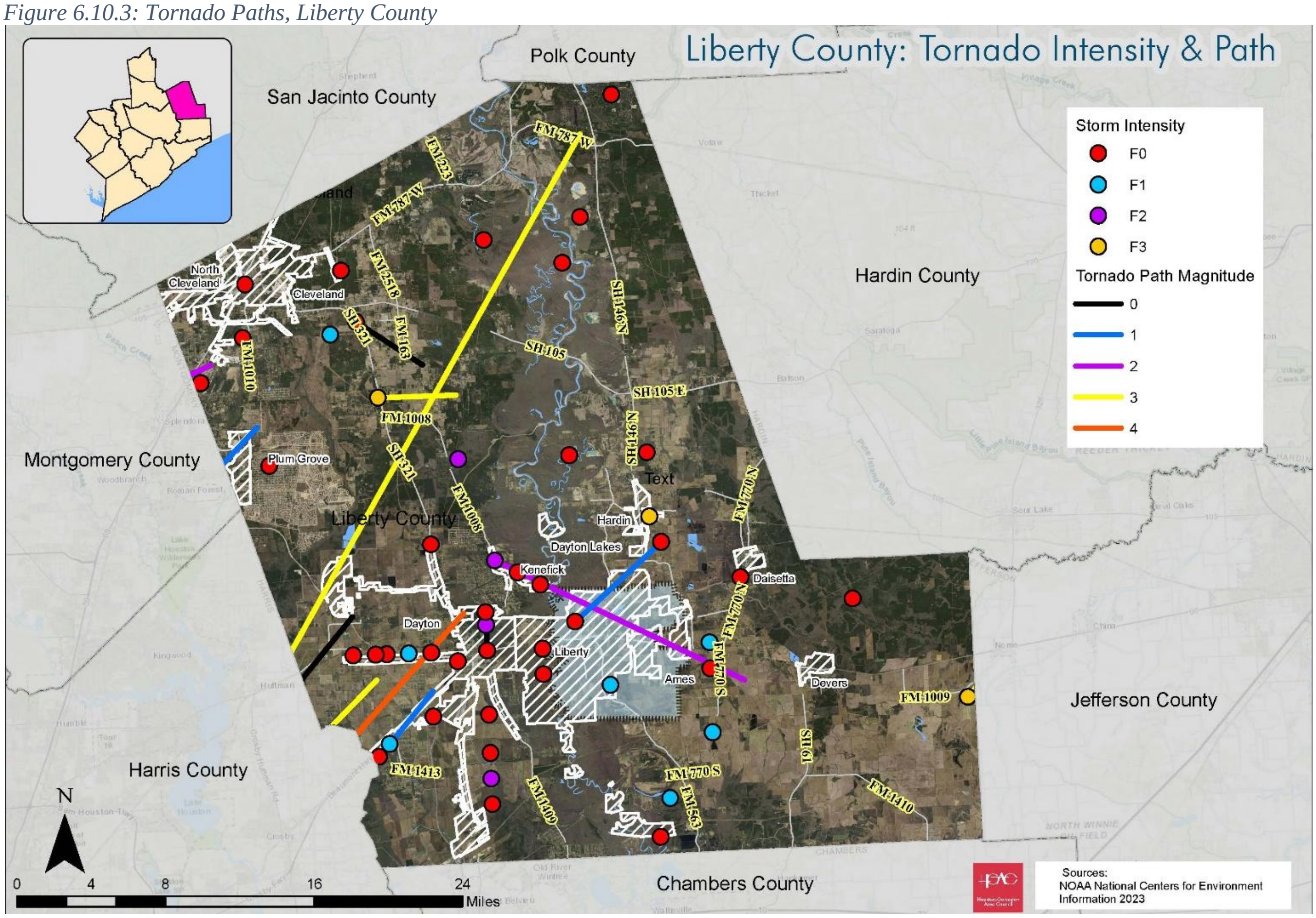


Table 6.10.3: Tornado Occurrences, Liberty County

Date	Event Type	Event Rating	Location	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
4/19/2020	Funnel Cloud	ND	ND	0	0	$-	$-
5/11/2021	Tornado	F1	ND	0	0	$300,000	$-
1/8/2022	Tornado	F0	ND	0	0	$-	$-
1/24/2023	Tornado	F2	ND	0	0	$150,000	$-

ND- No Data
$- No dollar amount ($0.00).

Presidential Disaster Declarations

There have been 0 disaster declarations for tornadoes, however, 7 disaster designations have included tornadoes in the declaration title for Liberty County. The declaration incident type for these events is listed as flood and severe storms.[2]

Table 6.10.4: Federal Disaster Declarations, Tornado

Declaration Year	Incident Type	Incident Title	Disaster Number	Declaration Type
1979	Severe Storm	SEVERE STORMS, TORNADOES & FLOODING	580	Major Disaster Declaration
1989	Severe Storm	SEVERE STORMS, TORNADOES & FLOODING	828	Major Disaster Declaration
1990	Severe Storm	SEVERE STORMS, TORNADOES AND FLOODING	863	Major Disaster Declaration
2003	Severe Storm	SEVERE STORMS, TORNADOES, AND FLOODING	1439	Major Disaster Declaration
2007	Severe Storm	SEVERE STORMS, TORNADOES, AND FLOODING	1709	Major Disaster Declaration
2015	Severe Storm	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	4223	Major Disaster Declaration
2016	Severe Storm	SEVERE WINTER STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	4245	Major Disaster Declaration

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since the last HMP are listed in the table below.[40]

Table 6.10.5: USDA Declared Disasters (2018-2023), Tornado

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

Tornado season usually refers to the time of year the U.S. sees the most tornadoes. The peak "tornado season" for the southern Plains (e.g., Texas, Oklahoma, and Kansas) is from May into early June. Along the Gulf Coast and surrounding region, it is earlier in the spring.[115] According to the FEMA NRI for tornadoes within Liberty County, annualized frequency values are 1 event per year over 72 years of record (1950-2021), with 51 events on record for this timeframe.[43]

Populations at Risk

All residents within the county are exposed to this hazard. The impacts of a tornado on the life, health, and safety of Liberty County residents depend on several factors, including the severity of the event and adequate warning time being provided to residents to take shelter. Tornadoes can lead to a disruption in emergency response services, shelters, electricity, clean water, and other forms of necessary medical assistance while repairs are made to critical facilities or power is being restored within the county.

The NCHH summarizes at-risk populations for several hazards. These include older adults, people experiencing homelessness, people with disabilities, and people with chronic health conditions. In addition to the dangers listed above, older adults can face social isolation, lack of electricity needed to run medical equipment, lack of access to a vehicle for evacuation, and lack of access to other critical supplies. Evacuation for these events is fast-paced, and older adults may not be able to seek adequate shelter before a tornado impacts their area. For people experiencing homelessness, adequate shelter is critical in keeping populations safe during a tornado. People with disabilities may require additional assistance to stay safe and prepare for these hazards and their after-effects such as creating a support network, finding accessible transportation to evacuate or get medical attention, and loss of power for needed medical equipment. Likewise, those with chronic health conditions may need similar assistance as those with disabilities. Residents impacted may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings, and debris carried by winds associated with tornadoes can lead to further injury or loss of life. Socially vulnerable populations are most susceptible based on several factors, including their physical and financial ability to react or respond during or directly following a hazard event. These issues disproportionately affect low-income communities and families who may lack the resources to pay for damages to their homes, lack insurance, or lack the resources to replace home contents or personal belongings.[45]

As the county continues to expand in both population and new developments, areas of future growth could increase the vulnerability of the county and its residents to this hazard. Those living in mobile/ manufactured housing are also at greater risk from this hazard as even anchored mobile homes can be seriously damaged or destroyed when winds gust over 80 mph.[55]

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below.

Table 6.10.6: Expected Annual Loss Exposure Values, Tornado

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Tornado	$10,266,884,211	$1,061,307,200,000/ 91,492	$34,324,048	$1,071,608,408,259

Table 6.10.7: Expected Annual Loss Values, Tornado

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Tornado	$1,492,769	$6,026,111/ 0.52	$1,059

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings, according to the FEMA NRI, for tornadoes within these census tracts are listed as very high for 11 census tracts and relatively high for 6 census tracts.[46] EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for tornadoes as relatively low.[45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.10.4: Risk Index, Liberty County, Tornado

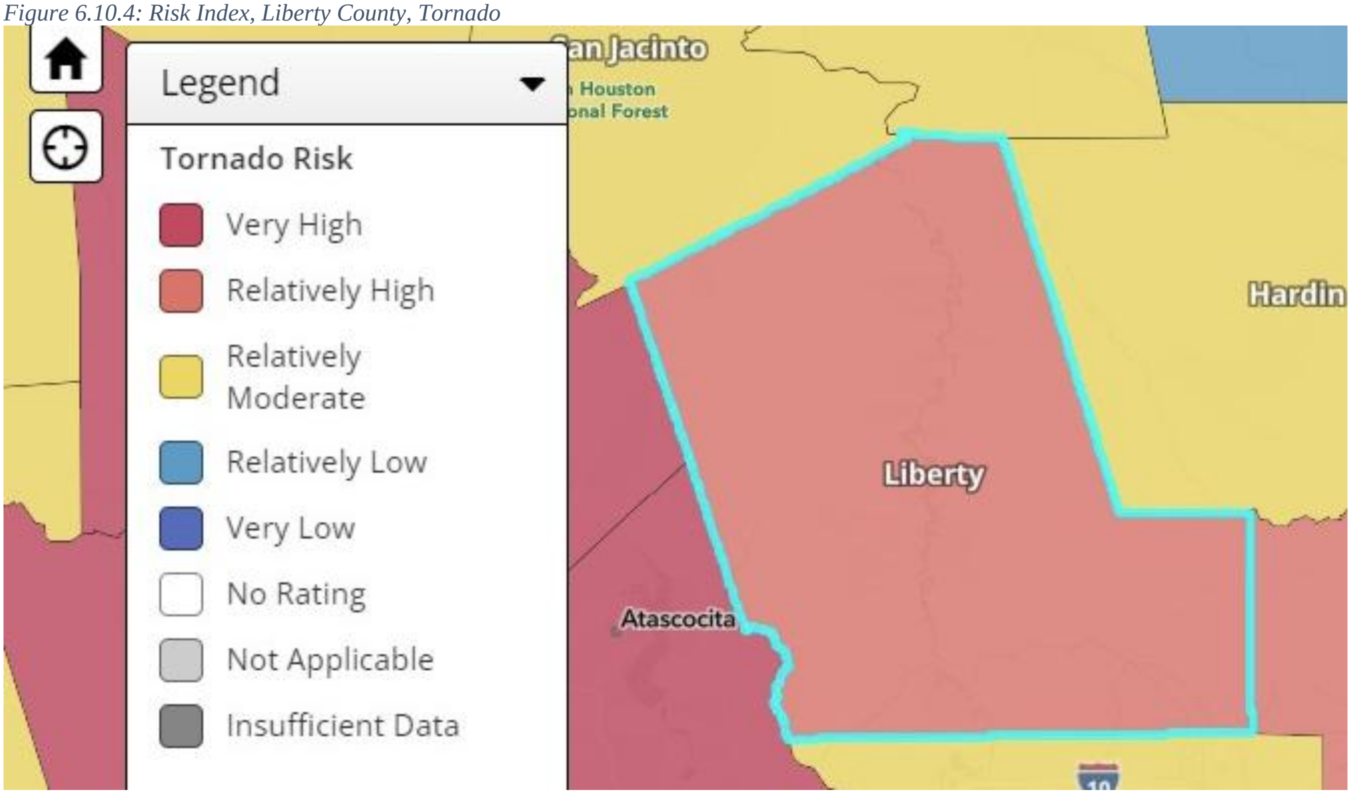


Figure 6.10.5: Risk Index by Census Tract, Liberty County, Tornado

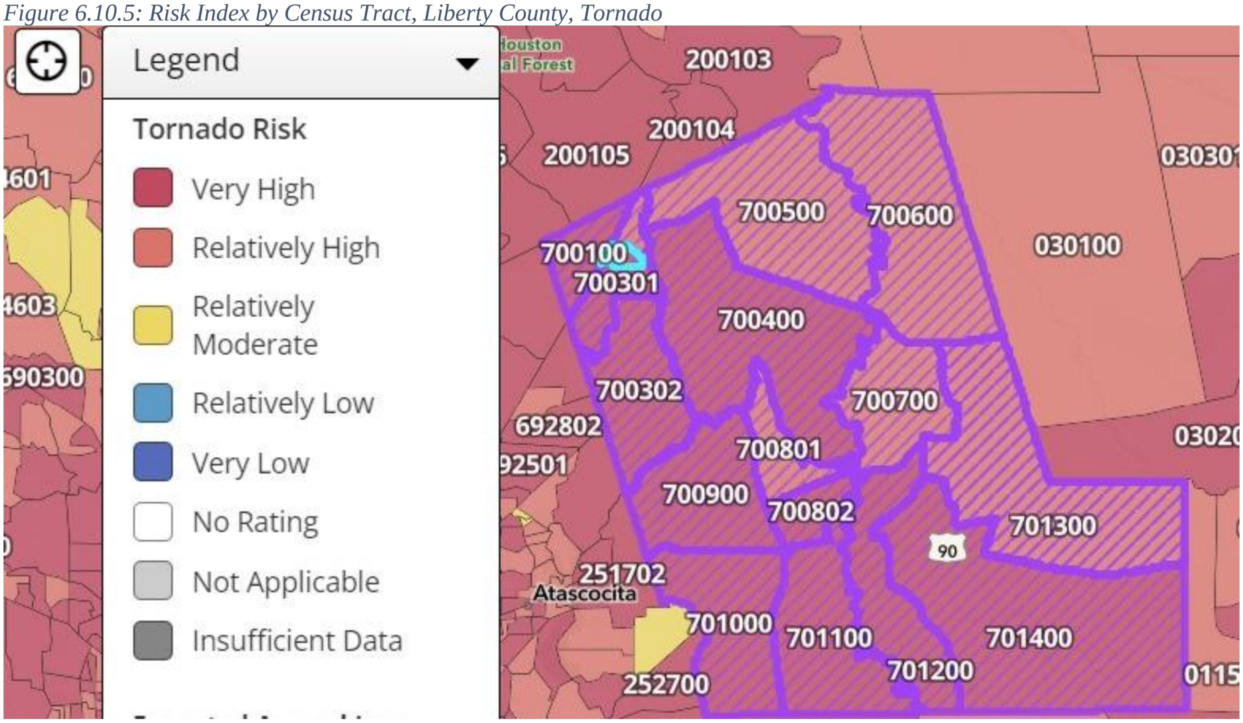


Figure 6.10.6: Social Vulnerability by Census Tract, Liberty County

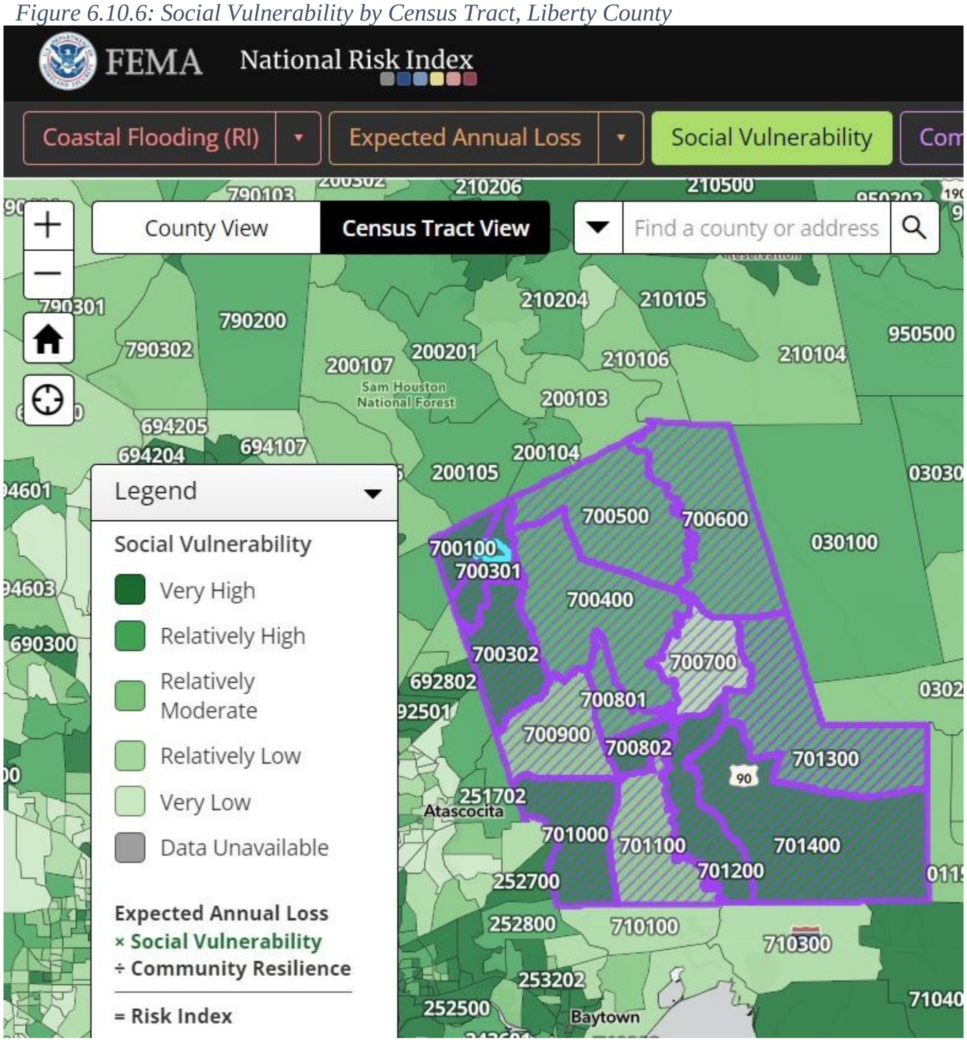


Figure 6.10.7: Social Vulnerability, Liberty County

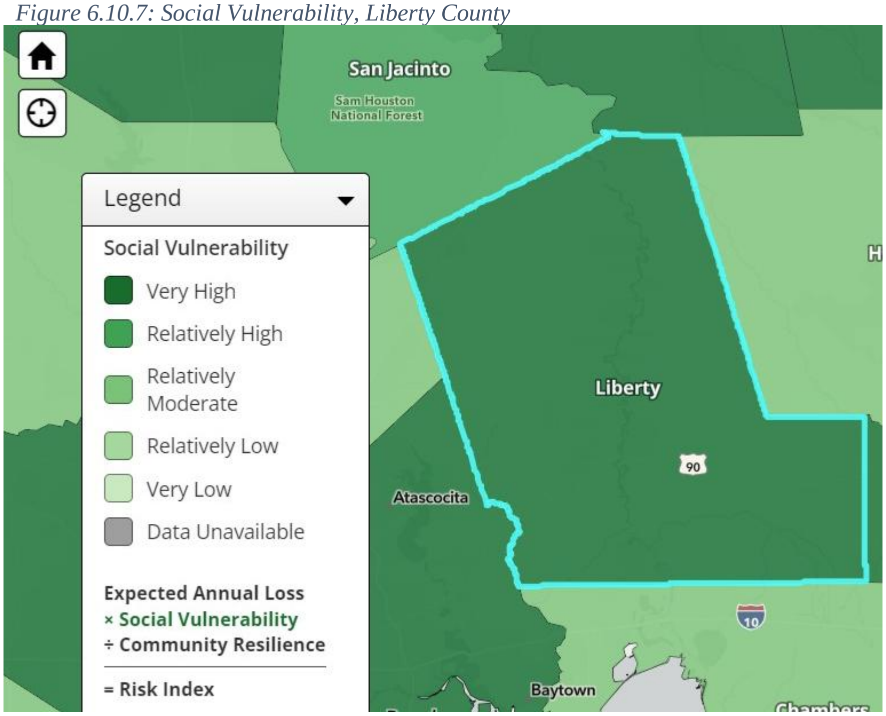


Figure 6.10.8: Community Resilience by Census Tract, Liberty County

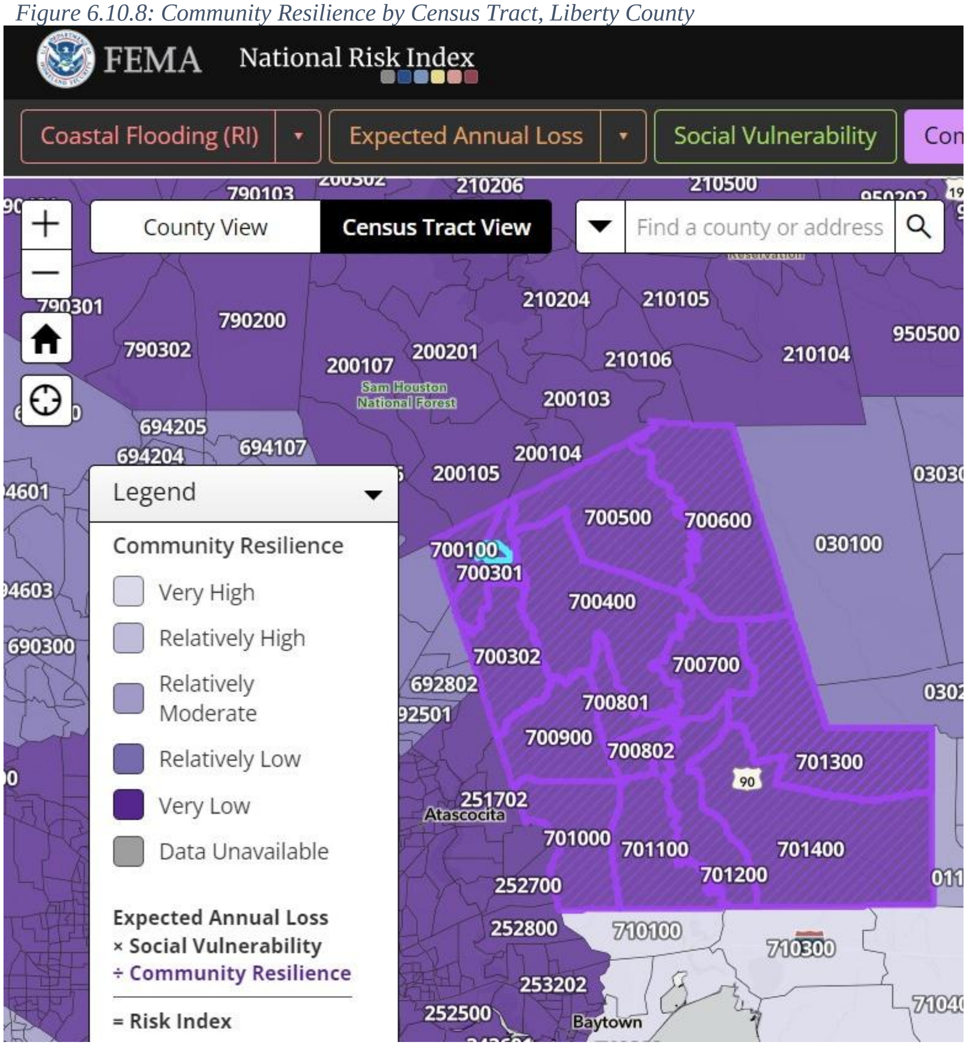


Figure 6.10.9: Community Resilience, Liberty County

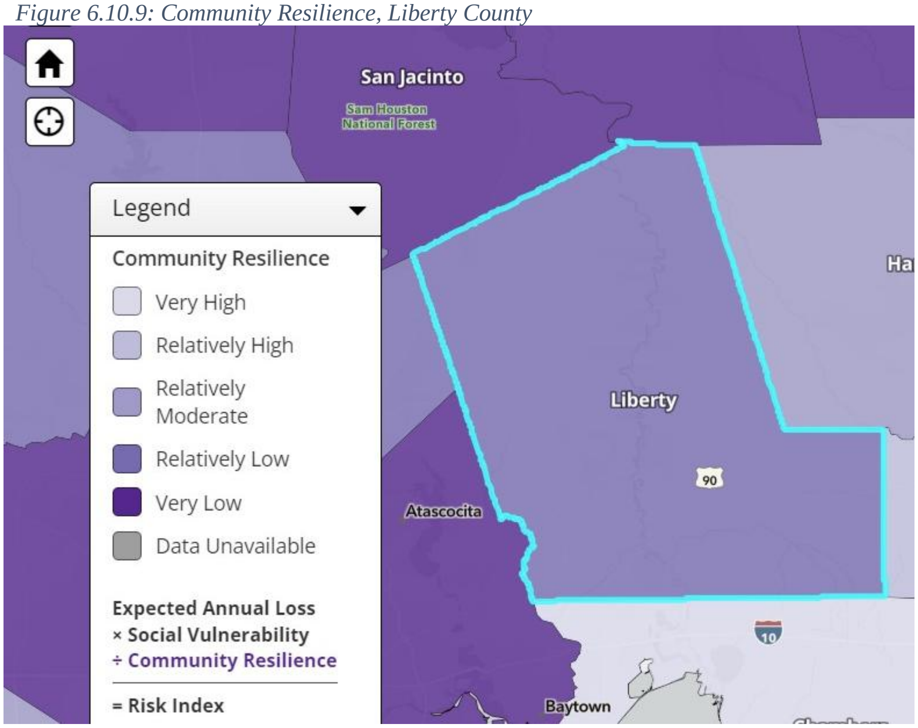


Figure 6.10.10: FEMA NRI Summary by Census Tract, Liberty County, Tornado

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Very High	99.8	0 100
2	Census tract 48291701400	TX	Very High	99.5	0 100
3	Census tract 48291701200	TX	Very High	99.44	0 100
4	Census tract 48291701000	TX	Very High	99.41	0 100
5	Census tract 48291700400	TX	Very High	98.91	0 100
6	Census tract 48291700802	TX	Very High	98.78	0 100
7	Census tract 48291701100	TX	Very High	98.58	0 100
8	Census tract 48291700100	TX	Very High	97.68	0 100
9	Census tract 48291700301	TX	Very High	96.3	0 100
10	Census tract 48291700900	TX	Very High	96.3	0 100
11	Census tract 48291700303	TX	Very High	94.47	0 100
12	Census tract 48291701300	TX	Relatively High	92.58	0 100
13	Census tract 48291700200	TX	Relatively High	92.26	0 100
14	Census tract 48291700801	TX	Relatively High	91.92	0 100
15	Census tract 48291700600	TX	Relatively High	88.16	0 100
16	Census tract 48291700500	TX	Relatively High	86.46	0 100
17	Census tract 48291700700	TX	Relatively High	78.81	0 100

Figure 6.10.11: FEMA NRI EAL Summary by Census Tract, Liberty County, Tornado

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$955,311	Very High	Very Low	1.53	$1,465,545	99.8
2	Census tract 48291701400	TX	$613,455	Very High	Very Low	1.72	$1,056,523	99.5
3	Census tract 48291701200	TX	$582,969	Very High	Very Low	1.75	$1,019,324	99.44
4	Census tract 48291701000	TX	$613,347	Very High	Very Low	1.64	$1,003,092	99.41
5	Census tract 48291700400	TX	$611,711	Relatively High	Very Low	1.35	$825,940	98.91
6	Census tract 48291700802	TX	$516,542	Very High	Very Low	1.55	$801,880	98.78
7	Census tract 48291701100	TX	$641,721	Relatively Moderate	Very Low	1.2	$767,618	98.58
8	Census tract 48291700100	TX	$390,629	Very High	Very Low	1.65	$645,104	97.68
9	Census tract 48291700301	TX	$313,254	Very High	Very Low	1.75	$549,523	96.3
10	Census tract 48291700900	TX	$463,121	Relatively Moderate	Very Low	1.19	$549,276	96.3
11	Census tract 48291700303	TX	$261,625	Very High	Very Low	1.81	$472,542	94.47
12	Census tract 48291701300	TX	$288,538	Relatively High	Very Low	1.45	$417,665	92.58
13	Census tract 48291700200	TX	$252,204	Very High	Very Low	1.63	$410,444	92.26
14	Census tract 48291700801	TX	$309,387	Relatively High	Very Low	1.3	$402,596	91.92
15	Census tract 48291700600	TX	$231,568	Relatively High	Very Low	1.43	$332,130	88.16
16	Census tract 48291700500	TX	$241,592	Relatively High	Very Low	1.27	$307,997	86.46
17	Census tract 48291700700	TX	$232,965	Relatively Low	Very Low	0.97	$226,306	78.81

Climate Change Impacts

According to the Office of the Texas State Climatologist, "The most robust trend in tornado activity is a tendency of more tornadoes in large outbreaks, but the factors driving that trend are not projected to continue."[47] Severe thunderstorms and lightning are more likely to occur in summer months when temperatures are higher and moisture from the gulf helps to fuel thunderstorm development, which could lead to the development of tornadoes along the front of the storm if the right conditions exist.

Table 6.10.8: Climate Change Impacts, Tornado

Location	The location of tornadoes is not expected to change.
Extent/Intensity	The extent and intensity of tornadoes within the county may change (increase) due to increased temperatures and energy available to fuel severe thunderstorms from the warm air within the Gulf of Mexico and the surrounding region.
Frequency	Tornado frequency is not expected to change. 62.7 percent of all Texas tornadoes occurred within the three months of April, May, and June, with almost one-third of the total tornadoes occurring in May
Duration	The duration of tornado events is not likely to change, however, the intensity of them, or outbreaks is expected to increase.

Section 6.11: Hail

6.11 Hail

NOAA's National Severe Storms Laboratory (NSSL) defines hail as "A form of precipitation consisting of solid ice that forms inside thunderstorm updrafts. Hail can damage aircraft, homes and cars, and can be deadly to livestock and people."[116] Hail varieties are determined by how they grow and the maximum size. These differentiating frozen precipitations and their definitions from NOAA's NSSL can be seen in the table below.[117]

Table 6.11.1: Types of Frozen Precipitation

Frozen Precipitation Type	Description
Snow	forms mainly when water vapor turns to ice without going through the liquid stage. This process is called deposition. Snow can form in the gentle updrafts of stratus clouds or at high altitudes in very cold regions of a thunderstorm.
Graupel	soft, small pellets formed when supercooled water droplets (at a temperature below 32°F) freeze onto a snow crystal, a process called riming. If the riming is particularly intense, the rimed snow crystal can grow to an appreciable size but remain less than 0.2 inches. Graupel is also called snow pellets or soft hail, as the graupel particles are particularly fragile and generally disintegrate when handled.
Sleet	small ice particles that form from the freezing of liquid water drops, such as raindrops. At ground level, sleet is only common during winter storms when snow melts as it falls, and the resulting water refreezes into sleet prior to hitting the ground. In thunderstorms, sleet is possible above the melting level where cloud droplets become supercooled and may instantaneously freeze when making contact with other cloud particles or debris, such as dust particles. Sleet is also called ice pellets.
Hail	frozen precipitation that can grow to very large sizes through the collection of water that freezes onto the hailstone's surface. Hailstones begin as embryos, which include graupel or sleet, and then grow in size. Hailstones can have a variety of shapes and include lumps and bumps that may even take the shape of small spikes. Hailstones must be at least 0.2 inches in size.

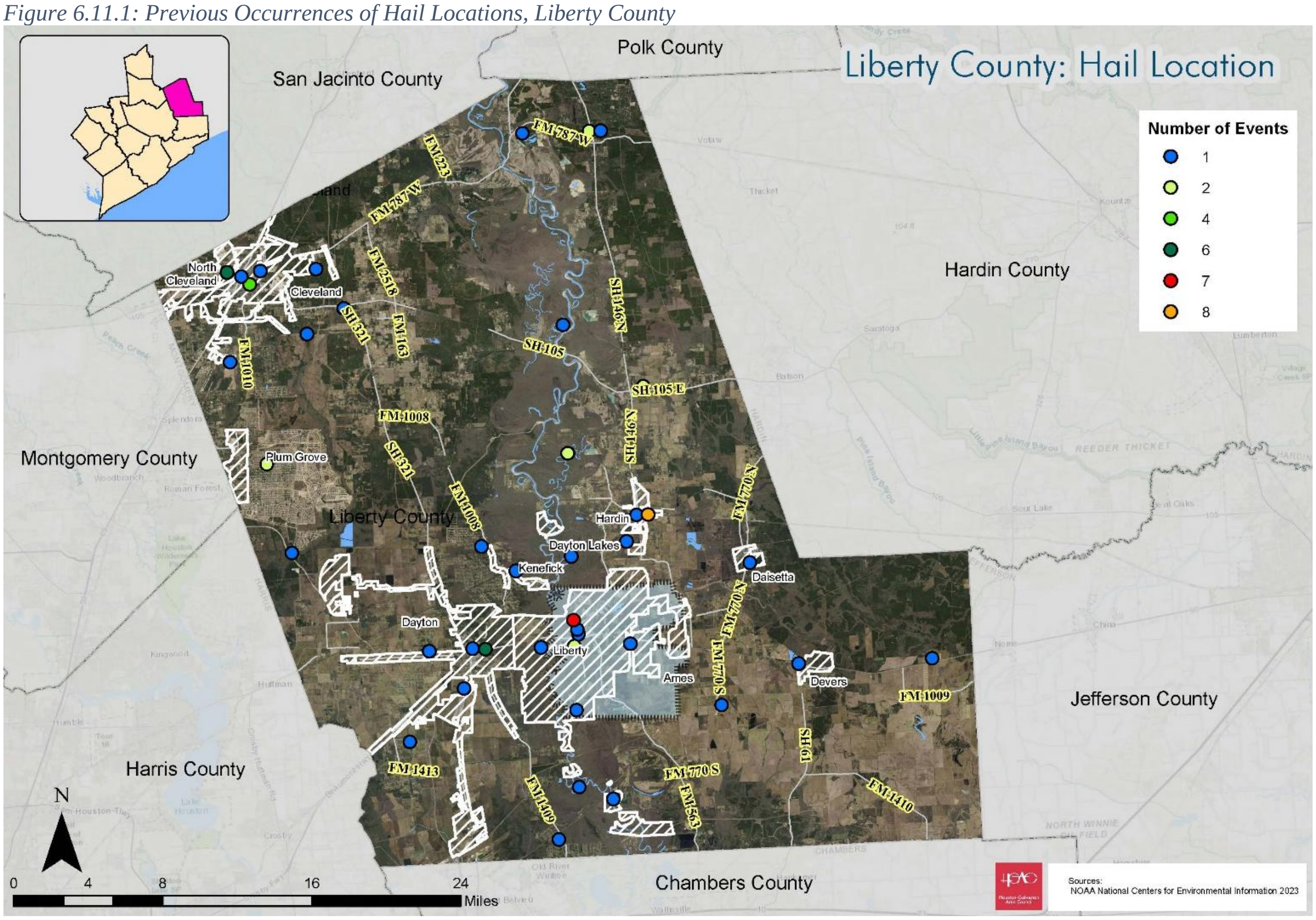
When forecasting for hail, forecasters look for deep moist convection, in addition to adequate updraft to keep the hailstone aloft for an appropriate amount of time, sufficient supercooled water near the hailstone to enable growth as it travels through an updraft, and a piece of ice, snow or dust for it to grow upon. There is no clear distinction between storms that do and do not produce hailstones. Nearly all severe thunderstorms probably produce hail aloft, though it may melt before reaching the ground.

Multi-cell thunderstorms can produce many small hailstones that are relatively short-lived and do not grow. In contrast, supercell thunderstorms have sustained updrafts that support large hail formation by repeatedly lifting the hailstones into the very cold air at the top of the thunderstorm cloud where they can accumulate more layers of ice. In general, hail 2 inches or larger in diameter is associated with supercells. Hail falls to the ground when the thunderstorm's updraft can no longer support the weight of the ice. The stronger the updraft, the larger the hailstone can grow. Additionally, large hail often appears near the area within a thunderstorm where tornadoes are most likely to form[118]

Location

Similar to the Severe Thunderstorms & Lightning (Section 6.3), and the Tornado (Section 6.10) hazard profiles, hail is not confined to any geographic boundaries and can occur if the right conditions are present within a thunderstorm, such as a supercell with a strong updraft. The entire county is at risk for this hazard. Thunderstorms and hail can happen at any time of the year. Typically, they occur most in warmer months such as Summer and Spring, and during the warmest parts of the day. Warm, moist air from the Gulf of Mexico is readily available to help fuel atmospheric conditions that produce thunderstorms and the updrafts that bring hail and damaging winds associated with them. Liberty County is in an area that can see anywhere from 72-81 thunderstorm days per year.[107] Figure 6.11.4 depicts the locations within the county where previous hail events have occurred, colors differentiate between the number of events in a given location.

Figure 6.11.1: Previous Occurrences of Hail Locations, Liberty County



Extent

The NWS classifies a hailstorm as "severe" if there is hail 0.75 inches in diameter or greater. Hail threats are categorized from non-threatening to extreme with associated map colors to depict hazard levels, as seen in the table below. NWS also generalizes hail sizes as small (less than 0.75 inches in diameter), large (0.75-1.75 inches in diameter), very large (1.75-2.75 inches in diameter), and giant (hail larger than 2.75 inches).[119]

Table 6.11.2: Severe Hail Threat Levels and Descriptions

Severe Hail Threat Level	Map Color	Threat Level Descriptions
Extreme		**"An Extreme Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, a moderate likelihood or greater (16% probability or greater) of severe hail, with storms capable of baseball to softball sized stones. *See diameter description below.* • A high likelihood or greater (26% probability or greater) of severe hail, with storms capable of golf ball to baseball sized hail stones. • Avery high likelihood (36% or greater) of severe hail, with storms capable of nickel to golf ball sized hail stones.
High		**"A High Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, a low likelihood (6% to 15% probability) of severe hail, with storms capable of baseball to softball sized stones. • A moderate likelihood (16% to 25% probability) of very large hail (golf ball to baseball sized hail stones). • A high likelihood (26% to 35% probability) of large hail (nickel to golf ball sized hail stones).
Moderate		**"A Moderate Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, a very low likelihood (2% to 5% probability) of severe hail, with storms capable of baseball to softball sized stones. • A low likelihood (6% to 15% probability) of severe hail, with storms capable of golf ball to baseball sized hail stones. • A moderate likelihood (16% to 25% probability) of severe hail, with storms capable of nickel to golf ball sized hail stones.
Low		**"A Low Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, a very low likelihood (2% to 5% probability) of severe hail, with storms capable of golf ball to baseball sized hail stones • A low likelihood (6% to 15% probability) of severe hail, with storms capable of nickel to golf ball sized hail stones.
Very Low		**" A Very Low Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, a very low likelihood (2% to 5% probability) of severe hail, with storms capable of nickel to golf ball sized hail stones. • A low likelihood or greater (6% or greater) of small hail (less than 3/4 inch).
Non-Threatening		**" No Discernable Threat to Life and Property from Severe Hail."** • Within 12 miles of a location, environmental conditions do not support the occurrence of severe hail.

The TORRO scale measures hail intensity. The scale starts with H0 and goes to H10 with each increment of intensity or damage potential related to hail size, texture, numbers, fall speed, speed of storm translation, and strength of the accompanying wind. The table below outlines the TORRO Hail Intensity Scale and some associated size comparisons.[120]

Table 6.11.3: TORRO Hail Intensity Scale

Scale	Intensity category	Typical hail diameter (in)	Size Comparison	Typical damage impacts
H0	Hard hail	Up to 0.33	Pea	No damage
H1	Potentially damaging	0.33-0.60	Marble	Slight general damage to plants, crops
H2	Significant	0.60-0.80	Dime	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.20-1.60	Quarter	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.60-2.0	Half Dollar	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries

Scale	Intensity category	Typical hail diameter (in)	Size Comparison	Typical damage impacts
H6	Destructive	2.0-2.4	Ping Pong Ball	Bodywork of grounded aircraft dented; brick walls pitted
H7	Destructive	2.4-3.0	Golf Ball	Severe roof damage, risk of serious injuries
H8	Destructive	3.0-3.5	Hen Egg	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Tennis Ball	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>4.0	Baseball	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

A worst-case scenario for this hazard would include a severe thunderstorm event that has the capability to produce straight-line winds in excess of 78 mph like the 2024 derecho event, F4 or stronger tornadoes similar to that of the 1992 Channelview Tornado, destructive hail of H5 or above, and frequent and severe CG lightning which results in dangerous and life-threatening conditions.

Historic Occurrences

NOAA collects historic climate data for the entire nation. NOAA's storm event data can be accessed on the NCEI storm events database. There have been 76 hail events recorded since 1950. The earliest record of hail within Liberty County occurred in 1973. A condensed version of Liberty County hail events since the last HMP update, 2018-2023, is provided in the table below.[39]

Table 6.11.4: Liberty County Hail Events (2018-2023)

Date	Location	Event Type	Injuries	Fatalities	Property Damage	Crop Damage	Magnitude (in.)
4/4/2019	DAISETTA	Hail	0	0	$-	$-	1.5
4/18/2020	DAYTON SEABERG ARPT	Hail	0	0	$-	$-	1.75
4/15/2023	DAYTON	Hail	0	0	$-	$-	1
4/15/2023	LIBERTY	Hail	0	0	$-	$-	1
2/11/2024	RYE STATION	Hail	0	0	$-	$-	1.25
3/21/2024	PLUM GROVE	Hail	0	0	$-	$-	1.75

$- No dollar amount ($0.00).

Presidential Disaster Declarations

There have been no disaster declarations in which hail was included within Liberty County.[2]

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor’s authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County, in which the Liberty County since the last HMP for this hazard are listed in the table below.[40]

Table 6.11.5: USDA Declared Disasters (2018-2023), Hail

Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

Severe thunderstorms and hail associated with them are more likely to occur in summer months when temperatures are higher and moisture from the gulf helps to fuel thunderstorm development. According to the FEMA NRI for hail, annualized frequency values are 2.5 events per year over a 34-year period of record (1986-2021), with 85 events on record for this timeframe. [45]

Populations at Risk

Hail can occur during thunderstorms, but larger hail occurs more often during warmer months because the heat provided aids in building up the thunderstorm higher in the air and also strengthens these storms to create sustained updrafts. Populations most at risk for hail include outdoor workers, athletes, and pets/animals. Outdoor workers, such as farmers or landscapers have a higher chance of exposure to hail due to the nature of their work. Likewise, athletes can be caught in a hailstorm and are more exposed to this hazard when engaged in outdoor activities. Pets and animals are also at risk from hail due to their increased exposure to outdoor elements. To cause serious injury to humans and animals, hail would have to be relatively larger in size (1" or larger). As the county continues to expand in both population and development, areas of future growth could increase the vulnerability of the county and its residents to this hazard.

National Risk Index

FEMA's NRI is a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards. It was designed and built by FEMA in close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions.[44]

The NRI considers the exposure of communities to hazards and incorporates factors such as population density, infrastructure systems, and critical facilities that may be at risk during a hazard event. The NRI also generates risk scores for communities across the U.S. that provide a relative ranking of areas based on their overall risk level. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts. The NRI risk equation includes 3 components. EAL represents the average economic loss in dollars resulting from natural hazards each year. The Community Risk Factor is a scaling factor that incorporates social vulnerability (the susceptibility of social groups to the adverse impacts of natural hazards) and community resilience (the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions) into the NRI. The outcome, the risk index, represents the potential negative impacts of natural hazards. The NRI EAL score, and rating, represent a community's relative level of expected loss each year when compared to all other communities at the same level.[45]

EAL Exposure Values and EAL Values for Liberty County can be found in the tables below.[45]

Table 6.11.6: Expected Annual Loss Exposure Values, Hail

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agricultural Value ($)	EAL Total ($)
Hail	$10,266,884,211	$1,061,307,200,000/ 91,492	$34,324,048	$1,071,608,408,259

Table 6.11.7: Expected Annual Loss Values, Hail

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Hail	$58,958	$96,006/ 0.01	$10,033

EAL for Liberty County was derived by creating a report that used census tract information for all tracts within Liberty County. These were census tracts 48291701400, 48291701300, 48291701200, 48291701100, 48291701000, 48291700900, 48291700801, 48291700400, 48291700700, 48291700600, 48291700500, 48291700302, 48291700301, 48291700100, 48291700200, 48291700303, and 48291700802.[46]

Risk Index Ratings, according to the FEMA NRI, for hail within these census tracts are listed as relatively moderate for 11 census tracts and relatively low for 6 census tracts.[46] EAL values, risk index ratings, risk index scores, social vulnerability, and community resilience for each census tract can be found in the figures below. Additionally, the FEMA NRI lists the HLR, a hazard- and county-specific estimate of the percentage of the exposed consequence type (building value, population, or agriculture value) expected to be lost due to a hazard occurrence, for hail as relatively low. [45]

When referencing the figures below, the last 6 digits of the census tract are used on FEMA NRI maps and correlate with the last 6 figures listed for census tracts in comparison charts. For instance, census tract 48291700400 will be listed as 700400 on the figures below. All figures below are from the FEMA NRI online map.[46]

Figure 6.11.2: Risk Index, Liberty County, Hail

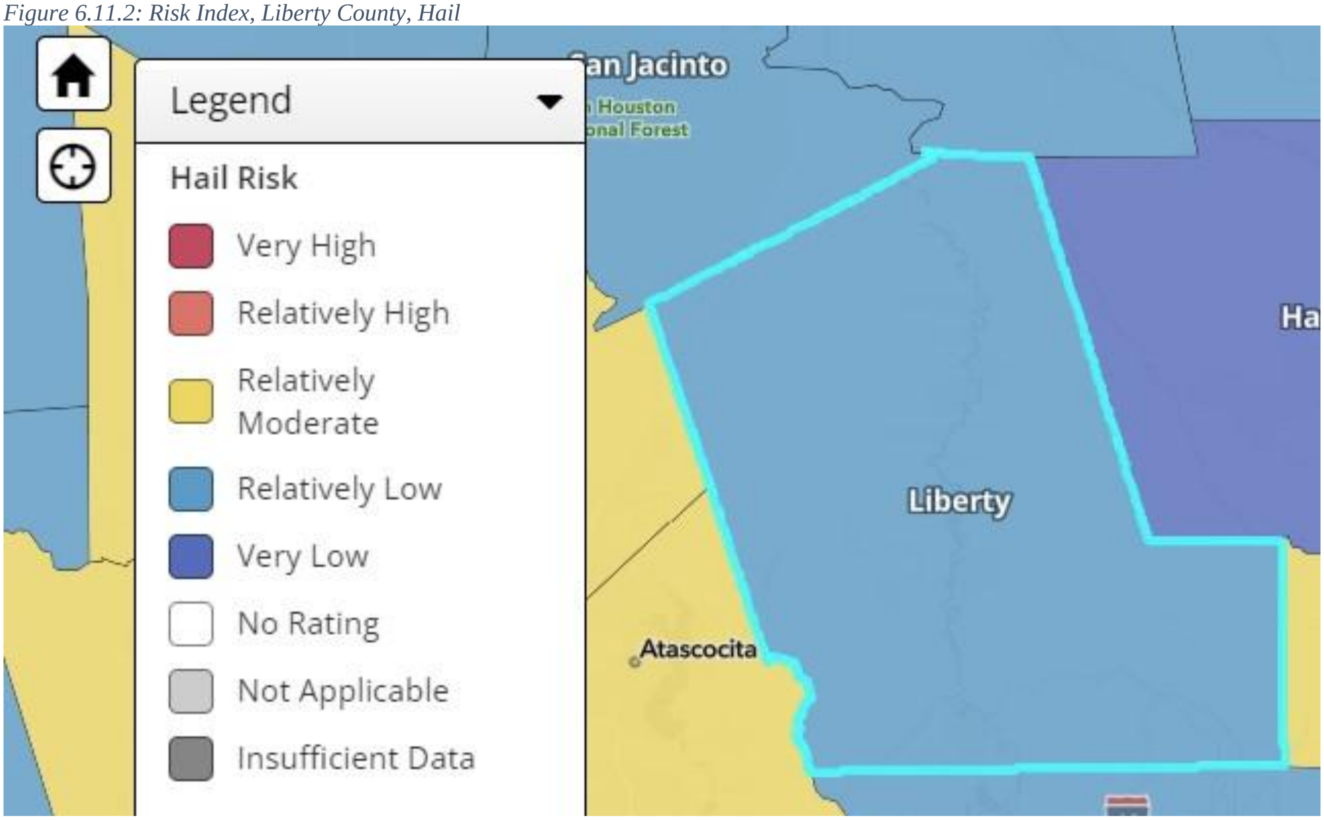


Figure 6.11.3: Risk Index by Census Tract, Liberty County, Hail

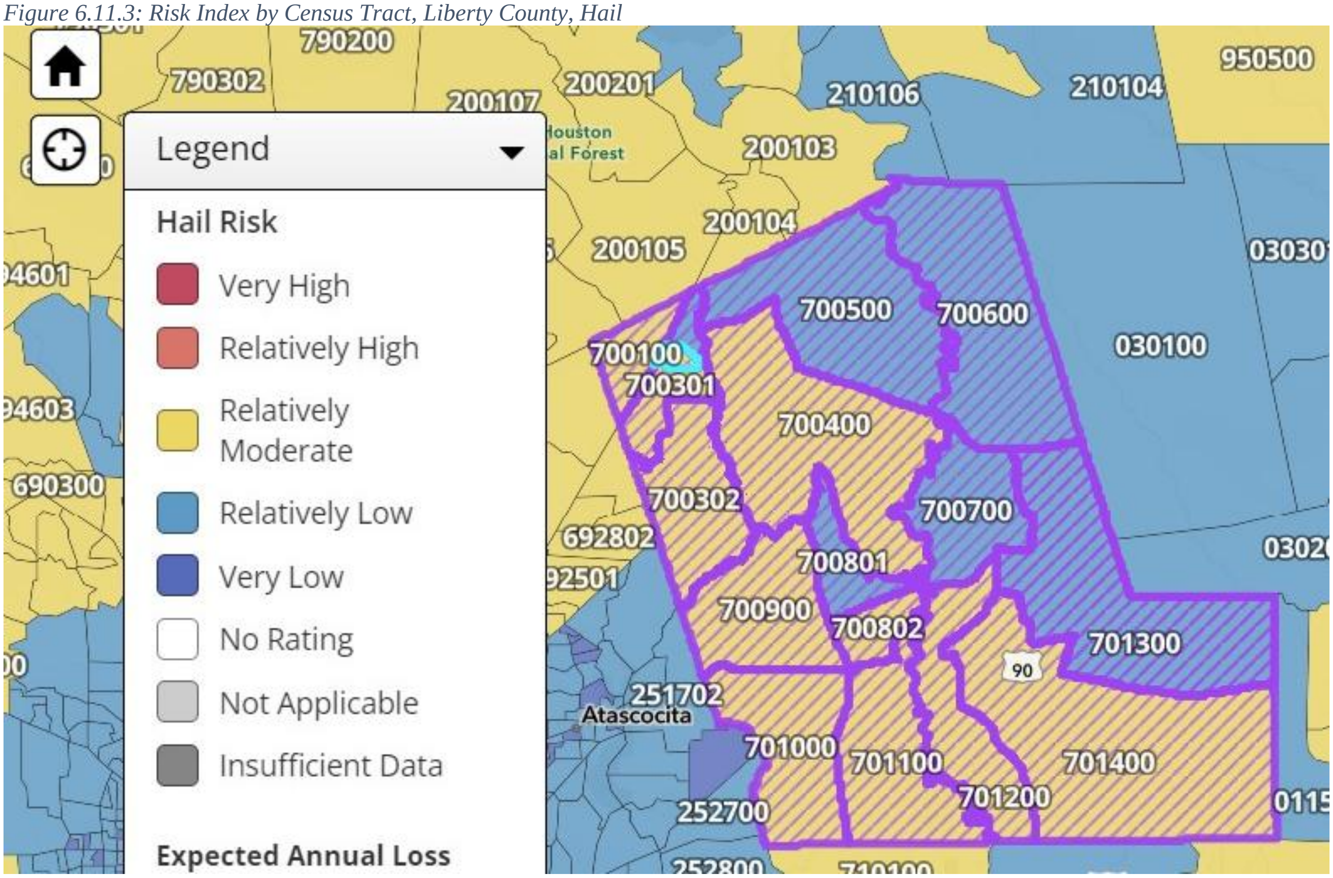


Figure 6.11.4: Social Vulnerability by Census Tract, Liberty County

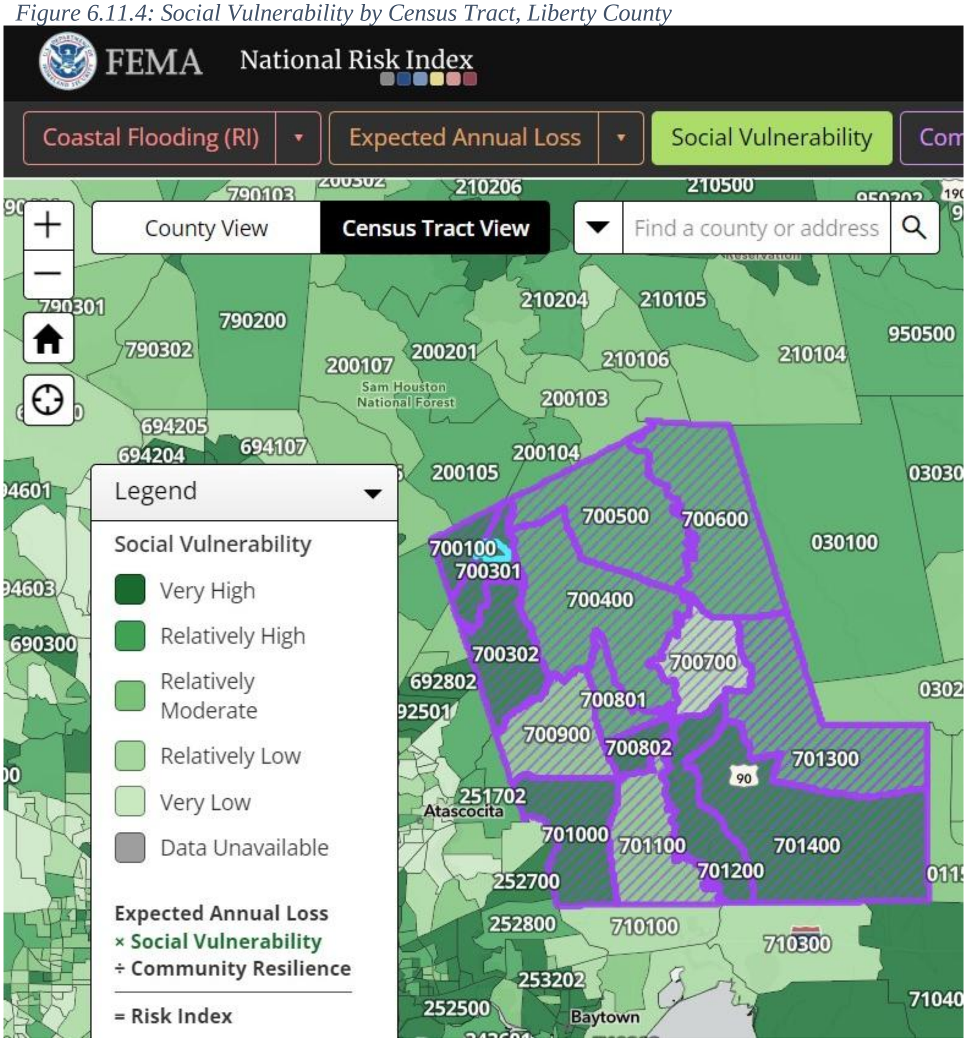


Figure 6.11.5: Social Vulnerability, Liberty County

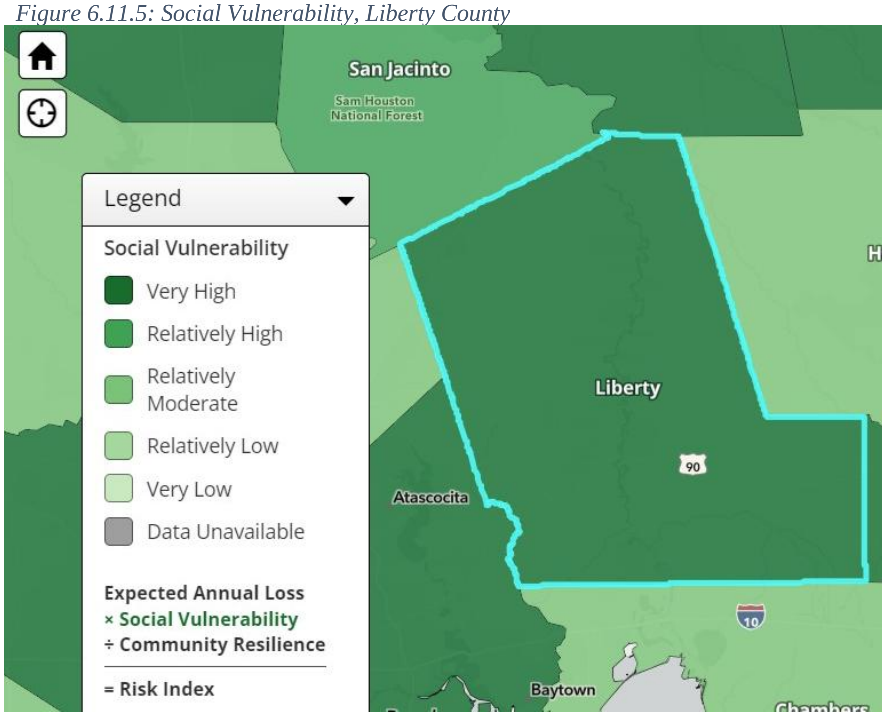


Figure 6.11.6: Community Resilience by Census Tract, Liberty County

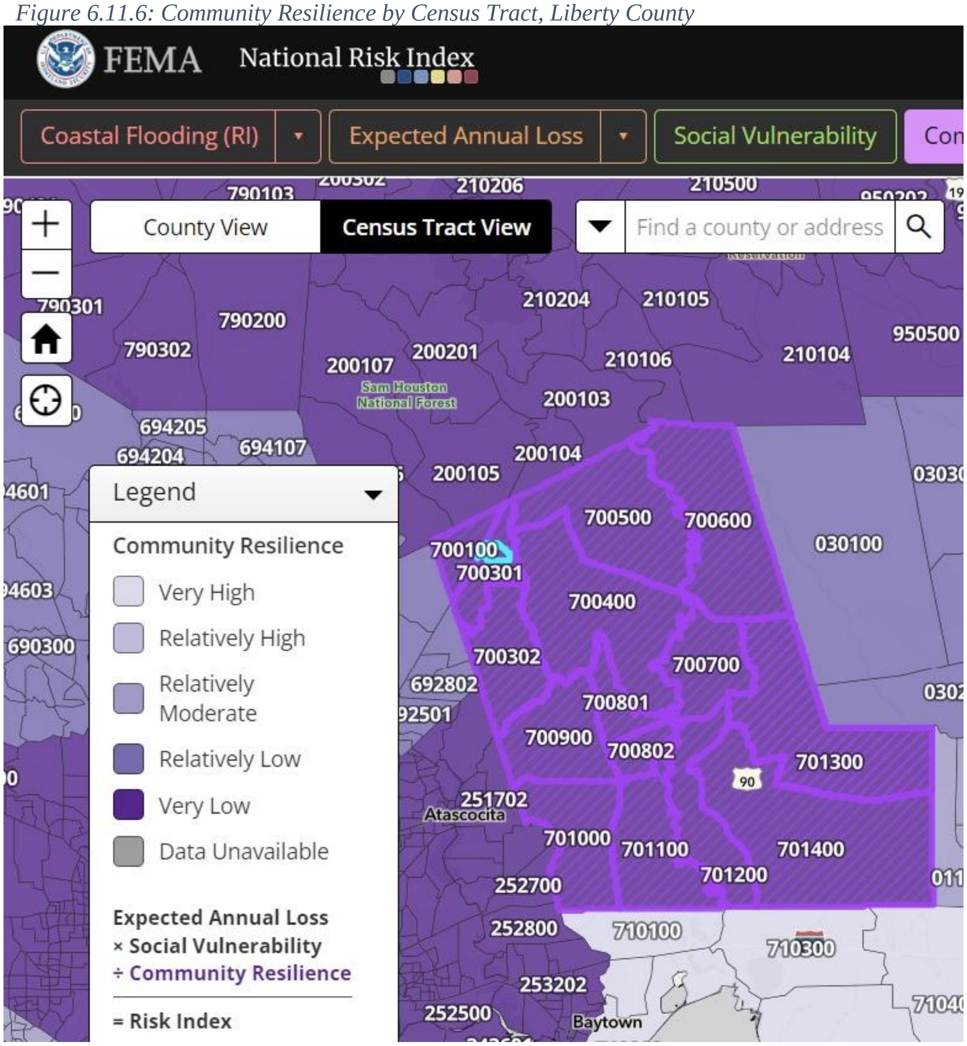


Figure 6.11.7: Community Resilience, Liberty County

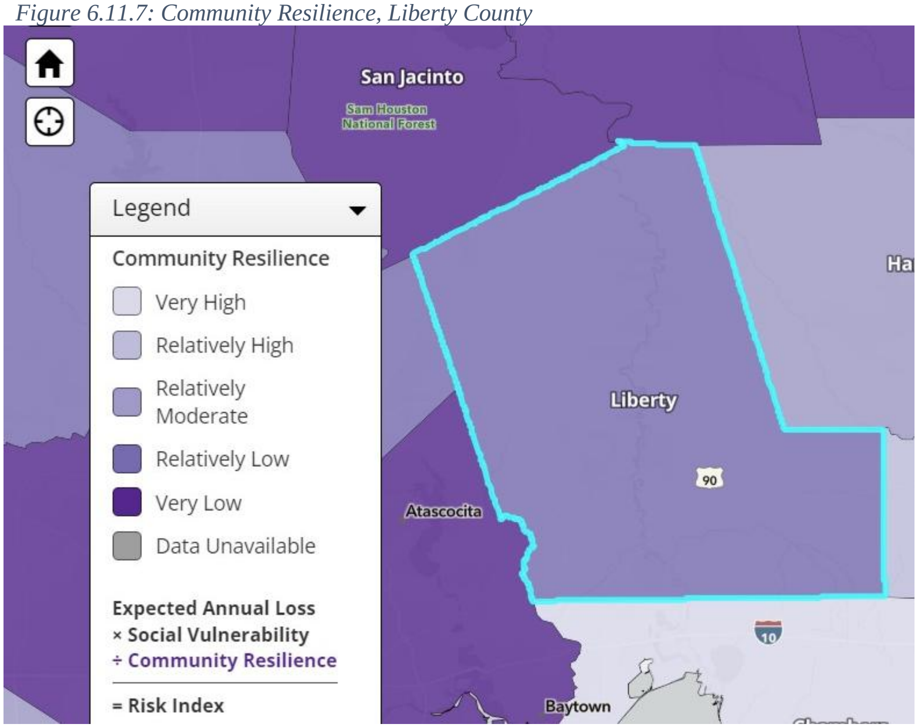


Figure 6.11.8: FEMA NRI Summary by Census Tract, Liberty County, Hail

Rank	Community	State	Risk Index Rating	Risk Index Score	National Percentile
1	Census tract 48291700302	TX	Relatively Moderate	83.6	0 100
2	Census tract 48291701400	TX	Relatively Moderate	82.75	0 100
3	Census tract 48291701000	TX	Relatively Moderate	81.08	0 100
4	Census tract 48291701200	TX	Relatively Moderate	80.85	0 100
5	Census tract 48291700400	TX	Relatively Moderate	78.88	0 100
6	Census tract 48291700100	TX	Relatively Moderate	77.73	0 100
7	Census tract 48291701100	TX	Relatively Moderate	77.45	0 100
8	Census tract 48291700802	TX	Relatively Moderate	77.39	0 100
9	Census tract 48291700900	TX	Relatively Moderate	73.88	0 100
10	Census tract 48291700301	TX	Relatively Moderate	73.87	0 100
11	Census tract 48291700303	TX	Relatively Moderate	73.8	0 100
12	Census tract 48291700200	TX	Relatively Low	72.16	0 100
13	Census tract 48291701300	TX	Relatively Low	71.49	0 100
14	Census tract 48291700801	TX	Relatively Low	68.77	0 100
15	Census tract 48291700600	TX	Relatively Low	68.23	0 100
16	Census tract 48291700500	TX	Relatively Low	67.79	0 100
17	Census tract 48291700700	TX	Relatively Low	64.34	0 100

Figure 6.11.9: FEMA NRI EAL Summary by Census Tract, Liberty County, Hail

Rank	Community	State	EAL Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Risk Index Score
1	Census tract 48291700302	TX	$19,268	Very High	Very Low	1.53	$29,560	83.6
2	Census tract 48291701400	TX	$15,679	Very High	Very Low	1.72	$27,004	82.75
3	Census tract 48291701000	TX	$13,802	Very High	Very Low	1.64	$22,572	81.08
4	Census tract 48291701200	TX	$12,600	Very High	Very Low	1.75	$22,032	80.85
5	Census tract 48291700400	TX	$13,432	Relatively High	Very Low	1.35	$18,136	78.88
6	Census tract 48291700100	TX	$9,823	Very High	Very Low	1.65	$16,223	77.73
7	Census tract 48291701100	TX	$13,207	Relatively Moderate	Very Low	1.2	$15,798	77.45
8	Census tract 48291700802	TX	$10,136	Very High	Very Low	1.55	$15,736	77.39
9	Census tract 48291700900	TX	$9,792	Relatively Moderate	Very Low	1.19	$11,614	73.88
10	Census tract 48291700301	TX	$6,614	Very High	Very Low	1.75	$11,603	73.87
11	Census tract 48291700303	TX	$6,387	Very High	Very Low	1.81	$11,535	73.8
12	Census tract 48291700200	TX	$6,172	Very High	Very Low	1.63	$10,044	72.16
13	Census tract 48291701300	TX	$6,554	Relatively High	Very Low	1.45	$9,488	71.49
14	Census tract 48291700801	TX	$5,797	Relatively High	Very Low	1.3	$7,543	68.77
15	Census tract 48291700600	TX	$5,017	Relatively High	Very Low	1.43	$7,196	68.23
16	Census tract 48291700500	TX	$5,438	Relatively High	Very Low	1.27	$6,932	67.79
17	Census tract 48291700700	TX	$5,277	Relatively Low	Very Low	0.97	$5,126	64.34

Climate Change Impacts

Since tornadoes, windstorms, and hail are heavily associated with severe thunderstorm development, this section will mirror that of Section 6.10, seen previously. According to the Office of the Texas State Climatologist, the climate data record for severe thunderstorms is poor and severe thunderstorms are too small to be simulated directly by present-day climate models. Over the past few decades, the severe storm environment over Texas has changed in complex and opposing ways. The amount of energy available for convection has decreased, and the amount of energy needed to initiate convection has increased at the same time. This suggests that environmental conditions have become less favorable for the occurrence of thunderstorms. However, the amount of low-level shear has increased, which would be expected to make thunderstorms more likely to become severe once they develop. Changes in severe storm environments have not been uniform throughout the year, with environments becoming more favorable for severe thunderstorms and significant hail in Texas early in the spring and less favorable later in the spring. Warmer temperatures are likely to lead to less hail overall, particular during the summer, but increases in available thunderstorm energy may lead to an increase of the risk of very large hail earlier in springtime. With these complex trends and partially contradictory information between models and observations, there is low confidence in any ongoing trend in the overall frequency and severity of severe thunderstorms.[47]

Table 6.11.8: Climate Change Impacts Summary, Hail

Location	The location of hail is not expected to change.
Extent/Intensity	The extent and intensity of hail is not expected to change. However, environments are becoming more favorable for hail in early spring.
Frequency	There are no clear trends in the frequency of hail within the county.
Duration	The duration of hail is not expected to change.

Section 6.12: Erosion

6.12 Erosion

Soil erosion consists of a series of natural processes that move earth and rock material. The land surface is worn away through the detachment and transport of soil and rock by moving water, wind, and other geologic agents.[121] Erosion removes topsoil (areas with the highest levels of organic matter and nutrients), reduces levels of organic matter within the soil, and creates a less favorable environment for plants due to breakdown within the soil structure. The different types of erosion are described in table 6.12.1 below.

FEMA defines erosion as "The process of the gradual wearing a way of land masses. Erosion can occur along coasts and rivers and streams." Although flood-related erosion is covered by flood insurance, this hazard is not covered under the NFIP. The mapping and regulatory standards of the NFIP do not currently address erosion, however, CRS credit is given to communities that include this hazard in their regulations, planning, public information, hazard disclosure, and flood warning programs. For example: communities that have established setbacks and other requirements in areas subject to erosion.

Table 6.12.1 Types of Erosion[122]

Type of Erosion	Description
Wind Erosion	Wind erosion is a natural process that moves loose soil from one location to another. Wind erosion can harm the fields where it picks up soil, as well as the areas where the dirt—and whatever minerals and contaminants it includes—are deposited. It can also have health impacts: worsening air quality, obscuring visibility, and causing people to experience breathing difficulties.
Water Erosion, Rainfall	Occurs when the rainfall intensity that hits the ground exceeds the absorbing capacities or the infiltration rate of soil affected. This leads to soil in water runoff and sediment transport to waterways resulting in deterioration in soil and water quality.
Water Erosion, Sheet	Sheet erosion is the removal of soil in thin, uniform layers (sheets) by raindrop impact and shallow surface water flow. Sheet erosion can sometimes be difficult to detect unless the soil is deposited nearby or if the damage is already severe. This erosion process removes the fine soil particles that contain most of the important nutrients and organic matter.
Water Erosion, Rill	Occurs when runoff becomes concentrated enough to cut small rivulets in the soil that carry sediment down hillsides.
Water Erosion, Gully	Gully Erosion is the washing away of soil through deep grooves or channels across unprotected land. Gully erosion can refer to soil being washed away through human-made drainage lines or describe the process of soil traveling through grooves created by hard rains. Farmers will typically fill these grooves back in with fresh soil as a temporary solution. Gully erosion can hinder the ability to plow fields and grow crops.
Water Erosion, Bank	The progressive undercutting, scouring, and slumping of natural rivers and streams as well as man-made drainage channels by the intense movement of water. When land managers remove vegetation or ranchers allow their livestock to overgraze the land near streams and riverbanks, it can exacerbate the problem.

Location

Soil erosion is typically measured in a variety of ways, both qualitative and quantitative. Within the county, inland erosion due to water is the main hazard of concern. One method is the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE). Potential erodibility for sheet and rill erosion is estimated by multiplying the following factors of the Universal Soil Loss Equation USLE: Rainfall and runoff factor (R), Susceptibility of the soil to water erosion (K), and Combined effects of slope length and steepness (LS). The K factor represents the susceptibility of soil to water erosion.[123] Past management or misuse of soil by intensive cropping can increase a soil's erodibility. The K factor may need to be increased if the subsoil is exposed or where the organic matter has been depleted, the soil's structure destroyed, or soil compaction has reduced permeability.[124] Table 6.12.2 below shows K factor scores, soil descriptions, and their associated soil erodibility. Figure 6.12.1 depicts these k-factors within the Liberty County. K-factors with high erodibility of 0.4 or greater are depicted in red. The legend breaks down the soil erodibility factor and how they were colored on the map. There are very few areas within the city that have a high erodibility score.

Table 6.12.2 K Factor, Soil Erodibility Scores

K-Factor	Soil Description	Erodibility
0.05 to 0.15	High in clay	Resistant to detachment
0.05 to 0.2	Coarse textured soils, such as sandy soils	Low runoff, easily detached
0.25 to 0.4	Medium textured soils, such as the silt loam soils	Moderately susceptible to detachment and they produce moderate runoff
>**0.4**	Soils with a high silt content	Most erodible of all soils, easily detached; tend to crust and produce high rates of runoff

Within the planning area, there is one unique related hazard, sinkholes, that affect the City of Daisetta. A sinkhole is a hole in the ground that forms when water dissolves surface rock. The City of Daisetta sits on the Hull Salt Dome, a natural formation created below the ground over millions of years where oil brine and natural gas accumulate.

Figure 6.12.1: Soil Erodibility Scores, Liberty County

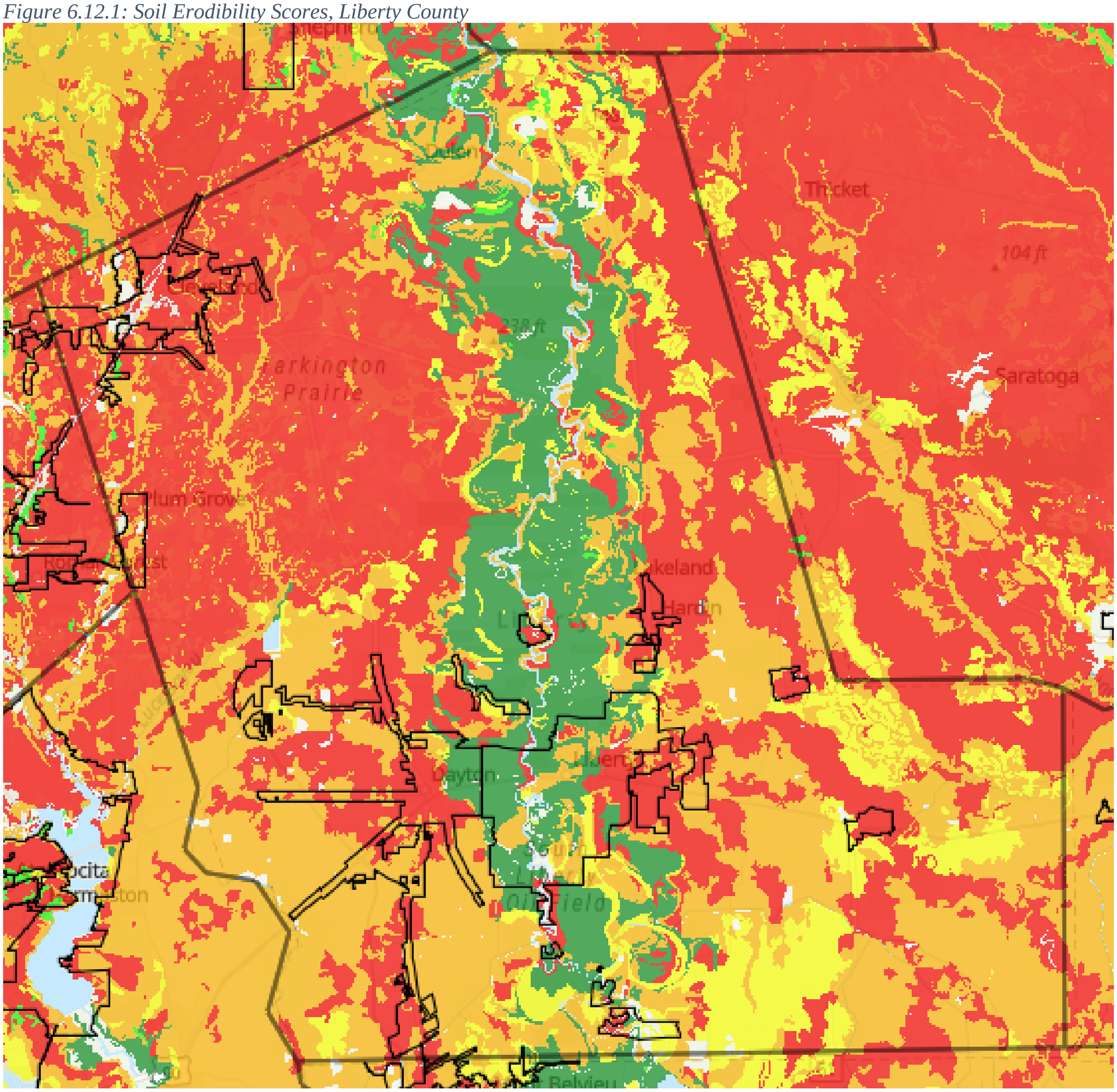
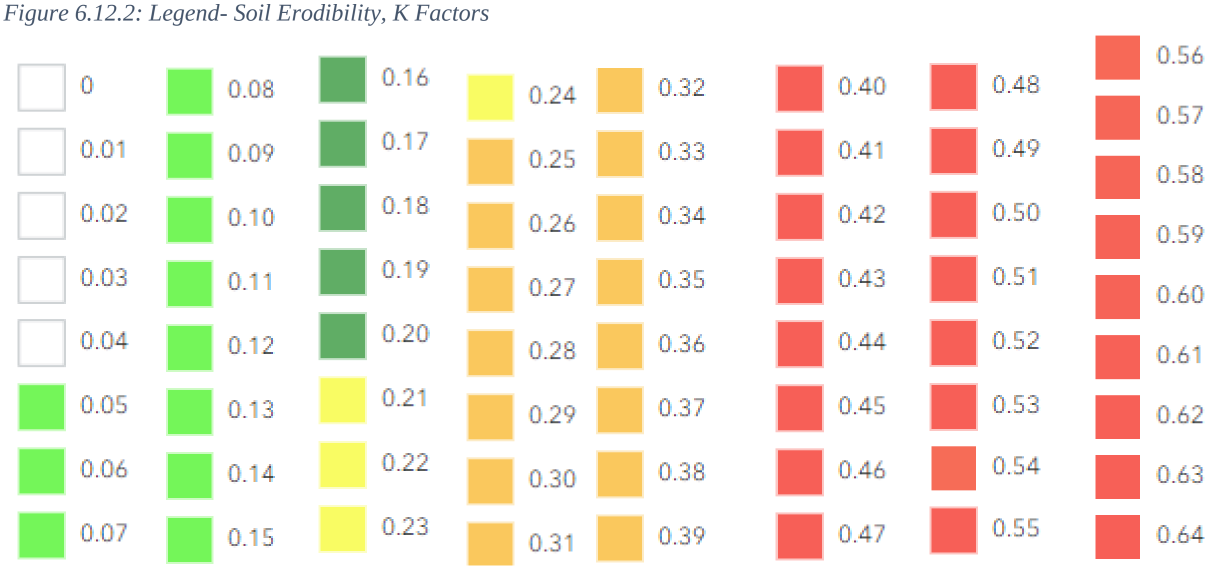


Figure 6.12.2: Legend- Soil Erodibility, K Factors

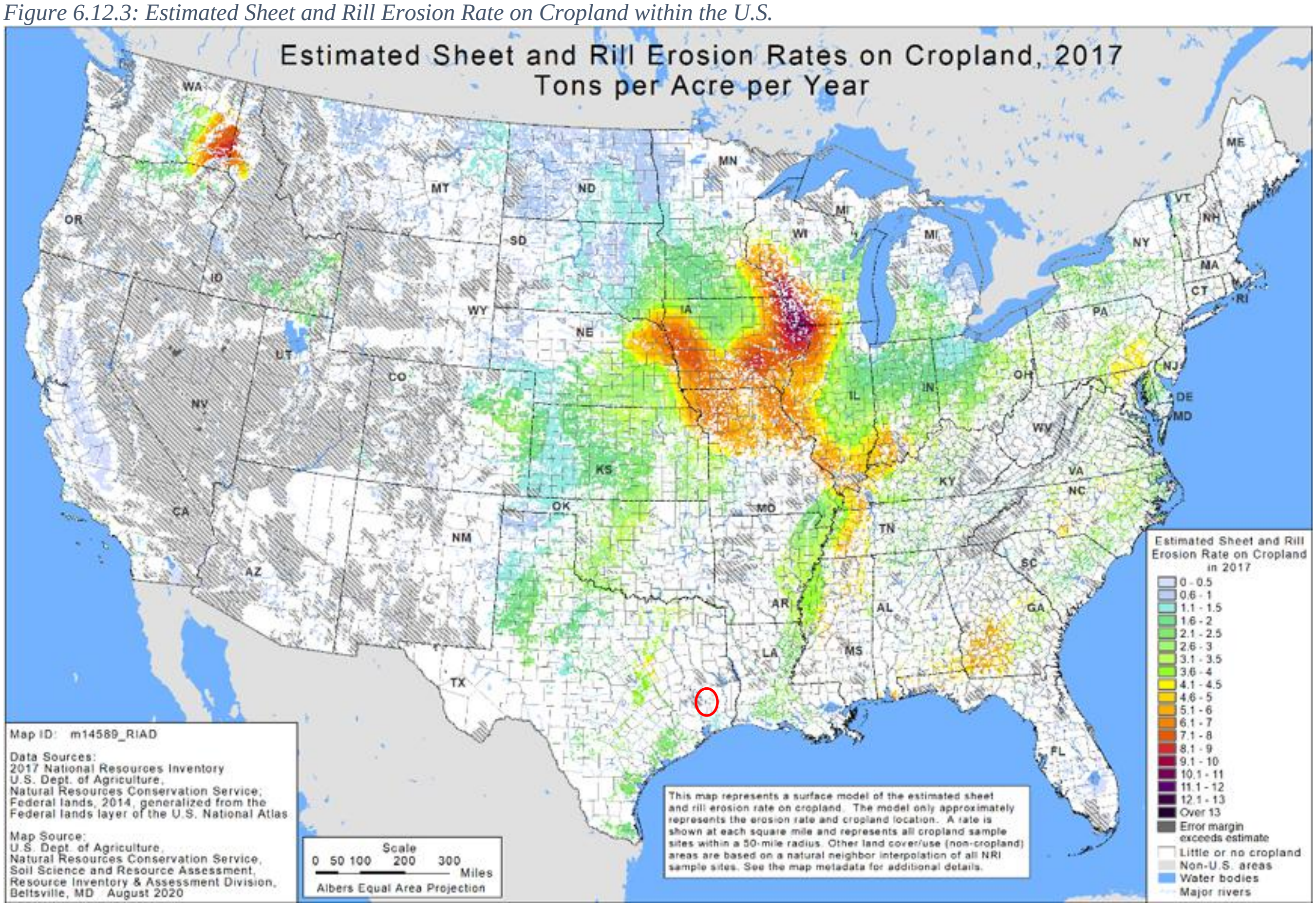


Extent

Soil erosion and its risk of occurring is difficult to measure without proper documentation techniques in place. Measuring certain properties in specific locations in the field, such as the surface and aggregate stability of the soil, infiltration rates, organic matter content, and sediment delivery ratios are all necessary components to quantify the rate of erosion in a given area Furthermore, using these quantitative measurements with photographs or visual observations of the soil or landmarks at specific locations would help to paint a clearer picture if erosion is occurring or likely to occur. Soil erosion rates on cropland within the U.S. decreased 35 percent between 1982 and 2017. The water (sheet and rill) erosion rate declined from 3.89 tons per acre per year to 2.67 tons per acre per year, and the erosion rate due to wind decreased from 3.24 tons per acre per year to 1.96 tons per acre per year.[125] Figure 6.12.2 shows the estimated sheet and rill erosion rates on cropland in tons per acre per year within the U.S. The rate of erosion due to sheet and rill within areas of Liberty County ranged from 0-0.5 tons per acre per year. Liberty County has extensive areas of erodible soils across the county and participating jurisdictions (as seen above). This hazard is also a greater risk to areas along the Trinity River whose banks can be eroded away during times of heavy rain or flooding if the river crests.

This map is derived from the 2017 summary resource report developed by the U.S. Department of Agriculture Natural Resources Conservation Service. It is the most recent report available and was published in 2020.

Figure 6.12.3: Estimated Sheet and Rill Erosion Rate on Cropland within the U.S.



A worst-case scenario for this hazard would be a heavy rainfall event that created flooding conditions within the Trinity River causing stream bank erosion from the river cresting. This happened most recently in both April and May 2024. For sinkholes, a worst-case scenario would be expansion of the current sinkholes within Daisetta, or a new one appearing.

Historic Occurrences

Presidential Disaster Declarations

There have been no disaster declarations for erosion within Liberty County, in which the Liberty County is located, since 1950.[2]

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Liberty County since 2018 are listed in the table below.[40]

Table 6.12.3: USDA Declared Disasters (2018-2023), Erosion

Crop Disaster Year	Disaster Description	Designation Number
	None	

In May 2008, a large sinkhole formed in Daisetta when an underground mound of rock salt collapsed. The sinkhole swallowed several cars, oil drilling equipment, and oil tanks. In one day, the Daisetta sinkhole had grown to 200 meters (656 feet) in diameter and 75 meters (246 feet) deep. Within a couple of weeks, a 23-meter (7-foot) deep lake had formed in the sinkhole-.[126]

Figure 6.12.4: The Daisetta Sinkhole, 2008

In April 2023, officials announced the sinkhole had expanded. State researchers noted the expansion was actually a new and smaller sinkhole that formed adjacent to the one from 2008.

Figure 6.12.5: The Daisetta Sinkhole, 2023

Figure 6.12.6: The Daisetta Sinkholes

Figure 2. Oblique drone image of the 2008 and 2023 sinkholes, Daisetta, Texas, acquired on April 8, 2023. "F" denotes areas of prominent concentric fissures, scarps, and cracks. View to the east–northeast.

Figure 6.12.7: The Daisetta Sinkholes, Contour Lines

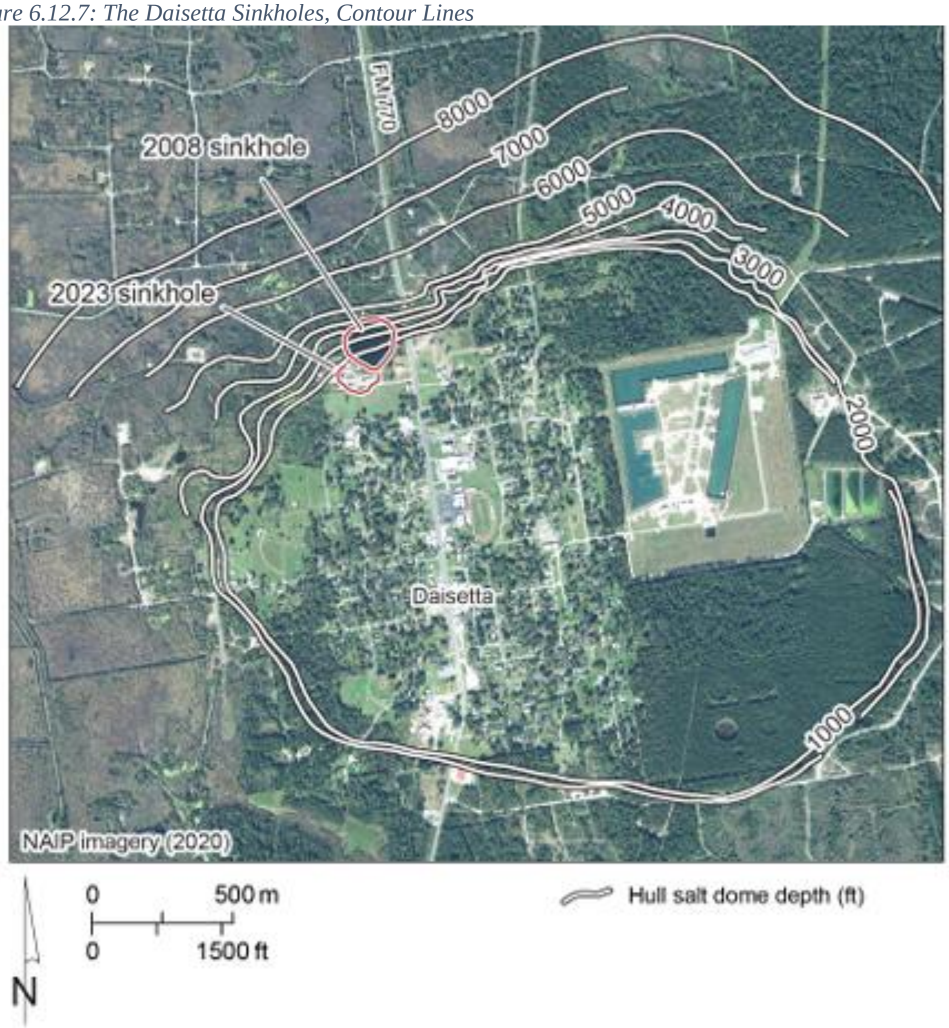


Figure 4. Map of the Daisetta, Texas area showing the May 7, 2008 and April 2, 2023 sinkhole locations and depth contours (in feet) to the top of the Hull salt dome superimposed on 2020 National Agriculture Inventory Program (NAIP) imagery from the Texas Natural Resources Information System. Depths to the top of salt were provided by Quail Creek Oil Company.

The Bureau of Economic Geology, a research unit at the University of Texas that serves as the State Geological Survey, detailed the 2023 sinkhole in a report shortly after it appeared. This report listed the new sinkhole as having a diameter of about 230 feet (70 m) and about 30 feet (9 m) deep. The report highlighted there was no indication the new sinkhole had impacted Farm-to-Market Road 770, the main roadway through Daisetta.[127] It is unknown if the sinkholes will continue to expand.

Probability of Future Occurrences

As mentioned above, the rate of erosion on croplands has been decreasing across the U.S. over time. It is hard to estimate the probability of future occurrence of this hazard due to a lack of data regarding previous erosion events through any formal system. In regard to the Daisetta sinkholes, it is unknown if expansion will occur. The Bureau of Economic Geology has recommended further study of the sinkhole to minimize risks associated with the expansion of the current sinkholes or new ones appearing.[117] In the interim, steel posts were placed 50 feet (15 m) apart in a pasture area near the sinkhole to monitor any changes in elevation and act as an early warning system for those nearby.

Populations at Risk

Populations at risk from erosion include those who work in agricultural fields. Erosion can greatly affect agriculture production through lost revenue and agricultural production. Those who own private property, particularly along areas near creeks and rivers may be more susceptible to this hazard as river cresting can exacerbate erosion damage that could require costly repairs and infrastructure reinforcement. The FEMA NRI does not account for erosion within its various analyses of natural hazards.

In regard to the sinkholes within Daisetta, populations at risk include those who live or work near the sinkhole, which is in close proximity to homes, a major roadway, a high school, and brand-new commercial businesses that opened in 2023.

As the county grows, the vulnerability of its residents to this hazard will expand as the entire county is vulnerable to this hazard. Any areas of future development could experience risks from erosion. Those living within the City of Daisetta also have a greater risk of being affected by sinkholes than other areas of Liberty County.

Climate Change Impacts

Climate change can increase the impacts felt from water erosion from more frequent and intense rainfall, longer periods of extreme heat and drought can lead to an increase in wind erosion, and as wildfires destroy areas- the loss of vegetation and groundcover are more prone to erosion by both wind and water. In addition, soil erosion can drive climate change. Soil is a vast storage center for carbon dioxide, organic matter, and microbes. When soil becomes degraded it can release carbon back into the atmosphere.[48]

Table 6.12.4: Climate Change Impacts, Erosion

Location	The location of erosion is not expected to change.
Extent/Intensity	The extent of erosion is not expected to change.
Frequency	The frequency of erosion is not expected to change. The rate of erosion on croplands has been decreasing across the U.S. over time. The frequency of this hazard is difficult to estimate.
Duration	The duration of erosion is not expected to change.

Section 6.13: Emerging Infectious Diseases

6.13 Emerging Infectious Diseases

Emerging Infectious Diseases (EID) are defined by the National Institute of Allergy and Infectious Diseases as "infectious diseases that have newly appeared in a population or have existed but are rapidly increasing in incidence or geographic range."[128] Similarly, a pandemic is a disease outbreak that spans several countries and affects many people. Pandemics are most often caused by viruses which can easily spread from person to person.[129] This hazard profile will refer to EID and use the 2019 coronavirus, SARS-CoV-2, pandemic to give a clearer picture of the risk and vulnerability of this new hazard of concern for the county.

Location

The risk of EID applies the same to the entire county as this hazard has no geographic boundaries. However, areas that are more densely populated can contribute to the rapid spread of EID.

Extent

The extent of an infected population depends on how the illness is spread and methods of transmissibility and detection. In areas that are more densely populated, contact between infected and uninfected individuals may be greater than in rural areas leading to more chances for infection. A worst-case scenario for this hazard would include an EID that spreads rapidly and has no readily available vaccine.

Historic Occurrences

Pandemics can emerge anywhere and quickly spread. It is difficult to predict when or where the next pandemic will occur.[130] According to the CDC, five pandemics have occurred in the US since 1918. The table below outlines these pandemics when they occurred, and the underlying cause.[131]

Table 6.13.1: Historic Pandemic Occurrences in the US

Pandemic Name	Estimated Deaths (US only)	Cause
1918 Pandemic	675,000	Influenza virus, H1N1
1957- 1958 Pandemic	116,000	Influenza virus, H2N2
1968 Pandemic	100,000	Influenza virus, H3N2
2009 H1N1 Pandemic	12,469	Influenza virus, H1N1 pdm09 virus
2020 Covid-19 Pandemic	1,181,607	SARS-CoV-2 virus

Presidential Disaster Declarations

There have been 2 federally declared emerging infectious disease-related disaster declarations in Liberty County for EID listed under biological incidents.[2]

Table 6.13.2: Federal Disaster Declarations for Emerging Infectious Diseases

Date	Disaster Number	Declaration Types	Incident Type	Declaration Title
3/13/2020	3458	Major Disaster Declaration	Biological	Covid-19
3/25/2020	4485	Emergency Declaration	Biological	Covid-19 Pandemic

USDA Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make EM loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. In addition to EM loan eligibility, other emergency assistance programs, such as FSA disaster assistance programs, have historically used disaster designations as an eligibility trigger. USDA Secretarial disaster designations must be requested of the Secretary of Agriculture by a governor or the governor's authorized representative, by an Indian Tribal Council leader, or by an FSA SED. The Secretarial disaster designation is the most widely used. When there is a presidential disaster declaration, FEMA immediately notifies FSA of the primary counties named in a Presidential declaration. USDA Disaster Declarations for Brazoria County since 2018 are listed in the table below.[40]

Table 6.13.3: USDA Declared Disasters (2018-2023), Emerging Infectious Diseases

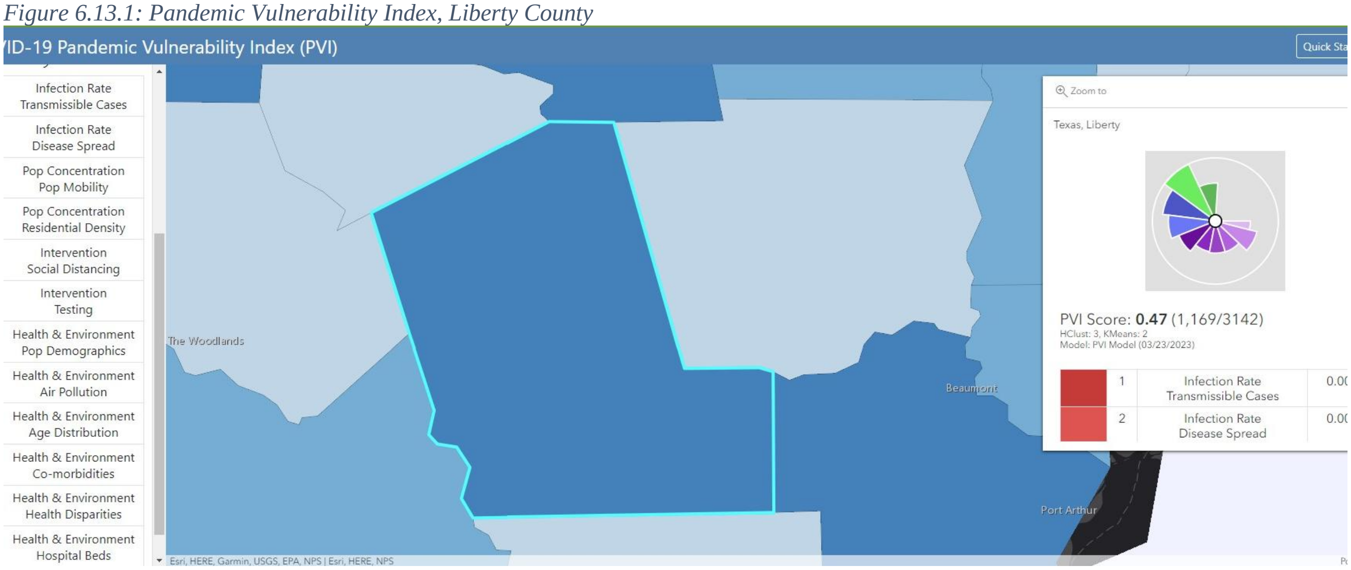
Crop Disaster Year	Disaster Description	Designation Number
	None	

Probability of Future Occurrences

EID and pandemics can emerge anywhere and quickly spread. It is difficult to predict when or where the next pandemic will occur. As seen in The National Center for Biotechnology Information review titled "The consequences of human actions on risks for infectious diseases" the number of events of emerging infections has been increasing over the last 100 years. EIDs have been reviewed extensively during the last two decades, and it is now generally accepted that most drivers of emerging diseases are ecological, and the majority of these are caused by anthropogenic influences such as increased traveling and transport of animals and goods; changes in ecosystems; deforestation and reforestation; altered land use; increased irrigation and creation of water dams and reservoirs; and urbanization.[132]

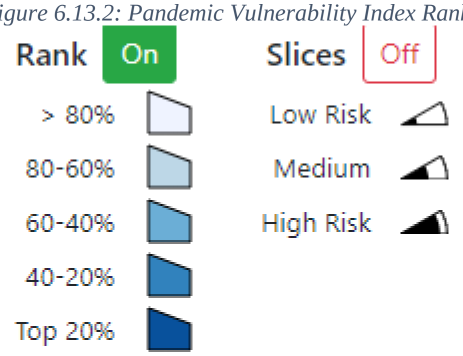
The National Institute of Environmental Health Sciences developed the COVID-19 Pandemic Vulnerability Index (PVI) Dashboard. This Dashboard creates risk profiles, called PVI Scorecards, for each county in the United States. The PVI summarizes and visualizes overall risk in a radar chart, which is a type of pie chart with various data sources comprising each slice of the pie. Liberty County saw 21,959 Covid-19 cases and 215 deaths during the most recent pandemic. As seen in the figure below, Liberty County's PVI score is 0.48.[133]

Figure 6.13.1: Pandemic Vulnerability Index, Liberty County



The slices shown in the chart to the right indicate a different data source (as described on the left of the figure). The information from each slice is combined to generate a PVI score for each county. A 0.48 PVI score puts Liberty County in the > 80% vulnerability ranking. Additionally, the bigger the "slice" shown for each item in the pie chart indicates the county has a higher risk for that area.

Figure 6.13.2: Pandemic Vulnerability Index Ranking Legend



Populations at Risk

EID can vary in severity for different populations based on age, underlying conditions, and how the disease is spread. The last 5 pandemics experienced in the US were respiratory illnesses. Populations that were/are most at risk include people who are older, those with heart or lung conditions, people with compromised immune systems, and people who are obese or diabetic.[134] As the county continues to grow, the vulnerability of residents to this hazard will also grow. Any areas of future development could be exposed to this hazard.

Climate Change Impacts

According to the CDC, milder winters, warmer summers, and fewer days of frost make it easier for these and other infectious diseases to expand into new geographic areas and infect more people. As climate changes, new infections may emerge that threaten human health or livelihood.[135]

Table 6.13.4: Climate Change Impacts Summary, Emerging Infectious Diseases

Location	The location of EID is expected to increase in urban areas of the county.
Extent/Intensity	The extent and intensity of EID is expected to increase.
Frequency	Frequency of EID is expected to increase.
Duration	There is no clear trend in duration of EID.

Section 6.14: Manmade Hazards

6.14 Manmade Hazards

This section includes hazards of concern for Liberty County that were not fully profiled due to various reasons or combinations of reasons such as being a human-induced hazard, lack of data regarding the hazard, lack of historic occurrences or reporting of the hazard, unable to quantify the future probability of the hazard occurring, and unable to identify the extent or populations impacted. However, these hazards were identified as concerning and warranting attention with this HMP update by the HMC during the Risk Assessment.

Cybersecurity

The Internet has improved communication, innovation, and access to information, however, due to its largely open and unregulated nature municipal governments are more vulnerable to the hazards associated with cybersecurity threats and incidents. FEMA defines cyberattacks as "malicious attempts to access or damage a computer or network system." Cyberattacks can lead to the loss of money or the theft of personal, financial, and medical information." Cybersecurity involves preventing, detecting, and responding to cyberattacks that can have wide-ranging effects on individuals, organizations, the community, and the nation.[136] Cyberterrorism refers to an attack on information technology itself in a way that would radically disrupt networked services. For example, cyber terrorists could disable networked emergency systems or hack into networks housing critical financial information. Cyber-attacks can take many forms. They can use computers, mobile phones, gaming systems, and other devices, they can include fraud or identity theft, block access or delete personal documents and pictures, may target children, and may cause problems with business services, transportation, and power.[137] The table below outlines some key terms and definitions for this hazard of concern.

Table 6.14.1: Key terms and definitions for Cybersecurity

Key terms	Definition
Threat actor	Who is behind the event? This could be the external "bad guy" that launches a phishing campaign or an employee who leaves sensitive documents in their seat back pocket.
Threat action	What tactics (actions) were used to affect an asset? The seven primary categories of threat actions include: Malware, Hacking, Social, Misuse, Physical, Error and Environmental.
Incident	A security event that compromises the integrity, confidentiality, or availability of an information asset.
Breach	An incident that results in the confirmed disclosure—not just potential exposure—of data to an unauthorized party. A Distributed Denial of Service (DDoS) attack, for instance, is most often an incident rather than a breach, since no data is exfiltrated. That doesn't make it any less serious.

Location

These attacks have no set geographic boundary and can occur anywhere, facilitated by the internet. Cybersecurity is an evolving, borderless challenge especially if there are vulnerabilities in software, unsecure or weak passwords, social engineering attacks, and unsecured internet connections.

Extent

The effect of a cyber-attack event can vary depending on the type of attack and the magnitude of the event or events. According to the Verizon Data Breach Investigations Report (DBIR), "There are four key paths leading cyber-attacks: Credentials, Phishing, Exploiting vulnerabilities, and Botnets. All four are pervasive in all areas of the DBIR, and no organization is safe without a plan to handle each of them."[138]

There have been no historic occurrences or documented cyber-attacks within Liberty County or participating jurisdictions. According to the Verizon DBIR, the North American Region (comprised of the US and Canada) has experienced 9,036 cybersecurity incidents, 1,924 of those with confirmed data disclosure between November 1, 2021, through October 31, 2022. 85% of breaches were due to system intrusion, basic web application attacks, and social engineering. Threat actors for these breaches included external (94%), internal (12%), multiple (9%), and partner (2%). Motives for these cyber-attacks were financial (99%), espionage (1%), and grudge (1%). Data comprised included credentials (67%), internal (50%), personal (38%), and other (24%).

Presidential and USDA Disaster Declarations

There have been no federally declared cyber-attack or cyber terrorism-related disaster declarations in Liberty County or participating jurisdictions since 1950. Similarly, there are no USDA Disaster Declarations associated with this hazard.[2, 40]

Probability of Future Occurrences

As cybercriminals become more sophisticated in the future, the county's vulnerability to cyber-attacks may change significantly. It is difficult to predict the probability of future occurrences due to the unpredictable nature of this hazard. Opportunistic criminals might also leverage natural disasters to target already vulnerable systems. To decrease the number of future cybersecurity-related attacks, FEMA suggests a variety of prevention methods that can be incorporated now, such as: keeping anti-virus software updated and using strong passwords. Changing passwords monthly, watching for suspicious activity, checking account statements and credit reports regularly, using secure internet communications, using a Virtual Private Network that creates a secure connection, using antivirus solutions (malware, and firewalls) to block threats, regularly backing up files in an encrypted file or encrypted file storage device, limiting any personal information shared online, changing privacy settings, and protecting home networks.[139]

Populations at Risk

Everyone is equally at risk for this hazard within Liberty County and Liberty County. As the US becomes increasingly reliant on technology, the vulnerability to cyber threats will increase. A significant number of people fear data breaches as the outcomes result in disruptions to sectors like transportation and healthcare and include societal impacts like mistrust.

Climate Change Impacts

Cybersecurity and Cyber Terrorism are human-caused hazards, thus no climate change impacts are associated with these hazards.

Hazardous Material Spill (Haz/Mat Spill)

The Occupational Safety and Health Administration (OSHA) defines hazardous materials as "any substance or chemical which is hazardous to people's health or is physically hazardous. This includes chemicals such as carcinogens, irritants, corrosives, toxic agents, sensitizers, agents that damage the lungs, skin, eyes, or mucous membranes; chemicals that can combust, explode, are flammable, oxidizers, pyrophoric, unstable-reactive or water-reactive. They also include chemicals that produce or release dust, gases, fumes, vapors, mists or smoke during normal handling, use, or storage."[140] These are a wide-ranging category of substances that can cause death or serious harm to people or may significantly damage human or environmental health. Hazardous materials pose a risk when they are released into the environment or an uncontrolled setting. Hazardous materials are widely used and in most cases are safe if used properly with the correct handling protocols.

Hazardous materials incidents can occur naturally and during the manufacture, transportation, storage, and use of hazardous materials. These incidents can occur as a result of human error, natural hazards, deliberate acts, or a breakdown in equipment or monitoring systems. The impact depends upon the quantity and physical properties of the hazardous material, environmental and weather factors at the point of release, the type of release, and its proximity to human and wildlife populations and valuable ecosystems. The duration of a hazardous materials incident can range from hours to days. Hazardous materials incidents include the unwanted, unplanned, or deliberate release or escape of explosive, flammable, combustible, corrosive, reactive, poisonous, toxic, or radioactive substances that may cause or create a potential risk to public health, safety, or the environment. For this HMP update, hazardous materials will refer to unusually harmful substances or large quantities of hazardous materials and will focus on releases from fixed sites. It does not address the potential of small-scale hazardous material releases of common supplies, such as cleaning supplies under a sink or a spare can of gasoline in a shed.

Location

The Toxics Release Inventory (TRI) is a publicly available database from the Federal Environmental Protection Agency (EPA) that contains information on toxic chemical releases and other waste management activities reported annually by certain industry groups and federal facilities.[141] This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to their state or tribal entity.

Liberty County contains 15 TRI facilities and various pipelines that transport these materials, as shown in the figures below.

Figure 6.14.1: Toxic Release Inventory Facilities, Liberty County

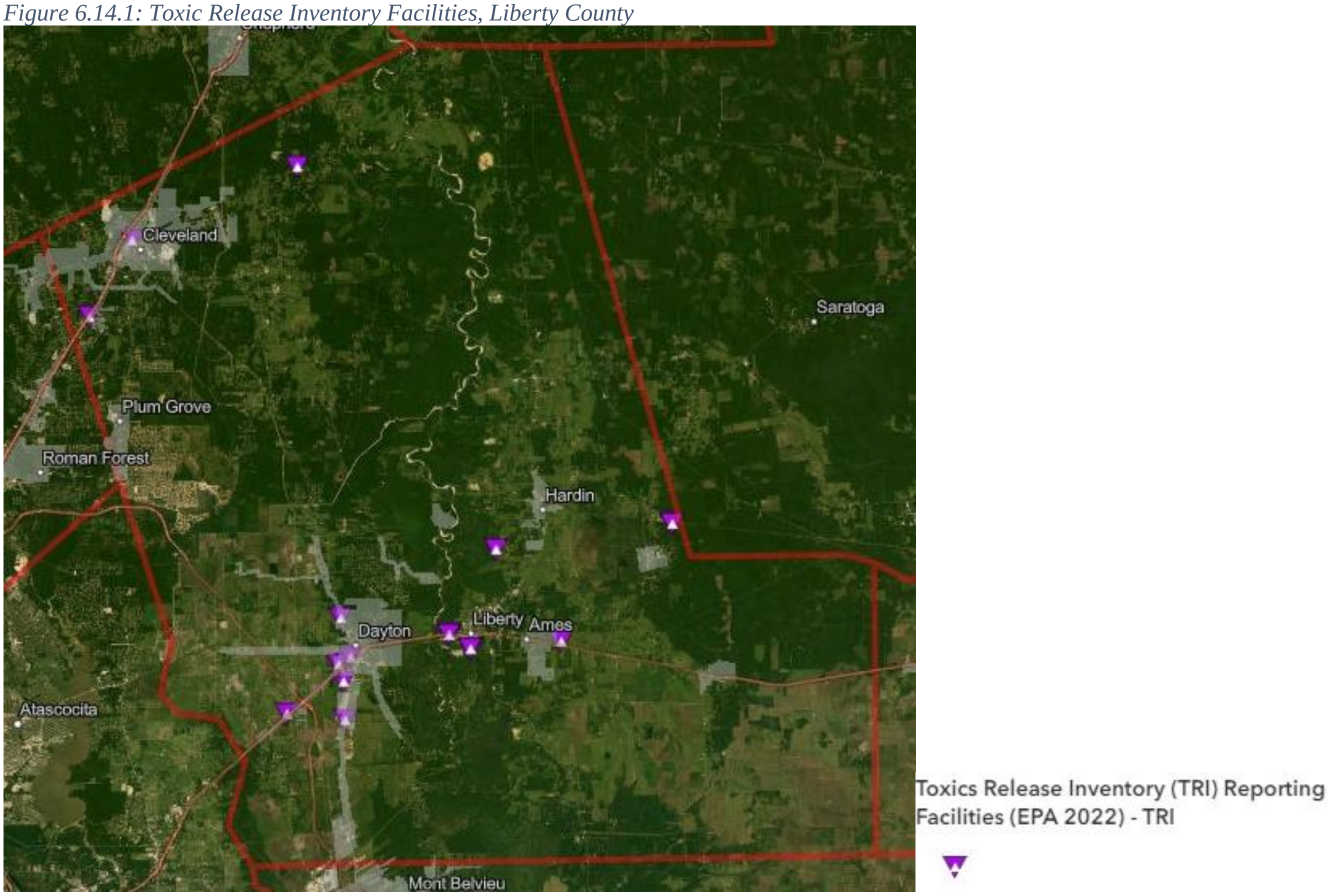
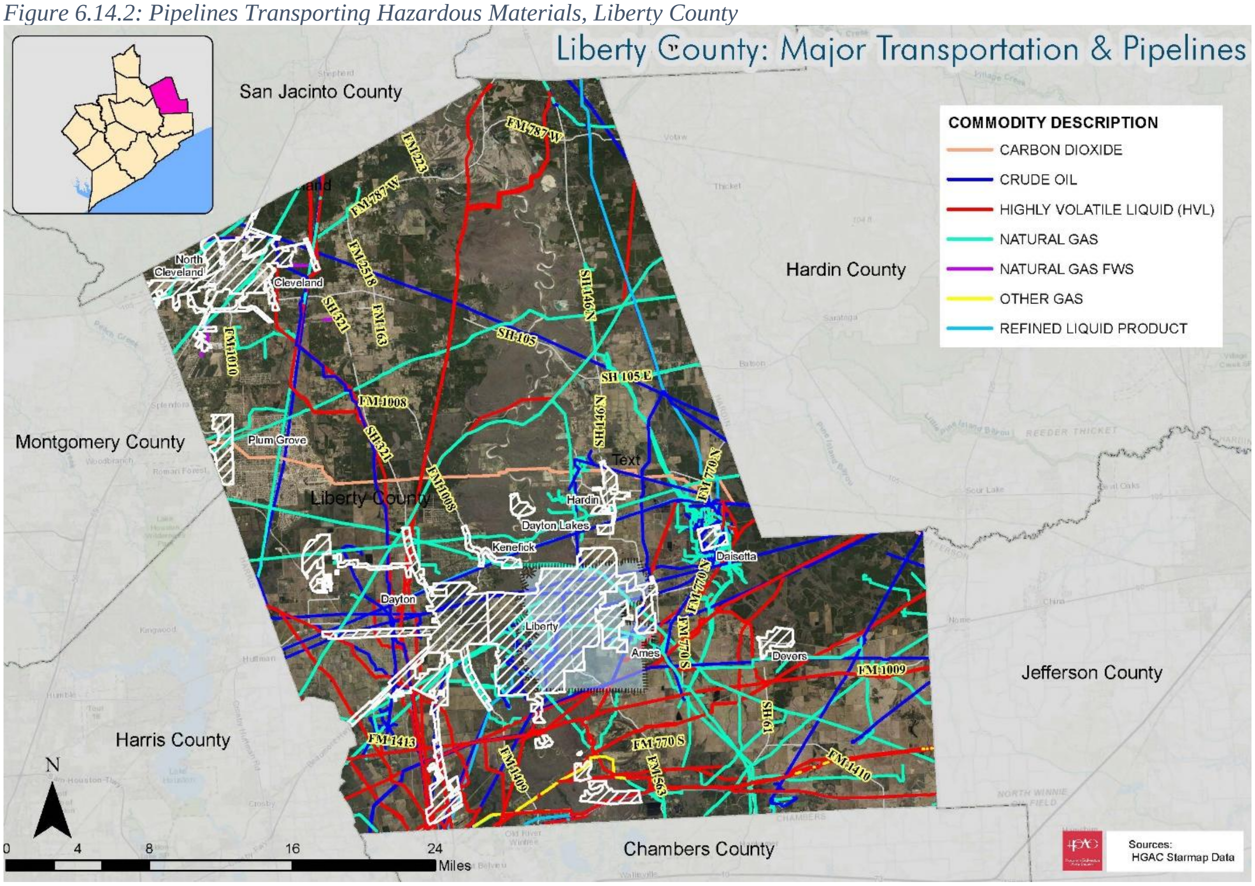


Figure 6.14.2: Pipelines Transporting Hazardous Materials, Liberty County



Extent

The extent of a hazardous substance release will depend on whether it is from a fixed or in-transit (mobile) source, the volume of substance released, the duration of the release, the toxicity and properties of the substance, and the environmental conditions (for example, wind and precipitation, terrain, etc.). Hazardous substance releases can contaminate air, water, and soils, possibly resulting in death and/or injuries. Dispersion can take place rapidly when the hazardous substance is transported by water and wind. While often accidental, releases can occur as a result of human negligence, intentional acts, or natural hazards.

When caused by natural hazards, these incidents are known as secondary events. These releases can affect nearby populations and contaminate critical or sensitive environmental areas. With a hazardous substance release, whether accidental or intentional, several potentially exacerbating or mitigating circumstances will affect its severity of impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact a release has on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place measures can help to protect people and property from the harmful effects of a hazardous substance release.

Historic Occurrences

Presidential and USDA Disaster Declarations

There have been no federally declared hazardous material-related disaster declarations in Liberty County or participating jurisdictions since 1950. Similarly, there are no USDA Disaster Declarations associated with this hazard.[2,40]

Probability of Future Occurrences

As development continues and populations increase, the risk for a hazardous material release and the potential impacts on the population, infrastructure, and environmental resources will increase. The number and types of hazardous chemicals stored in and transported through Liberty County and Texas will likely continue to increase.

Populations at Risk

As the population grows, the number of people vulnerable to the impacts of hazardous materials spills and transportation incidents will increase. Populations living and/or working near facilities that produce, store, or transport hazardous substances are at higher exposure risk. Population and business growth along major transportation corridors increases the vulnerability to transportation-related hazardous material spills. Growth increasing commercial and residential density near fixed-site hazardous materials facilities will also increase vulnerability. Populations considered most vulnerable to this hazard include persons over the age of 65 (elderly individuals), children, pregnant women, and those with chronic health conditions or who are immunocompromised. Depending on the type of release and environmental conditions, people may be evacuated as a precaution or instructed to shelter in place. A hazardous substance release, whether fixed-site or in-transit can also negatively impact the natural environment. Depending on the nature and amount of the substance, the release may contaminate the air, water, or soil potentially causing concern for direct human and animal exposure, recreational usage, crop irrigation, and fish and wildlife consumption. Water contamination, whether surface water, groundwater, or marine, is an immediate concern from a hazardous materials release potentially impacting potable water supplies, wildlife, and recreational activities. Environmental damages can linger for decades and result in extensive remediation costs.[142]

Climate Change Impacts

Climate change-related events may affect the frequency and/or intensity of hazardous material releases. For example, extreme heat events can buckle railways, which can lead to train derailments and potentially cause hazardous material releases. Sites that store hazardous materials that are at risk from current flooding will become more vulnerable to climate change. Flooding during a storm event could cause the release of hazardous materials if they are not properly stored or contained. The release of these hazardous materials may in turn expose the nearby population, harm water quality, and negatively affect the overall environmental and economic health of the area.

Terrorism

Terrorism is the use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks; and the use of chemical, biological, nuclear, and radiological weapons.[143]

Location

These attacks can occur anywhere. Locations with a high population density will be attractive targets for terror attacks.

Extent

*A*cts of terrorism can occur anywhere at any time of day. The National Terrorism Advisory System is designed to communicate information about terrorist threats by providing timely, detailed information to the American public. All Americans share responsibility for the nation's security and should always be aware of the heightened risk of terrorist attack in the United States and what they should do.[144] The effect of a terrorism event can vary depending on the type of attack and the magnitude of the event or events. A terrorism event can cause public fear regarding the use of mass transportation. Communication systems, both public and private, can fail because of an overwhelming amount of usage or damage to its infrastructure. Healthcare facilities can become inundated and must be prepared to triage injured patients, handle mass casualties, and conduct decontamination operations.

Extent of a terrorist attack within Liberty County would be widespread. Life, property, and the economy of the county and surrounding areas would be seriously impaired. Secondary hazards that would arise as a result of a terrorist attack within the county include widespread utility failure, health effects such as epidemics or pandemics, flooding (if a dam/levee was destroyed), and environmental contamination.

Historic Occurrences

The most significant terrorist incident to occur in the United States occurred in Lower Manhattan, New York, when an extreme terrorist group hijacked two commercial airplanes and flew them into the Towers 1 and 2 of the World Trade Center. Additionally, a simultaneous attack occurred in the Washington D.C. area where a plane was crashed into the Pentagon. There have been no historic occurrences of a terrorism attack within Liberty County.

Presidential Disaster Declarations

There have been no federally declared terrorism disaster declarations in Liberty County.

USDA Disaster Declarations

There are no USDA Disaster Declarations associated with this hazard.

Probability of Future Occurrences

The potential for future terrorism incidents in is difficult to predict. Efforts from local, state, and federal officials must be coordinated to prevent future terrorist incidents from occurring.

Populations at Risk

The entire population Liberty County is exposed to the effects of terrorism. However, because terrorists typically prefer to impact the greatest number of individuals, it can be inferred that those living in urban areas will have a greater exposure to these incidents than those living in rural areas. Because terrorist attacks are designed to take victims by surprise, predicting the location and nature of potential attacks is extremely difficult, as is assessing the population's vulnerability.

Climate Change Impacts

No climate change impacts are associated with this hazard as it is a human-caused event.

Section 7: Mitigation Strategy

Section 7: MITIGATION STRATEGY

The planning process, hazard analysis, and vulnerability assessment are foundations for a meaningful hazard mitigation strategy. The mitigation strategy provides an outline for how the county and the local jurisdictions aim to address and reduce the risks associated with the natural hazards identified in the HMP and reduce the potential impact on residents and structures. The mitigation strategy is divided into three sections the mission statement, goals and objectives, and the mitigation action plan (HMAP). The mission statement provides the overall purpose of the mitigation strategy and the HMP. The goals and objectives provide milestones for how the county aims to meet this purpose. The mitigation action plan details specific mitigation actions, or projects, programs, and policies the county aims to meet these goals and objectives.

Mission Statement

The HMP aims to implement new policies, programs, and projects to reduce the risks and impacts associated with natural hazards, including public education and partnerships between local officials and residents.

Goals

1) Educate citizens regarding emergency situations related to natural hazards.
2) Develop publications and educational information on all hazards and make them easily accessible to all within Liberty County and participating jurisdictions.
3) Promote the use of emergency notification systems and weather alerts for all hazards.
4) Decrease the risk to life and property from hazards through planning, preparation, and mitigation.
5) Develop policies and strategies to effectively manage and reduce risk.
6) Increase the resiliency of Liberty County and participating jurisdictions through projects and strategies that reduce the impacts of hazards.
7) Enhance coordination between local jurisdictions, county, state, and federal agencies.
8) Support the continuity of operations before, during, and after hazard events.
9) Incorporate hazard mitigation into community planning such as codes/ordinances, day-to-day operations, and projects.
10) Identify, protect, and assist socially vulnerable populations in recovery from hazard impacts.

Objectives

- Protect the lives and property of residents and business owners.
- Eliminate the number of vulnerable structures in areas susceptible to repetitive flooding.
- Increase public education and awareness of hazards that affect the County and participating jurisdictions.
- Provide alternative power sources for critical facilities and infrastructure.
- Upgrade deteriorating infrastructure.

Mitigation Action Plan

The mitigation action plan explains the specific programs, policies, and projects that the county and the local jurisdictions aim to implement for the county to reach its HMAP objectives and goals. The mitigation action plan provides the details of each mitigation action including which local department will oversee implementing the actions, how the city intends to fund these actions, and the estimated time for implementing these actions.

The county and participating jurisdictions submitted their mitigation actions based on the greatest vulnerabilities, goals, and needs. Each action was evaluated for feasibility using FEMA's Benefit-Cost

Analysis (BCA) Toolkit or other means, such as a Benefit-Cost Ratio (BCR). The actions are separated by jurisdiction and, where applicable, include the BCA or BCR score for each.

Priority Rankings

Mitigation actions below were given a priority rating of 1- high, 2- medium, or 3- low based on feasibility, potential funding, BCA or BCR scores, priorities within the jurisdiction, and implementation timeframes.

All Participating Jurisdictions

Priority Ranking: A11, A1, A3, A5, A2, A7, A9
Priority was determined by the HMC considering what was the most feasible and important for their communities.

Table 7.1: 2017 HMP Action Items- All Participating Jurisdictions

Action Item #	Remove from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
A1		X	Ongoing
A2		X	Not started
A3		X	Not started
A4	X		No longer feasible
A5		X	Not started
A6	X		No longer feasible, no support
A7		X	Not started
A8	X		No longer feasible

Jurisdiction:	All participating jurisdictions	**Action Number:**	A1
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion Emerging Infectious Diseases Manmade Hazards		
Project Title:	Educating public on mitigation techniques		
Project Description:	Implement an outreach and education campaign to educate the public on mitigation techniques for all hazards to reduce loss of life and property.		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Reduce loss of life and property.		
Cost Estimate:	$7,000	**Timeframe:**	1 month
Potential Funding Sources:	Local budget and salary, HMPG, Fire Prevention and Safety Grants	**Benefit-Cost Analysis:**	More than a 1:4 BCR
Priority Rating	1	**Status:**	Ongoing

Is this action related to a critical facility or lifeline?	No
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

Jurisdiction:	All participating jurisdictions	**Action Number:**	A2
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Windstorm Tornado Hail		
Project Title:	Retrofitting structures for hail and wind protection		
Project Description:	All participating jurisdictions will retrofit city and county-owned structures with roofs that can withstand hail and high wind damage		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Buildings, residents, and city/ county employees in county and city buildings when a hailstorm hits.		
Cost Estimate:	$600,000	**Timeframe:**	48 months
Potential Funding Sources:	HMGP, PDM, Local budgets	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	**Status:**	Not started.
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All participating jurisdictions	**Action Number:**	A3
Hazard(s) Addressed:	Wildfire		
Project Title:	Technical support for residents to reduce the risk of wildfire		
Project Description:	The county and partnering cities will provide incentives and technical support for property owners to reduce underbrush throughout the county to properly cut back trees, upgrade fences, and replace landscape materials with nonflammable materials		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Homes within the WUI and residents living within these areas		
Cost Estimate:	$5,000	**Timeframe:**	3 months
Potential Funding Sources:	HMPG, Current county and city budget/ staff time	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	**Status:**	Not yet started.
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All participating jurisdictions	**Action Number:**	A5
Hazard(s) Addressed:	Drought & Expansive Soils		
Project Title:	Drought tolerant plants		
Project Description:	All participating jurisdictions will develop an ordinance to incorporate drought-tolerant landscape design into all new county and city-owned properties.		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Structures throughout the jurisdiction impacted by drought		
Cost Estimate:	$1,000	**Timeframe:**	3 months
Potential Funding Sources:	Current staff time	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	**Status:**	Not started.
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	All participating jurisdictions	**Action Number:**	A7
Hazard(s) Addressed:	Drought & Expansive Soils		
Project Title:	Drip irrigation		
Project Description:	All participating jurisdictions will install drip irrigation around critical facilities' foundations throughout the county. This action mitigates the damage that shrinking and expanding soils cause on foundations and pipes.		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Cost of repair to critical facilities' foundations, water and sewer lines.		
Cost Estimate:	$250,000	**Timeframe:**	12 months
Potential Funding Sources:	HMGP, FP&S Grants	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	**Status:**	Not started.

Is this action related to a critical facility or lifeline?	Yes
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

Jurisdiction:	All participating jurisdictions	**Action Number:**	A9
Hazard(s) Addressed:	Flooding Drought & Expansive Soils Dam/ Levee Failure Erosion		
Project Title:	Data deficiencies		
Project Description:	Address data deficiencies for flooding, expansive soils, erosion and dam/ levee failure hazards to identify the extent of the hazard, vulnerability, and potential impacts. For dam/ levee failure: Conduct a risk assessment of all dams categorized as high or significant hazard potential to identify inundation areas.		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Loss of life and property		
Cost Estimate:	$600,000	**Timeframe:**	12 –36 months
Potential Funding Sources:	USACE, USGS, USDA, NWS	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	**Status:**	Not started.
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	All participating jurisdictions	**Action Number:**	A10
Hazard(s) Addressed:	Heat Events Severe Winter Storms		
Project Title:	Enhance Public Awareness		
Project Description:	Enhance outreach and education campaigns to increase public awareness regarding heat events and severe winter storm hazards through warnings and suggested actions to take in order to reduce loss of life and property damage.		
Responsible Entity:	Liberty County Emergency Management Coordinator, City of Ames Mayor, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator, City of Daisetta Mayor, City of Dayton Mayor/ City Manager, City of Devers Mayor, City of Hardin Mayor, City of Kenefick Mayor, City of Liberty Mayor/ City Manager/ Emergency Management Coordinator, City of North Cleveland Mayor, City of Plum Grove Mayor, Liberty County WCID #1 President/ General Manager, Liberty County WCID #5 President/ General Manager		
Losses avoided:	Reduce loss of life and property damage.		
Cost Estimate:	$5,000	**Timeframe:**	1 month
Potential Funding Sources:	Local budget and salary, HMPG, PDM	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	**Status:**	Ongoing
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Liberty County

Priority Ranking: J4, J1, J3, J5, J6, J7, J9, J11, J2, J8, J10
Priority was determined by County staff considering timeframe, BCR, costs, and what was the most feasible for implementation.

Table 7.2: 2017 HMP Action Items- Liberty County

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
J1		X	Not started
J2		X	Not started
J3		X	Not started
J4		X	Not started
J5		X	Not started
J6		X	Not started
J7		X	Not started
J8		X	Not started
J9		X	Not started
J10		X	Not started
J11		X	Not started

Jurisdiction:	Liberty County	**Action Number:**	J1
Hazard(s) Addressed:	Flooding Dam/ Levee Failure Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning		
Project Title:	Hardening Infrastructure		
Project Description:	Harden bridge, dam and spillway in Winter Valley Subdivision under TCEQ permit NO. 366.		
Responsible Entity:	Liberty County Engineering Department		
Losses avoided:	Residential Flood Damages		
Cost Estimate:	$350,000	**Timeframe:**	36 months
Potential Funding Sources:	NRCS, USACE-Clearing and Snagging Projects, USACE-Emergency Rehabilitation of Flood Control Works for Federally Authorized Coastal Protection Works, USACE-Small Flood Control Projects, HMGP, 406 Public Assistance	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County	**Action Number:**	J2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning		
Project Title:	Acquire properties in floodplains		
Project Description:	Acquire property located in the floodplain including properties located in subdivisions along the Trinity River.		
Responsible Entity:	Liberty County Permit Department, County Engineer		
Losses avoided:	Repetitive flood losses		
Cost Estimate:	$2,000,000	**Timeframe:**	48 months
Potential Funding Sources:	HMGP, Flood Mitigation Assistance Program, CDBG Program, HUD-Disaster Recovery Initiative, USACE-Planning Assistance to States, PDM, Repetitive Flood Claim Program	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County	**Action Number:**	J3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning		
Project Title:	Culvert replacement project		
Project Description:	Increase culvert size in identified flood hazard problem areas within Liberty County.		
Responsible Entity:	Liberty County Drainage Department		
Losses avoided:	Residential & Business & Infrastructure Losses due to flooding		
Cost Estimate:	$2,000,000	**Timeframe:**	24 months
Potential Funding Sources:	USACE-Clearing and Snagging Projects, USACE-Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works, USACE-Small Flood Control Projects, HMGP, 406 Public Assistance, NRCS, Declaration), NRCS, PDM, FMA	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County	**Action Number:**	J4
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Drainage Plan		
Project Description:	Establish a county-wide drainage plan		
Responsible Entity:	Liberty County Engineering Department		
Losses avoided:	Prevent home-business-Infrastructure damage due to flooding		
Cost Estimate:	$125,000	**Timeframe:**	36 months
Potential Funding Sources:	USACE-Small Flood Control Projects, USDA NRCS-Emergency Watershed Protection Agency, TWDB-Clean Water State Revolving Fund, TWDB (Development Fund II)-Texas Water Development Fund, USDA NRCS-Watershed Protection and Flood Prevention Program, EPA-NPS Grant Program, HMGP, 406 Public Assistance, PDM, FMA	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County	**Action Number:**	J5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Erosion		
Project Title:	Recanalization Feasibility Study		
Project Description:	Dechannelize existing feeder creeks that flow from north to south and improve drainage for storm water runoff.		
Responsible Entity:	Liberty County Engineering Department		
Losses avoided:	Flood damages to Residential - Commercial Structures		
Cost Estimate:	$500,000	**Timeframe:**	36 months
Potential Funding Sources:	HMGP, PDM, FMA, County budget	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County	**Action Number:**	J6
Hazard(s) Addressed:	Flooding		
Project Title:	Update FEMA FIRM Maps to include benchmarks		
Project Description:	Add benchmarks to updated FEMA Flood Insurance Rate Maps		
Responsible Entity:	Liberty County Permit Department., County Surveyor		
Losses avoided:	Residential & Business & Infrastructure losses due to flooding		
Cost Estimate:	$50,000	**Timeframe:**	24 months
Potential Funding Sources:	FEMA Map Modernization Program, FEMA Flood Hazard Mapping Program, Dept. of The Interior, USGS Mapping Standards Support, FEMA Flood Recovery Mapping, PDM, HMGP, FMA	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County	**Action Number:**	J7
Hazard(s) Addressed:	Flooding		
Project Title:	Update Firm Maps		
Project Description:	Update Flood Insurance Rate Maps (FIRMs)		
Responsible Entity:	Liberty County Permit Department, County Surveyor		
Losses avoided:	Residential & Business Losses due to flooding		
Cost Estimate:	$100,000	**Timeframe:**	24 months
Potential Funding Sources:	FEMA-Map Modernization Program, FEMA-Flood Hazard Mapping Program, Department of the Interior, United States Geological Survey-Mapping Standards Support, FEMA Flood Recovery Mapping, PDM, HMGP, FMA	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County	**Action Number:**	J8
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Update Topographic Maps		
Project Description:	Purchase updated topographic maps/complete LiDAR aerial survey for drainage plan.		
Responsible Entity:	Liberty County Permit Department, County Surveyor		
Losses avoided:	Maps will assist in identifying problem flood areas in need of mitigation		
Cost Estimate:	$100,000	**Timeframe:**	24 months
Potential Funding Sources:	FEMA-Map Modernization Program, FEMA-Flood Hazard Mapping Program, Department of the Interior, United States Geological Survey-Mapping Standards Support, FEMA-Flood Recovery Mapping, PDM, HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County	**Action Number:**	J9
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Flood Control - Drainage Project		
Project Description:	Work with adjoining counties in regards to flood and drainage issues.		
Responsible Entity:	Liberty County Drainage District		
Losses avoided:	Lessen risk of damage to homes and businesses due to flooding		
Cost Estimate:	$500,000	**Timeframe:**	24 months
Potential Funding Sources:	HMGP, USACE - Small Flood Control Projects, TWDB-Clean Water State Revolving Fund, Texas Water Development Fund, USDA NRCS Watershed Protection and Flood Prevention Program, EPA NPS Grant Program	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County			**Action Number:**	J10
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms Windstorm Drought & Expansive Soils Tornado Hail Erosion				
Project Title:	Engineering Study				
Project Description:	Conduct structural engineering study on all public buildings				
Responsible Entity:	Liberty County Engineering Department				
Losses avoided:	Prevent damage to critical assets due to described hazards				
Cost Estimate:	$50,000	**Timeframe:**	36 months		
Potential Funding Sources:	Hazard Mitigation Grant Program, Pre-Disaster Mitigation, County Budget	Benefit-Cost Analysis:	More than a 1:4 BCR		
Priority Rating	2	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Jurisdiction:	Liberty County			**Action Number:**	J11
Hazard(s) Addressed:	Wildfire				
Project Title:	Reducing underbrush for wildfire prevention				
Project Description:	The County and will work to reduce underbrush on identified wild-urban interface areas through management techniques such as using skid steers or goats.				
Responsible Entity:	Liberty County Emergency Management				
Losses avoided:	current and future buildings and residents in wild-urban interface areas				
Cost Estimate:	$500,000	**Timeframe:**	12-24 months		
Potential Funding Sources:	HMGP, local budget and current salary, fire prevention and safety grants	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

City of Ames

Priority Ranking: A1, A4, A3, A5, A2, A6
Priority was determined by City Staff considering what was the most feasible and important for the community with their limited staff and resources.

Table 7.3: 2017 HMP Action Items- City of Ames

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
A1		X	Not started
A2		X	Not started
A3		X	Not started
A4		X	Not started
A5		X	Not started
A6		X	Not started

Jurisdiction:	Ames	**Action Number:**	A1
Hazard(s) Addressed:	Flooding		
Project Title:	Improve drainage system		
Project Description:	Widening culverts and ditches throughout the jurisdiction		
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$500,000	**Timeframe:**	24-36 months
Potential Funding Sources:	USACE-Small Flood Control Projects, USDA NRCS-Emergency Watershed Protection Agency, TWDB (Development Fund II)-Texas Water Development Fund, USDA NRCS-Watershed Protection and Flood Prevention Program, EPA NPS Grant Program, PDM, HMGP, 406 Public Assistance	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Ames		**Action Number:**	A2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms Wildfire Tornado Manmade Hazards			
Project Title:	Evacuation routes			
Project Description:	Implement a system that notifies public of evacuation routes			
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management			
Losses avoided:	Buildings, residents, and city/county employees in county and city			
Cost Estimate:	$5,000	**Timeframe:**	24-36 months	
Potential Funding Sources:	Local Commitment, Partnership with Public radio	Benefit-Cost Analysis:	Approximately a 1:4 BCR	
Priority Rating	3	Status:	Not started	
Is this action related to a critical facility or lifeline?				Yes
Does this action reduce the effects of hazards on existing buildings?				No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?				No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?				No

Jurisdiction:	Ames		**Action Number:**	A3
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions			
Project Title:	Conduct hurricane outreach and education campaign.			
Project Description:	Conduct hurricane outreach and education campaign.			
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management			
Losses avoided:	Buildings, residents, and city/county employees in county and city			
Cost Estimate:	$5,000	**Timeframe:**	24-36 months	
Potential Funding Sources:	PDM, HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR	
Priority Rating	2	Status:	Not started	
Is this action related to a critical facility or lifeline?				No
Does this action reduce the effects of hazards on existing buildings?				Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?				Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?				No

Jurisdiction:	Ames			**Action Number:**	A4
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Severe Winter Storms Windstorm Tornado Manmade Hazards				
Project Title:	Generators for Critical Facilities				
Project Description:	Purchase and provide back-up generators to all critical facilities throughout the jurisdiction				
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management				
Losses avoided:	Vulnerable populations and any city resident without power				
Cost Estimate:	$15,000	**Timeframe:**	12 months		
Potential Funding Sources:	HMG	Benefit-Cost Analysis:	More than a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Jurisdiction:	Ames			**Action Number:**	A5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion Emerging Infectious Diseases Manmade Hazards				
Project Title:	Conduct outreach and education campaign.				
Project Description:	Conduct outreach and education campaign for all hazards.				
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management				
Losses avoided:	Buildings, residents, and city/county employees in county and city				
Cost Estimate:	$5,000	**Timeframe:**	24-36 months		
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	2	Status:	Not started		
Is this action related to a critical facility or lifeline?					No
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Jurisdiction:	Ames	**Action Number:**	A6
Hazard(s) Addressed:	Flooding		
Project Title:	CRS Participation and Training		
Project Description:	Become a CRS community and send staff to CRS workshops or trainings.		
Responsible Entity:	City of Ames Mayor, Liberty County Emergency Management		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$8,000	**Timeframe:**	12 months
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	3	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

City of Cleveland

Priority Ranking: I2, I1, I5, I10, I12, I13, I6, I7, I8, I9, I11
Priority was determined by City staff considering timeframes, costs, BCR, and feasibility of the action.

Table 7.4: 2017 HMP Action Items- City of Cleveland

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
I1		X	Not started
I2		X	Ongoing, applied for a grant
I3	X		Completed
I4	X		Completed
I5		X	Not started
I6		X	Not started
I7		X	Not started
I8		X	Not started
I9		X	Not started
I10		X	Not started
I11		X	Not started
I12		X	Not started
I13		X	Not started

Jurisdiction:	Cleveland	**Action Number:**	I1
Hazard(s) Addressed:	Flooding		
Project Title:	Adopting land-use ordinance		
Project Description:	The city shall adopt a land-use ordinance which prohibits building residential or commercial structures in the 100-year floodplain		
Responsible Entity:	City manager, City council, Office of Code Enforcement		
Losses avoided:	Future buildings and infrastructure that may have been built within the 100 year floodplain.		
Cost Estimate:	$5,000	**Timeframe:**	4 months
Potential Funding Sources:	Current city budget and salary, HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started

Is this action related to a critical facility or lifeline?	Yes
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	Yes

Jurisdiction:	Cleveland			**Action Number:**	I2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail				
Project Title:	Retrofit Police Department Emergency Operations Center (EOC)				
Project Description:	Retrofit police department EOC with generators for emergency backup power to maintain critical services during power outages caused by natural hazards.				
Responsible Entity:	Police Department /EOC				
Losses avoided:	Buildings, residents, and city/county employees in county and city				
Cost Estimate:	$100,000	**Timeframe:**	24-36 months		
Potential Funding Sources:	General Fund, EDC, FEMA, Homeland Security, Grants, HMGP, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Jurisdiction:	Cleveland			**Action Number:**	I5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure				
Project Title:	Property Protection				
Project Description:	Removal of debris, silt and vegetation obstacles in drainageways. Project will clear obstacles, mow and reshape ditches, and upgrade culverts to restore adequate drainage to mitigate flooding				
Responsible Entity:	City Engineer				
Losses avoided:	Homes, businesses, and public facilities				
Cost Estimate:	$5,000,000	**Timeframe:**	60 Months		
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					Yes

Jurisdiction:	Cleveland	**Action Number:**	I6
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Installing drainage lines		
Project Description:	Install larger drainage lines in downtown Cleveland to reduce flooding.		
Responsible Entity:	Public Works Department		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$1,000,000	**Timeframe:**	24-36 months
Potential Funding Sources:	CDBG, USACE, Small Flood Control Projects, TWDB Clean Water State Revolving Fund, PDM, HMGP, 406 Public Assistance	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Cleveland	**Action Number:**	I7
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Windstorm		
Project Title:	Hurricane resistant power line poles		
Project Description:	All new power line poles installed within the jurisdiction will be wind resistant		
Responsible Entity:	Engineering Department		
Losses avoided:	Homes, business, and public facilities		
Cost Estimate:	$120,000	**Timeframe:**	36 months
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I8
Hazard(s) Addressed:	Flooding		
Project Title:	Set back from pipeline right-of-way.		
Project Description:	Adopt 25-foot setback from pipeline right-of-way.		
Responsible Entity:	Building and Inspection Department		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$2,000	**Timeframe:**	4-6 months
Potential Funding Sources:	General Fund- Local Commitment	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	3	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I9
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion		
Project Title:	Educate public of home improvement opportunities		
Project Description:	Educate elderly, low-income residents of grant funding opportunities to insulate the foundation of pier and beam homes, and update homes to withstand hurricane force winds and hail		
Responsible Entity:	Liberty County Emergency Management, partnering jurisdictions mayors and city councils, code enforcement and building departments		
Losses avoided:	Life, health, and safety of vulnerable populations and property damage		
Cost Estimate:	$2,500	**Timeframe:**	6 months
Potential Funding Sources:	HMGP, USDA Home Repair Grant	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I10
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion Emerging Infectious Diseases Manmade Hazards		
Project Title:	Public Information and Awareness		
Project Description:	Contract with First Call Network to notify citizens by phone of possible hazards.		
Responsible Entity:	Emergency Management Coordinator		
Losses avoided:	Life safety		
Cost Estimate:	$25,000	**Timeframe:**	12 Months
Potential Funding Sources:	General Fund, National Weather Service, USDA Rural Utilities Service-Weather Radio Grant Program, FEMA Hurricane Local Grant Program, HMGP, PDM, FEMA, Emergency Management Performance Grant, USDA Environmental Quality Incentives Program	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I11
Hazard(s) Addressed:	Wildfire		
Project Title:	Reducing underbrush for wildfire prevention		
Project Description:	The city and county will work to reduce underbrush on identified wild-urban interface areas through techniques such as using skid steers or goats		
Responsible Entity:	Liberty County Emergency Management, City of Cleveland Mayor/ City Manager/ Emergency Management Coordinator		
Losses avoided:	current and future buildings and residents in wild-urban interface areas.		
Cost Estimate:	$500,000	**Timeframe:**	12-24 months
Potential Funding Sources:	HMGP, local budget and current salary, fire prevention and safety grants	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I12
Hazard(s) Addressed:	Wildfire		
Project Title:	Becoming an active participant in Firewise USA program		
Project Description:	The City will become an active participant in the Firewise USA program and encourage local neighborhoods to join the program as well		
Responsible Entity:	Mayor and City Council		
Losses avoided:	Property and residents throughout the city		
Cost Estimate:	$4,000	**Timeframe:**	12 months
Potential Funding Sources:	HMGP, local budget and current salary, fire prevention and safety grants	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Cleveland	**Action Number:**	I13
Hazard(s) Addressed:	Wildfire		
Project Title:	Outreach and education campaign.		
Project Description:	Conduct wildfire outreach and education campaign.		
Responsible Entity:	Director of Fire and EMS		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$5,000	**Timeframe:**	24-36 months
Potential Funding Sources:	HMGP, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

City of Daisetta

Priority Ranking: B1, B2, B11, B6, B3, B4, B5, B7, B8, B10
Priority was determined by City staff considering timeframes, costs, BCR, and feasibility of the action.

Table 7.5: 2017 HMP Action Items- City of Daisetta

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
B1		x	Ongoing
B2		x	Not started
B3		x	Ongoing
B4		x	Ongoing
B5		x	Ongoing
B6		x	Not started
B7		x	Not started
B8		x	Not started
B9	x		No longer feasible
B10		x	Not started

Jurisdiction:	Daisetta	**Action Number:**	B1
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms		
Project Title:	City Ordinance		
Project Description:	The city shall adopt a land use ordinance which requires any structure within the 100-year floodplain to be elevated 2 feet above base flood elevation.		
Responsible Entity:	City council and mayor		
Losses avoided:	Homes, businesses, and residents within the 100 year floodplain.		
Cost Estimate:	$5,000	**Timeframe:**	6 months
Potential Funding Sources:	HMGP, current city budget and staff time	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Daisetta	**Action Number:**	B2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms		
Project Title:	Adopting land-use ordinance		
Project Description:	The city shall adopt a land-use ordinance which prohibits building residential or commercial structures in the 100-year floodplain		
Responsible Entity:	City Manager, City Council, Office of Code Enforcement		
Losses avoided:	Future buildings and infrastructure that may have been built within the 100 year floodplain		
Cost Estimate:	$5,000	**Timeframe:**	4 months
Potential Funding Sources:	Current city budget and salary, HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Daisetta	**Action Number:**	B3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms		
Project Title:	Property Protection		
Project Description:	Removal of debris, silt and vegetation obstacles in drainage ways. Project will clear obstacles, mow and reshape ditches, and upgrade culverts to restore adequate drainage to mitigate flooding from hazard events.		
Responsible Entity:	City Manager, City Council, Office of Code Enforcement		
Losses avoided:	Homes, business, and public facilities		
Cost Estimate:	$250,000	**Timeframe:**	6 months
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Daisetta	**Action Number:**	B4
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail		
Project Title:	Retrofit high school, city hall for shelter during emergency.		
Project Description:	Retrofit high school, city hall for shelter during emergency.		
Responsible Entity:	City Manager, City Council, Office of Code Enforcement		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$75,000	**Timeframe:**	24 months
Potential Funding Sources:		**Benefit-Cost Ratio:**	1:4 cost-benefit ratio
Potential Funding Sources:	HMGP, Red Cross, FEMA-Emergency Operation Center Funding, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Daisetta	**Action Number:**	B5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Drainage projects		
Project Description:	Drainage projects. Including widening culverts and ditches.		
Responsible Entity:	Mayor		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$750,000	**Timeframe:**	24 months
Potential Funding Sources:	HMGP, PDM, FMA	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Daisetta	**Action Number:**	B6
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion Emerging Infectious Diseases Manmade Hazards		
Project Title:	Educate city council and residents		
Project Description:	Educate city council and residents on benefits of mitigation and encourage council members to become more involved.		
Responsible Entity:	City Manager, City Council, Office of Code Enforcement		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$1,000	**Timeframe:**	Ongoing
Potential Funding Sources:	Staff time and resources, FEMA and Red Cross materials free of charge, HMGP, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Daisetta	**Action Number:**	B7
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Windstorm		
Project Title:	Hurricane resistant powerline poles		
Project Description:	All new power line poles installed within the jurisdiction will be wind resistant		
Responsible Entity:	City Manager, City Council, Office of Code Enforcement		
Losses avoided:	Homes, business, and public facilities		
Cost Estimate:	$120,000	**Timeframe:**	36 months
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Daisetta	**Action Number:**	B8
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms Wildfire Windstorm Drought & Expansive Soils Tornado Hail Erosion		
Project Title:	Educate public of home improvement opportunities		
Project Description:	Educate elderly, low-income residents of grant funding opportunities to insulate the foundation of pier and beam homes, and update homes to withstand hurricane force winds and hail.		
Responsible Entity:	Liberty County Emergency Managements, partnering jurisdictions mayors and city councils, code enforcement and building departments		
Losses avoided:	Life, health, and safety of vulnerable populations, and property damage		
Cost Estimate:	$2,500	**Timeframe:**	6 months
Potential Funding Sources:	HMGP, USDA Home Repair Grant	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Daisetta	**Action Number:**	B10
Hazard(s) Addressed:	Wildfire		
Project Title:	Becoming an active participant in Firewise USA program		
Project Description:	The City will become an active participant in the Firewise USA program and encourage local neighborhoods to join the program as well.		
Responsible Entity:	Mayor and city council		
Losses avoided:	Property and residents throughout the city.		
Cost Estimate:	$4,000	**Timeframe:**	12 months
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Daisetta	**Action Number:**	B11
Hazard(s) Addressed:	Erosion		
Project Title:	Daisetta 770 Sink Holes		
Project Description:	Use surveys to set benchmarks and monitor the sink holes on main & hwy. 770		
Responsible Entity:	Mayor, Liberty County Emergency Management		
Losses avoided:	Current and Future Buildings, Residents & Schools		
Cost Estimate:	$8,500	**Timeframe:**	12 months
Potential Funding Sources:	HMGP, current city budget and staff time	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started

Is this action related to a critical facility or lifeline?	Yes
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

City of Dayton

Priority Ranking: C9, C13, C3, C8, C7, C5
Priority was determined by City Staff considering what was the most feasible and important for the community with their limited staff and resources.

Table 7.6: 2017 HMP Action Items- City of Dayton

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
C1	X		It has been determined that the responsibility lies with TXDOT and Union Pacific Railroad.
C2	X		Project complete
C3		X	Not started
C4	X		Project complete
C5		X	In the early stages of discussion, has been placed in the strategic plan.
C6	X		Project complete
C7		X	Not started
C8		X	Ongoing, being worked into the development code.
C9		X	Not started
C10	X		Project Complete, placed in the development code.
C11	X		Project Complete, placed in the development code.
C12	X		Already in place through DPS and TXDOT
C13		X	Not started

Jurisdiction:	Dayton	**Action Number:**	C3
Hazard(s) Addressed:	Flooding		
Project Title:	Increase culvert size		
Project Description:	Increase culvert size at all railroad crossings.		
Responsible Entity:	Department of Planning and Community Development		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$15,000	**Timeframe:**	12 months
Potential Funding Sources:	Local funding through Capital Improvements, DOT Grants-in-Aid for Railroad Safety Program, USACE Clearing and Snagging Projects, USACE Small Flood Control Projects, CDBG, USDA NRCS Emergency Watershed Protection Agency, TWDB Clean Water State Revolving Fund TWDB (Development Fund II)-Texas Water Development Fund, USDA NRCS Watershed Protection and Flood Prevention Program, 406 Public Assistance, HMGP, PDM	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Dayton	**Action Number:**	C5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Wildfire		
Project Title:	Truck Bypass		
Project Description:	Develop a truck bypass around Dayton.		
Responsible Entity:	Department of Planning and Community Development		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$10,000,000	**Timeframe:**	120 months
Potential Funding Sources:	TXDOT Pass Through Funding, Toll Road	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Dayton	**Action Number:**	C7
Hazard(s) Addressed:	Flooding		
Project Title:	Enlarge storm drain		
Project Description:	Enlarge storm drain to reduce flooding from Main Street to Church Street.		
Responsible Entity:	Department of Planning and Community Development		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$15,000	**Timeframe:**	12 months
Potential Funding Sources:	Local funding through Capital Improvements and operating budget, 406 Public Assistance(following federal disaster declaration), HMGP, PDM Program	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Dayton	**Action Number:**	C8
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Drainage Master Plan		
Project Description:	Develop drainage master plan.		
Responsible Entity:	Department of Planning and Community Development		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$100,000	**Timeframe:**	12 months
Potential Funding Sources:	Local funding through Capital Improvements, USACE-Planning Assistance to States, Flood Mitigation Assistance Program, TWDB- Research and Planning Fund Grants, HMGP, PDM	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Dayton	**Action Number:**	C9
Hazard(s) Addressed:	Flooding		
Project Title:	Increase culvert size		
Project Description:	Increase culvert size to reduce flooding at Highway 90 and Waco Street.		
Responsible Entity:	Department. of Streets and Drainage		
Losses avoided:	Residents and buildings prone to flooding		
Cost Estimate:	$75,000	**Timeframe:**	24-36 months
Potential Funding Sources:	Local funding through Capital Improvements and operating budget, 406 Public Assistance(following federal disaster declaration), HMGP, PDM Program	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Dayton	**Action Number:**	C13
Hazard(s) Addressed:	Flooding		
Project Title:	Develop a capital improvement program		
Project Description:	Develop a capital improvement program addressing drainage issues.		
Responsible Entity:	Department. of Planning and Community Development		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$20,000	**Timeframe:**	12 months
Potential Funding Sources:	Local funds, PDM, HMGP	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

City of Devers

Table 7.7: 2017 HMP Action Items- City of Devers

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
		None	

No Action Items.

City of Hardin

Priority Ranking: Action items were organized below in the order they appear by feasibility for implementation within the city due to limited staff time and budget.

Table 7.8: 2017 HMP Action Items- City of Hardin

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
E1		X	Not started
E2		X	Not started
E3		X	Not started
E4		X	Not started
E5		X	Not started
E6		X	Not started
E7		X	Not started

Jurisdiction:	Hardin	**Action Number:**	E1
Hazard(s) Addressed:	Flooding		
Project Title:	Implement subdivision ordinance		
Project Description:	Implement subdivision ordinance regulations concerning building in flood-prone areas.		
Responsible Entity:	Mayor, City Council		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$2,000	**Timeframe:**	24-36 months
Potential Funding Sources:	Staff time and resources, HMGP, TWDB-Research and Planning Fund Grants, PDM	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Hardin			**Action Number:**	E2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms				
Project Title:	Reduce flooding by increasing size of culverts				
Project Description:	Reduce flooding by increasing size of culverts to 24 inches on County Road 2361, 2362, 2363, and 2364 and CR 2358.				
Responsible Entity:	Mayor, City Council				
Losses avoided:	Buildings, residents, and city/county employees in county and city				
Cost Estimate:	$15,000	**Timeframe:**	24-36 months		
Potential Funding Sources:	USACE-Small Flood Control Projects, USACE-Clearing and Snagging Projects, CDBG, USDA NRCS-Emergency Watershed Protection Agency, TWDB-Clean Water State Revolving Fund, TWDB (Development Fund II)-Texas Water Development Fund, USDA NRCS-Watershed Protection and Flood Prevention Program, 406 Public Assistance, HGMP, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					No
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					Yes

Jurisdiction:	Hardin			**Action Number:**	E3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms				
Project Title:	Join the community rating system.				
Project Description:	Join the community rating system.				
Responsible Entity:	Mayor, City Council				
Losses avoided:	Buildings, residents, and city/county employees in county and city				
Cost Estimate:	$2,000	**Timeframe:**	24-36 months		
Potential Funding Sources:	City Council	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					No
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					Yes

Jurisdiction:	Hardin	**Action Number:**	E4
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms Windstorm Tornado		
Project Title:	Wind-resistant construction techniques.		
Project Description:	Inform the public regarding the use of wind-resistant construction techniques.		
Responsible Entity:	Mayor, City Council, and local agencies		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$5,000	**Timeframe:**	24-36 months
Potential Funding Sources:	Local Commitment, HMGP	Benefit-Cost Analysis:	Approximately a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Hardin	**Action Number:**	E5
Hazard(s) Addressed:	Hail		
Project Title:	Hail Damage Protection		
Project Description:	Retrofit city and county owned structures with roofs and window panes that can withstand hail damage		
Responsible Entity:	Emergency Coordinator and Local Building Department		
Losses avoided:	Buildings, residents, and city/county employees in county and city buildings when a hail storm hits.		
Cost Estimate:	$20,000	**Timeframe:**	24-36 months
Potential Funding Sources:	HMGP, Housing Preservation Grants, Weatherization Assistance Program	Benefit-Cost Analysis:	More than a 1:4 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

<table>
<tr><td>Jurisdiction:</td><td colspan="3">Hardin</td><td>Action Number:</td><td>E6</td></tr>
<tr><td>Hazard(s) Addressed:</td><td colspan="5">Flooding
Hurricanes, Tropical Storms & Tropical Depressions
Severe Thunderstorm & Lightning
Heat Events
Dam/Levee Failure
Severe Winter Storms
Wildfire
Windstorm
Tornado
Hail
Manmade Hazards</td></tr>
<tr><td>Project Title:</td><td colspan="5">Generators for Critical Facilities</td></tr>
<tr><td>Project Description:</td><td colspan="5">Purchase and provide back-up generators to all critical facilities throughout the jurisdiction</td></tr>
<tr><td>Responsible Entity:</td><td colspan="5">Emergency Coordinator</td></tr>
<tr><td>Losses avoided:</td><td colspan="5">Vulnerable populations and any city resident without power</td></tr>
<tr><td>Cost Estimate:</td><td>$15,000</td><td>Timeframe:</td><td colspan="3">12 months</td></tr>
<tr><td>Potential Funding Sources:</td><td>HMGP</td><td>Benefit-Cost Analysis:</td><td colspan="3">More than a 1:4 cost-benefit ratio</td></tr>
<tr><td>Priority Rating</td><td>2</td><td>Status:</td><td colspan="3">Not started</td></tr>
<tr><td colspan="5">Is this action related to a critical facility or lifeline?</td><td>No</td></tr>
<tr><td colspan="5">Does this action reduce the effects of hazards on existing buildings?</td><td>Yes</td></tr>
<tr><td colspan="5">Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?</td><td>Yes</td></tr>
<tr><td colspan="5">Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?</td><td>Yes</td></tr>
</table>

<table>
<tr><td>Jurisdiction:</td><td colspan="3">Hardin</td><td>Action Number:</td><td>E7</td></tr>
<tr><td>Hazard(s) Addressed:</td><td colspan="5">Hurricanes, Tropical Storms & Tropical Depressions
Severe Thunderstorm & Lightning
Tornado
Windstorm</td></tr>
<tr><td>Project Title:</td><td colspan="5">Tornado mitigation through rebate program</td></tr>
<tr><td>Project Description:</td><td colspan="5">The city will develop a rebate program for building owners who install straps, structural bracings, window shutters, or interlocking roof shingles in new construction or when renovating residences or businesses.</td></tr>
<tr><td>Responsible Entity:</td><td colspan="5">City Manager, Office of Code Enforcement</td></tr>
<tr><td>Losses avoided:</td><td colspan="5">Residents, homes, business, and local facilities.</td></tr>
<tr><td>Cost Estimate:</td><td>$5,000</td><td>Timeframe:</td><td colspan="3">3 months</td></tr>
<tr><td>Potential Funding Sources:</td><td>Current city budget and salary, HMGP</td><td>Benefit-Cost Analysis:</td><td colspan="3">More than a 1:4 cost-benefit ratio</td></tr>
<tr><td>Priority Rating</td><td>3</td><td>Status:</td><td colspan="3">Not started</td></tr>
<tr><td colspan="5">Is this action related to a critical facility or lifeline?</td><td>No</td></tr>
<tr><td colspan="5">Does this action reduce the effects of hazards on existing buildings?</td><td>Yes</td></tr>
<tr><td colspan="5">Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?</td><td>Yes</td></tr>
<tr><td colspan="5">Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?</td><td>Yes</td></tr>
</table>

City of Kenefick

Priority Ranking: Action items were organized below in the order they appear by feasibility for implementation within the city due to limited staff time and budget.

Table 7.9: 2017 HMP Action Items- City of Kenefick

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
F1		X	Not started
F2		X	Not started
F3		X	Not started

Jurisdiction:	Kenefick	**Action Number:**	F1
Hazard(s) Addressed:	Flooding		
Project Title:	Improve grading of ditches		
Project Description:	Improve grading of road ditches adjacent to existing roads.		
Responsible Entity:	City of Kenefick Mayor, Liberty County Floodplain Administrator		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$30,000	**Timeframe:**	24-36 months
Potential Funding Sources:	USACE-Small Flood Control Projects, TxDOT, HMGP, USACE-Clearing and Snagging Projects, CDBG, USDA NRCS, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Kenefick	**Action Number:**	F2
Hazard(s) Addressed:	Flooding		
Project Title:	Culvert improvement program		
Project Description:	Develop culvert widening and clean out program.		
Responsible Entity:	City of Kenefick Mayor, Liberty County Floodplain Administrator		
Losses avoided:	Buildings, residents, and city/county employees in county and city		
Cost Estimate:	$20,000	**Timeframe:**	24-36 months
Potential Funding Sources:	USACE-Small Flood Control Projects, TxDOT, HMGP, USACE-Clearing and Snagging Projects, CDBG, USDA NRCS, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Kenefick	**Action Number:**	F3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail Manmade Hazards		
Project Title:	Generators for Critical Facilities		
Project Description:	Purchase and provide back-up generators to all critical facilities throughout the jurisdiction		
Responsible Entity:	City of Kenefick Mayor,		
Losses avoided:	Vulnerable populations and any city resident without power		
Cost Estimate:	$15,000	**Timeframe:**	12 months
Potential Funding Sources:	HMPG	**Benefit-Cost Ratio:**	More than a 1:4 BCR
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	3	Status:	Not started

Is this action related to a critical facility or lifeline?	Yes
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

City of Liberty

Priority Ranking: Action items were organized below in the order they appear by feasibility for implementation within the City due to limited staff time and budget.

Table 7.10: 2017 HMP Action Items- City of Liberty

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
K1	X		Completed
K2		X	Not started
K3		X	Moved to WCID #5 Projects
K4		X	Moved to WCID #5 Projects
K7	X		Completed

Jurisdiction:	City of Liberty	**Action Number:**	K2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions		
Project Title:	Levee Certification		
Project Description:	Levee certification for new levee around wastewater treatment plant		
Responsible Entity:	City of Liberty Floodplain Administrator, Emergency Management Coordinator		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$600,000	**Timeframe:**	12-20 months
Potential Funding Sources:	US Army Corp of Engineers – Small Flood Control Projects, USDA Natural Resources Conservation Service – Emergency Watershed Protection Agency, Texas Water Development Board – Clean Water State Revolving Fund, USDA Natural Resources Conservation Service – Watershed Protection and Flood Prevention Program, FEMA Disaster Mitigation, City of Liberty, Liberty Community Development Corporation.	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	1	Status:	Not started

Is this action related to a critical facility or lifeline?	Yes
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

Jurisdiction:	City of Liberty	**Action Number:**	K5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail Manmade Hazards		
Project Title:	Beaumont Electrical Substation		
Project Description:	Upgrade transformer, switches, and other electrical equipment within substation		
Responsible Entity:	City of Liberty Emergency Management Coordinator		
Losses avoided:	Residents, homes, businesses, and local facilities		
Cost Estimate:	$15,000,000	**Timeframe:**	36-48 months
Potential Funding Sources:	HMGP, City Budget	Benefit-Cost Analysis:	More than 1:3 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	City of Liberty	**Action Number:**	K6
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail Manmade Hazards		
Project Title:	Liberty Electrical Substation		
Project Description:	Upgrade transformer, switches, and other electrical equipment within substation		
Responsible Entity:	City of Liberty Emergency Management Coordinator		
Losses avoided:	Residents, homes, businesses, and local facilities		
Cost Estimate:	$15,000,000	**Timeframe:**	36-48 months
Potential Funding Sources:	HMGP, City Budget	Benefit-Cost Analysis:	More than 1:3 cost-benefit ratio
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	City of Liberty	**Action Number:**	K8
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail		
Project Title:	Generators		
Project Description:	Install generators at various facilities.		
Responsible Entity:	City of Liberty Emergency Management Coordinator		
Losses avoided:	Residents, homes, businesses, and local facilities		
Cost Estimate:	$1,600,000	**Timeframe:**	24-36 months
Potential Funding Sources:	HMGP, PDM, City Budget	Benefit-Cost Analysis:	More than 1:4 cost-benefit ratio
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

City of North Cleveland

Priority Ranking: Action items were organized by feasibility for implementation within the City due to limited staff time and budget.

Table 7.11: 2017 HMP Action Items- City of North Cleveland

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
G1		X	Not started
G2		X	Not started
G3		X	Not started
G4		X	Not started
G5		X	Not started
G6		X	Not started

Jurisdiction:	North Cleveland	**Action Number:**	G1
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms Erosion		
Project Title:	Design and construct new bridge		
Project Description:	Design and construct new bridge over East Fork San Jacinto River on Low Water Bridge Road (County Road 388) to reduce flooding.		
Responsible Entity:	City of North Cleveland Mayor, Liberty County Emergency Management Coordinator		
Losses avoided:	Loss of life and property		
Cost Estimate:	$1,000,000	**Timeframe:**	12-24 months
Potential Funding Sources:	HMGP, PDM, County funds	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	North Cleveland	**Action Number:**	G2
Hazard(s) Addressed:	Flooding		
Project Title:	Property Protection		
Project Description:	Acquisition of property in the floodplain.		
Responsible Entity:	City of North Cleveland Mayor, Liberty County Emergency Management Coordinator		
Losses avoided:	Loss of life and property		
Cost Estimate:	$750,000	**Timeframe:**	12-24 months
Potential Funding Sources:	HMGP, Flood Mitigation Assistant Program, PDM, HUD-Disaster Recovery Initiative Program, CDBG	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	North Cleveland	**Action Number:**	G3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail Emerging Infectious Diseases Manmade Hazards		
Project Title:	New emergency shelter		
Project Description:	North Cleveland emergency shelter located at old TxDOT offices on FM 2025.		
Responsible Entity:	City of North Cleveland Mayor, Liberty County Emergency Management Coordinator		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$500,000	**Timeframe:**	36-60 months
Potential Funding Sources:	HMGP, Pre-Disaster Mitigation, County Funds	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	North Cleveland	**Action Number:**	G4
Hazard(s) Addressed:	Flooding		
Project Title:	Engineering study		
Project Description:	Engineering study for drainage improvements.		
Responsible Entity:	City of North Cleveland Mayor, Liberty County Emergency Management Coordinator		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$30,000	**Timeframe:**	12-24 months
Potential Funding Sources:	HMGP, Pre-Disaster Mitigation	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	North Cleveland	**Action Number:**	G5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure Severe Winter Storms Erosion		
Project Title:	Elevate Bridge Road		
Project Description:	Elevate Bridge Road.		
Responsible Entity:	City of North Cleveland Mayor, Liberty County Emergency Management Coordinator		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$2,000,000	**Timeframe:**	12-24 months
Potential Funding Sources:	PDM, HMGP, County, State, Federal, TXDOT, 406 Public Assistance (following federally declared disaster)	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	North Cleveland	**Action Number:**	G6
Hazard(s) Addressed:	Tornado Windstorm		
Project Title:	Tornado mitigation through rebate program		
Project Description:	The city will develop a rebate program for building owners who install straps, structural bracings, window shutters, or interlocking roof shingles in new construction or when renovating residences or businesses.		
Responsible Entity:	City of North Cleveland Mayor		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$5,000	**Timeframe:**	3 months
Potential Funding Sources:	HMGP,	Benefit-Cost Analysis:	More than a 1:4 BCR
Priority Rating	2	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

City of Plum Grove

Priority Ranking: H3, H2, H1
Action items were organized by need, cost, timeframe, and feasibility for implementation.

Table 7.12: 2017 HMP Action Items- City of Plum Grove

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
H1		X	Not started
H2		X	Not started
H3		X	Not started

Jurisdiction:	Plum Grove	**Action Number:**	H1
Hazard(s) Addressed:	Flooding		
Project Title:	Raise road surfaces		
Project Description:	Reduce flooding by raising road surface of Plum Grove Road and installing larger culverts from FM 1010 intersection to Paul Campbell Loop and at Orange Branch crossing.		
Responsible Entity:	Mayor		
Losses avoided:	Residents, homes, business, and local facilities.		
Cost Estimate:	$35,000	**Timeframe:**	12-24 months
Potential Funding Sources:	Local Funding through Capital Improvements, TX DOT, USACE-Small Flood Control Projects, TWDB-Clean Water State Revolving Fund, TWDB, USDA NRCS-Watershed Protection and Flood Prevention Program, EPA, HMGP, 406 Public Assistance Program, PDM	Benefit-Cost Analysis:	Approximately a 1:4 BCR
Priority Rating	1	Status:	Not started

Is this action related to a critical facility or lifeline?	No
Does this action reduce the effects of hazards on existing buildings?	Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?	Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?	No

Jurisdiction:	Plum Grove			**Action Number:**	H2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail Manmade Hazards				
Project Title:	Expand development of emergency notification system (Phase 2)				
Project Description:	Expand development of emergency notification system/work to establish public awareness of emergency notification process. • Phase 1 Underway with the introduction of First Call to the community • Phase 2 Pending funding				
Responsible Entity:	City of Plum Grove Mayor, Liberty County Emergency Management Coordinator				
Losses avoided:	Loss of life				
Cost Estimate:	$10,000	**Timeframe:**	12 months		
Potential Funding Sources:	National Weather Service, FEMA Emergency Management Performance Grant, Dept. of Homeland Security-State Homeland Security Grant Program, Private Industry such as Insurance Companies and Pipeline Operators, HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					No
Does this action reduce the effects of hazards on existing buildings?					No
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Jurisdiction:	Plum Grove			**Action Number:**	H3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Heat Events Dam/Levee Failure Severe Winter Storms Wildfire Windstorm Tornado Hail				
Project Title:	Purchase generator for City Hall				
Project Description:	Purchase generator for City Hall to run water well, air conditioning and lights during emergencies.				
Responsible Entity:	Mayor				
Losses avoided:	Residents, homes, business, and local facilities.				
Cost Estimate:	$5,000	**Timeframe:**	12-24 months		
Potential Funding Sources:	HMGP	Benefit-Cost Analysis:	Approximately a 1:4 BCR		
Priority Rating	1	Status:	Not started		
Is this action related to a critical facility or lifeline?					Yes
Does this action reduce the effects of hazards on existing buildings?					Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?					No
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?					No

Liberty County Water Control Improvement District #1

Priority Ranking: Action items were organized by feasibility for implementation and cost. All actions are considered high priority for Liberty County WCID#1

Table 7.13: 2017 HMP Action Items- Liberty County Water Control Improvement District #1

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
None			

Jurisdiction:	Liberty County WCID #1	**Action Number:**	M1
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms		
Project Title:	Drainage Criteria Manual Update		
Project Description:	Our District is experiencing rapid growth, and it is imperative that WCID#1 provide appropriate drainage regulations for our community. We will update our Drainage Criteria Manual to the latest NOAA "Atlas 14" release. • Our current DCM was last updated in 2016. • Other updates will include detention rates, minimum finished flood elevation of new structures, and other important additions.		
Responsible Entity:	Liberty County Water Control and Improvement District #1 President		
Losses avoided:	Loss of life, homes, businesses, and local facilities.		
Potential Partners:	None		
Cost Estimate:	$50,000	**Timeframe:**	
Potential Funding Sources:	FEMA, TWDB, HMGP	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			Yes

Jurisdiction:	Liberty County WCID #1		**Action Number:**	M2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms			
Project Title:	Culvert Improvements			
Project Description:	WCID#1 has a program to assess the condition of stormwater culverts throughout our district. We have experienced culvert damage as a result of severe storms (i.e. washouts and partial collapse). Construction materials and culvert designs must be upgraded for extended life.			
Responsible Entity:	Liberty County Water Control and Improvement District #1 President			
Losses avoided:	Loss of life, homes, businesses, and local facilities.			
Potential Partners:	None			
Cost Estimate:	$450,000	**Timeframe:**		
Potential Funding Sources:	FEMA, TWDB, HMGP	Benefit-Cost Analysis:		
Priority Rating	1	Status:	Not started	
Is this action related to a critical facility or lifeline?				No
Does this action reduce the effects of hazards on existing buildings?				Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?				Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?				No

Examples:

a. Replace Culvert at CR612/CR605 crossing due to partial collapse. Estimated cost $350,000.
b. Complete repair culvert at CR622.
   - FEMA recommended that bulkheads and riprap needs to be added to prevent another washout. Estimated cost $100,000.

Jurisdiction:	Liberty County WCID #1		**Action Number:**	M3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms			
Project Title:	Stormwater Ditch Repair			
Project Description:	Recent storms have damaged several of our large stormwater ditches. The damage includes wall collapse and sloughing. Corrections require extensive excavation and mitigation upgrades to prevent reoccurrence.			
Responsible Entity:	Liberty County Water Control and Improvement District #1 President			
Losses avoided:	Loss of life, homes, businesses, and local facilities.			
Potential Partners:	None			
Cost Estimate:	$2,100,000	**Timeframe:**		
Potential Funding Sources:	FEMA, TWDB, HMGP	Benefit-Cost Analysis:		
Priority Rating	1	Status:	Not started	
Is this action related to a critical facility or lifeline?				No
Does this action reduce the effects of hazards on existing buildings?				Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?				Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?				No

Examples:

a. Repair sloughing CR 6026 Ditch excavation, mitigation upgrades, and easement extensions. Estimated cost $700,000
b. Repair sloughing CR 612 Ditch excavation and mitigation upgrades. Estimated cost $1,400,000

Jurisdiction:	Liberty County WCID #1	**Action Number:**	M4
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms		
Project Title:	Stormwater Ditch Capacity Upgrades		
Project Description:	Landowners' complaints of flooding due to undersized stormwater ditches need to be addressed. We are studying ditch capacities and preparing design alternatives. Modifications will include wider ditches, larger culverts and road modifications.		
Responsible Entity:	Liberty County Water Control and Improvement District #1 President		
Losses avoided:	Loss of life, homes, businesses, and local facilities.		
Potential Partners:	None		
Cost Estimate:	$2,100,000	**Timeframe:**	
Potential Funding Sources:	FEMA, TWDB, HMGP	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			No
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Examples:

a. Increase CR6042 ditch capacity. This project requires extensive excavation, 7 culvert replacements and road modifications. Estimated cost $1,800,000.
b. Replace County Road 602 Crossing on County Road 6042 Ditch to increase capacity. Estimated cost $300,000.

Jurisdiction:	Liberty County WCID #1		Action Number:	M5
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms			
Project Title:	Feasability Studies and Design			
Project Description:	Liberty County WCID#1 has five Projects accepted into the Region-6 San Jacinto-RFPG Flood Plan. Each project proposes detention ponds and ditch system/upgrades to control stormwater flows. Estimated costs range from $3,000,000 to $5,000,000/project. Projects referenced can be found below.			
Responsible Entity:	Liberty County Water Control and Improvement District #1 President			
Losses avoided:	Loss of life, homes, businesses, and local facilities.			
Potential Partners:	TWDB			
Cost Estimate:	$3,000,000 to $5,000,000/project	Timeframe:		
Potential Funding Sources:	FEMA, TWDB, HMGP	Benefit-Cost Analysis:		
Priority Rating	1	Status:	Not started	
Is this action related to a critical facility or lifeline?				No
Does this action reduce the effects of hazards on existing buildings?				Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?				Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?				No

Action ID	Action Type	Action Name	Description	Action Estimated Total Cost
061000495	FME	Preliminary Engineering Design of Detention Pond & Conveyance System for Buddy Grass and Railroad Ditches	Study to create detention pond & Ditch system for Buddy Grass and RR Ditches	$5,000,000
061000496	FME	Feasibility Study - Convert Enderli Reservoir into a Detention Pond	Request to study converting Enderli Reservoir into a detention pond	$4,000,000
061000497	FME	Preliminary Engineering Design of Detention Pond at intersection of HWY90 & Railroad near Cedar Bayou	Study to create detention pond & Ditch system for Buddy Grass and RR Ditches	$3,000,000
061000498	FME	Preliminary Engineering Design of Detention Pond at Gier Road & Cedar Bayou	Study to create detention pond at Gier Road Ditch & Cedar Bayou Intersection	$3,500,000
061000499	FME	Preliminary Engineering Design of Detention Pond at Hatcherville & Cedar Bayou Farm Ditches	Study to create detention pond for Hatcherville & Cedar Bayou Farms Ditches	$3,500,000

Liberty County Water Control Improvement District #5

Priority Ranking: Action items were organized by project cost. All actions are considered high priority for Liberty County WCID#5

Table 7.14: 2017 HMP Action Items- Liberty County Water Control Improvement District #5

Action Item #	Removed from HMP	Keep in HMP	What is the status of the Action Item? If the Action Item is being removed, note why.
None			

Jurisdiction:	Liberty County WCID #5	**Action Number:**	L1
Hazard(s) Addressed:	Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms		
Project Title:	Main A pump station and conveyance improvements		
Project Description:	Improve pump station, install larger box culverts under Travis street and widen channel		
Responsible Entity:	Liberty County Water Control and Improvement District #5 President		
Losses avoided:	Residents, homes, businesses, and local facilities.		
Potential Partners:	City of Liberty		
Cost Estimate:	$17,639,000	**Timeframe:**	
Potential Funding Sources:	FEMA, USACE, TWDB, USDA	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County WCID #5	**Action Number:**	L2
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Dam/Levee Failure		
Project Title:	Main B pump station, detention, and conveyance improvements		
Project Description:	Rehabilitation of Pump Station B, upsize the culverts at North Travis Street, Milam and Woods , and construction of a detention basin.		
Responsible Entity:	Liberty County Water Control and Improvement District #5 President		
Losses avoided:	Homes, businesses, and property damage		
Potential Partners:	City of Liberty, FEMA & TDEM		
Cost Estimate:	$14,433,000	**Timeframe:**	
Potential Funding Sources:	FEMA, USACE, TWDB, USDA	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County WCID #5	**Action Number:**	L3
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms		
Project Title:	New and improved channel from Main A Pump Station to Trinity River		
Project Description:	Install an improved channel built to current standards for the flow of flood waters during excessive flood events.		
Responsible Entity:	Liberty County Water Control and Improvement District #5 President		
Losses avoided:	Flooding of homes, businesses, and property		
Potential Partners:	City of Liberty, FEMA & TDEM		
Cost Estimate:	$5,500,00	**Timeframe:**	
Potential Funding Sources:	FEMA, USACE, TWDB, USDA	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Jurisdiction:	Liberty County WCID #5	**Action Number:**	L4
Hazard(s) Addressed:	Flooding Hurricanes, Tropical Storms & Tropical Depressions Severe Thunderstorm & Lightning Severe Winter Storms		
Project Title:	Channel and Crossing Improvements on Redmond Creek		
Project Description:	Channel widening to a 5' bottom width and a trapezoidal shape with 4:1 side slopes with 4-8'x7' RCB		
Responsible Entity:	Liberty County Water Control and Improvement District #5 President		
Losses avoided:	Residents, homes, businesses, and local facilities.		
Potential Partners:	City of Ames, FEMA & TDEM		
Cost Estimate:	$1,255,000	**Timeframe:**	
Potential Funding Sources:	FEMA, USACE, TWDB, USDA	Benefit-Cost Analysis:	
Priority Rating	1	Status:	Not started
Is this action related to a critical facility or lifeline?			Yes
Does this action reduce the effects of hazards on existing buildings?			Yes
Does this action reduce the effects of hazards for new buildings, infrastructure, or future development?			Yes
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?			No

Section 8: PLAN MAINTENANCE

To remain an effective tool, the HMP will undergo continuous review and updates. This practice is known as plan maintenance and requires monitoring, evaluating, updating, and implementing the plan. To accomplish this, a Plan Maintenance Team (PMT) has been determined and is comprised of representatives from each of the County's participating jurisdictions.

Plan Maintenance Team	
Plan Maintenance Team Leader	Liberty County Emergency Management Coordinator
Jurisdiction	**Responsible Entity**
Unincorporated Liberty County	Liberty County OEM and County Judge
Liberty County	Deputy Emergency Management Coordinator
City of Ames	Mayor
City of Cleveland	Mayor
City of Daisetta	Mayor
City of Dayton	Mayor
City of Devers	Mayor
City of Hardin	Mayor
City of Kenefick	Mayor
City of Liberty	Emergency Management Coordinator
City of North Cleveland	Mayor
City of Plum Grove	Mayor
Liberty County WCID #1	President
Liberty County WCID #5	President

Public Involvement

Continued stakeholder and public involvement will remain a vital component of the HMP. The HMP will be hosted on the County and H-GAC websites, and public input can be submitted at any time. The PMT is responsible for documenting public feedback and presenting the comments for discussion at each annual Plan Maintenance Meeting. The PMT Leader will also conduct outreach and invite the public to annual Plan Maintenance meetings. The PMT Leader will advertise all annual meetings in local newspapers, post invitations on the County's social media pages, and post fliers at city and county buildings 30 days prior to the meetings. In addition, each participating jurisdiction will seek input from the public on the status of existing hazards, and emerging vulnerabilities, and evaluate the HMP's strategy with the public. During each meeting, the PMT will provide an open comment forum for interactive discussion with the public. The development of new goals and strategies will be a joint effort between the PMT and public participants.

Procedures & Schedule

Procedures to monitor and evaluate the HMP were determined during the November 11th meeting. This ensures that the goals, objectives, and mitigation strategy are regularly examined for feasibility and that the HMP remains a relevant and adaptive tool. The PMT will meet as needed and hold its first meeting within one year after the plan's approval date. An additional mid-year meeting will be held 12-18 months prior to the plan's expiration to develop a timeline and strategy to update the HMP.

Table 8.1: Plan Maintenance: Evaluation & Monitoring Procedures

Method and Procedures	Schedule	Responsible Entity
The PMT Leader will advertise all annual meetings in local newspapers, post invitations on the County social media pages, and post fliers at city and county buildings 30 days prior to the meetings.	30 days prior to annual meetings	Plan Maintenance Team Leader
The PMT Leader is responsible for evaluating the entire plan prior to the meeting. Each PMT member will be asked to identify and discuss any deficiencies in the plan as it relates to their jurisdiction. Each PMT member will discuss their findings followed by public input and comments.	As needed	PMT Leader, PMT member for each participating jurisdiction, and Public
Emerging hazards, risks, and vulnerabilities will be identified and discussed. 1) PMT members are responsible for monitoring each natural hazard in their jurisdiction and providing a written and/or verbal update on any new occurrences and emerging risks. 2) The PMT Leader will seek input from participants and the public at the annual meetings by opening the meeting for public comment. 3) Newly identified hazards, risks, and vulnerabilities will be assigned to a PMT member to research and monitor.	As needed	Public and all participating jurisdictions
The PMT will evaluate the mitigation goals and objectives to ensure the HMP remains relevant, and the strategy continues to be effective. 1) PMT members will identify new projects and/or re-prioritize existing strategies based on changes in their jurisdiction, emerging hazards, and shifting priorities. 2) Mitigation strategies for the newly identified hazards, risks, and vulnerabilities will be proposed and discussed. 3) Funding sources and multijurisdictional cooperation for new initiatives will be determined.	As needed	PMT member for each participating jurisdiction
Each participating jurisdiction will evaluate their progress implementing the mitigation strategy. 1) Representatives will publicly discuss progress and submit written progress reports to the team leader. 2) Completed and ongoing mitigation actions will be discussed by the responsible entity. 3) Unaddressed mitigation actions will be evaluated for relevancy and/or amended to increase feasibility. 4) The feasibility of the mitigation strategy will be evaluated, and any necessary revisions will be proposed. 5) The team leader will seek comments from the public after each participating jurisdiction's presentation.	As needed	PMT, the responsible department identified in the mitigation action up for discussion, and the public.
The PMT will develop a timeline and strategy to update the plan 12-18 months before it expires. The update strategy will include: 1) Establish entities responsible for drafting and submitting the update to TDEM 2) Send appropriate representatives to G-318 training. 3) Determine funding needs and funding sources for plan update.	Every 5 years, To begin 12-18 months before expiration	PMT

Plan Integration

Integrating the HMP into county and local planning mechanisms is key to its success. Effective integration allows communities to benefit from existing plans and procedures to further reduce their vulnerability and risk. Upon approval of the plan and approval of updates or revisions as proposed by the Plan Maintenance team, each participating jurisdiction will follow the pre-determined actions:

Table 8.2: Hazard Mitigation Plan Adoption and Integration Procedures

Jurisdiction	Integration Method
Liberty County	The HMP and plan amendments will be presented to Commissioner’s Court by the PMT Leader. Upon approval by the Commissioner’s Court, approved actions will be acted upon as funding becomes available and integrated into the identified county planning mechanisms.
Cleveland	Cleveland's PMT representative will select appropriate mitigation actions to be implemented using the City's local budget and develop an implementation proposal. The budget request and implementation proposal will be presented before City Council. An agenda will be published 30 days before the meeting.
Daisetta	Daisetta’ s PMT representative will draft a proposal for incorporating the HMP's mitigation strategy into their existing planning mechanisms. Upon approval, city staff will act to incorporate the HMP into their existing planning mechanisms.
North Cleveland	The North Cleveland’s PMT representatives will draft a proposal for incorporating the HMP's mitigation recommendations into their existing planning mechanisms.
Ames	Ames' PMT representative will select mitigation actions to be budgeted into the City of Ames' annual budget to be implemented the following year. The proposal will be presented before City Council. An agenda will be published 30 days in advance.
Dayton	Dayton’s City Manager will draft a proposal for incorporating the HMP's mitigation strategy into their existing planning mechanisms. The proposal will be presented to the City Council and mayor for consideration. Dayton will post an agenda for the public hearing no less than 30 days before the meeting when it will be considered. Upon approval, the city manager will initiate the process to incorporate the HMP into their existing planning mechanisms.
Devers	Devers PMT representative will draft a proposal for incorporating the HMP's mitigation strategy into their existing planning mechanisms. Upon approval, city staff will act to incorporate the HMP into their existing planning mechanisms.
Hardin	Hardin's PMT representative will select mitigation actions to be budgeted into the Hardin annual budget and be implemented the following year. The budget request and implementation proposal will be presented before City Council. An agenda will be published 30 days before the meeting.
Kenefick	Kenefick’ s PMT representative will select mitigation actions to be implemented using the local budget. An agenda will be published 30 days in advance, the proposal will be presented before the council.
Plum Grove	The Plum Grove’s PMT representative will draft a proposal for incorporating the HMP's mitigation recommendations into their existing planning mechanisms. Plum Grove’s representative will present proposal for approval. Upon approval, city staff will act to incorporate the HMP into their existing planning mechanisms.
Liberty	Liberty's PMT representative will select mitigation actions to be budgeted into the City of Liberty’s annual budget to be implemented the following year. The proposal will be presented before City Council. An agenda will be published 30 days in advance.
Liberty County WCID #1	Liberty County WCID #1 PMT Representative will draft a proposal for incorporating the HMP's mitigation strategy into their existing budget for capital programs.
Liberty County WCID #5	Liberty County WCID #5 Representative will draft a proposal for incorporating the HMP's mitigation strategy into their existing budget for capital programs.

To update and revise existing planning mechanisms to further integrate the HMP, each participating jurisdiction will follow a basic process(es) described in this section.

1. Propose a policy, strategy, or regulatory amendment to the proper governing body.
2. Advertise the amendment 15 days prior to the meeting where it will be discussed. Advertising procedures for the public meeting(s) are outlined in the public involvement measures described in Section 8 of this plan.
3. Provide the public, elected officials, and governing bodies the opportunity to discuss and comment upon proposed change(s).
4. If the proposal is accepted, the change is implemented by the appropriate governing authority.

Several existing plans and programs that require integration of the HMP have been identified by the participating jurisdictions. The PMT will initiate the process described above. As each participating jurisdiction develops or approves new planning mechanisms, the mechanism's name and the integration method will be added to the HMP within the table below.

Since the last plan approval, the County and a majority of the participating jurisdictions to this plan update have not integrated the 2018 HMP into current planning mechanisms. Many planning documents, like those seen in the table below, have not been updated in the 5-year timeframe since the last update. Hazard mitigation action items are routinely considered when annual budgets are reviewed by all jurisdictions, but very few action items were completed from the 2018 HMP to this update. Funding has been listed as a reoccurring capability limitation for all jurisdictions throughout HMP updates. The cities of Cleveland, Daisetta, Dayton, and Liberty had action items that were completed from the previous plan update, as seen in Section 7.

Table 8.3: Integration of HMP and Planning Mechanisms

Planning Mechanism	Integration Method
Liberty County	
Disaster Recovery Plan	Both plans should be updated and maintained in accordance with the other plan's goals and strategies. The HMP will be consulted before any revisions or updates to the disaster recovery plans are made.
Emergency Operations Plan	Both plans will be continuously evaluated and monitored. Any Emergency Operations Plan updates will refer to, incorporate, and/or complement the HMP.
Subdivision Regulations	All participating jurisdictions within this plan update will review their codes and propose the adoption of codes that support mitigation activities defined in the HMP when appropriate.
Planning & Development Regulations	Each participating jurisdiction has reviewed the vulnerabilities defined in the HMP and will adopt codes that support the mitigation strategy and mitigation activities. PMT members will propose code amendments to the appropriate governing body, following the process to amend codes in the jurisdiction, and document any regulation amendments to be included in the HMP update.
Annual Budget	Liberty County and each participating jurisdiction will review their annual budget in July for opportunities to fund their highest priority mitigation actions.
Mutual Aid Agreements	Liberty County and each participating jurisdiction was satisfied with their mutual aid agreements when the HMP was drafted. If any mutual aid agreements change and negatively impact a participating jurisdiction(s), Liberty County and each participating jurisdiction will amend the HMP to include the new vulnerability and include a mitigation action to address it.
Floodplain Regulations	Liberty County's floodplain regulations provide preventative measures to prevent future development in the floodplains, and it also provides corrective guidance on development in the floodplain. When the regulations are updated, it will be reflected in the mitigation action strategy for flooding in Section 7 of this plan.
Transportation Plan	When the plan is updated or revised, the PMT will propose the adoption of codes that support mitigation strategy and mitigation activities.

Planning Mechanism	Integration Method
Participating Jurisdictions	
City of Ames, Subdivision Ordinance	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Ames, Comprehensive Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Cleveland, Strategic Plan	Continue to include a member of the HMC on the Facilitator and Team Members for the Strategic Plan and any updates.
City of Daisetta. Subdivision Ordinance	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Daisetta, FDPO	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Devers, Subdivision Ordinance	Include a member of the HMC when the plan is updated or revised to support the mitigation strategy and mitigation activities.
City of Dayton, Comprehensive Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Dayton, Downtown Revitalization Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Dayton, Parks Master Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Dayton, Water and Wastewater Master Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Hardin, Subdivision Ordinance	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Kenefick, FDPO	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Liberty, FDPO	Include a member of the HMC when the ordinance is updated or revised to support the mitigation strategy and mitigation activities.
City of Liberty, Comprehensive Plan	Continue to include a member of the HMC on the Facilitator and Team Members for the Strategic Plan and any updates.
City of Liberty, Disaster Recovery Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Liberty, Stormwater Management Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Liberty, Floodplain Management Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
City of Liberty, Emergency Operations Plan	Include a member of the HMC in the steering committee for plan updates to support plan integration, the mitigation strategy and mitigation activities.
Liberty County WCID #1, Drainage Ditch and Easement Regulations	Include a member of the HMC when the regulation is reviewed or updated to support the mitigation strategy and mitigation activities.

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