2025 DICKINSON WCID

HAZARD MITIGATION PLAN

TXGLO

Houston-Galveston Area Council

DICKINSON'S Water District

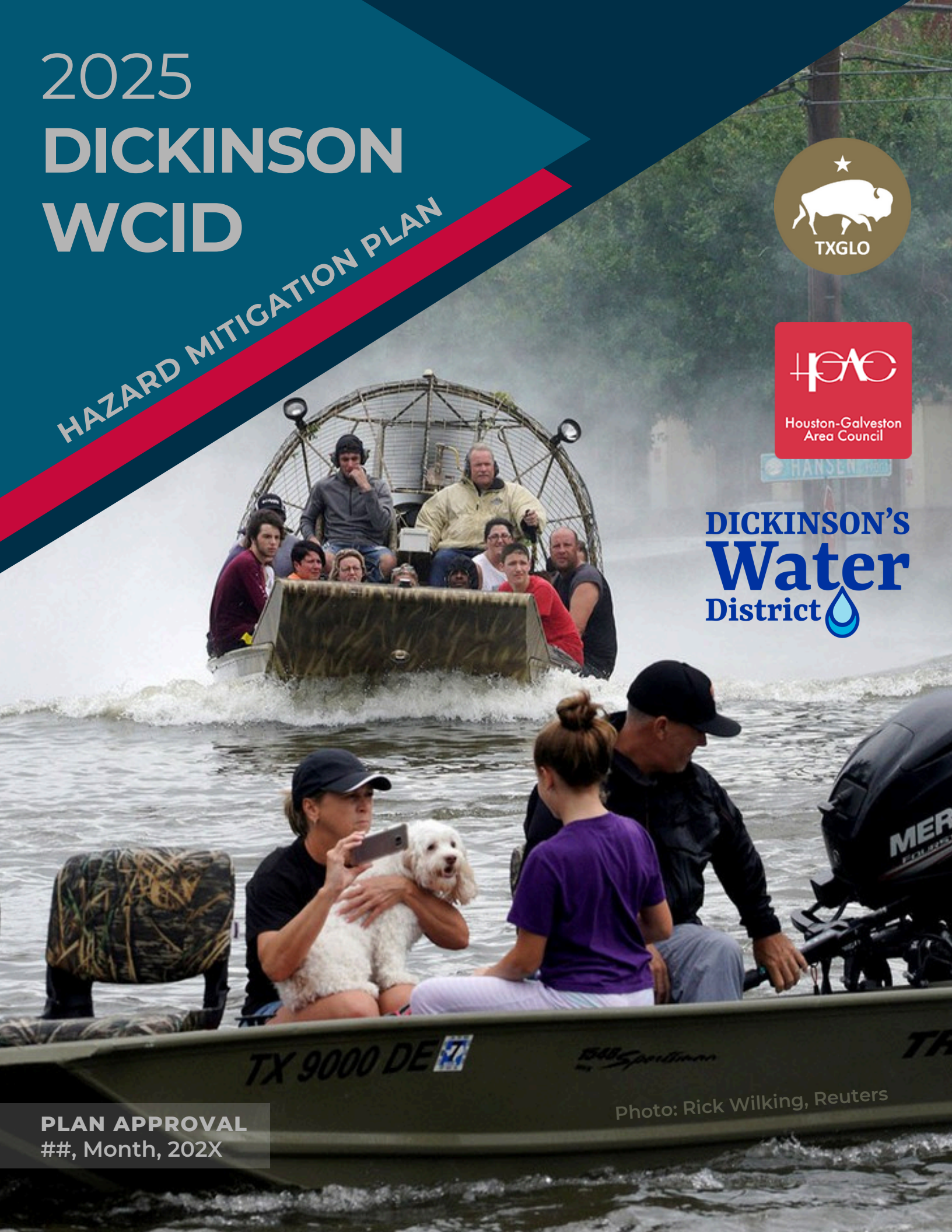

Photo: Rick Wilking, Reuters

PLAN APPROVAL
##, Month, 202X

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Acronyms

AGL — Above Ground Level
ASCE — American Society of Civil Engineers
ASL — Above Sea Level
ATSDR — Agency for Toxic Substances and Disease Registry
BFE — Base Flood Elevation
CAA — Clean Air Act
CDC — Centers for Disease Control and Prevention
CG – Cloud-to-Ground Lightning
CFR — Code of Federal Regulations
CIP — Capital Improvements Program
CISA — Cybersecurity and Infrastructure Security Agency
CWA — Clean Water Act
DBIR — Data Breach Investigations Report
DCP — Drought Contingency Plan
DDoS — Distributed Denial of Service
DMA — Disaster Mitigation Act of 2000
EAP — Emergency Action Plan
EID — Emerging Infectious Diseases
EAL — Expected Annual Loss
EMC — Emergency Management Coordinator
EPA — Environmental Protection Agency
FIS — Fire Intensity Scale
FMA — Flood Mitigation Assistance
GCAD — Galveston Central Appraisal District
GCWA — Gulf Coast Water Authority
GIS — Geographic Information Systems
HAZMAT — Hazardous Material
HCFCD — Harris County Flood Control District
H-GAC — Houston-Galveston Area Council
HGSD — Harris-Galveston Subsidence District
HLR — Historic Loss Ratio
HMA — Hazard Mitigation Assistance
HMGP — Hazard Mitigation Grant Program
HMP — Hazard Mitigation Plan
HMSC — Hazard Mitigation Steering Committee
IBC — International Building Code
IRC — International Residential Code
ISD — Independent School District
LEPC — Local Emergency Planning Committee
LHMP — Local Hazard Mitigation Plan
MGD — Million Gallons per Day
MS4 — Municipal Separate Storm Sewer System

NCHH — National Center for Healthy Housing
NCEI — National Center for Environmental Information
NDFD — National Digital Forecast Database
NFIP — National Flood Insurance Program
NFPA — National Fire Protection Association
nmi — Nautical Miles
NOAA — National Oceanic and Atmospheric Administration
NPMS — National Pipeline Mapping System
NSSL — National Severe Storms Laboratory
NWS — National Weather Service
OT — Operational Technology
PMT — Plan Maintenance Team
PT — Planning Team
RUSLE — Revised Universal Soil Loss Equation
SHELDUS — Spatial Hazard Events and Losses Database for the United States
SFHA — Special Flood Hazard Area
SVI — Social Vulnerability Index
SWPPP — Stormwater Pollution Prevention Plan
TCEQ — Texas Commission on Environmental Quality
TDEM — Texas Division of Emergency Management
TRI — Toxics Release Inventory
TWDB — Texas Water Development Board
TXDOT — Texas Department of Transportation
TxWRAP — Texas Wildfire Risk Assessment Portal
UDC — Unified Development Code
U.S. — United States
USACE — United States Army Corps of Engineers
USDM — United States Drought Monitor
USGS — United States Geological Survey
USDA — United States Department of Agriculture
USLE — Universal Soil Loss Equation
WCP — Water Conservation Plan
WCID — Water Control and Improvement District
WSSI — Winter Storm Severity Index
WWTP — Wastewater Treatment Plant
WUI — Wildland Urban Interface
ZCTA — Zip Code Tabulation Area

Plan Organization

The sections that comprise the District's Local Hazard Mitigation Plan (LHMP, HMP) include:

Executive Summary – This section includes the executive summary of the LHMP and addresses the formal adoption of the plan by the District's Board of Directors to demonstrate the commitment of the community and elected officials to furthering the District's goal of becoming disaster-resistant.

Section 1: Introduction – This section describes the purpose of the LHMP update, the benefits of hazard mitigation planning, the federal and state regulatory requirements, and the background of the District's hazard mitigation planning process.

Section 2: Planning Process – This section identifies the planning process, the planning team that helped create this HMP for the District, the meetings held as part of the planning process, results from worksheets and outreach efforts, and the review and incorporation of existing plans, reports, and other appropriate information.

Section 3: District Profile and Capability Assessment – This section provides the history and background of the District, including population characteristics, population trends, and the demographic and economic conditions that have shaped the service area, the District's water customers, and the community's water demands.

Section 4: Hazard Identification and Risk Assessment (HIRA)– This section describes the process through which the Hazard Mitigation Steering Committee and local partners identified, screened, and selected the hazards to be profiled. The hazard analysis includes the description, location, extent, and probability of future events for each hazard. This section also includes a Vulnerability Assessment for all hazards listed within this HMP and considers the impact on the following assets: property; people (water customers); critical water facilities and infrastructure (the District assets); natural and cultural resources (if applicable); economic conditions of the District; and future development trends that may influence water demand on the District resources.

Section 5: Mitigation Strategy – This section provides a plan for reducing the potential losses identified in the vulnerability analysis, including mitigation goals and actions to minimize the risk to each hazard with a strategy for implementation.

Section 6: Plan Adoption, Implementation, and Maintenance – This section describes the method for plan adoption and the schedule for monitoring, evaluating, and updating the plan to ensure it remains an active and applicable document.

References – Found at the end of the LHMP, lists the sources cited in the plan.

Appendices:

- Appendix A- Hazus Analysis
    - Flood- 100 year
    - Flood- 500 year
- Appendix B- Maps
- Appendix C- Reference Documents
- Appendix D- Meeting Documentation
- Appendix E- Survey Results
- Appendix F- Plan Adoption
    - F1. (Requirement 44 CFR § 201.6(c)(5))

Executive Summary

The purpose of hazard mitigation is to reduce or eliminate long-term risk to people and property from hazards. The Dickinson Water Control and Improvement District, formerly known as the Galveston County Water Control and Improvement District #1, and herein referred to as "the District" or "WCID", developed this LHMP to make the WCID's service area (herein referred to as the District's planning area) and its customers less vulnerable and more resilient to future hazard events. This plan was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (DMA) so that the District would be eligible for the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grant programs.

The District followed a planning process prescribed by FEMA, which began with the formation of a Hazard Mitigation Steering Committee (hereinafter referred to as the "steering committee" or "HMSC") comprised of key WCID staff and participants from the Galveston County Office of Emergency Management, Galveston County Volunteer Fire Department, Gulf Coast Water Authority (GCWA), the City of Dickinson, the Galveston County Constable's Office, the Texas Department of Public Safety, and the Greater New Hope Baptist Church of Dickinson. The HMSC conducted a risk assessment that identified and profiled hazards that pose a risk to the District, assessed the District's vulnerability to these hazards, and examined the capabilities in place to mitigate them.

The District is vulnerable to several hazards that are identified, profiled, and analyzed within this plan. Cyber threats; Winter weather hazards (such as ice storms, heavy snow, or blizzards); Hurricanes, tropical storms, and associated storm surges; Severe weather (including thunderstorms, hailstorms, lightning, windstorms, and tornadoes); Flooding; Extreme heat; Drought; Geologic hazards (such as expansive soils and erosion), and fire are among the hazards that can have a significant impact on the District.

Based on the risk assessment review and goal-setting process, the HMSC identified the following five goals, which provide the direction for reducing future hazard-related losses :

- **Goal 1:** Protect life and property during disasters
- **Goal 2:** Minimize damage to critical infrastructure to maintain continuity of essential water services
- **Goal 3:** Protect natural resources, including local water supply sources
- **Goal 4:** Increase public education, awareness, support, and demand for hazard mitigation activities
- **Goal 5:** Maintain and enhance mitigation capabilities

To meet identified goals and objectives, the plan recommends 7 mitigation actions, which can be found in Section 5- Mitigation Strategy. Once formally approved by FEMA and adopted by the District, this plan will be updated every five years.

Section 1: Introduction

Purpose of the Plan

The District, in partnership with the Houston-Galveston Area Council (H-GAC), has prepared this LHMP to guide hazard mitigation planning to better protect the people served by, and assets of, the District from the effects of hazard events.

The purpose of this LHMP is to identify policies, actions, and strategies that will help to reduce risk and prevent future losses to the District. Hazard mitigation is best realized when community leaders, businesses, citizens, and other stakeholders join together to undertake a process of learning about hazards that can affect their area and use this knowledge to prioritize needs and develop a strategy for reducing damage. Hazard mitigation is most effective when it is based on a comprehensive long-term plan developed prior to a disaster occurring. This plan shows the District's commitment to reducing hazard risks and serves as a tool to help the Board of Directors implement mitigation activities to ensure the district becomes more resilient to disasters.

LHMPs qualify communities and special districts (including water districts) for federal mitigation grant programs, including FEMA's HMA Program, the Hazard Mitigation Grant Program (HMGP), and Flood Mitigation Assistance (FMA). The District planning area is subject to many kinds of hazards, and access to these programs is vital. As a result, the District must complete a comprehensive plan update every five years after this HMP is approved.

Mission Statement

A mission statement focuses on the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The mission statement for this HMP is:

To be proactive in reducing risk and increasing resiliency of the District's water and wastewater systems during disasters by developing a hazard mitigation plan that focuses on protecting life, property, infrastructure, and the environment.

Authority

Authority for the preparation of the HMP is derived from Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act)[1], as amended; The National Flood Insurance Act of 1968, as amended; and Title 44 Code of Federal Regulations Section 201.6 (44 CFR 201.6). These require State and local governments to develop, formally adopt, and regularly update HMPs in order to be eligible for certain disaster mitigation grant funding sources.

Scope

This LHMP was developed for the District and profiles the following hazards:

1. Cyber Threats
2. Winter Weather (Ice Storm, Heavy Snow, Blizzard)
3. Hurricane and Storm Surge
4. HazMat / Toxic Release
5. Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)
6. Flooding
7. Extreme Heat
8. Drought
9. Geologic Hazards (Expansive Soils, Erosion, Land Subsidence)
10. Pandemic
11. Fire

Goals and Objectives

C3. (Requirement 44 CFR § 201.6(c)(3)(i))

Goals	Objectives
Goal 1: Protect life and property during disasters	1.1 Implement projects that assist in protecting lives by making infrastructure, critical facilities, and other District property more resistant to natural hazards.
	1.2 Improve the District's ability to immediately and effectively respond to hazards through the utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events to all District customers. District communications should provide public outreach to inform customers of the hazards identified to the drinking water system in emergencies. Including how to conserve water in the event of a disaster and how to obtain drinking water when water may not be available.
	1.3 Build and support local partnerships to continuously become less vulnerable to hazards. Improve collaboration between partner water agencies, first responders, emergency management planners, and the public to maintain water system reliability.
	1.4 Review the District's assets in high-risk areas to ensure they are adequately prepared for hazards
Goal 2: Minimize damage to critical infrastructure to maintain the continuity of essential water services	2.1 Address aging infrastructure issues to reduce/minimize the impacts from future hazards and disasters
	2.2 Increase water system redundancy
	2.3 Participate in programs that promote hazard mitigation strategies
Goal 3: Protect natural resources, including local water supply sources	3.1 Implement projects that reduce/minimize the impacts on adjacent natural resources from future hazards and disasters
	3.2 Promote beneficial uses of high-risk areas
	3.3 Increase the resiliency of the water supply to drought and other future weather effects
Goal 4: Increase public education, awareness, support, and demand for hazard mitigation activities	4.1: Raise awareness of customers to all hazards that can affect service and communicate the risk these hazards have in regard to District assets and continuity of service.
	4.2 Expand Public Outreach Campaigns for all hazards. Educate the public on actions they can take to prevent or reduce the loss of life or property from natural hazards.
Goal 5: Maintain and enhance mitigation capabilities	5.1 Incorporate hazard mitigation strategies and concerns into budgeting, plans, and polices of the district.
	5.2 Improve collaboration between partner water agencies, first responders, emergency management planners, and the public to maintain water system reliability
	5.3 Identify training opportunities for district employees
	5.4 Implement and maintain the HMP

Plan Development

This plan serves as the first LHMP developed for the District. The District LHMP adhered to the FEMA updated policy guide, FP-206-21-0002, Effective April 11, 2025, for all plan approvals.

Several factors underscore the need for this planning effort:

- The District is exposed to many natural hazards that have caused past damage.
- Limited local resources make it difficult to be preemptive in reducing risk. Eligibility for federal financial assistance is paramount to promote successful hazard mitigation in the planning area.
- The District recognizes the probability of certain future hazards increasing in severity or occurrences and wants to identify and implement mitigation actions that will address the needs of the District's customers most vulnerable to these hazards' impacts.
- The District and its partners participating in the development of this plan want to be proactive in preparing for the probable impacts of natural hazards.

This HMP was developed pursuant to the regulations of DMA 2000, and the implementing regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 CFR Section 201.6). While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that LHMPs must meet for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288).

Information in this plan will be used to help guide and coordinate mitigation activities in the future. Proactive mitigation planning will help reduce the cost of disaster response and recovery to the community and its property owners by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruption.

The plan was developed to meet the following objectives:

- Meet or exceed the requirements of the DMA.
- Enable the District to use federal grant funding to reduce risk through mitigation.
- Meet the needs of the District as well as state and federal requirements.
- Create a risk assessment that focuses on the District hazards of concern.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.

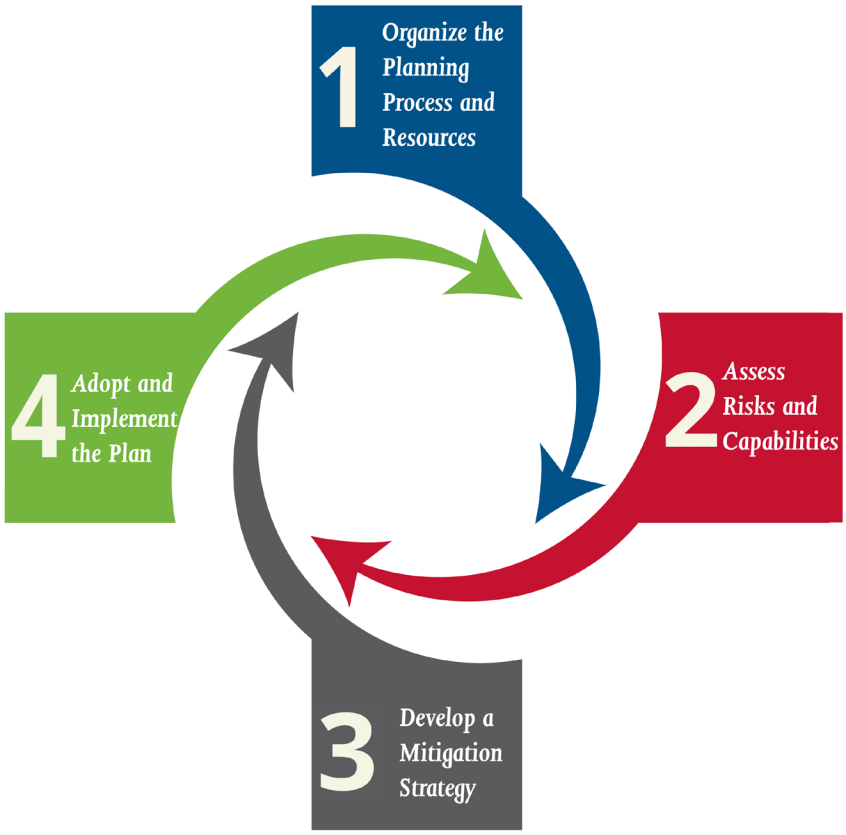
The District HMP is a customized single-jurisdictional plan tailored for a water district that geographically covers people (water customers), property, and critical water assets within the District's service area (hereinafter referred to as the planning area) This service area closely follows the City of Dickinson's jurisdictional boundary, but also includes land within areas that are considered unincorporated Galveston County.

All citizens and businesses that are service customers of the District are the ultimate beneficiaries of this LHMP.

Section 2: Planning Process

A1. (Requirement 44 CFR § 201.6(c)(1))

The mitigation planning process is slightly different for all, but regardless of the plan type, there are four core steps, or phases, in completing the development of a HMP or plan update. [2]



Phase 1 includes assembling the resources needed for a successful mitigation planning process. This includes securing technical expertise, defining the planning area, and identifying key individuals, agencies, neighboring jurisdictions, businesses, and/or other stakeholders to participate in the process.

The planning process for local governments must include opportunities for the public to comment on the plan.

Phase 2 includes identifying the characteristics and potential consequences of hazards. It is important to understand what geographic areas each hazard might impact and what people, property, or other assets might be vulnerable. The four basic components of a risk assessment are:

- Hazard identification;
- Profiling of hazard events;
- Inventory of assets; and
- Estimation of potential human and economic losses based on the exposure and vulnerability of people, buildings, and infrastructure.

Phase 3 is where the mitigation strategy for the HMP is developed. The strategy is based on an assessment of the unique set of regulatory, administrative, and financial capabilities the local government has in its tool belt to undertake mitigation. The mitigation strategy also includes a description of how the mitigation actions will be implemented and administered.

Phase 4 includes Plan adoption and implementation. Once FEMA has approved the HMP and received the adoption from the governing body, the local government can bring the mitigation plan to life in a variety of ways, ranging from implementing specific mitigation actions to changing aspects of day-to-day organizational operations.

To ensure success, the plan must remain a relevant, living document through routine maintenance. The District will need to conduct periodic evaluations to assess changing risks and priorities and make revisions to this HMP as required.

Phase 1: Organize Resources

In partnership with the District, H-GAC approached the hazard mitigation planning process by first organizing resources and establishing a Planning Team (PT) and a HMSC to guide the HMP. The PT included H-GAC staff and appointed staff from the District, which met biweekly to keep track of plan progress and milestones.

Pre-Kickoff Meeting, *April 16, 2024*

An initial meeting between H-GAC and the District was held on April 16th, 2024, to discuss the organizational aspects of the HMP, the formation of the steering committee, and scheduling a kickoff meeting of those invited to the HMSC.

Planning Team Members

Agency/ Organization	Title
WCID	General Manager
WCID	Management and Board Support Specialist
WCID	Water & Wastewater Superintendent
Communications Strategies, WCID	Owner, Communications Consultant
HDR Inc., WCID	Water & Wastewater Team Lead, District Engineer
H-GAC	Senior Planner, Community & Environmental Planning
H-GAC	Senior Manager, Community & Environmental Planning
H-GAC	Director, Community & Environmental Planning

Those who actively participated and attended meetings of the HMSC were considered an "HMSC Member" This list of active participants that helped guide plan development for the District is comprised of the PT (above), representatives from the Galveston County Office of Emergency Management, the City of Dickinson, the Gulf Coast Water Authority, the Galveston County Constable's Office, the Texas Department of Public Safety, and the Greater New Hope Baptist Church.

Other local, state, federal, and nongovernmental agencies and stakeholders who were invited to participate in this planning process are included in the table below and listed as "HMSC Invitee".

These invitees were included in copy to all HMSC meetings and public events and kept up to date on the HMP development through email (meeting announcements, meeting agendas, meeting notes, and handouts), social media posts, and text alerts (if they are a customer of the District). Invitations to attend and participate in the HMP development were continually extended to this extensive list of key stakeholders identified as they represent a range of community lifelines and essential services within the planning area and to neighboring communities, residents, and businesses. Additionally, H-GAC maintained an email list of interested citizens who signed up to

receive HMP updates at meetings, public events, and via email request to join the mailing list. These individuals are also included in the table below under the Plan Role: Mailing List.

A2. (Requirement 44 CFR § 201.6(b)(2))

Additional Invitees, HMSC, and Mailing List

Agency/ Organization	Title	Plan Role
American Red Cross- Texas Coastal Plains Chapter	Executive Director	HMSC Invitee
Bay Area Recovery Center-Rehab	Co-owner	HMSC Invitee
Bay Oil	Commercial Sales Manager	HMSC Invitee
Bayou Animal Services	Shelter Manager	HMSC Invitee
CenterPoint Energy, Electric	Utilities Manager	HMSC Invitee
CenterPoint Energy, Gas	Contact Coordinator	HMSC Invitee
City of Dickinson	EMS Director/ Emergency Management Coordinator (EMC)	**HMSC Member**
City of Dickinson	Councilmember	HMSC Invitee
City of Dickinson, Police Department	Criminal Investigations Division Sergeant/ Emergency Operations Coordinator	HMSC Invitee
City of Dickinson, Police Department	Police Chief	**HMSC Member**
City of League City	Emergency Management Coordinator	HMSC Invitee
City of League City	Director of Public Works	HMSC Invitee
City of Texas City	Emergency Manager	HMSC Invitee
Dickinson ISD Administration	Superintendent	HMSC Invitee
Dickinson ISD, Education Foundation	Director	HMSC Invitee
Dickinson Volunteer Fire Department	Battalion Chief	HMSC Invitee
Galveston County	Constable, Precinct 1	HMSC Invitee
Galveston County	Constable, Precinct 2	HMSC Invitee
Galveston County	Constable, Precinct 3	HMSC Invitee
Galveston County	Sergeant, Precinct 4	**HMSC Member**
Galveston County Emergency Communications District	Executive Director	HMSC Invitee
Galveston County Local Emergency Planning Committee	Fire Marshall/ Emergency Management Coordinator	HMSC Invitee

Agency/ Organization	Title	Plan Role
Galveston County Office of Emergency Management	Emergency Management Coordinator	**HMSC Member**
Galveston County Office of Emergency Management	Deputy Emergency Management Coordinator, Retired	**HMSC Member**
Galveston County Office of Emergency Management	Emergency Management Specialist	**HMSC Member**
Galveston County Sheriff's Office	Retired	HMSC Invitee
Greater New Hope Baptist Church	Pastor	**HMSC Member**
Gulf Coast Water Authority	Plant Manager	**HMSC Member**
HAZMAT-League City Fire Department	Chief	HMSC Invitee
HAZMAT-Texas City Fire Department	Chief	HMSC Invitee
Higher Up Texas	Chief Executive Officer	HMSC Invitee
M.I. Lewis Social Service Center	Executive Director	HMSC Invitee
McRee Ford	Parts and Services Director	HMSC Invitee
National Weather Service	Meteorologist	HMSC Invitee
Queen of Angels Academy		HMSC Invitee
Red Cross Texas Coastal Plains Chapter	Disaster Program Specialist	HMSC Invitee
TDEM	Disaster & Recovery Agent	HMSC Invitee
Texas A&M AgriLife Extension Service, Texas Community Watershed Partners	Green Infrastructure for Texas (GIFT) Program Director	HMSC Invitee
Texas Department of Public Safety	Sergeant, Highway Patrol	HMSC Invitee
Texas EquuSearch		HMSC Invitee
Texas Department of Public Safety	DPS Sergeant	**HMSC Member**
Texas-New Mexico Power	Team Assistant III	HMSC Invitee
Texas-New Mexico Power	Project Manager	HMSC Invitee
Texas-New Mexico Power		HMSC Invitee
True Cross Catholic School	Principal	HMSC Invitee
TXDOT La Marque Office	Area Engineer	HMSC Invitee
TXDOT La Marque Office	Maintenance Supervisor	HMSC Invitee
Union Pacific	Senior Director, Public Affairs	HMSC Invitee
United Way of Galveston County	Executive Director	HMSC Invitee
Veterans of Foreign Wars of the United States	Quarter Master	HMSC Invitee

Agency/ Organization	Title	Plan Role
	Citizen	Mailing List, Attended Kickoff Meeting
	Citizen	Mailing List, Attended Kickoff Meeting
	Citizen	Mailing List, Attended Public Event
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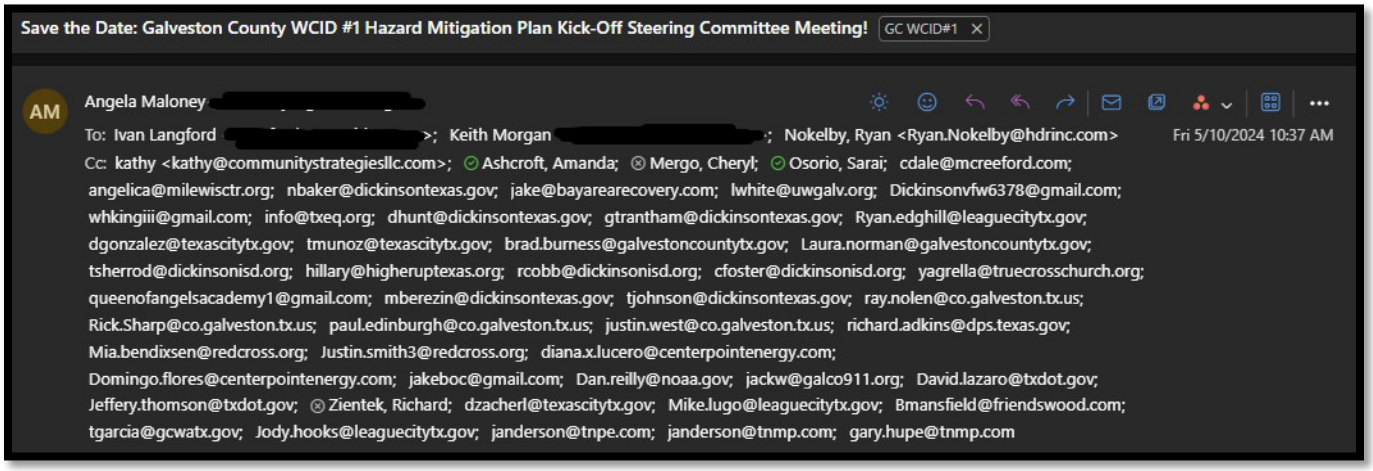
	Citizen	Mailing List, Attended Public Event

Meeting announcements and notes were shared via email to all mailing lists (PT, HMSC, Mailing list subscribers) on the District website, the H-GAC Hazard Mitigation website, and on the District's social media accounts. All HMSC meetings hosted for this plan development were open to the public and were conducted in a hybrid format via Zoom, and at locations within the City of Dickinson that were accessible for all residents (City Hall or District offices).

Meeting 1: HMSC Kickoff, *June 4, 2024*

The beginning of Phase 1 for the District included a HMP kickoff meeting, held in June 2024. This meeting covered the scope of work, DMA 2000 requirements, the purpose and need for the District to develop a LHMP, project timeline, and HMSC expectations for active participation. This invitation can be viewed below.

District HMP Kickoff Meeting Invitation, HMSC invitees



Save the Date: Galveston County WCID #1 Hazard Mitigation Plan Kick-Off Steering Committee Meeting! GC WCID#1

AM **Angela Maloney** [redacted]

To: Ivan Langford [redacted]; Keith Morgan [redacted]; Nokelby, Ryan <Ryan.Nokelby@hdrinc.com> Fri 5/10/2024 10:37 AM

Cc: kathy <kathy@communitystrategiesllc.com>; Ashcroft, Amanda; Mergo, Cheryl; Osorio, Sarai; cdale@mcreeford.com; angelica@milewisctr.org; nbaker@dickinsontexas.gov; jake@bayarearecovery.com; lwhite@uwgalv.org; Dickinsonvfw6378@gmail.com; whkingiii@gmail.com; info@txeq.org; dhunt@dickinsontexas.gov; gtrantham@dickinsontexas.gov; Ryan.edghill@leaguecitytx.gov; dgonzalez@texascitytx.gov; tmunoz@texascitytx.gov; brad.burness@galvestoncountytx.gov; Laura.norman@galvestoncountytx.gov; tsherrod@dickinsonisd.org; hillary@higheruptexas.org; rcobb@dickinsonisd.org; cfoster@dickinsonisd.org; yagrella@truecrosschurch.org; queenofangelsacademy1@gmail.com; mberezin@dickinsontexas.gov; tjohnson@dickinsontexas.gov; ray.nolen@co.galveston.tx.us; Rick.Sharp@co.galveston.tx.us; paul.edinburgh@co.galveston.tx.us; justin.west@co.galveston.tx.us; richard.adkins@dps.texas.gov; Mia.bendixsen@redcross.org; Justin.smith3@redcross.org; diana.x.lucero@centerpointenergy.com; Domingo.flores@centerpointenergy.com; jakeboc@gmail.com; Dan.reilly@noaa.gov; jackw@galco911.org; David.lazaro@txdot.gov; Jeffery.thomson@txdot.gov; Zientek, Richard; dzacherl@texascitytx.gov; Mike.lugo@leaguecitytx.gov; Bmansfield@friendswood.com; tgarcia@gcwatx.gov; Jody.hooks@leaguecitytx.gov; janderson@tnpe.com; janderson@tnmp.com; gary.hupe@tnmp.com

Save the Date: Galveston County WCID #1 Hazard Mitigation Plan Kick-Off Steering Committee Meeting!
Date: Tuesday, June 4th, 6:00 PM
Location: Dickinson City Hall
4403 Highway 3, Dickinson, TX 77539
RSVP by Tuesday, May 21, 2024
Light refreshments will be served.
Although in person attendance is preferred, for those who cannot attend in person, a Zoom link will be provided closer to the meeting date.

We would like to invite you or another representative from your organization to participate in the planning process to develop a Hazard Mitigation Plan (HMP) for Galveston County Water Control and Improvement District #1 (Galveston County WCID #1). Galveston County WCID #1 is working in partnership with the Houston-Galveston Area Council (H-GAC) to develop the plan. The planning process will require a broad range of input and expertise from individuals, ***and any interested person may serve on this committee***. We will meet periodically to discuss items pertinent to the HMP, host public engagement events, and solicit your feedback on the draft plan and its various components.

The Hazard Mitigation Committee will examine Galveston County WCID #1's risks and vulnerability to all hazards and assess Galveston County WCID #1's vulnerability to those risks. Additionally, they will look at critical infrastructure and key resources to determine which are most susceptible to risks.

What is the Hazard Mitigation Plan? The Hazard Mitigation Plan is a framework that guides our community in making decisions and developing policies to reduce or eliminate risk to life and property. The plan identifies the types of hazards that threaten our community, evaluates our vulnerability to those threats, and outlines a strategy to reduce or eliminate the risk posed by those threats to break the cycle of repeated destruction by natural hazard events.

Who participates in the Hazard Mitigation Plan? Hazard mitigation planning is the process used by state, local and tribal leaders to understand risks from natural hazards and develop long-term strategies to reduce the impacts of disasters on people, property, and the environment.

Why is the plan important? The Federal Disaster Mitigation Act of 2000 (DMA 2000) requires that a community/Special Purpose District have an approved hazard mitigation plan in order to be eligible to apply for and receive FEMA hazard mitigation funds. Receipt of these funds can be critical to implementation of identified hazard mitigation programs.

Don't miss this opportunity to shape the future of Galveston County WCID #1. Your presence and input are invaluable as we work together towards a safer, more resilient community. See you there!

Angela Maloney
Management & Board Support Specialist
Galveston County WCID #1

A summary of those who participated in meetings and events held for this plan development can be seen in the table below.

Participation Matrix

Agency / Organization	Position	Kickoff Meeting	Hurricane Preparedness Fair 6/15/24	HIRA 8/6/24	Dickinson Bicentennial 10/12/24	Goals & Objectives 10/24/24
American Red Cross- Texas Coastal Plains Chapter	Executive Director					
Bay Area Recovery Center-Rehab	Co-owner					
Bay Oil	Commercial Sales Manager					
Bayou Animal Services	Shelter Manager					
CenterPoint Energy, Electric	Utilities Manager					
CenterPoint Energy, Gas	Contact Coordinator					
City of Dickinson	EMS Director/ EMC	X				X
City of Dickinson	Councilmember					
City of Dickinson, Police Department	Criminal Investigations Division Sergeant/ Emergency Operations Coordinator					
City of Dickinson, Police Department	Police Chief	X				
City of League City	Emergency Management Coordinator					
City of League City	Director of Public Works					
City of Texas City	Emergency Manager					
Communications Strategies, Galveston County WCID #1	Owner, Communications Consultant	X		X		
Dickinson ISD Administration	Superintendent					
Dickinson ISD, Education Foundation	Director					

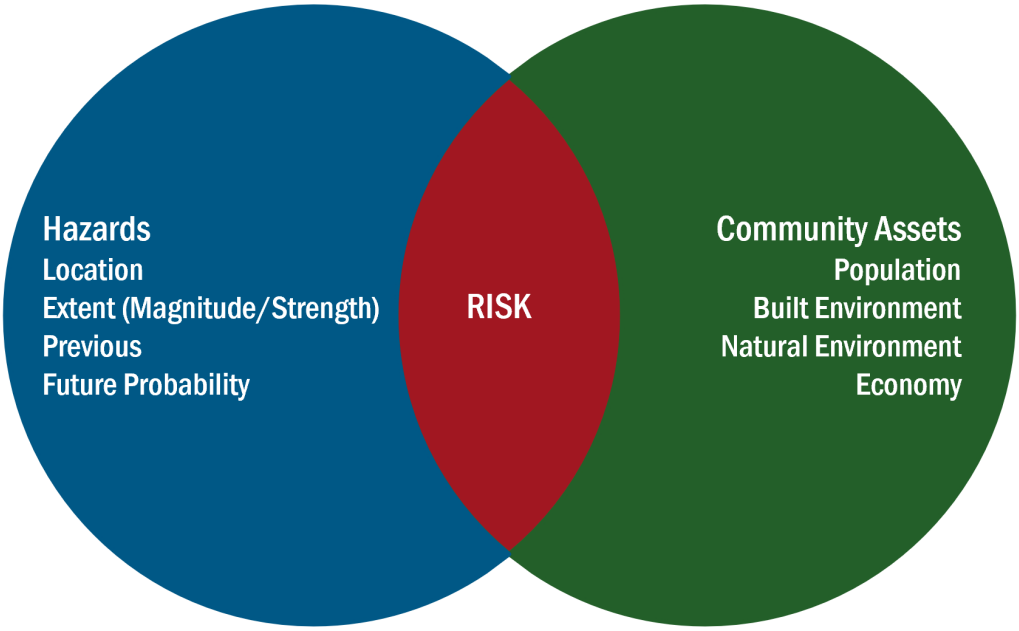
Agency / Organization	Position	Kickoff Meeting	Hurricane Preparedness Fair 6/15/24	HIRA 8/6/24	Dickinson Bicentennial 10/12/24	Goals & Objectives 10/24/24
Dickinson Volunteer Fire Department	Battalion Chief					
Galveston County	Constable, Precinct 1					
Galveston County	Constable, Precinct 2					
Galveston County	Constable, Precinct 3					
Galveston County	Sergeant, Precinct 4	X		X		X
Galveston County Emergency Communications District	Executive Director					
Galveston County Local Emergency Planning Committee	Fire Marshall/ Emergency Management Coordinator					
Galveston County Office of Emergency Management	Emergency Management Coordinator			X		X
Galveston County Office of Emergency Management	Deputy Emergency Management Coordinator, Retired	X	X			
Galveston County Office of Emergency Management	Emergency Management Specialist			X		X
Galveston County Sheriff's Office	Retired					
Galveston County WCID #1	General Manager	X		X	X	X
Galveston County WCID #1	Management and Board Support Specialist	X		X	X	X
Galveston County WCID #1	Water & Wastewater Superintendent	X		X		X
Greater New Hope Baptist Church	Pastor	X		X	X	
Gulf Coast Water Authority	Plant Manager	X		X		X
HAZMAT-League City Fire Department	Chief					
HAZMAT-Texas City Fire Department	Chief					

Agency / Organization	Position	Kickoff Meeting	Hurricane Preparedness Fair 6/15/24	HIRA 8/6/24	Dickinson Bicentennial 10/12/24	Goals & Objectives 10/24/24
HDR Inc., Galveston County WCID #1	Water & Wastewater Team Lead, District Engineer	X		X		
H-GAC	Senior Planner	X	X	X	X	X
H-GAC	Senior Manager	X	X	X	X	
H-GAC	Director, Community & Environmental					
Higher Up Texas	Chief Executive Officer					
M.I. Lewis Social Service Center	Executive Director					
McRee Ford	Parts and Services Director					
National Weather Service	Meteorologist					
Queen of Angels Academy						
Red Cross Texas Coastal Plains Chapter	Disaster Program Specialist					
TDEM	Disaster & Recovery Agent					
Texas A&M AgriLife Extension Service	Green Infrastructure for Texas (GIFT) Program Director					
Texas Department of Public Safety	Sergeant, Highway Patrol					
Texas EquuSearch						
Texas Department of Public Safety	DPS Sergeant			X		
Texas-New Mexico Power	Team Assistant III					
Texas-New Mexico Power	Project Manager					
Texas-New Mexico Power						
True Cross Catholic School	Principal					
TXDOT La Marque Office	Area Engineer					
TXDOT La Marque Office	Maintenance Supervisor					

Agency / Organization	Position	Kickoff Meeting	Hurricane Preparedness Fair 6/15/24	HIRA 8/6/24	Dickinson Bicentennial 10/12/24	Goals & Objectives 10/24/24
Union Pacific	Senior Director, Public Affairs					
United Way of Galveston County	Executive Director					
Veterans of Foreign Wars of the United States	Quarter Master					

Phase 2: Assess Risks

Risk assessments are conducted to determine the potential impacts of identified hazards on human safety, the planning area, the economy, and both the developed and natural environments. Risk, as viewed from a hazard mitigation perspective, is the potential for loss of life, personal injury, property damage, loss or other impacts created by the interaction of natural hazards with local citizens and community assets FEMA has provided a diagram, seen below, that helps best illustrate the concept of risk as the overlap between hazards and community assets – the smaller the overlap, the lower the risk.

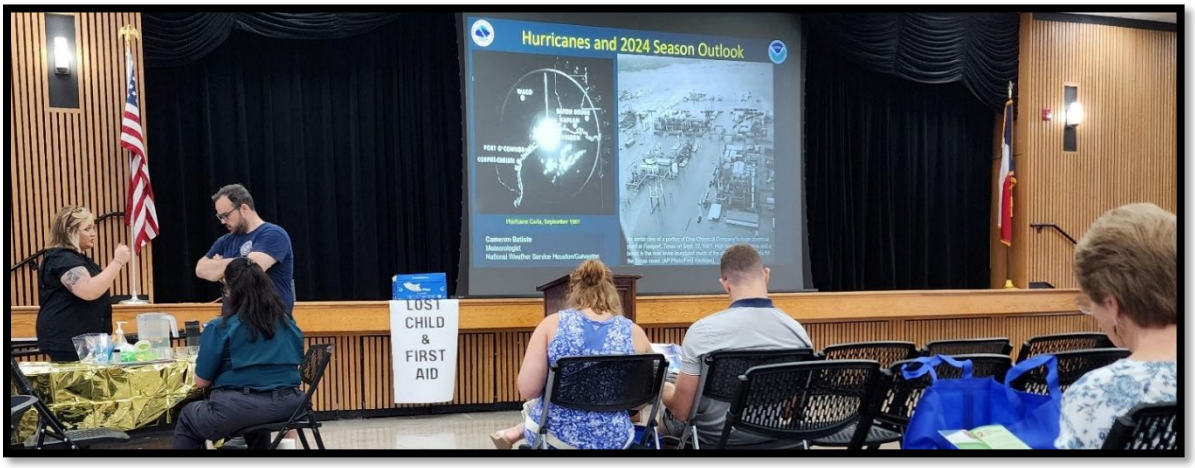


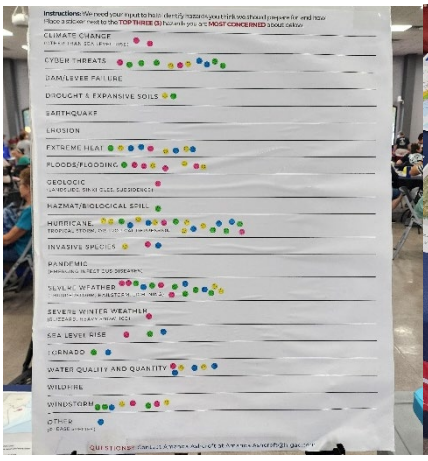
Each hazard identified within this HMP includes a description of the location, extent, previous occurrence, and probability of future occurrences. Hazards are then evaluated on the basis of potential impact on the community and the community's overall vulnerability.

A3. (Requirement 44 CFR § 201.6(b)(1))

Public Engagement Event: Hurricane Preparedness and Safety Fair, *June 15, 2024*

This event, hosted by the Dickinson Office of Emergency Management in collaboration with the City of League City Office of Emergency Management, was heavily attended. various information about risks and resources available to them, with free food, emergency vehicle tours, and raffle prizes of emergency preparedness items. During the event, H-GAC set up a table to gather input for the HMP. The District provided branded rubber ducks and kids' coloring book packets for attendees who interacted with the public engagement materials. Materials included a dot exercise where residents could mark their top 3 hazards of concern (in relation to their water and wastewater services). There was a large format printed map of the District boundaries where participants could mark areas of concern within their community or add critical facilities to the map, an input exercise where participants could make suggestions on the drafted HMP mission statement, and a sign-up sheet to join the mailing list for HMP updates. H-GAC also provided handouts and information about the HMP and its importance, disaster preparedness flyers with preparedness checklists for vulnerable populations (translated in 4 different languages), and flyers with a QR code that linked to the online survey that also gave a brief overview of the HMP.





Meeting 2: Hazard Identification and Risk Assessment, *August 6, 2024*

At this meeting, H-GAC staff discussed the HIRA process for developing a HMP specific to the District. The HMSC received a handout that included various hazards included in the Texas Division of Emergency Management's (TDEM) 2023 Texas State HMP, hazards included within other recent HMPs from surrounding areas/counties, and public input results that were obtained at the Galveston County Hurricane Preparedness and Safety Fair on 6/15. The Steering Committee then identified key natural and human-caused hazards of concern that could affect the District and its critical infrastructure.

Identified hazards included hurricanes, severe winter weather, flooding, drought/expansive soils, extreme heat, severe weather (tornadoes, hail, lightning, wind), wildfire, cyber threats, water quality/quantity issues, hazmat, and pandemic. The Steering Committee discussed grouping related hazards (e.g., severe weather including tornado, hail, lightning) into hazard profiles.

The Steering Committee was provided a Risk Assessment worksheet to rank the probability and severity for each hazard identified in the previous exercise. Scores given were specific to their impact on GCWCID#1 operations and infrastructure. The Risk Assessment was discussed, and hazards were scored collectively as a HMSC. The hazard ranking was then compared to the State HMP for Region 4 and public input data. The Steering Committee discussed their scores and agreed on the ranking of Hazards (High, Medium, Low). Risk Assessment results can be viewed in more detail with other meeting documentation in Appendix D.

Risk Assessment

RISK ASSESSMENT: To rank hazard risk, probability and severity must be determined.

PROBABILITY: A measure of how likely an event will occur
SEVERITY: How much a hazard affects the functionality of society and natural environment
Use the tables above as a guide

Hazard	Probability (1, 2, 3, 4)	Severity (1, 2, 4, 8)	Risk (P x S)	Ranking
~~Hurricane~~				
Severe Winter Weather	4	4	16	1
Hurricane,	4	4	16	1
Flooding	3	2	6	2
Drought & Expansive Soils	4	1	4	3
Extreme Heat	4	1	4	3
Severe Weather	4	1	4	3
Dam/Levee Failure	1	1	1	3
[redacted] fire	1	1	1	3
Cyber Threats	4	8	32	1
[redacted]				
Water Quality & Quantity	2	4	8	2
Hazmat	1	8	8	2
Pandemic	2	1	2	3
[redacted]				

20ft Surge would put water plant underwater

Hurricane + Storm Surge

Hail Tornado Lightning Wind

IT (Internet Technology)
OT (operational technology)
PS (physical security)

* WCID #1 Drought Contingency Plan

Gulf Coast Water Authority
↳ Water Supplier

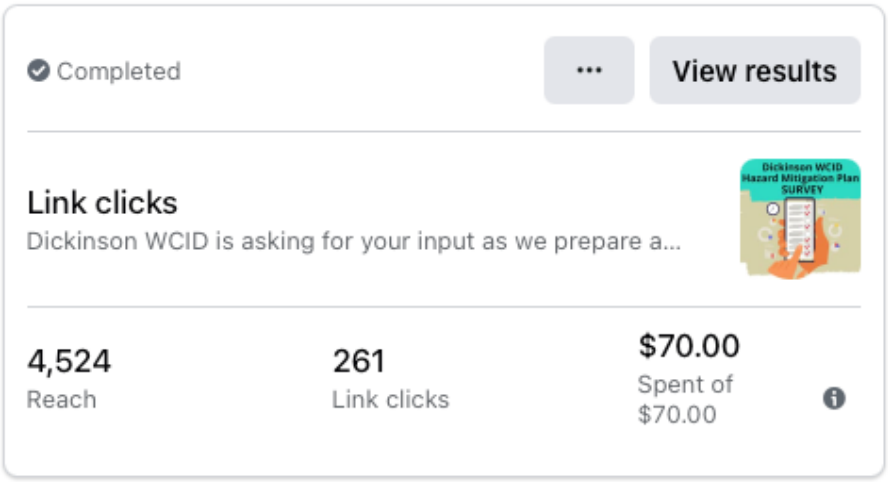
Planning Team Meeting: Capability Assessment, *September 11, 2024*

The PT held a regularly scheduled biweekly meeting where the various components of the capability assessment worksheet were reviewed. The worksheet was sent out to the PT to be completed and returned.

Online Public Survey, *October 17, 2024 – November 22, 2024*

An online survey was developed to gather input from the public regarding hazards of concern and levels of preparedness to hazards. The survey was shared on the District website and social media, sent to District customers via water bill inserts, and advertised via the H-GAC Hazard Mitigation website. The survey was also advertised on social media and boosted for visibility.

The HMP Survey ad had a reach of 4,524 and 261 clicks to the survey link. The online survey was open from October 17, 2024, to November 22, 2024, and received 451 views and 80 responses through the survey website, JotForm. Survey results were compiled and presented to the HMSC to highlight where the public and HMSC differed on hazard rankings and concerns before a final ranking for this LHMP was decided. A full list of survey results can be found in Appendix E.



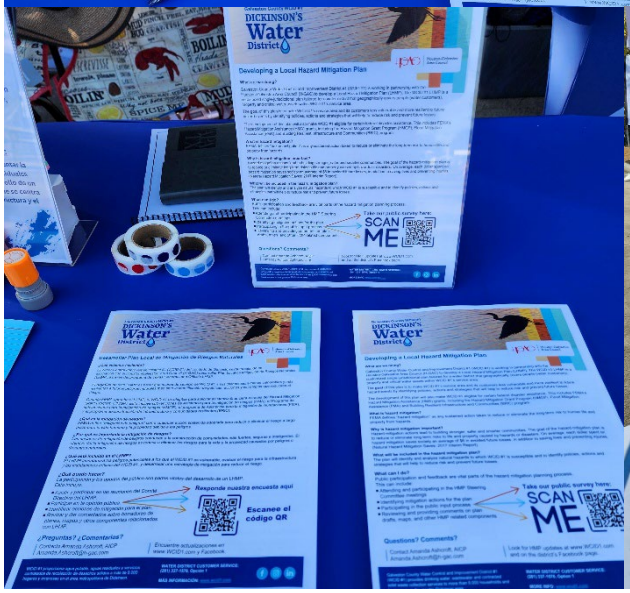
Public Engagement Event: Dickinson's Bicentennial Celebration, *October 12, 2024*

The 200th year celebration for the City of Dickinson was hosted by Keep Dickinson Beautiful, a 501c(3) non-profit organization, comprised of Dickinson citizens interested in creating a beautiful, sustainable community environment. The festival was held around the grounds of City Hall and had a full schedule of performers and events throughout the day. There were multiple vendors, a vintage car parade, a cook-off, a vintage car show, and carnival rides and games. The District helped sponsor the event by providing waste services and staff time. During the event, H-GAC and District staff set up a table to gather input for the HMP. The District provided branded rubber ducks and kids' coloring book packets for attendees who interacted with the public engagement materials. Materials included a dot exercise where residents could mark their top 3 hazards of concern (in relation to their water and wastewater services). There was a large format printed map of the District boundaries where participants could mark areas of concern within their community or add critical facilities to the map, an input exercise where participants could make suggestions on the drafted HMP mission statement, and a sign-up sheet to join the mailing list for HMP updates. H-GAC also provided handouts and information about the HMP and its importance, disaster preparedness flyers with preparedness checklists for vulnerable populations (translated in 4 different languages), and flyers with a QR code that linked to the online survey that also gave a brief overview of the HMP.

All materials were translated into Spanish, including the online survey.


LHMP Mission Statement:
Declaración de la misión del LHMP:
Rate our Mission Statement
I like it!
Tell us how we can improve!

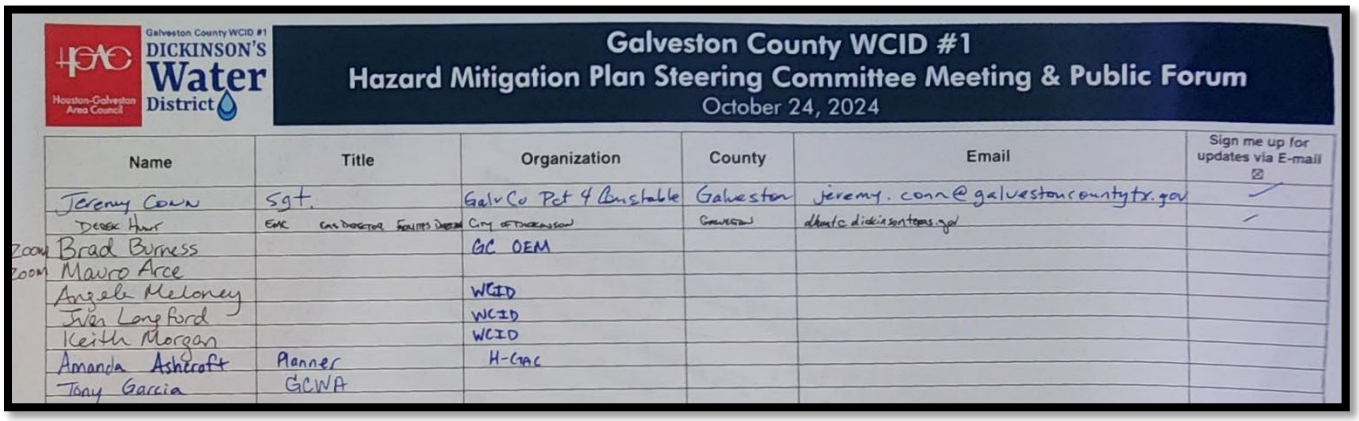

GC WCID #1: Floodplain
SCAN ME
SEVERE WEATHER (TH
CLIMA SEVERO (TORM
PANDEMIC
PANDEMICO
EXTREME HEAT
CALOR EXTREM


DICKINSON'S
Water
District
Developing a Local Hazard Mitigation Plan
SCAN ME
Escanee el código QR

Phase 3: Develop the Mitigation Strategy

Meeting 3: Public Forum, Goals and Objectives, *October 24, 2024*

The purpose of this Public Forum and HMSC meeting was to provide a hazard mitigation planning project overview from the PT and solicit feedback and information from stakeholders. Feedback activities were organized 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 planning area, how these communications could be improved, and a dot exercise where participants had to notate their top three hazards of concern using stickers. Unfortunately, no members of the public attended.



Galveston County WCID #1
DICKINSON'S Water District

Galveston County WCID #1
Hazard Mitigation Plan Steering Committee Meeting & Public Forum
October 24, 2024

Name	Title	Organization	County	Email	Sign me up for updates via E-mail
Jeremy Conn	Sgt.	GalvCo Pct 4 Constable	Galveston	jeremy.conn@galvestoncountytx.gov	✓
Derek Hur	EMC Coordinator Facilities Director	City of Dickinson	Galveston	dhur@ci.dickinson.tx.us	✓
Zoom Brad Burress		GC OEM			
Zoom Mauro Arce					
Angela Meloney		WCID			
Ivan Longford		WCID			
Keith Morgan		WCID			
Amanda Ashcroft	Planner	H-GAC			
Tony Garcia	GCWA				

Those in attendance included members of the HMSC who then conducted a SMART goal-setting exercise to help guide the mitigation strategy, reviewed online survey results, notated differences in responses from the public, and outlined the next steps for the HMP.

Phase 4: Plan Implementation and Monitoring

Planning Team Meeting: Content Review, *February 20, 2025*

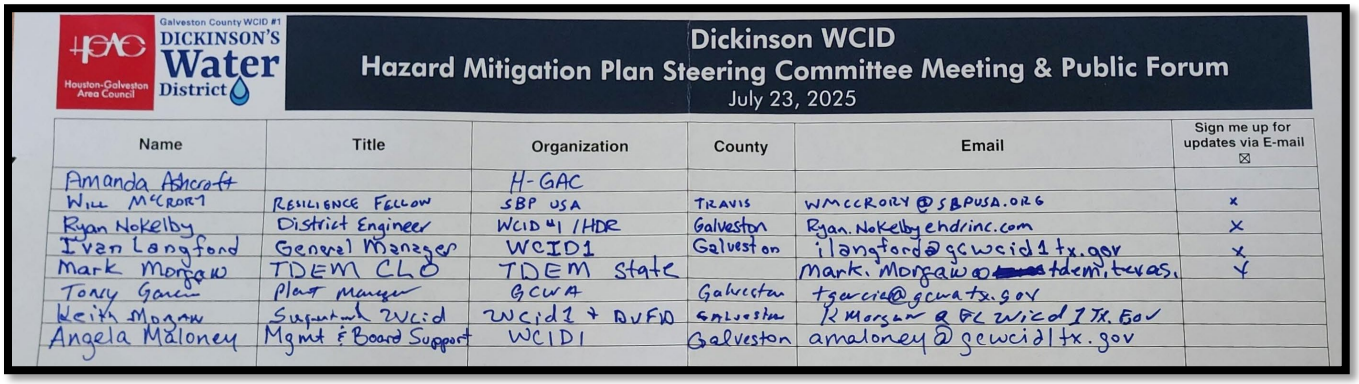
The PT held a regularly scheduled biweekly meeting where the draft plan content was reviewed. The PT made suggestions to be incorporated while H-GAC staff made changes in real time.

Planning Team Meeting: Plan Maintenance Procedures, *March 21, 2025*

The PT held a regularly scheduled biweekly meeting where the draft plan content was reviewed and the plan maintenance procedures were discussed. The PT also outlined procedures for continued public outreach to communicate plan updates, the roles and responsibilities of the Plan Maintenance Team (PMT), and timelines leading up to the regular 5-year update (as required by FEMA) so there is no lapse in HMP coverage for the District.

Meeting 4: Public Forum, Draft Plan Review, *July 24, 2025*

The purpose of this Public Forum was to provide an opportunity for the public to provide comments on the draft plan and ask questions directly to staff and HMSC members in attendance. The meeting was hosted in person at the City of Dickinson City Hall at 6:00 PM. Despite being advertised via website and social media, there were no members of the public in attendance. H-GAC staff discussed the next steps for the draft plan- submittal to TDEM.



Galveston County WCID #1
DICKINSON'S Water District
Houston-Galveston Area Council

Dickinson WCID
Hazard Mitigation Plan Steering Committee Meeting & Public Forum
July 23, 2025

Name	Title	Organization	County	Email	Sign me up for updates via E-mail ☒
Amanda Ashcraft		H-GAC			
Will McCrory	Resilience Fellow	SBP USA	Travis	WMccrory@SBPUSA.org	x
Ryan Nokelby	District Engineer	WCID #1 / HDR	Galveston	Ryan.Nokelby@hdrinc.com	x
Ivan Langford	General Manager	WCID1	Galveston	ilangford@gcwcid1tx.gov	x
Mark Morgan	TDEM CLO	TDEM State		Mark.Morgan@tdem.texas.	x
Tony Garcia	Plant Manager	GCWA	Galveston	tgarcia@gcwatx.gov	
Keith Morgan	Superintendent WCID	WCID1 + DVFD	Galveston	KMorgan@DCwcid1Tx.Gov	
Angela Maloney	Mgmt & Board Support	WCID1	Galveston	amaloney@gcwcid1tx.gov	

Section 3: District Profile and Capability Assessment

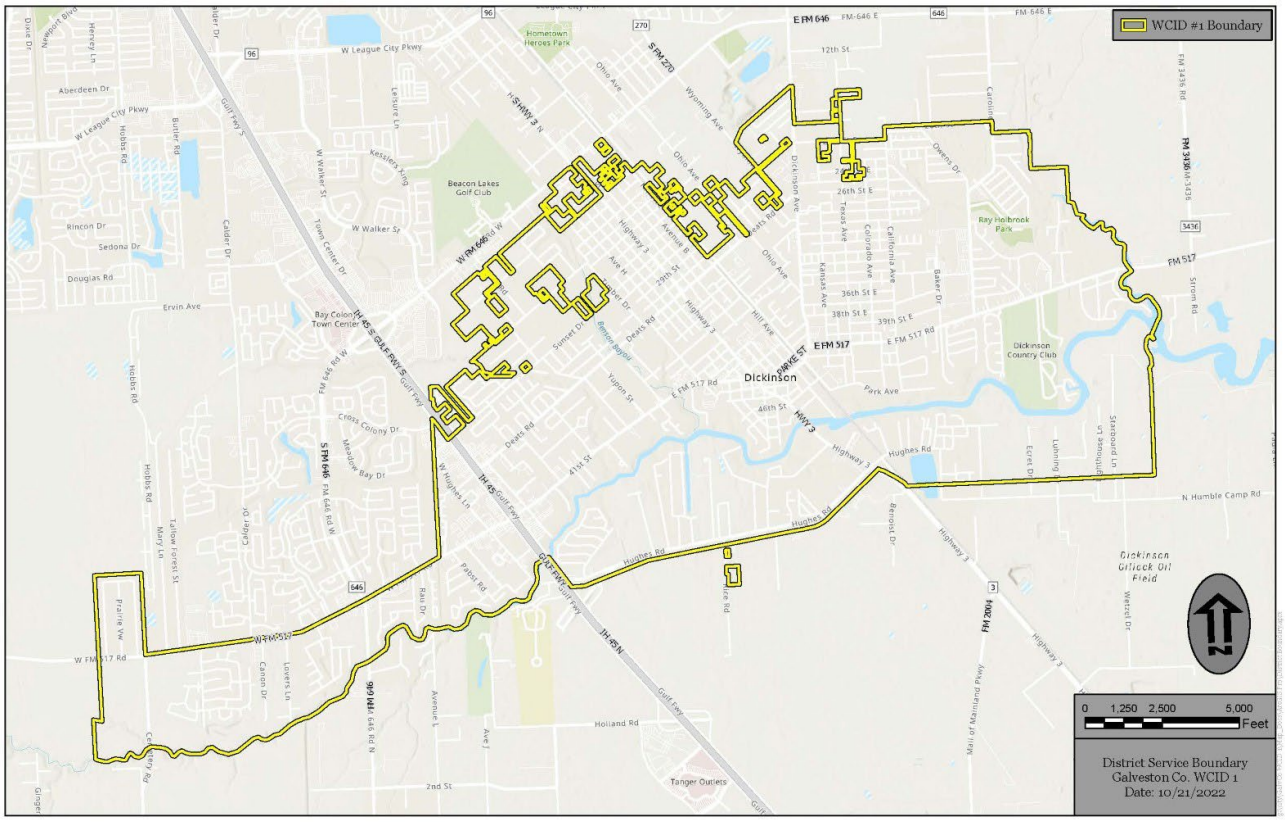
C1. (Requirement 44 CFR § 201.6(c)(3))

The District was established in 1938 by a vote of Dickinson residents as the Dickinson Fresh Water Supply District No. 1 to provide water services. It converted to the Galveston County Water Control and Improvement District No. 1 in 1939 to provide water and sewer services. In 1995, the District adopted a doing business as (DBA) of The Water Company, which has since been changed to Dickinson's Water District.

The District is the oldest and largest retail water district in the state of Texas and has a population of 19,849 based on the most recent metered unit connection count and the average number of people per metered unit. Most of these customers are residential, but the District has many commercial customers as well along the IH-45, FM 517, and Highway 3 corridors.

In 2024, the District's name was formally changed to Dickinson Water Control and Improvement District to more accurately reflect the area served.

Service Area Map



Water Supply

Due to regional land subsidence issues, the District converted from groundwater to surface water in 1983. Since then, the District has purchased treated drinking water (sourced at the Brazos River) from the GCWA's Thomas Mackey Water Treatment Plant located in Texas City.

NFIP Participation

C2. (Requirement 44 CFR § 201.6(c)(3)(ii))

Due to the District's limited authority, the District is not a participant in the National Flood Insurance Program (NFIP). The land within the district's boundaries is either within Galveston County or the City of Dickinson; both entities are participants in the NFIP. The City of Dickinson is the Floodplain Administrator for the area within the District's boundaries.

District Assets

This HMP assesses the potential risk that natural hazards pose to buildings, infrastructure, and equipment owned by the District. This assessment of risk requires that an inventory of key facilities be developed. The inventory created for this plan includes two parts: an overview count of specific types of assets that the District owns, and a listing of the estimated replacement value of key assets. The key assets generally consist of buildings, pumps, tanks, valves, and pipelines, which are defined for this plan as the District's critical facilities. The list below includes key points regarding the District's assets and critical facilities, while the table highlights replacement cost values of those assets and critical infrastructure.

- The population estimate for customers served is over 19,000, with 8,430 active connections.
- The District's primary source of potable (finished) water is from the GCWA.
- The District's water distribution system contains 146 miles of water pipelines ranging from 20" to 2" in diameter.
- Wastewater Treatment Plant (WWTP)- The site is an active wastewater treatment facility with three clarifiers, two aeration basins, two contact chambers, one sand filter, one sand digester, and one sludge press. The clarifiers, aeriation basins, and contact chambers are open to the elements on top. A warehouse, office/lab, and multiple electrical/control buildings are also located on the property. All other chemicals and areas with pollutants of concern are contained under rain-resistant shelters and do not come in contact with normal stormwater runoff.

- System water demands in million gallons per day (MGD)
    - System Capacity:
        - Normal Operation: 5.5 MGD
        - Emergency Operation (the demand in MGD from the highest usage within the last 3 years, excluding fire events and large water main breaks): 8.5 MGD
    - Average daily demand:
        - Normal Operation: 2.2 MGD
        - Emergency Operation: 4.6 MGD
    - Maximum daily demand:
        - Normal Operation: 3.5 MGD
        - Emergency Operation: 4.6 MGD

The table below summarizes the District's critical facilities and their replacement cost value.

WCID, Critical Infrastructure

Type	Number of Structures	Replacement Cost Value
Administrative Facilities		
Buildings – Front Office	1	$2,000,000
Buildings – Field Office	1	$2,000,000
TOTAL:		**$4,000,000**
Potable Water Facilities		
Potable Water Pump Stations	4	$20,000,000
Elevated Storage Tanks	2	$30,000,000
Ground Storage Tanks	4	$25,000,000
Ground Water Wells	4	$15,000,000
Hydrants	1,025	$7,500,000
Water Pipe, 2" to 20"	765,000 feet	$200,000,000
TOTAL:		**$297,500,000**
Wastewater Facilities		
Wastewater Treatment Plant	1	$100,000,000
Lift Stations	34	$51,000,000
Sewer Force Mains	84,500 feet	$13,000,000
Gravity Sewer Lines	630,000 feet	$315,000,000
Sewer Manholes	1,800	$27,000,000
TOTAL:		**$506,000,000**
Service Connections		
Water Service Connections	8,500	$8,500,000
Sewer Service Connections	8,500	$8,500,000
TOTAL:		**$17,000,000**
Other		
Vehicle Fleet – rolling stock	60	$4,200,000
Maintenance Buildings	2	$4,000,000
Alternate Power Source	20	$10,000,000
TOTAL:		**$18,200,000**
TOTAL:		**$842,700,000**

History of Hazard Events

There are two types of disaster declarations provided for in the Stafford Act: emergency declarations and major disaster declarations. Both authorize the President to provide supplemental federal disaster assistance. However, the events related to the two different types of declaration, scope, and amount of assistance will differ.

The United States (U.S.) began systematically recording presidential disaster declarations with the passing of the Disaster Relief Act of 1974 which established the process for presidential disaster declarations, marking the first federal legislation detailing this procedure; this is considered the starting point for comprehensive disaster declaration recording. [3] 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. [4]

Emergency Declarations

The President can declare an emergency for any occasion or instance when they determine federal assistance is needed. Emergency declarations supplement government efforts in providing emergency services (e.g. the protection of lives, property, public health, and safety) or to lessen or avert the threat of a catastrophe in any part of the U.S.

Major Disaster Declarations

The President can declare a major disaster for any natural event, including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought, or, regardless of cause, fire, flood, or explosion, that the President determines has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond. A major disaster declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work.

Review of presidential disaster declarations helps establish the probability of recurrence and identify goals and actions for risk reduction.

There have been **31** presidential disaster declarations in Galveston County, Texas, since the recording of the first disaster declaration began in 1953. [5,6] The table below highlights disaster declarations that have occurred within the last 30 years (there are 26 events in total).

Federal Disaster Declarations

Date	Disaster #	Declaration Type	Incident Type	Title
10/18/1994	1041	Major Disaster Declaration	Flood	Severe Thunderstorms and Flooding
8/26/1998	1239	Major Disaster Declaration	Severe Storm	Tropical Storm Charley
9/23/1998	1245	Major Disaster Declaration	Severe Storm	Hurricane Georges - Texas
10/21/1998	1257	Major Disaster Declaration	Flood	Tx-Flooding 10/18/98
9/1/1999	3142	Emergency Declaration	Fire	Extreme Fire Hazards
6/9/2001	1379	Major Disaster Declaration	Coastal Storm	Tx-Tropical Storm Allison
9/26/2002	1434	Major Disaster Declaration	Coastal Storm	Tropical Storm Fay
7/17/2003	1479	Major Disaster Declaration	Hurricane	Hurricane Claudette
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
8/18/2007	3277	Emergency Declaration	Hurricane	Hurricane Dean
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
11/25/2015	4245	Major Disaster Declaration	Severe Storm	Severe Storms, Tornadoes, Straight-Line Winds, and Flooding
8/25/2017	4332	Major Disaster Declaration	Hurricane	Hurricane Harvey

Date	Disaster #	Declaration Type	Incident Type	Title
3/13/2020	3458	Emergency Declaration	Biological	Covid-19
3/25/2020	4485	Major Disaster Declaration	Biological	Covid-19 Pandemic
7/26/2020	3530	Emergency Declaration	Hurricane	Hurricane Hanna
8/24/2020	3540	Emergency Declaration	Hurricane	Tropical Storms Marco and Laura
12/9/2020	4485	Major Disaster Declaration	Hurricane	Hurricane Laura
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
7/9/2024	4798	Major Disaster Declaration	Hurricane	Hurricane Beryl

United States Department of Agriculture (USDA) Disaster Declarations

The Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans available to producers suffering losses in those counties, and in counties that are contiguous to a disaster-designated county. In addition to emergency loan eligibility, other emergency assistance programs, such as USDA Farm Service Agency (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 authorized representative, by an Indian Tribal Council leader, or by an FSA State Executive Director (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.

The table below includes six events that resulted in a USDA disaster designation for Galveston County within the last 10 years. Years not listed in this table had no USDA disaster declarations.

USDA Disaster Declarations

Year	Disaster No.	Incident Type
2020	S4669	Drought
2022	S5188	Drought
2022	S5197	Drought
2022	S5209	Drought
2022	S5350	Heat, Excessive Heat
2023	S5499	Drought

Physical Setting

Describing the physical setting is crucial for planning because it helps understand how the environment influences activities, impacts people's well-being, and informs design choices for creating functional, safe, and engaging spaces. For this HMP, the following characterizations are made for Galveston County or the City of Dickinson as this is the area that encompasses the District's service boundaries.

Galveston County is located on the Gulf Coast of Texas, east of Brazoria County, west of Chambers County and south of Harris County. The planning area is bordered by the neighboring cities of Texas City, Bacliff, League City, and La Marque. According to the Texas Almanac and the U. S. Census Bureau, Galveston County has 378 square miles of land area, 495 square miles of water area, and is the 244th largest county in Texas by total area. [7]

Topography, Geology, and Climate

Topography

Galveston County is part of the Coastal Prairie physiographic province, underlaid by Deltaic sands and muds in a nearly flat stratum. The topography consists of a nearly flat prairie. Galveston County is located in the Gulf Coast Prairie and Marshes ecoregion of Texas, which is characterized by expansive rolling brushlands and prairies that transition to estuarine marshes and dune environments. The County is a small part of this ecosystem, which stretches from Louisiana to Mexico. The Gulf coastline is characterized by marshy plains, narrow beach ridges, and long barrier islands that separate the mainland coast from the Gulf waters. On the coast, Galveston Island has an elevation of approximately 7 feet, while inland the City of Dickinson is approximately 10 feet.

Geology and Soils

Galveston County is comprised of soils within the Coast Prairie and Coast Saline Prairie land resource area. Soils within these areas and the city range from deep, dark-colored clays and loams in the south, and deep, dark-gray, neutral to slightly acid clay loams and clays in the north. Soils within the Coast Saline Prairie, in which a majority of the city sits, have very slow surface drainage due to the water table being located at or near the surface and elevation above sea level (ASL) is only a few feet.

Climate

Galveston County's temperatures range from an average low of 48.6 degrees in January to an average high of 90.3 degrees in August. The County receives approximately 50.76 inches of rainfall each year. [8] Normal monthly rainfall in the area varies, with the heaviest rainfall during the hurricane season, June through November.

The climate of southeastern Texas is generally classified as subtropical, where prevailing southeastern winds from the Gulf of Mexico result in high temperatures and humidity. Severe weather occurs as tropical storms and hurricanes, which are associated with strong winds and heavy rainfall, winter northern frontal passages, and occasional tornadoes. Summers are hot and humid and characterized by afternoon thunderstorms.

Natural Resources

Hydrography and Hydrology

Galveston County is bordered to the north by Clear Creek, a small river, which forms the boundary with Harris County and empties into Clear Lake, which in turn feeds Galveston Bay. Galveston Bay is the seventh-largest estuary in the U.S. and is connected to the Gulf of Mexico. Two major bayou watersheds are also located in the County, with the planning area residing solely within the Dickinson Bayou Watershed.

Dickinson Bayou Watershed

The Dickinson Bayou watershed encompasses approximately 63,830 acres or 99.7 square miles of land that drains water into the bayou located within the San Jacinto-Brazos Coastal Basin. It is located to the southeast of Houston and west of Galveston Bay. The Dickinson Bayou watershed is elongated in shape, with a length of 22 miles from west to east. The maximum width of the watershed is approximately 7 miles. Water falling in this area eventually makes its way into Dickinson Bayou. About 55% of the watershed is within the 100-year floodplain (a floodplain based on a 1% chance of flooding in any given year). Adjoining watersheds include Clear Creek to the north, Mustang Bayou, Halls Bayou, Highland Bayou, and Moses Bayou to the south. Two major irrigation canals, the GCWA's American Canal and Galveston System cross the watershed.[9]

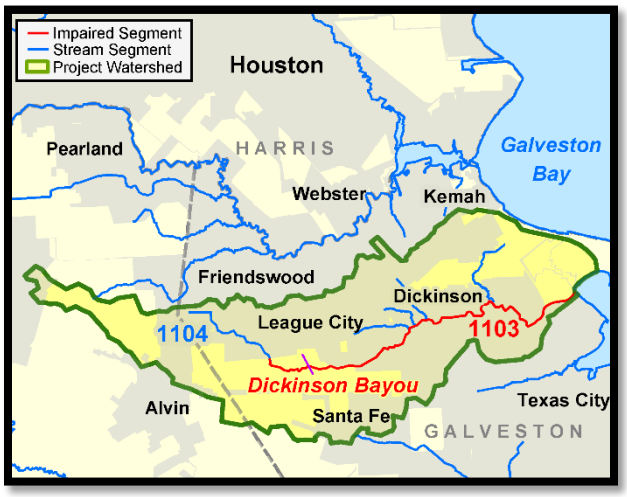
Dickinson Bayou

The bayou begins near the town of Alvin in Brazoria County as an intermittent stream and flows easterly through flat to rolling prairies through the City of Dickinson before joining Dickinson Bay, a secondary bay of Galveston Bay. The bayou has two segments- the tidal portion, Segment 1103, and the portion above tidal influence, Segment 1104. Upstream of the tidal influence, Dickinson Bayou is a small coastal prairie stream. [10]

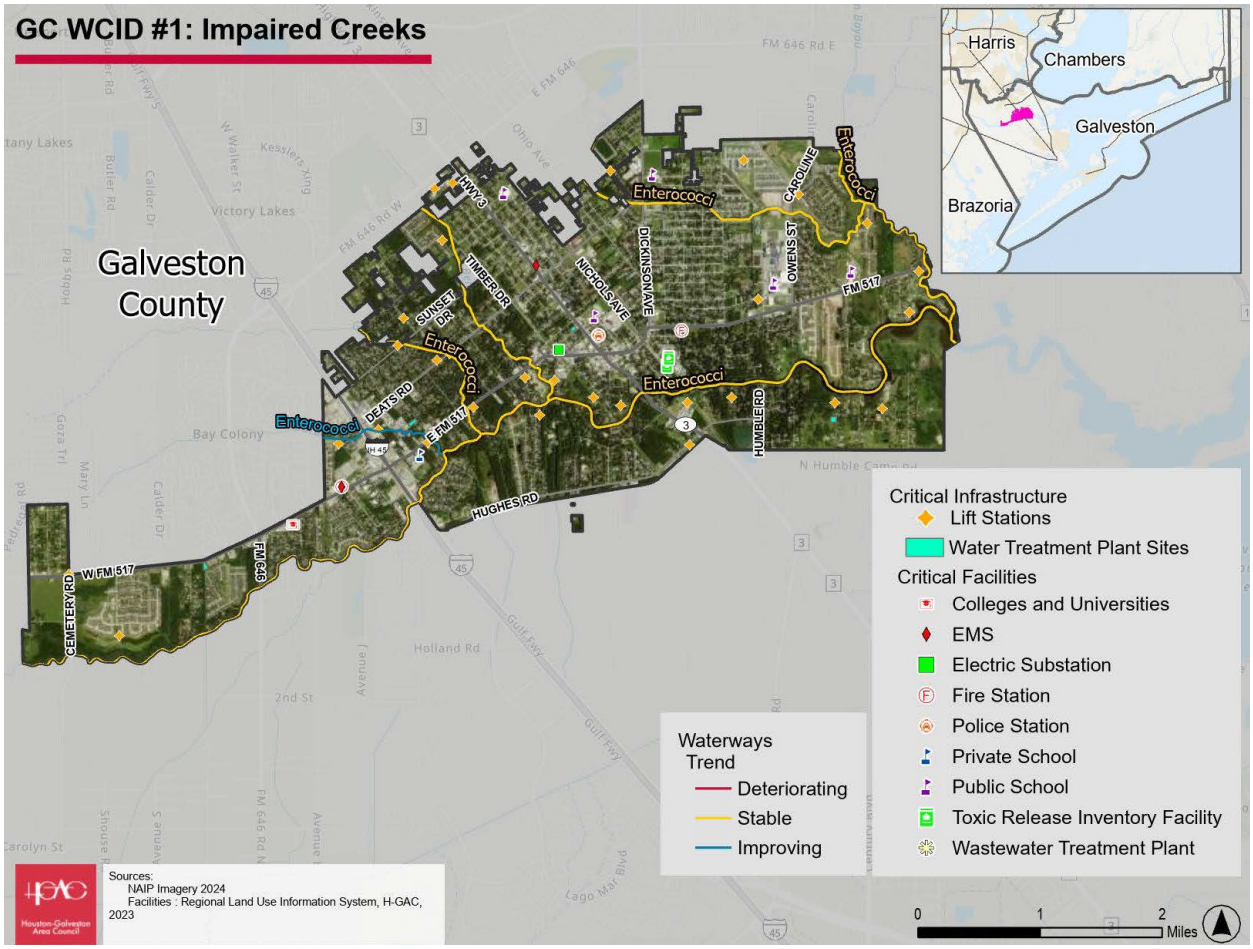
As early as 2000, low concentrations of dissolved oxygen in Dickinson Bayou Tidal (Segment 1103) were less than optimal compared to standards defined for the support of aquatic life. This segment ranges from a relatively narrow, forested stream in the upper reaches to a very wide and relatively deep tidal stream at, and downstream from, the city of Dickinson, and is used by local residents for recreational boating, fishing, water skiing, canoeing, and other activities. The lower

portions of this tidal segment support some commercial shrimp boat and barge traffic. The entire watershed (Segment 1103 and 1104) is listed as impaired for high bacteria levels (enterococci). [11]

Dickinson Bayou Segments



Impaired Creeks and Waterway Trends



Galveston Bay

Galveston Bay is in the western Gulf of Mexico along the upper coast of Texas. It is the seventh-largest estuary in the U.S., and the largest of seven major estuaries along the Texas Gulf Coast. It is connected to the Gulf of Mexico and surrounded by the sub-tropical marshes and prairies on the mainland. The water in the bay is a complex mixture of sea water and fresh water, which supports a wide variety of marine life. With a maximum depth of about 10 feet and an average depth of only 6 feet, it is unusually shallow for its size. [12]

Galveston Bay [13]

Land Use and Land Cover

Current Land Use

The following information is derived from the City of Dickinson's Comprehensive Plan. [14]

A description of existing land use patterns and the character of development is essential to plan for future development, economic growth, and open space preservation that is compatible with the character of the community. This description of existing land uses in Dickinson is based on information obtained from the Galveston Central Appraisal District (GCAD) and the City of Dickinson Code of Ordinances. The existing land use description is based on parcel data, property values, and ownership status obtained from GCAD. Understanding land use and development patterns will help city administrators project future population and infrastructure needs, which in turn affect the District. The existing land uses in Dickinson, Texas, are:

General Residential (Suburban Residential) General Residential represents detached single-family dwellings on small lots (typically 0.25 acre) and patio homes with zero lot lines. Zero lot line development allows building footprints to abut on a side lot boundary in order to increase available and useable land on the opposing side lot boundary. More than 50 percent of Dickinson's land coverage is residential, of which 80 percent is suburban with concentrations of homes between IH-45 and Country Club Drive.

Farm and Ranchland Farm and Ranchland is used for agricultural crop, animal husbandry, and related by-products.

Rural Residential Rural Residential land use represents low-density dwelling units typically located in rural settings. Conventional detached single-family dwellings at a density typically not exceeding one (1) dwelling unit per acre. Includes existing large lots, unplatted tracts of land, areas where adequate public facilities are not available to support higher density urban development, and areas that are appropriate for large lot development given the surrounding land use and zoning.

General Commercial General Commercial provides for a variety of commercial uses including wholesale sales and services, general retail and service businesses, and office uses. Typically concentrated in high traffic areas adjacent to arterial streets and highways. Automobile-centric site designs facilitate commercial developments that are characterized by large parking lots surrounding stand-alone storefronts, drive-through establishments and strip centers. Includes commercial businesses that require a large amount of land such as vehicle and farm equipment sales, plant nurseries, other outdoor sales, and big-box retailers. Dickinson's commercial properties are typically concentrated along the IH-45 highway corridor, FM 517 and SH 3.

Undeveloped Represents undeveloped, vacant or developable land. Undeveloped parcels are generally found along Dickinson Bayou.

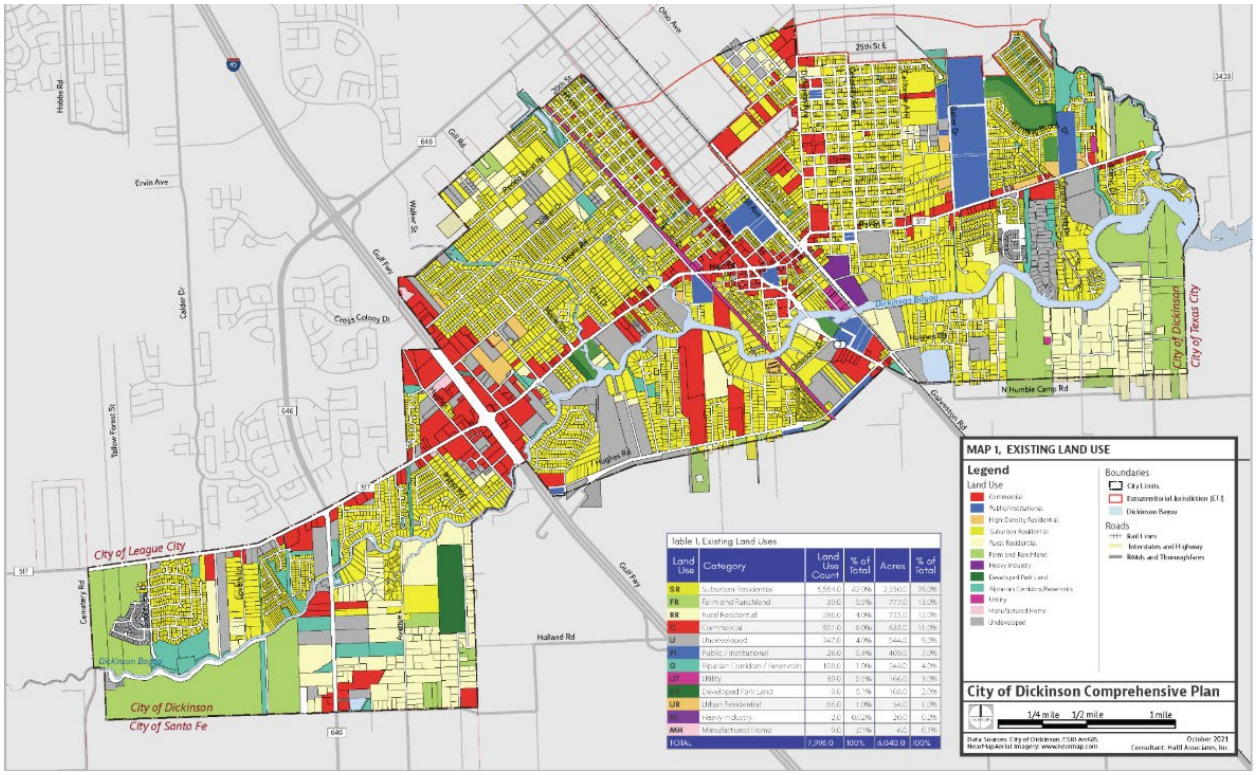
Public and Institutional Public and Institutional land uses include improved parcels and facilities which are held in the public interest. This category typically encompasses major City-owned facilities, schools, hospitals, universities, and other public and private buildings and sites with an institutional nature. Other essential utility services include wastewater treatment plants and landfills. Public and institutional land uses are concentrated in central Dickinson around City Hall and other municipal offices.

Multi-Family Residential (Urban Residential) Multi-family Residential represents dwellings such as duplexes, triplexes, town homes, condominiums and apartments. Provides for development of quality apartments in a high-density setting, while ensuring livability, property values, open space, design quality and landscaping, safety and the general welfare of its residents.

Developed Park Land Developed Park Land represents parks, recreational, or other natural environmental areas. Intended to provide open space for outdoor recreational activities and to create an aesthetically pleasing environment that may improve quality of life, prevent overcrowding of land, and provide visual buffering between roadways and structures. Dickinson has two traditional parks, one golf course, and one boat launch, which provides access to Dickinson Bayou.

Heavy Industry Heavy Industrial land uses include high-impact manufacturing or industrial uses that can create nuisance and environmental impacts, which are not compatible with residential or commercial developments.

The City of Dickinson Land Use Map, 2024



Future Development

Growth within the District's service area will impact the demand for its services. The following is an overview of the expected future development trends for the portions of Galveston County, primarily the City of Dickinson, that interface with the District's service area.

The City of Dickinson has no current plans for future developments that would increase the risk or vulnerability to any of the hazards identified in this HMP. The City of Dickinson has a number of projects in progress or soon to be started related to drainage improvements, culvert clearing, ditch digging, planning studies and updates, and street improvements that would aid in reducing the risk of flooding and other hazards where flooding is a secondary concern (Hurricanes, Severe Weather, etc.).

Similarly, the District also has no plans to add any new development or impervious surfaces to the planning area at this time that would increase the risk to any of the hazards identified within this HMP. There are a variety of projects the District has planned as it performs continual rehabilitation and/or replacement of its infrastructure to ensure safe, reliable, and compliant services. The District utilizes a Capital Improvements Program (CIP) to forecast the required capital projects based on short-term (years 1-5), mid-term (years 5-10), and long-term (years 15-20) planning and funding requirements.

Current CIP projects listed below are being funded from the 2022 and 2023 bonds. However, rising construction costs within the last 2 years have limited what the district is able to fund out of these planned improvements. These include:

- **Hollywood Water Plant Rehabilitation-** In May 2021, the Texas General Land Office notified the District that they were selected for a $8.189 million Community Development Block Grant Mitigation (CDBG-MIT) grant. This grant project includes total rehabilitation of the District's Hollywood Water Plant, including repainting the elevated and ground storage tanks; replacing existing booster pumps, yard piping, and electrical control building; and installing a new permanent natural gas emergency generator.

- **WWTP Rehabilitation-** The District operates and maintains one WWTP, which has gone through several upgrades and expansions, with the last major project occurring more than 20 years ago. The WWTP is currently permitted for a daily average flow of 4.8 MGD and a 2-hour peak effluent flow of 21.6 MGD. In 2023, the District Engineer performed an evaluation of the existing WWTP hydraulic profile and a preliminary schematic design of proposed improvements to the main lift station, solids screening, replacement of the final stage filters, and replacement of the disinfection system. The project will be constructed in phases due to anticipated construction costs. Work is tentatively scheduled to begin in spring 2026.

- **Water Quality Improvements-** The District operates and maintains the Lobit Water Plant located on Lobit Drive. The plant's primary operation is to use surface water from the distribution system to fill and cycle the elevated and ground storage tanks on the site. The District plans to add a disinfection residual control system to help improve water quality.

- **Sewer Lift Station Rehabilitation-** Two of the District's largest and most critical wastewater collection lift stations are the County Barn and Hughes Lane lift stations. The County Barn lift station services the entire portion of the District east of Interstate Highway 45 (IH-45) and south of Dickinson Bayou. The Hughes Lane lift station services the entire western portion of the District west of IH-45. The District plans to rehabilitate both lift stations, including replacement and/or upgrades of submersible pumps, guide rails, hatches, valves, wet well top concrete slab replacement, wet well wall rehabilitation with epoxy liner, electrical equipment replacement, installation of emergency natural gas generators, and system upgrades to meet District needs and current Texas Commission on Environmental Quality (TCEQ) requirements.

- **16” Water Line Installation-** The District currently has one 10-inch water line built in the 1970s that services the western side of the district from Medical Park Drive to Cemetery Road along FM 517. In 2021, an update to the District’s water model performed by the District Engineer found that this water line along FM 517 needs to be replaced with a 16-inch water line to meet the water supply and fire flow demands on the west side of the District. The District plans to install a 16-inch PVC water line with gate valves, fire hydrants, and water services from Medical Park Drive to FM 646.

- **36-Inch Sanitary Sewer Rehabilitation-** In 2022, the District performed a television inspection of the existing 36-inch-diameter sanitary sewer main along FM 517 from Hughes Lane to FM 646. Built in the 1970s, this is the sole sewer line for collecting all flows on the west side of the District. The results of the visual inspection showed numerous pipe deformations, penetrations, and groundwater infiltrations, which, if not repaired, can lead to significant maintenance costs. This project will include repairing the pipe deformation areas and then installing a new 30-inch-diameter pipe inside the existing 36-inch-diameter pipe. This project is estimated to start construction in summer 2025.

- **Barber Sewer Lift Station Force Main Extension-** The Barber lift station is a regional lift station that collects sewer flow from the east and southeast sides of the District. In 2023, the District Engineer performed a hydraulic evaluation, which showed that the eastside large sewer trunk mains have insufficient capacity to handle the high flows that occur during significant rainfall events. After evaluation of alternatives, the most cost-effective solution is to extend the Barber lift station force main further downstream to discharge to a larger gravity sewer collection pipe.

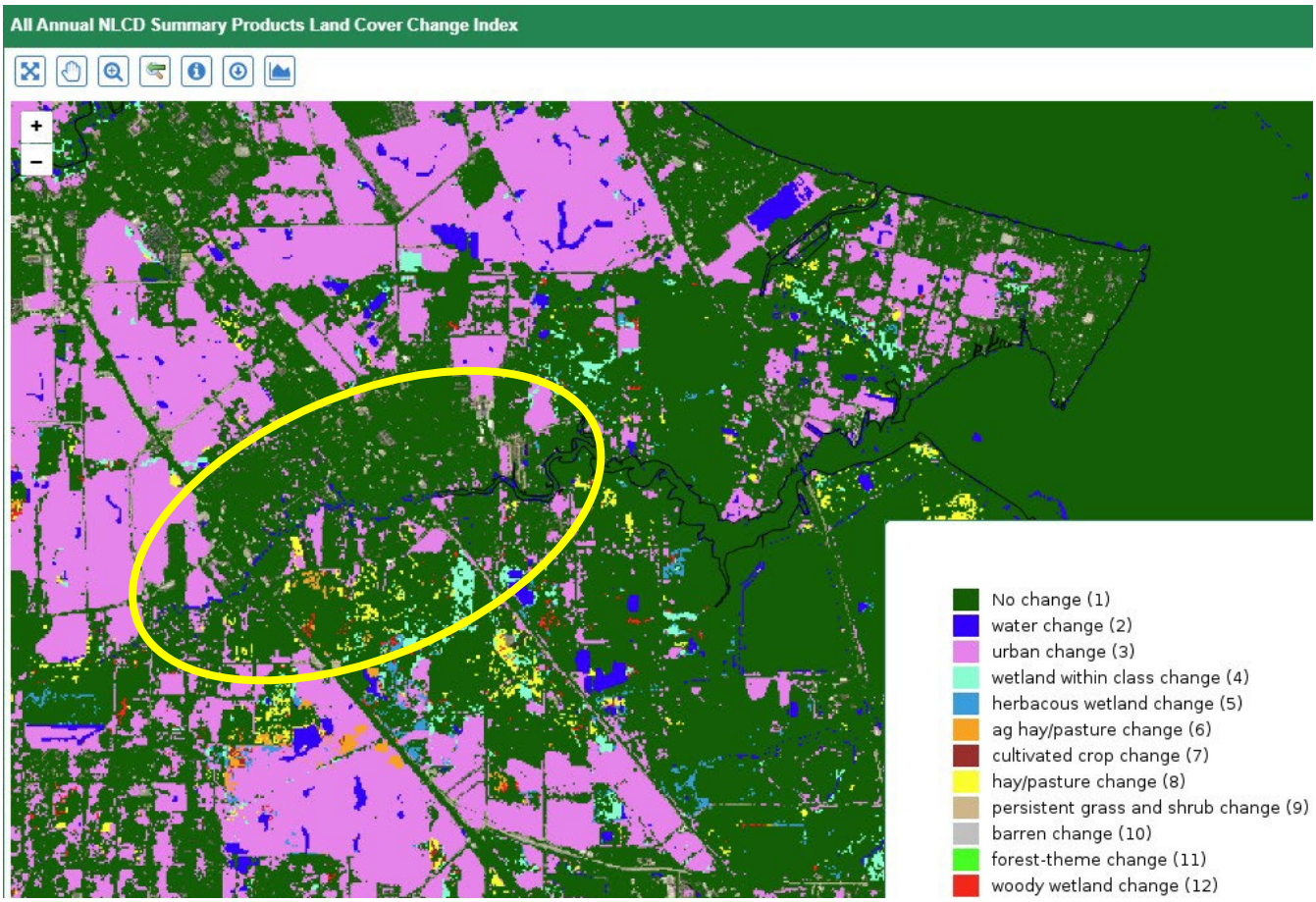
- **Deats/Geisler Gully Lift Station and Force Main Replacement-** The Deats lift station is currently located within the Deats Road right-of-way at Geisler Gully. In 2024, the District Engineer performed a capacity evaluation, which showed that the existing lift station and force main have insufficient capacity to handle the high flows that occur during significant rainfall events. This project will include the replacement of the 8-inch force main with a new 12-inch force main and relocation of the lift station to a property that the District purchased in 2023.

Land Cover

The figure below shows the distribution of land cover within the planning area, and how these land cover classifications have changed over time (the planning area is depicted within the yellow outline). Current land cover consists of wetlands, forested areas, and croplands, with a large majority of the area being developed. The City of Dickinson is primarily built out, surrounded by other cities, and has no room to expand. A majority of the land cover changes shown within the planning area below over the last 10 years are urban changes (undeveloped land becoming developed). [15]

Current Land Cover, 2024 [16]

Land Cover Change, 2011-2023



Population Characteristics

The table below is from the US Census Bureau Quick Facts for the City of Dickinson and indicates the population breakdown for various factors, including age, race, sex, and languages spoken. It is helpful to understand the breakdown of the population to help identify potential vulnerable populations.

Population Characteristics, Age

Age	Population	Percentage (of total)
Under 5	1,707	7.9%
Under 18	6,375	29.5%
Over 65	2,636	12.2%

Population Characteristics, Race

Race	Population	Percentage (of total)
White	13,357	61.8%
Two or more races	4,090	18.92%
Black or African American	1,982	9.17%
Another race	1,896	8.77%
Asian	166	0.77%
Native American	121	0.56%
Native Hawaiian or Pacific Islander	0	0%

Population Characteristics, Sex

Sex	Population	Percentage (of total)
Female persons	11,174	51.7%
Male persons	10,438	48.3%

Languages spoken within the planning area are primarily English and Spanish.

Population Characteristics, Language

(2019-2023)	Percentage (of total)
Language other than English spoken at home, % of persons age 5+	28%
Speak only English at home, % of persons age 5+	71.19%

Population Growth

It is helpful to understand population trends historically to demonstrate potential growth trends for the planning area. For the City of Dickinson, population growth is currently 0.57% per year.

The entire State of Texas has grown by nearly 15.9% from 2010 to 2020. Galveston County, of which the District resides, grew an astounding 20.38% (estimated at 291,309 in 2010 to 350,682 in 2020). Galveston County includes both incorporated and unincorporated areas and contains 16 incorporated cities. A majority of this area is outside of the District's jurisdiction. The District's service boundaries mainly cover the City of Dickinson with small unincorporated areas to the west. For this HMP, characteristics and totals will focus on those of the City of Dickinson, as that is where the District's service customers reside. In comparison to the County, the City of Dickinson grew from 18,680 people in 2010 to 20,847 in 2020, a 11.6% increase. Population as of 2023 was 21,612, a 3.6% increase from 2020.

Housing

Housing market outcomes following disasters reflect the choices of those directly impacted and others whose choices may reflect awareness of the disaster. Households and businesses may change their location and investment choices based on an area's perceived disaster risks. Looking at housing trends aids in informing long-term plans for an area. [17]

Below are housing trends for the planning area, which primarily covers the City of Dickinson, Texas.

The median property value in Dickinson, Texas was $244,500 in 2023, which is 0.806 times smaller than the national average of $303,400. Between 2022 and 2023 the median property value increased 13.5% from $215,400 to $244,500.

The homeownership rate in Dickinson, Texas is 72.8%, which is approximately the same as the national average of 65%. 67.5% were homeowners with a mortgage. In 2023, 72.8% of the housing units in Dickinson, Texas were occupied by their owner. This percentage declined from 2022's rate of 79%. The median rent in Dickinson, Texas, from 2019-2023 was $1,235.

Income

In 2023, the median household income of the 7,750 households in Dickinson, Texas grew to $82,018 from the 2022 value of $81,739.

Education

Within the planning area, 24.1% of people have obtained a bachelor's degree or higher, while 52.3% have a high school or equivalent degree.

Workforce

From 2022 to 2023, employment in the planning area declined from 10,500 employees to 9,850 employees, a rate of −5.79%. The most common job groups, by number of people living in the planning area are Office & Administrative Support (1,219 people), Management (1,179 people), and Education Instruction & Library Occupations (974 people).

Economy

The economy of Dickinson, Texas, employs about 9,850 people. The largest industries within the planning area are manufacturing (1,344 people), construction (1,251 people), and health care & social assistance (997 people). The highest paying industries are mining, quarrying, & oil & gas extraction ($173,750), utilities ($115,208), and agriculture, forestry, fishing & hunting, & mining ($113,281). [18]

High-Risk Populations

B2. (Requirement 44 CFR § 201.6(c)(2)(ii))

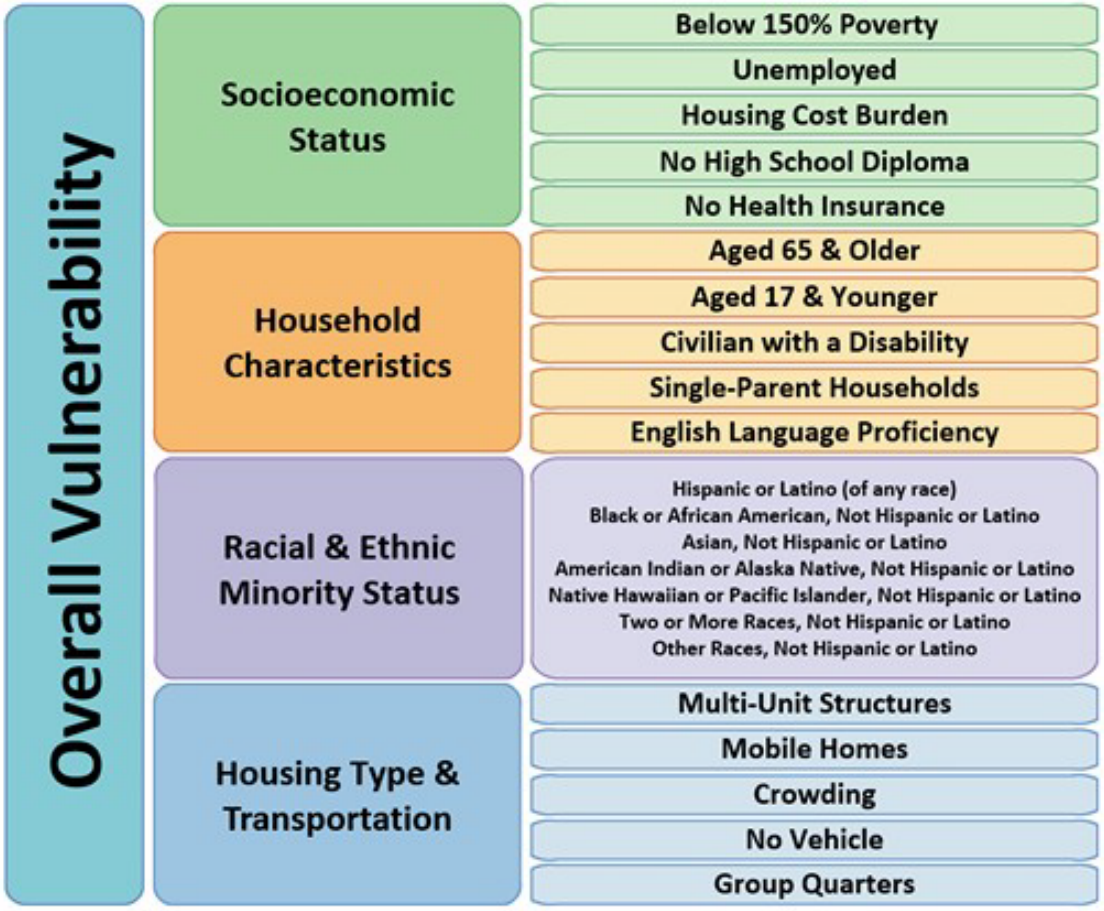
Every community must prepare for and respond to hazardous events, whether a natural disaster like a tornado or a disease outbreak, or an anthropogenic event such as a harmful chemical spill. The degree to which a community exhibits certain social conditions, including high levels of poverty, low percentage of vehicle access, or crowded households, among others, may affect that community's ability to prevent human suffering and financial loss in the event of a disaster. These factors describe a community's social vulnerability and help identify areas with high-risk populations that may benefit from increased planning, preparation, and response, or additional resources during a disaster.

The Centers for Disease Control and Prevention and Agency for Toxic Substances and Disease Registry Social Vulnerability Index (CDC/ATSDR SVI or SVI) aids public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event (severe weather, floods, disease outbreaks, or chemical exposure, etc.). SVI indicates the relative vulnerability of every U.S. census tract and ranks the tracts on 16 social factors, such as unemployment, racial and ethnic minority status, and disability status. Then, SVI further groups the factors into four related themes. The image(s) below highlight the variables used and data sources for overall SVI scores and the four themes. Images depicting the four themes include the planning area within the Zip Code Tabulation Area of 77539, which also includes San Leon, Texas. [19]

Methods

Variables Used

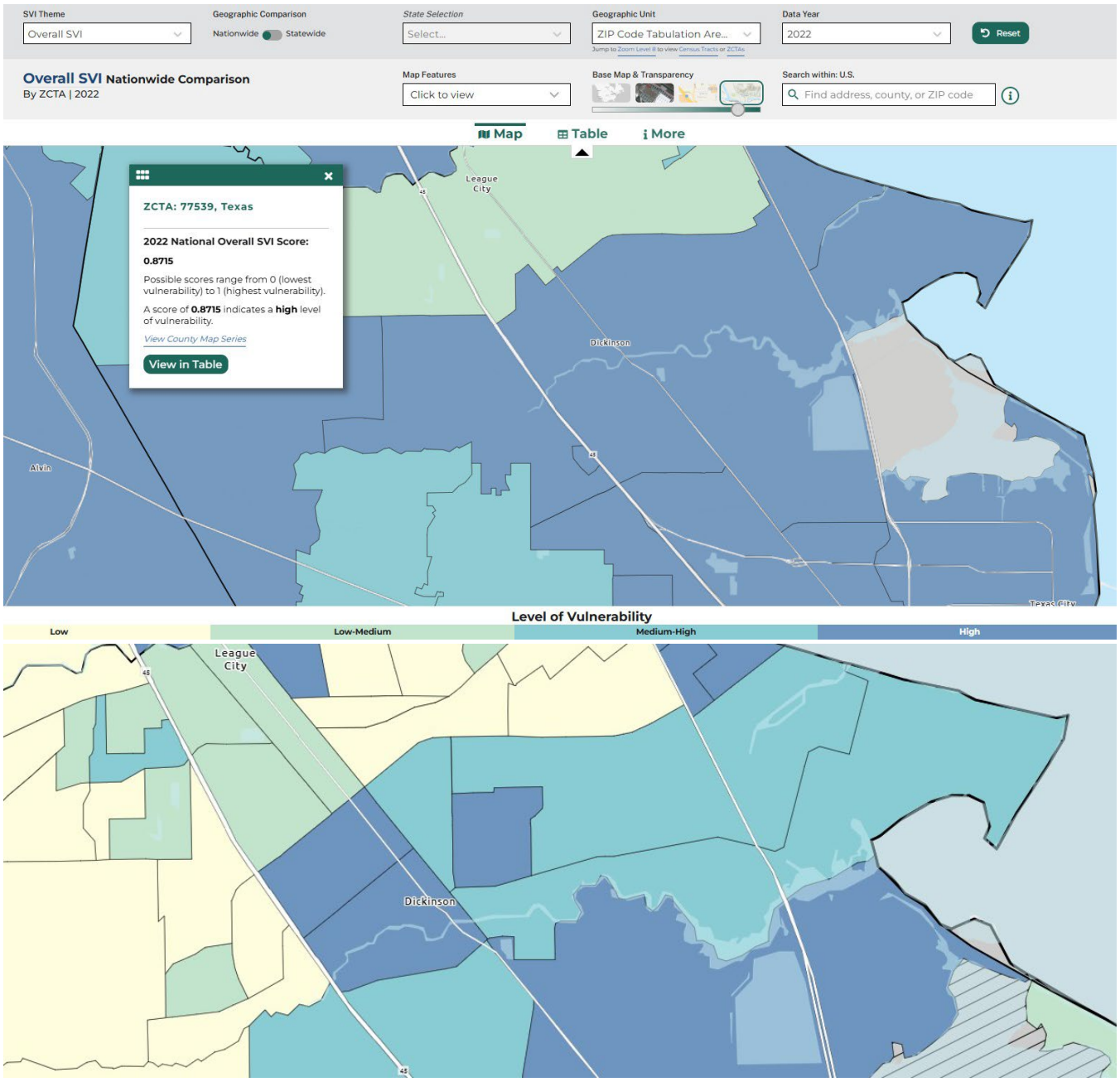
American Community Survey (ACS), 2018-2022 (5-year) data for the following estimates:



2022 National Overall SVI Score: 0.8715

Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). A score of 0.8715 indicates a **high** level of vulnerability.

SVI, Overall Vulnerability for ZCTA: 77539



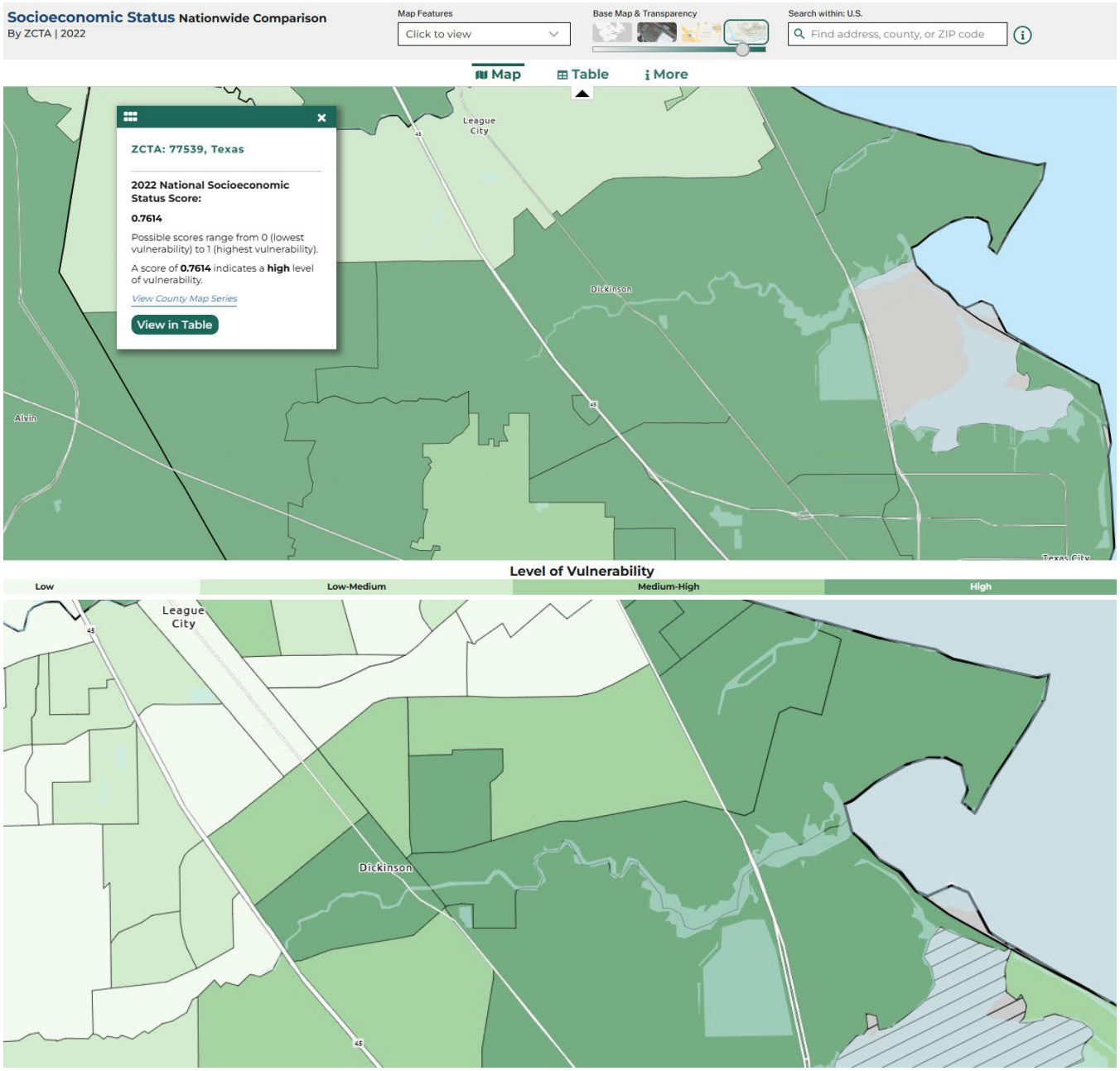
Selected factors from each of these themes are described below to give a clear picture of how they can affect a person's vulnerability, especially in relation to disasters and recovery.

Socioeconomic Status

2022 National Socioeconomic Status Score: 0.7614

Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). A score of 0.7614 indicates a **high** level of vulnerability.

SVI, Socioeconomic Status for ZCTA: 77539



Poverty

Disasters can contribute to more adversity for people of low socioeconomic status than for others who are not of low socioeconomic status, in part due to their financial effects. Natural disasters make it more likely that people in poverty will remain in poverty. In the U.S., people of low socioeconomic status are more likely to live in homes that are more vulnerable to the impact of disasters (e.g., lower quality construction, older homes, mobile homes). As a result, their experience may involve more material losses, less protection from disasters, and greater damage to or destruction of their homes. [20]

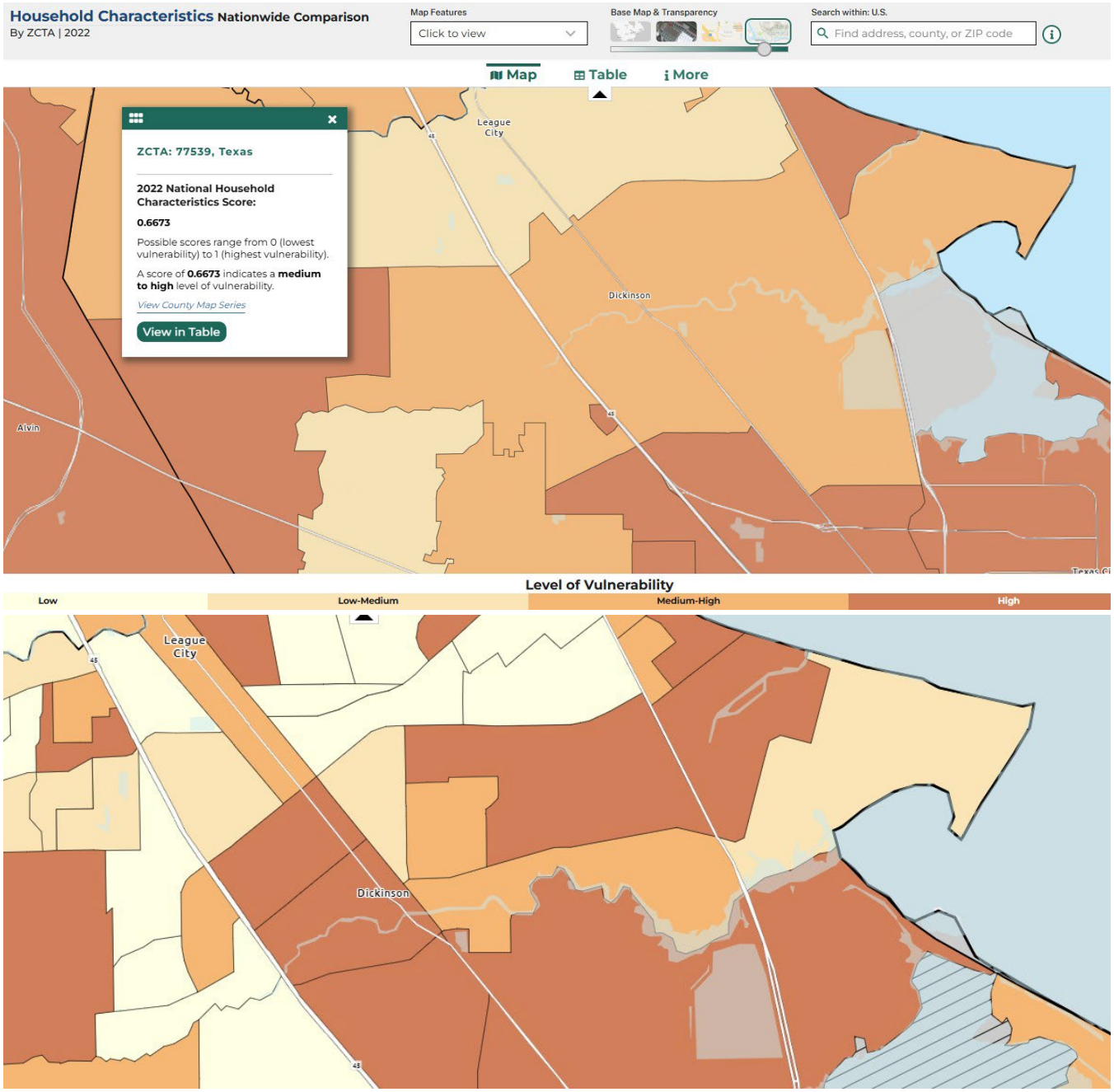
14.8% of the population in Dickinson, Texas (3,190 people) live below the poverty line. This is higher than the national average of 12.4%. The largest three demographics living in poverty within the planning area are Females aged 18 - 24, followed by Females aged 6 - 11, and then Females aged 35 - 44. [21]

Household Characteristics

2022 National Household Characteristics Score: 0.6673

Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). A score of 0.6673 indicates a **medium to high** level of vulnerability.

SVI, Household Characteristics for ZCTA: 77539



Various household characteristics that can contribute to a population's vulnerability to disasters come into play with this SVI theme.

Age

Populations within the planning area who are over 65 or under 18 may have more difficulty evacuating, receiving disaster-related information or alerts, and may require additional resources during a disaster. Population characteristics for the City of Dickinson can be found in the table below.

Population Characteristics, Age

Age	Population	Percentage (of total)
Under 5	1,707	7.9%
Under 18	6,375	29.5%
Over 65	2,636	12.2%

Physically/ Mentally Disabled

According to the CDC, "A disability is any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions)." 22 Cognitive impairments can increase the level of difficulty that individuals might face during an emergency and reduce an individual's capacity to receive, process, and respond to emergency information or warnings. Individuals with physical or sensory disabilities can face issues related to mobility, sight, hearing, or reliance on specialized medical equipment, which may not be accessible during an emergency. According to the U.S. Census QuickFacts, 9.9% (2,139 people) of residents within the planning area are living with a disability. [23]

English Language Proficiency

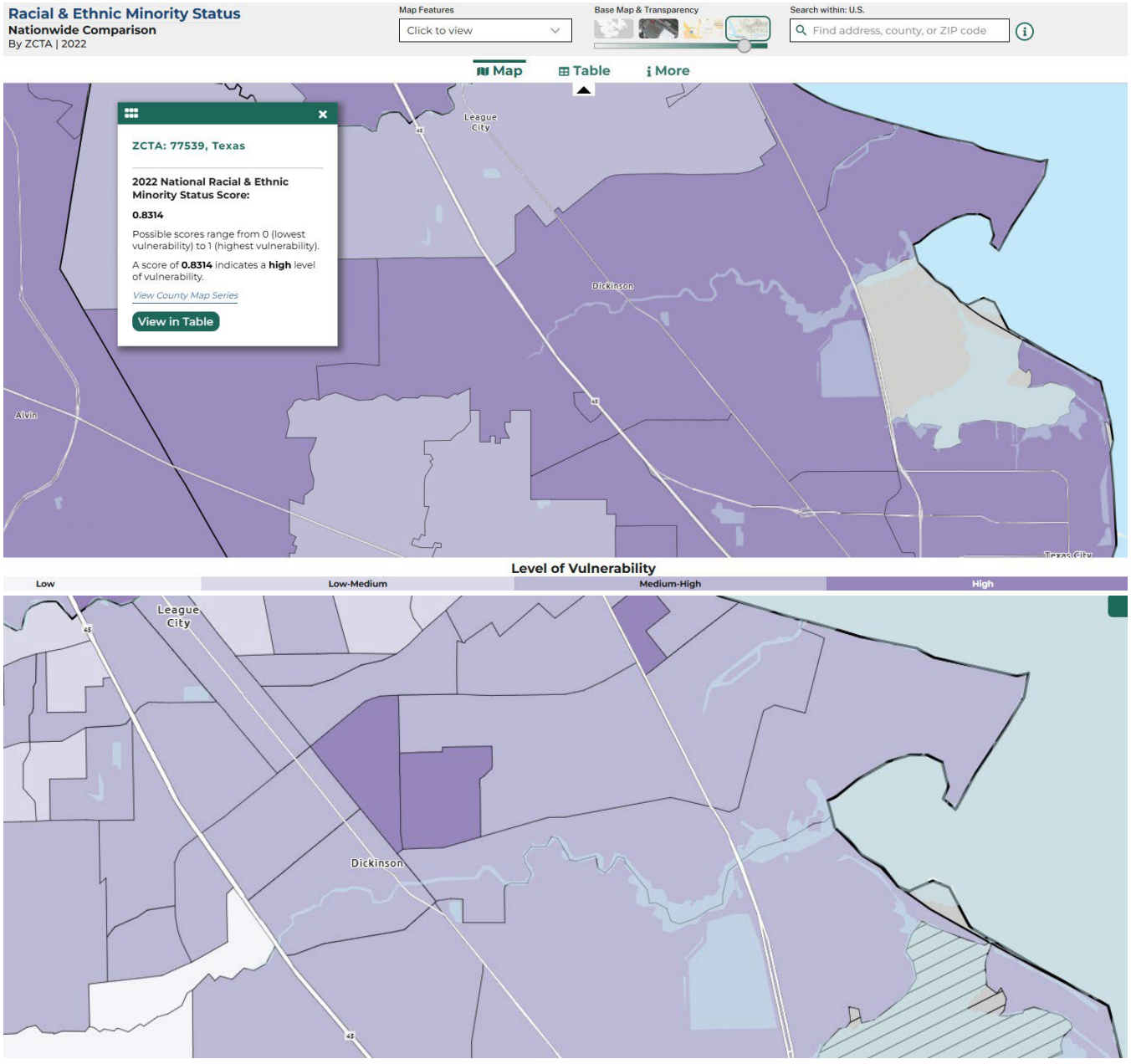
Individuals who are not fluent or have a lower level of proficiency in English are vulnerable as they can have difficulty understanding information being conveyed to them. When a disaster strikes, it is often the quick dissemination of information from emergency personnel that aid in keeping residents safe. [24] According to the U.S. Census QuickFacts, 28% of the planning area's population over the age of 5 primarily speaks a language other than English at home.

Racial and Ethnic Minority Status

2022 National Racial & Ethnic Minority Status Score: 0.8314

Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). A score of 0.8314 indicates a **high** level of vulnerability.

SVI, Racial and Ethnic Minority Status for ZCTA: 77539



People in racial and ethnic minority groups are disproportionately affected by natural disasters and extreme weather events. Most factors related to such negative effects are systemic societal

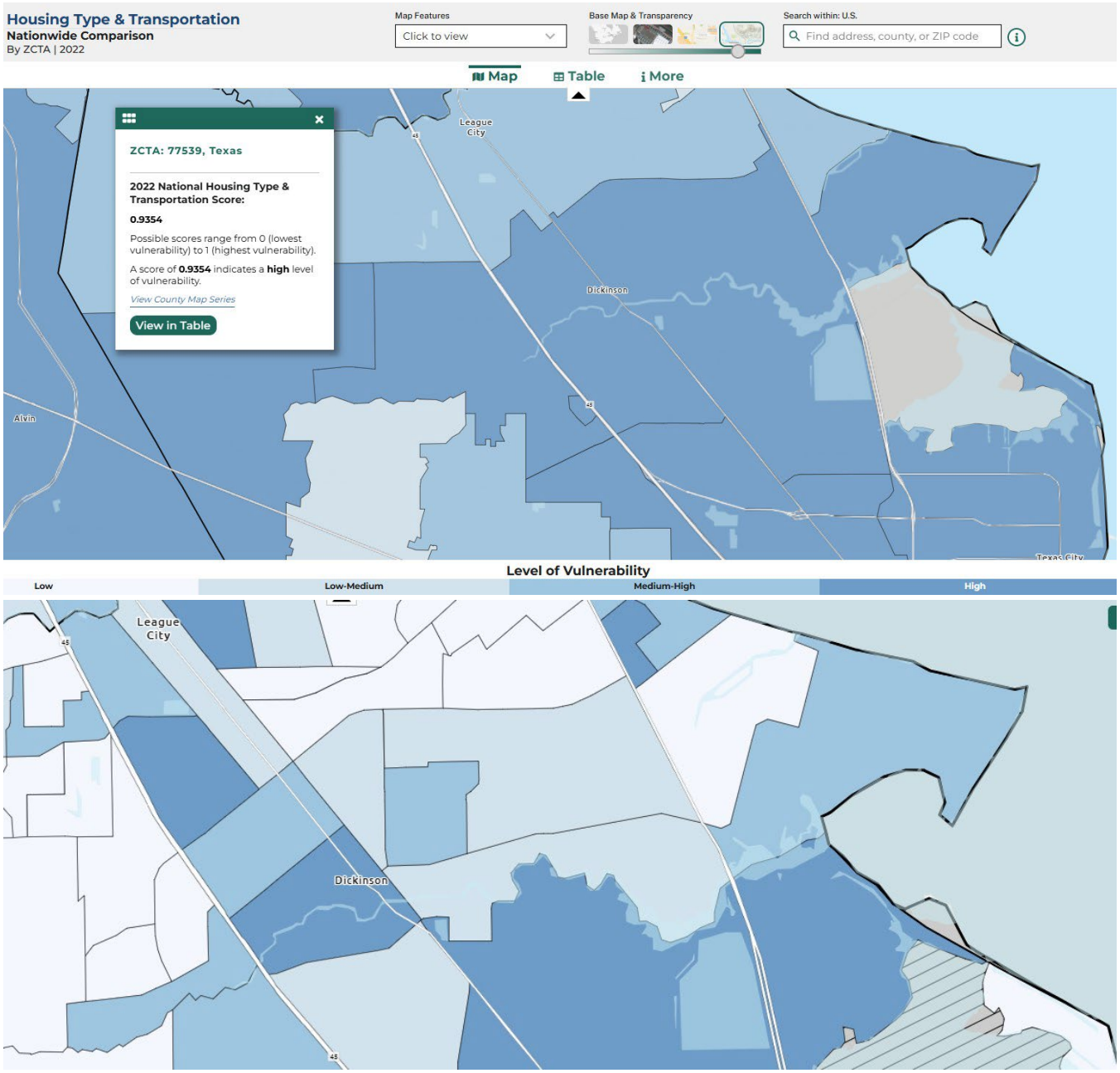
issues that prevent some populations from having equal access to preparedness and response resources. Disparities in language, disaster preparedness resources, and resources available for disaster response contribute to the vulnerability of racial and ethnic minority groups to the detrimental effects of natural disasters and extreme weather. [25]

Housing Type and Transportation

2022 National Housing Type & Transportation Score: 0.9354

Possible scores range from 0 (lowest vulnerability) to 1 (highest vulnerability). A score of 0.9354 indicates a **high** level of vulnerability.

SVI, Housing Type and Transportation for ZCTA: 77539



No Vehicle Access

Individuals who lack access to a vehicle may have difficulties when attempting to evacuate. Highlighting these vulnerable populations helps allocate resources appropriately during a disaster. According to the U.S. Census QuickFacts,

SVI can be used to:

- Assess community needs during emergency preparedness planning.
- Estimate the type and quantity of needed supplies such as food, water, and medicine.
- Decide the number of emergency personnel required to assist people.
- Identify areas in need of emergency shelters.
- Create a plan to evacuate people, accounting for those who have special needs.
- Identify communities that will need continued support to recover following an emergency or natural disaster.

District Capabilities

D3. (Requirement 44 CFR § 201.6(c)(4)(ii))

Administration

The District is established under Chapters 49 and 51 of the Texas Water Code. Chapter 49 outlines general rules and powers applicable to all Texas water districts, while Chapter 51 specifically details the establishment, powers, and limitations of water control and improvement districts.

The District is governed by a five-member Board of Directors in accordance with the laws of the State of Texas. All five board members are elected at large, for four-year terms, in even-numbered years, by plurality vote. The board elects its officers after each election. Responsibilities of the board include awarding contracts; setting policies; approving budgets; and appointing the general manager, the district's legal counsel, and consultants. The board operates under a set of bylaws that were last updated in November 2022. The general manager is responsible for the appointment and dismissal of all district employees

In order to improve capabilities, the District actively participates in regional emergency planning exercises with adjacent cities, special districts, and County staff. Communication to residents occurs through many forms, including a District-specific website which was launched in 2018. Furthermore, the District maintains and regularly updates its Emergency Action Plan (EAP), which establishes procedures and processes for the District to employ during a severe flood event. To address significant maintenance or upgrade needs, the District also administers a capital improvement program.

Planning and Regulatory Mitigation Capabilities

A4. (Requirement 44 CFR § 201.6(b)(3))

Planning and regulatory capabilities are based on the implementation of ordinances, policies, local laws, and state statutes, and plans and programs that relate to guiding and managing growth and development. Planning and regulatory capabilities refer not only to the current plans and regulations, but also to the jurisdiction's ability to change and improve those plans and regulations as needed. The following provides the planning and regulatory capabilities for The District, Galveston County, and the City of Dickinson.

Related Plans and Regulations

Dickinson Water Control and Improvement District

Galveston County WCID #1 Drought Contingency Plan (DCP)
Plan Date: April 19, 2024
Updates: Every 5 years

The objective of the DCP is to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions. Water uses regulated or prohibited under this DCP are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply conditions are deemed to constitute a waste of water which subjects the offender(s) to penalties.

Galveston County WCID #1 WWTP EAP
Plan Date: June16, 2022, Updated: February 16, 2024
Updates: Every 5 years, or when disinfection is modified

The objective of the EAP is to comply with the Occupational Safety and Health Administration's Emergency Action Plan Standard, 29 CFR 1910.38, the Risk Management Program 40 CFR 68, and to prepare employees for dealing with emergency situations. This plan is designed to minimize injury, loss of human life, and company resources by training employees, procuring and maintaining necessary equipment, and assigning responsibilities. This plan applies to emergencies involving accidental chemical releases.

Galveston County WCID #1 Emergency Preparedness Plan
Plan Date: April 13, 2023

Updates: As needed when new alternate power sources are installed at District facilities

The Emergency Preparedness Plan document is submitted to TCEQ pursuant to the requirements of the Texas Water Code (TWC) 13.1394 because the District's water system meets the definition of an affected utility. Through implementing the approved EPP, the District indicates it will be able to maintain pressures at a minimum of 20 psi throughout its distribution system during extended power outages lasting more than 24 hours and that water service will be reestablished as soon as it is safe and practicable following the occurrence of a natural disaster.

Galveston County WCID #1 Water Conservation Plan (WCP)
Plan Date: April 19, 2024
Updates: Every 5 years

The purpose of the WCP is to set forth uniform requirements, guidelines and recommendations to minimize water use through implementation of efficient water use practices.

Galveston County WCID #1 WWTP Emergency Response Plan
Plan Date: August 2021
Updates:

The Emergency Response Plan document is a set of instructions and procedures to manage the effects of an emergency to minimize the impact on people, property, and the environment. This includes outlining roles and actions, timeframes, worksite layouts: Where employees are located and what structural features are present

Galveston County WCID #1 WWTP Risk Management Plan
Plan Date: June 6, 2022
Updates: Every 5 years

The WWTP Risk Management Plan outlines personnel assigned to manage and train the WWTP operators with their assigned elements to develop, implement, and integrate those tasks required to ensure the safety, health, and environmental requirements of proper operation and maintenance of the wastewater treatment plant.

Galveston County WCID #1 WWTP Risk and Resilience Assessment
Plan Date: May 10, 2021
Updates: Every 5 years

This document includes all the basic elements of a risk and resilience assessment for small systems to comply with America's Water Infrastructure Act of 2018.

Galveston County WCID #1 WWTP Stormwater Pollution Prevention Plan (SWPPP)
Plan Date: November 2022
Updates: Must be updated whenever there is a change in design, construction, operations, or maintenance, which has an impact for potential pollutants to enter stormwater discharge.

This SWPPP covers the operations at the district as required by the TCEQ Texas Pollutant Discharge Elimination System Multi-Sector General Permit. The goal of the Storm Water Permit program is to improve the quality of surface waters by reducing the amount of pollutants potentially contained in the storm water runoff being discharged. Industrial facilities subject to storm water permit requirements must prepare and implement an SWP3 for their facility. The SWP3 must also determine if the permitted discharge is to an impaired water body as listed in accordance with the latest TCEQ and Environmental Protection Agency (EPA) approved Clean Water Act Section (CWA) 303(d). This plan describes the facility and its operations; identifies potential sources of storm water pollution; recommends appropriate best management practices or pollution control measures to reduce the discharge of pollutants in storm water runoff; and provides for periodic review of the SWPPP.

The District serves as a critical function service provider and lacks regulatory capabilities and police powers to regulate land use and/or development within its service area. Therefore, the legal/regulatory authorities possessed by the district are vastly different than those of a municipal government that has permit authorities and police powers.

D3. (Requirement 44 CFR § 201.6(c)(4)(ii))

Within the District's planning area, there are many existing plans and programs with more regulatory authority over land use and development in place from neighboring communities, counties, and special purpose districts that support hazard mitigation and risk management that which this HMP can coordinate and integrate. The items below summarize the planning and regulatory capabilities available to Galveston County and the City of Dickinson.

Galveston County

Building Codes: The County is governed by the Texas Administrative Code § 5.4008 The 2018 International Building Code (IBC), the 2018 International Residential Code (IRC), and the National Fire Protection Association (NFPA). By using the IRC, IBC and NFPA, the highest standards are assured for County construction to reduce the risk of hazards and protect both lives and property.

Subdivision Ordinance: Rules, Regulations and Requirements Relating to the Approval and Acceptance of Improvements in Subdivisions or Re-Subdivisions
Ordinance Date: 3/3/1997, Update: 10/3/2005

Major drainage ways through a subdivision shall be designed and constructed to accommodate the 100-year peak rate of runoff, in the manner prescribed by the applicable Galveston County Drainage District and the Galveston County Engineer.

The following requirements shall apply to all developments planned within the 100-year flood plain:

1. Any construction and/or fill that would obstruct flow and cause any increase in flood levels must be fully offset with conveyance improvements.

2. Flood plain storage volumes shall not be reduced by way of fill. Where flood plain fill is proposed and is demonstrated not to adversely affect conveyance, compensatory storage equal in volume and effect shall be excavated.

Flood Damage Prevention and Protection Ordinance
Ordinance Date: August 2019

Floodplain regulations reduce risk to lives and property by ensuring mitigation measures are put into place for repetitive loss properties and new construction.

Capital Improvement Plan
Ordinance Date: August 2019

The County encourages departments to submit two-to-five-year capital plans for approval by the Commissioners Court. Approved plans shall be given priority during the annual budget process. Capital spending is reserved for major renovation, building, or road and bridge related projects that are planned for the fiscal year.

Parks, Recreation, Open Space, and Conservation/Natural Resource Master Plan
Plan Date: January 2012-2017

This Master Plan document establishes the guidelines which will direct the acquisition and development of parks, recreation areas, and open spaces for the next eight years. The Master Plan Drawing illustrates the general type and location of recommended parks and open spaces This document also includes specific recommendations for future land acquisition, park development and natural resources conservation initiatives to serve the growing population and needs of Galveston County residents.

Stormwater Management Plan
Plan Date: 2019-2023

Stormwater Management reduces the risk of pollutants that may have the potential to endanger local residents through inspection and enforcement of the Municipal Separate Storm Sewer System, or MS4 regulations.

Comprehensive Plan Update- Charting Our Course to 2045
Plan Date: May 9. 2023

A Comprehensive Plan is a long-range policy document that provides recommendations for a municipality's future land use, transportation, housing and neighborhoods, parks, infrastructure, and economic development-related issues, challenges, and opportunities. The Comprehensive Plan addresses growth pressures in the city, future utility needs, preservation of community character and natural resources, economic growth, and quality of life initiatives.

Comprehensive Economic Development Strategic Plan
Plan Date: August 2023

This plan is designed to uncover the unique market position that belongs to the City of Dickinson and provide that focused and unified plan for getting there.

Hazard Mitigation Task Force

The City of Dickinson has created the Hazard Mitigation Task Force in 2017 for the purpose of gathering information and developing recommendations on possible mitigation actions to help with the reduction of loss of people and property in the wake of a hazard.

City of Dickinson Parks, Trails, and Recreations Master Plan
Plan Date: July 11, 2023

The purpose of this plan is to evaluate the current parks, trails and recreation amenities and determine the future needs for improving the entire system to meet the short- and long-term needs of the community. The master plan is a guide for policy and decision-making related to the availability, location, type, scale and quality of the park and recreation opportunities to meet the needs of Dickinson residents and visitors. The plan considers the needs and priorities based on the current deficiencies as well as the current and projected population and development within Dickinson as well as opportunities and interests.

City of Dickinson Unified Development Code
Updated: July 23, 2024

A Unified Development Code (UDC) is a one-stop resource for anyone wanting to develop land in Dickinson. The UDC updates our Zoning Ordinance, Subdivision Regulations, and other standards into one code. This makes it easier to get all the information necessary to develop and removes contradictory codes.

Development Regulations being incorporated in the proposed UDC include:

- Subdivision Regulations (Appendix A)
- Zoning Ordinance (Chapter 18)
- Manufactured Homes (Chapter 9)
- Planning & Development (Floodplain) (Chapter 14)
- Sign Regulations (Chapter 15.1)
- Tree Preservation & Landscaping (Chapter 16.10)

Fiscal Mitigation Capabilities

Assessing fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. The ability of the District to implement these projects is closely associated with the amount of fiscal resources available. This assessment identifies both outside resources, such as grant funding, and district-based revenue and financing, such as through fees the district could utilize for hazard mitigation.

The cost of mitigation policy and project implementation vary widely. In some cases, mitigation actions are tied primarily to staff time or administrative costs associated with creation and monitoring of a given program. In other cases, direct expenses are linked to an actual project, such as installing backup power generators and sustainable energy resources, which can require a substantial commitment from the District, state, and federal funding sources.

Completing this HMP will enable the District to facilitate and obtain grant funding in the future through programs such as HMGP or FMA grants. Grant opportunities will be reviewed each year to ensure there will be funding available for specific mitigation items. Each of the identified funding sources below could be utilized as a source of local contributions for federal grants that require a local match. The District intends to leverage state and federal grant funding as much as possible to increase the resilience of the District.

Fiscal Capabilities	
Fiscal Resources	**Accessible or Eligible to use?**
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Utility Service	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	No
State-Sponsored Grant Programs	Yes
Federal-Sponsored Grant Programs	Yes
Other	N/A

The fiscal resources for the District include the following:

- **Water** is the district's cost to buy drinking water from a wholesale water provider and to deliver it for consumption and firefighting throughout the district.
- **Sanitary Sewer** is the district's cost to collect and treat our customers' sanitary sewage at the wastewater treatment plant.

- **TCEQ Regulatory Assessment** is a monthly charge mandated by the TCEQ, the state agency that regulates water districts in Texas. The fee is .5% of monthly water and sewer charges.
- **Garbage Collection** is the district's cost to contract with a third-party private contractor to provide garbage collection services.
- **Texas Sales Tax** is required by the state to be collected on garbage services only.
- **Fire Protection Fees** were approved by the district's voters in 2017 *to provide a steady revenue source to the Dickinson Volunteer Fire Department to pay for the equipment they need to provide firefighting services throughout Dickinson*. The fire department receives no other guaranteed financial support.
- **Property Tax** is an annual tax levy for repayment of the District's bonds and for maintenance and operation purposes.

Administrative and Technical Mitigation Capabilities

These focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation

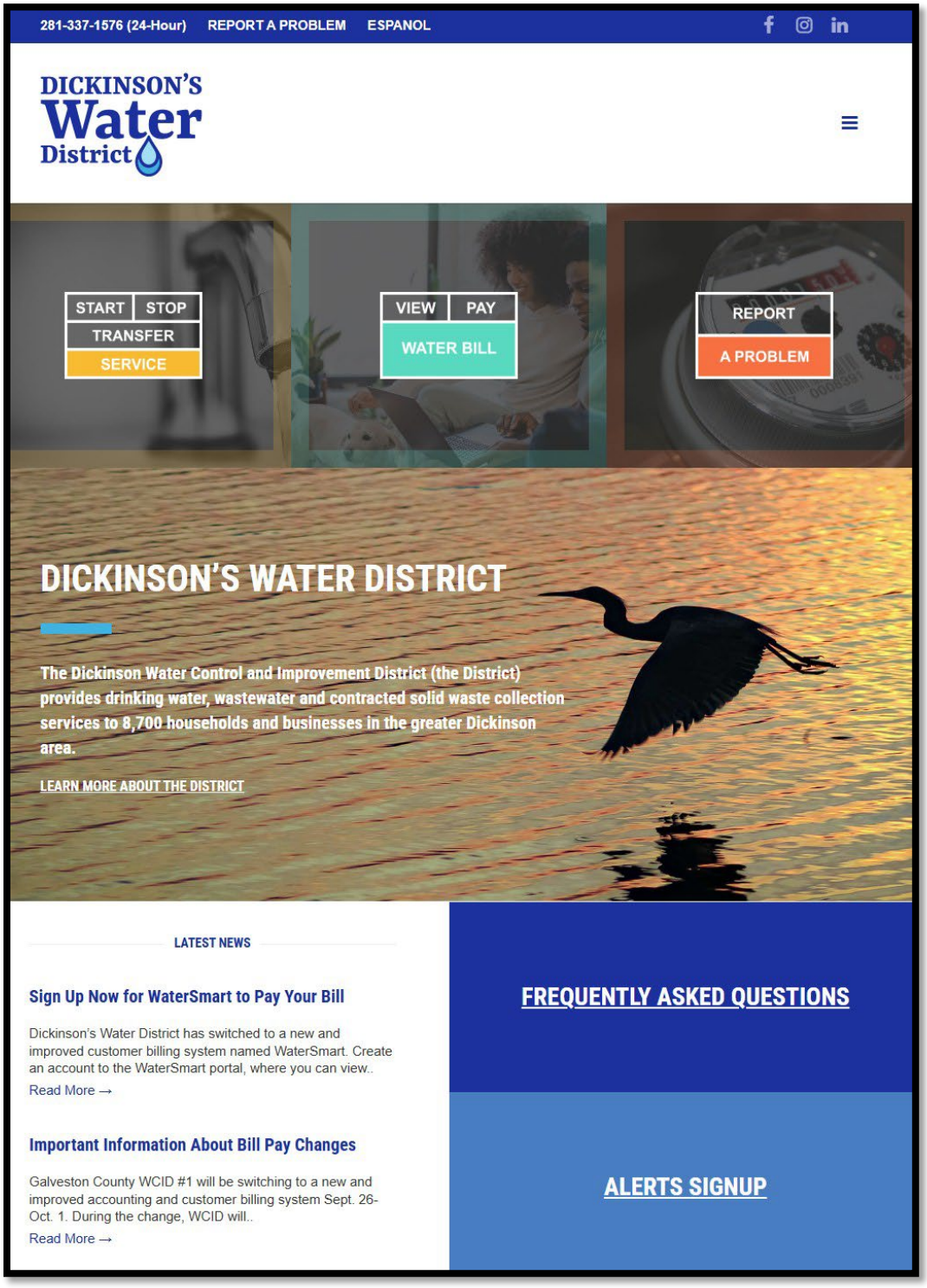
Administrative and Technical Capabilities		
Staff/Personnel	**Available? Full-time or part-time?**	**Agency, Department, or Position**
Planners or engineers with knowledge of water supply infrastructure	Contract service	
Planners or engineers with an understanding of natural hazards	Contract service	
Staff with training in benefit/cost analysis	Full-time available	Finance Director
Personnel skilled or trained in Geographic Information Systems (GIS) applications	Full-time available	Engineering Department
Scientist familiar with natural hazards locally	Contract service	
Emergency Manager	Full-time available	General Manager
Grant writers	Part-time available	Admin Department
Other	N/A	N/A

Education and Outreach Mitigation Capabilities

These illustrate the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement.

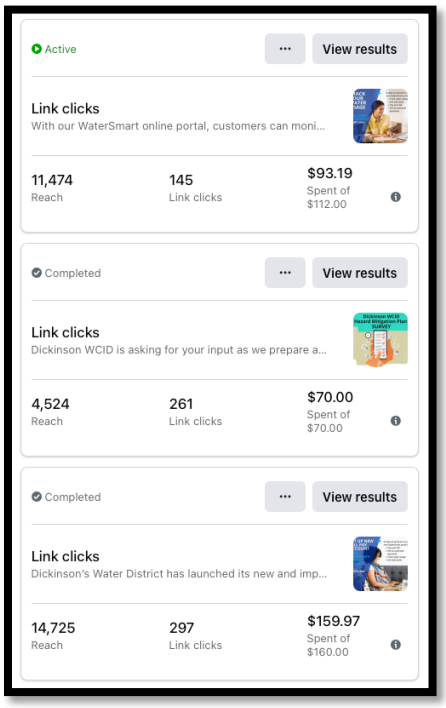
Education and Outreach Capabilities	
Criteria	**Response**
Do you have a public information officer or communications office?	Yes, contract service
Do you have personnel skilled or trained in website development?	Yes, contract service
Do you have hazard mitigation information available on your website? If yes, briefly describe.	Yes, hurricane info, news alerts
Do you use social media for hazard mitigation education and outreach? If yes, briefly describe.	Yes, Facebook and Instagram posts
Do you have any citizen boards or commissions that address issues related to hazard mitigation? If yes, briefly describe.	Yes, HMP steering committee
Do you have any other programs already in place that could be used to communicate hazard-related information? If yes, briefly describe.	Yes, back of water bills
Do you have any established warning systems for hazard events? If yes, briefly describe.	Yes, web-based emergency notification system
Other? Please describe	N/A

District Website: Provides public information and resources on water supply planning, including information on water conservation efforts, hazard mitigation, and emergency water supply.

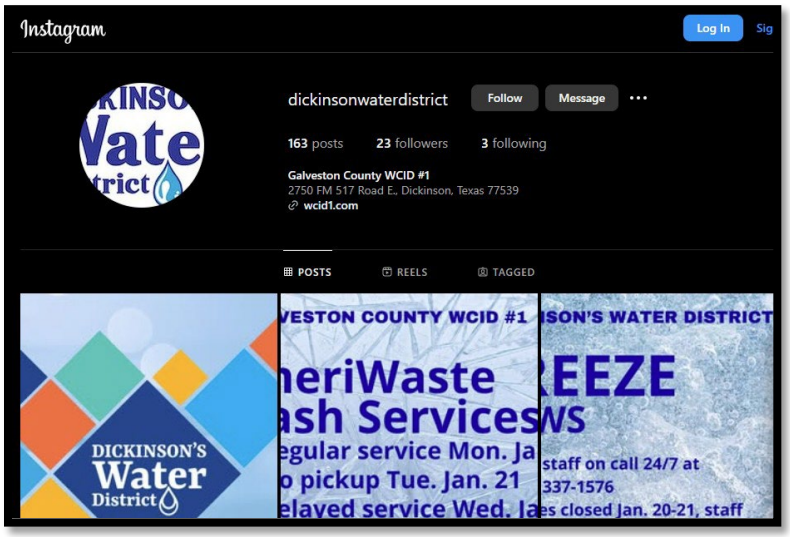


District Social media accounts: Used to disseminate public information.

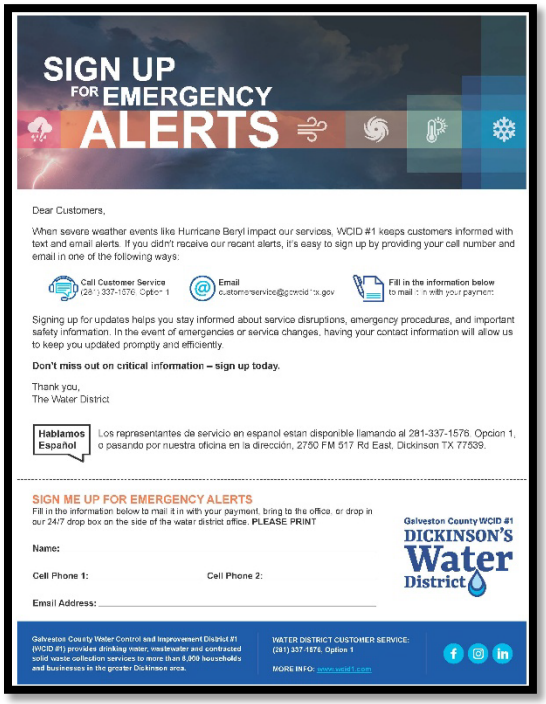
- Facebook

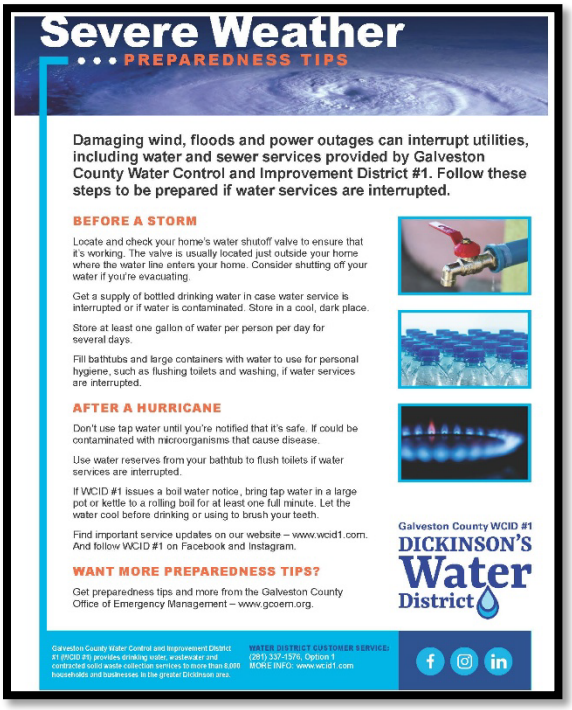


- Instagram

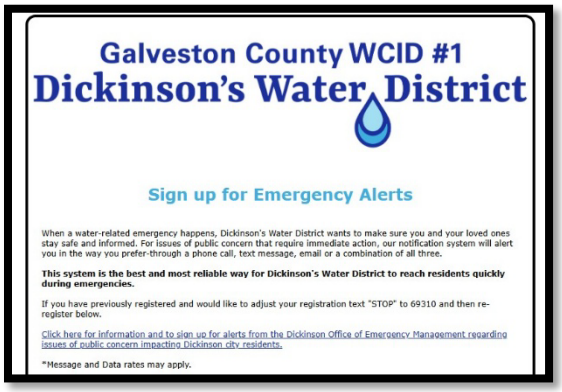


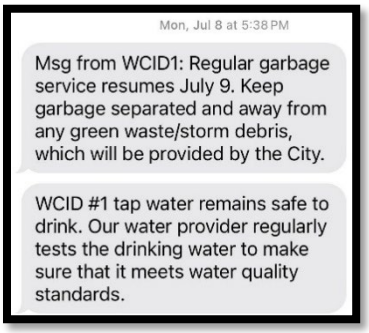
Back of water bills: Used to disseminate public information, disaster preparedness tips, emergency alert sign-up instructions, etc.

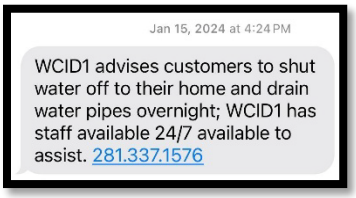




Web-based emergency notification system: Used to disseminate public information, disaster preparedness tips, emergency alert sign-up instructions, etc.







Political Mitigation Capabilities

The local political climate must be considered in designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing their adoption and implementation.

Hazard mitigation may not be a local priority or may conflict with or be seen as an impediment to other goals of the community. Examples of political capabilities within the District service area include the following:

- Grants and Reimbursements
- Partnerships

Other Mitigation Programs and Partnerships

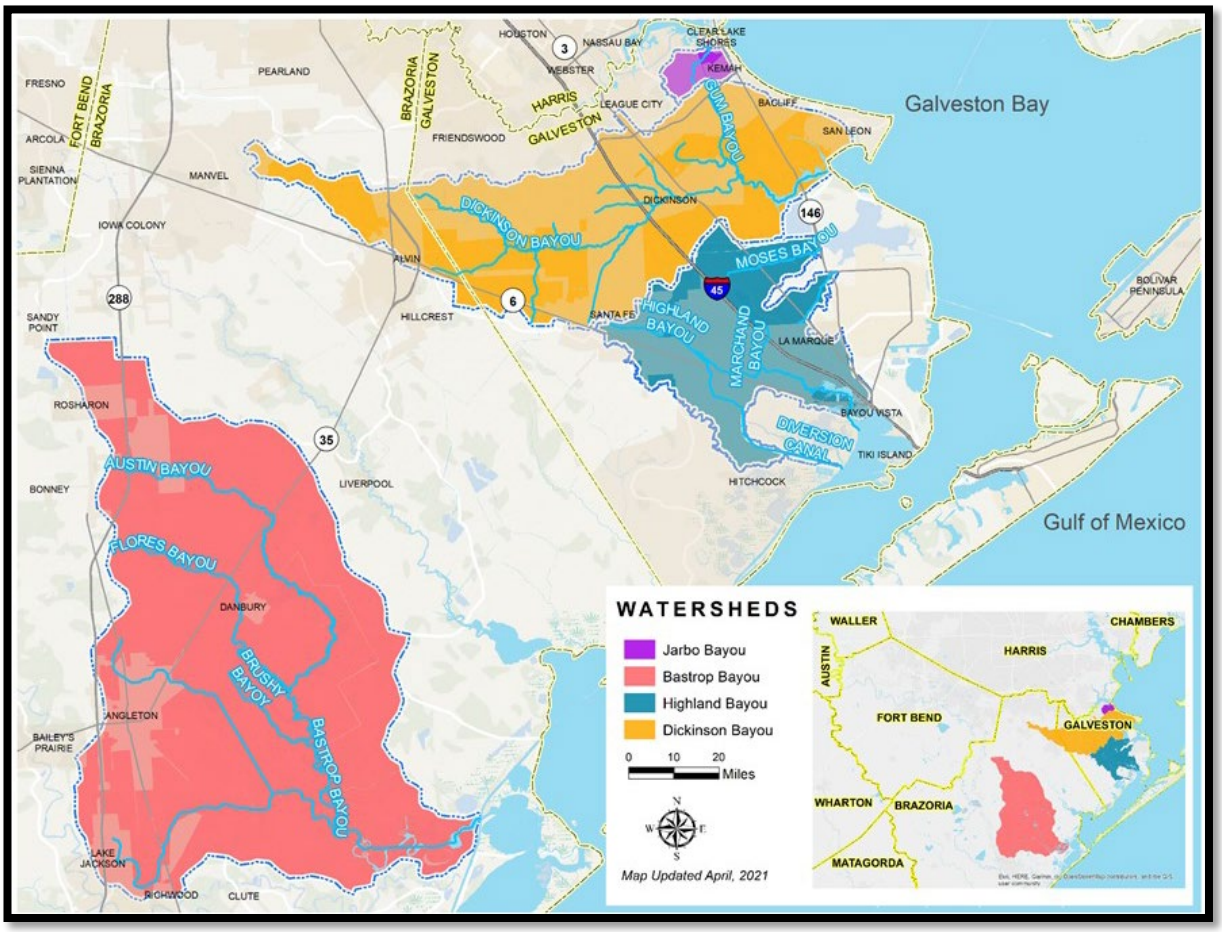
Regional Water Planning Group, Notification and Coordination with the Texas Water Development Board (TWDB)[26]

The service area of the District is located within the Region H Regional Water Planning Group, of which the General Manager of the WCID serves as a representative on their committee. The District will provide a copy of this Plan to such regional water planning group within ninety (90) days following its adoption. Further, the District will also submit the Plan to the TWDB, as required. To the extent applicable, the District may provide a copy of this Plan to the GCWA or such other regional water authority with jurisdiction.

Galveston Bay Coalition of Watersheds

The Galveston Bay Coalition of Watersheds promotes widespread community awareness and engagement in the protection and improvement of the participating watersheds (Jarbo, Bastrop, Highland, and Dickinson Bayous). [27] The District will continue to participate in these meetings.

Galveston Bay Coalition of Watersheds Map



Local Emergency Planning Committee (LEPC)

The Galveston County LEPC is dedicated to ensuring the safety and well-being of the residents and visitors of Galveston County. The District will continue to participate in LEPC meetings and coordination.

Opportunities for Integration and Expansion

Requirement: 44CFR section 201.6(c)(3)

The District has a high degree of core capability for funding, administrative and technical functions, and public awareness and outreach with its existing plans and programs. These capabilities represent opportunities for future integration with this HMP.

Planning and Regulatory- The District serves as a critical function service provider, lacks regulatory capability and police powers to regulate land use and/or development within its service area. Therefore, the legal/regulatory authorities possessed by the district are vastly different than those of a municipal government that has permit authorities and police powers.

All plans listed above are considered to be current and provide the District a high degree of planning capability. For this planning effort, the District sees no need to identify specific actions for the expansion of these plans and programs as they are currently adequately equipped to meet the District's needs and capabilities.

The District is fully committed to plan integration where feasible and valuable. the District staff will update existing planning and regulatory capabilities identified to incorporate recommendations from this LHMP.

This LHMP includes information that can be used for:

1) Updates to the District's Emergency Preparedness Plan
2) Updates to the District's Emergency Action Plan
3) Updates to the District's Emergency Response Plan
4) Updates to the District's Risk and Resiliency Assessment
5) Updates to the District's Risk Management Plan

Financial- The District's principal objective for the creation of this LHMP is to gain eligibility to pursue hazard mitigation grant funding under FEMA's HMA grant programs, thus leveraging the district's funding for capital improvement projects. However, in order to be successful, communities must be able to have sources for the local match contributions, as FEMA HMA grants are typically funded at 75% federal, and require 25% local contribution.

Administrative and Technical- The District capability assessment for this category identified that there is in-house capability, or the ability for the District to contract out for services relating to all core capabilities identified.

Outreach and Education- The District capability assessment for this category identified that there is in-house capability, or the ability for the District to contract out for services relating to all core capabilities identified.

Section 4: Hazard Identification and Risk Assessment

As defined by the Federal Emergency Management Agency (FEMA), risk is a combination of hazard, vulnerability, and exposure. “It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.”

The risk assessment process identifies and profiles relevant hazards and assesses the exposure of lives, property, and infrastructure to these hazards. The process allows for a better understanding of a jurisdiction’s potential risk to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events. This risk assessment builds upon the methodology described in the 2025 FEMA Local Mitigation Planning Handbook, which recommends a five-step process for conducting a risk assessment:

1. Identify Hazards
2. Describe Hazards
3. Identify Community Assets
4. Analyze Impacts
5. Summarize Vulnerability

Data collected through this process has been incorporated into the following sections of this chapter:

- **Section 4.1 Hazard Identification** describes the methodology used to identify and rank the hazards that threaten the District by the HMSC and describes why some hazards were omitted from this plan.
- **Section 4.2 Hazard Profiles** define the hazards that pose a threat to the Planning Area, identify the location where the hazards could occur, describes the extent of the hazard, lists previous occurrences of hazard events, the likelihood of future occurrences, and summarizes the District’s vulnerability to each hazard.

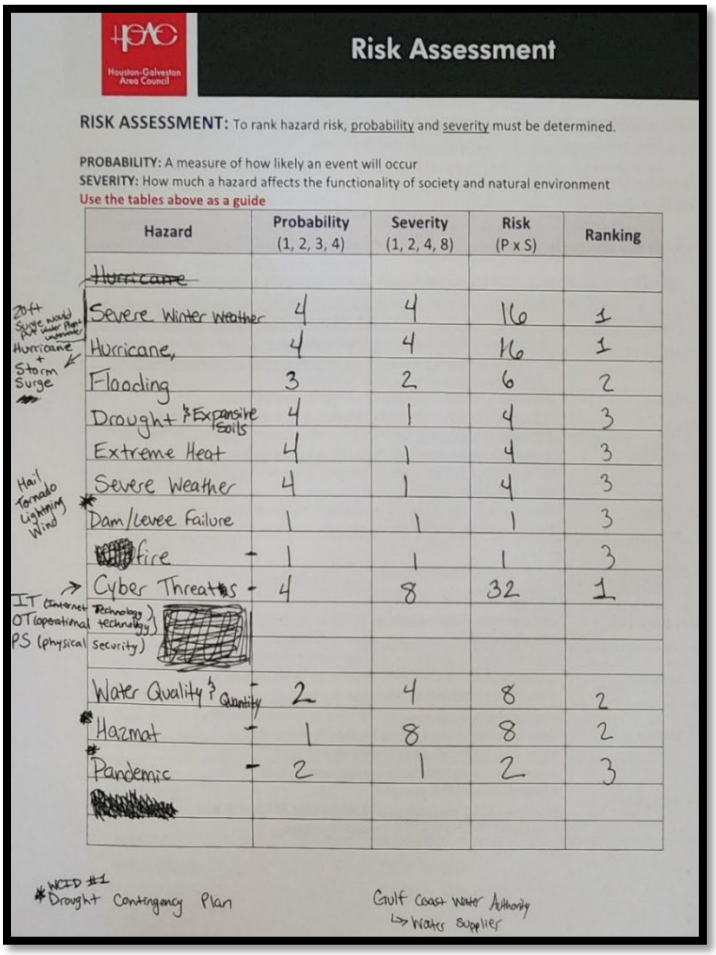
4.1 Hazard Identification

B1. (Requirement 44 CFR § 201.6(c)(2)(i))

The 2023 Texas State HMP identified 11 major natural hazards that affect the region. These include hurricanes, floods, wildfires, droughts, and tornadoes. [28] The PT identified 11 hazards of concern to the district.

Methodology

The HMSC was provided with a risk assessment worksheet and tasked with determining what hazards pose a risk to the District, assessing the probability and severity of those hazards, and assigning them accurate scores based on relatable characteristics for those 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). Scores and associated characteristics can be found below. Results can be found below and in Appendix D, which includes completed worksheets and a summary of hazard ranking scores from participating HMSC members, public events, and the PT.



H-GAC Houston-Galveston Area Council

Risk Assessment

RISK ASSESSMENT: To rank hazard risk, probability and severity must be determined.

PROBABILITY: A measure of how likely an event will occur
SEVERITY: How much a hazard affects the functionality of society and natural environment
Use the tables above as a guide

Hazard	Probability (1, 2, 3, 4)	Severity (1, 2, 4, 8)	Risk (P x S)	Ranking
~~Hurricane~~				
Severe Winter Weather	4	4	16	1
Hurricane,	4	4	16	1
Flooding	3	2	6	2
Drought & Expansive Soils	4	1	4	3
Extreme Heat	4	1	4	3
Severe Weather	4	1	4	3
Dam/Levee Failure	1	1	1	3
Fire	1	1	1	3
Cyber Threats	4	8	32	1
Water Quality & Quantity	2	4	8	2
Hazmat	1	8	8	2
Pandemic	2	1	2	3

WCID #1 Drought Contingency Plan

Gulf Coast Water Authority → Water Supplier

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

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

Results

HMSC scores, seen in the table below, were given a score and a ranking (High, Medium, or Low) based on their overall risk and potential impact on district operations and infrastructure. These hazards were identified and scored collectively as a committee at the August 6, 2023 meeting.

High: Probability of occurrence and severity of impacts are both high and the event is likely to occur over a significant portion of the planning area.

Medium: Probability of occurrence and severity of impacts fall mostly in the middle range of characteristics. The impacts on the planning area are noticeable but not catastrophic. This rating is sometimes used for hazards with a high severity rating but a very low probability rating.

Low: Probability of occurrence and severity of impacts are both low, and the event has negligible to minimal impact on the planning area. This rating is sometimes used for hazards with a minimal or unknown record of occurrences or for hazards with minimal mitigation potential.

HMSC Risk Assessment and Hazard Identification

Hazard	Probability (1, 2, 3, 4)	Severity (1, 2, 4, 8)	Risk (P x S)	Ranking
Cyber Threats	4	8	32	**1, high**
Hurricane & Storm Surge	4	4	16	**1, high**
Winter Weather (Ice Storm, Heavy Snow, Blizzard)	4	4	16	**1, high**
Water Quality & Quantity	2	4	8	2, medium
HazMat / Toxic Release	1	8	8	2, medium
Flooding	3	2	6	2, medium
Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)	4	1	4	2, medium
Extreme Heat	4	1	4	2, medium
Drought ~~& Expansive Soils~~	4	1	4	2, medium
Geologic (Expansive Soils, Erosion, Land Subsidence)	4	1	4	2, medium
Pandemic	2	1	2	1, low
Fire	1	1	1	1, low
Dam/Levee Failure	1	1	1	1, low

Calculated hazard rankings were then compared to the State of Texas HMP for Region 4 and data from the public gathered at community events and the online survey. The table below highlights the HMSC hazard rankings compared to the combined hazard rankings from all public input. Differences in rankings that were over a score of 4 were highlighted and discussed by the HMSC when determining final rankings. It was determined that this discrepancy in ranking may be due to the lack of awareness regarding cyber threats and their impacts, especially crucial systems and services like those that the district provides.

HMSC and Public Input Risk Assessment Rankings Compared

Hazard Name	HMSC Ranking	Public Ranking	Difference
Cyber Threats	1	9	8
Winter Weather (Ice Storm, Heavy Snow, Blizzard)	2	4	2
Hurricane & Storm Surge	3	1	2
HazMat / Toxic Release	4	7	3
Flooding	5	2	3
Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)	6	3	3
Extreme Heat	7	6	1
Drought	8	5	3
Geologic (Expansive Soils, Erosion, Land Subsidence)	9	10	1
Pandemic	10	8	2
Fire	11	11	0

Hazards Ranked by Risk

Each identified hazard in the table below poses a risk to the District. Ranking the hazards within this plan 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, the public, and the HMSC. Hazards were then categorized with a risk rating of High (score of 16-32), Medium (score of 4-15), or Low (score of 3 and below).

Risk Rating	*Ranking*	*Hazards*
High	1	Cyber Threats
	2	Winter Weather (Ice Storm, Heavy Snow, Blizzard)
	3	Hurricane and Storm Surge
Medium	4	HazMat / Toxic Release *
	5	Flooding
	6	Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)
	7	Extreme Heat
	8	Drought
	9	Geologic Hazards (Expansive Soils, Erosion, Land Subsidence)
Low	10	Pandemic *
	11	Fire

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

4.2 Hazard Profiles

The 2023 Texas State HMP identified 16 major natural hazards that affect the state. These include hurricanes, floods, wildfires, drought, and tornadoes. [29] The local planning team identified 12 hazards that could affect the District. Not all hazards were profiled fully for this HMP. The District focused on hazards that occur within the planning area that historically have had an impact (e.g., damage to property, infrastructure, injury or death) for which mitigation of that hazard is necessary for the welfare of the community, District assets, and continuity of essential water services. Additionally, the District, which has limited to no authority to mitigate against most hazards that the City of Dickinson and Galveston County can address, focused on hazards that affect the planning area, the District's service area boundaries, directly, and for which it has authority to mitigate.

Certain hazards have negligible impacts or no history of occurrence in the planning area; therefore, the District has decided to omit these hazards. The table below provides a list of hazards from the 2023 Texas State HMP and a brief explanation on each hazard that was omitted from this HMP. The District will reevaluate these hazards when conducting their annual review of the HMP to determine if the impact has changed and if so, will update the HMP accordingly.

Hazard Name	Status in the plan	Justification
Coastal Erosion	Omitted	Does not occur in planning area
Dam/Levee Failure	Omitted	Does not occur in planning area
Drought	Included	
Earthquake	Omitted	Does not occur in planning area
Expansive Soils	Included under Geologic Hazards	
Extreme Heat	Included	
Flood	Included	
Hailstorm	Included under Severe Weather	
Hurricane, Tropical Storm and Depression	Included	
Land Subsidence	Included under Geologic Hazards	
Lightning	Included under Severe Weather	
Pandemic	Included	
Severe Coastal Flood	Included under Flooding	
Severe Wind	Included under Severe Weather	
Severe Winter Weather	Included	
Tornado	Included under Severe Weather	
Wildfire	Included	

4.2.1 Cyber Threats

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. [30] Cyber terrorism 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. Cyberattacks 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. [31] The table below outlines some key terms and definitions for this hazard.

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.
Information Technology (IT)	Primarily deals with data and information systems for storing, retrieving, and sending information.
Operational Technology (OT)	OT focuses on ensuring the safe, efficient, and reliable operation of physical assets and infrastructure.
Physical Setting (PS)	The physical environment and infrastructure where sensitive data and systems are located, encompassing measures like access control, surveillance, and security personnel to protect against real-world threats

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, weak passwords, social engineering attacks, and insecure 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." [32] A worst-case scenario for this hazard would include a cyber-attack that locks District staff out of systems used to control the operations of the District, leading to a shutdown of water and wastewater operations within the planning area.

Historic Occurrences

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. The threat actors for these breaches included external (94%), internal (12%), multiple (9%), and partner (2%). Motives for these cyberattacks were financial (99%), espionage (1%), and grudges (1%). Data included credentials (67%), internal (50%), personal (38%), and other (24%). [33]

There have been zero historic occurrences or documented cyberattacks against the District. However, recent attacks on nearby municipalities and other water providers within the state highlight the increasing risk this hazard poses to the district. Recently, in the neighboring city of Nassau Bay, Texas, and Matagorda County, Texas, cyberattacks locked municipal staff out of their systems and took 10+ days for staff to regain control, and upwards of 3 weeks to fully recover. More notably, in January 2024, hackers targeted the water systems in 3 rural towns, gaining access to one. In Muleshoe, Texas (population of about 5,000), hackers caused the water system to overflow before it was shut down and taken over manually by officials. [34]

In March 2024, a letter from the EPA Administrator and Assistant to the President for National Security Affairs was sent to the nation's governors, asking them to take steps to protect the water supply, including assessing cybersecurity and planning for a cyberattack. In the letter, they wrote, "Drinking water and wastewater systems are an attractive target for cyberattacks because they

are a lifeline critical infrastructure sector but often lack the resources and technical capacity to adopt rigorous cybersecurity practices." [35]

Presidential Disaster Declarations

There have been no federally declared cyberattacks or cyber terrorism-related disaster declarations within the planning area.[5,6]

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

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 significant disruptions that can ripple across multiple sectors. For example, for an entity that provides water services, like that of the District, a cyber-attack that shuts down these services would not only impose a health risk to citizens, it would also impact businesses (restaurants and food chains being forced to close if there is no water available), healthcare facilities, schools, etc.

Critical Facilities

This hazard poses a direct impact on existing building stock, critical facilities, and/or critical infrastructure owned or operated by the District. Data breaches can have serious detrimental outcomes for the District, such as disruptions to various sectors like water supply and power.

Economy

A cyber-attack on water systems and infrastructure can have significant economic and social ramifications. These attacks can disrupt operations, leading to financial losses for both public utilities and private businesses that rely on the District for services. Disruptions can also cause significant damage to the economy by impacting industries that rely on water (agriculture, manufacturing, etc.).

Probability of Future Occurrences

As cybercriminals become more sophisticated in the future, the vulnerability to cyberattacks may change significantly. Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. Opportunistic criminals may leverage natural disasters to target already vulnerable systems. Based on previous occurrences of cyberattacks in surrounding communities and the increased risk for cyber threats as systems evolve, the District expects this hazard to occur at least once per year.

Future Conditions

Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates. The following factors were used to examine potential conditions that may affect hazard vulnerability:

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is not anticipated.
- **Future weather conditions**- This is a technological hazard; no future weather condition impacts are associated.

For this hazard, the District considers the overall vulnerability **high**. The HMSC rated the probability of occurrence as highly likely and the severity of impacts as catastrophic. Additionally, such an event would be expected to impact a significant portion of the planning area.

To decrease the number of future cybersecurity-related attacks, FEMA and the Cybersecurity and Infrastructure Security Agency (CISA) suggest a variety of actions water systems can take today to reduce cyber risk and improve resilience to cyberattacks. [36] These include:

- Reduce Exposure to the Public-Facing Internet
- Conduct Regular Cybersecurity Assessments- Conduct a cybersecurity assessment on a regular basis to understand the existing vulnerabilities within OT and IT systems. Assessments enable you to identify, assess, and prioritize mitigating vulnerabilities in both OT and IT networks.
- Require unique, strong, and complex passwords for all water systems, including connected infrastructure.
- Create an inventory of software and hardware assets to help understand what you need to protect. Focus initial efforts on internet-connected devices and devices where manual operations are not possible. Use monitoring to identify the devices communicating on your network.
- Develop and Exercise Cybersecurity Incident Response and Recovery Plans- incident response actions, roles, responsibilities, as well as who to contact and how to report a cyber incident before one occurs to ensure readiness against potential targeting.
- Regularly back up Operational Technology /Information Technology systems so you can recover to a known and safe state in the event of a compromise.
- Mitigate known vulnerabilities and keep all systems up to date with patches and security updates.

4.2.2 Winter Weather

Winter weather is defined by the National Weather Service (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." [37]

Location

Winter weather occurs on a regional scale, with no specific geographic boundary, and can happen anywhere within the state, the region, the county, city, or other areas within the District's boundaries.

Extent

The Winter Storm Severity Index (WSSI) is a recent 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 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.

Winter Storm Severity Index Datasets

Data Source	Dataset
Official NWS Forecast datasets from NDFD	6-hour snow accumulation, ice accumulation, and 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 National Oceanic and Atmospheric Administration (NOAA) 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 of 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.

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: [38]

- Snow Load Index- Indicates potential infrastructure impacts due to the weight of the snow. This index accounts for the land cover type. This component is significant because the weight of the snow creates a threat to the structural integrity of residential and commercial buildings, as well as tree and powerline damage.

- 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.

- Blowing Snow Index- Indicates the potential disruption due to blowing and drifting snow. This index accounts for land use type. The impacts created by this component of winter weather are visibility and drifting snow issues. It is highly dependent on the type of land cover; an open field is more susceptible to blowing snow than a heavily forested area.

- Flash Freeze Index- Indicates the potential impacts of flash freezing (temperatures starting above freezing and quickly dropping below freezing) during or after precipitation events. The main hazard for this component is black ice on surfaces.

- 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 impacts created by this component of winter weather are visibility and drifting snow issues. It is highly dependent on the type of land cover; an open field is more susceptible to blowing snow than a heavily forested area. [39]

Not all sub-components above are included for every planning area due to different locations, climates, and geographies. For the District, anticipated intensities for the WSSI sub-components mentioned above per the American Society of Civil Engineers (ASCE) are highlighted and explained in more detail below. These values given are used for determining loads for structures with a risk category of 4 (those that have the greatest impact on life, health, and welfare). [40]

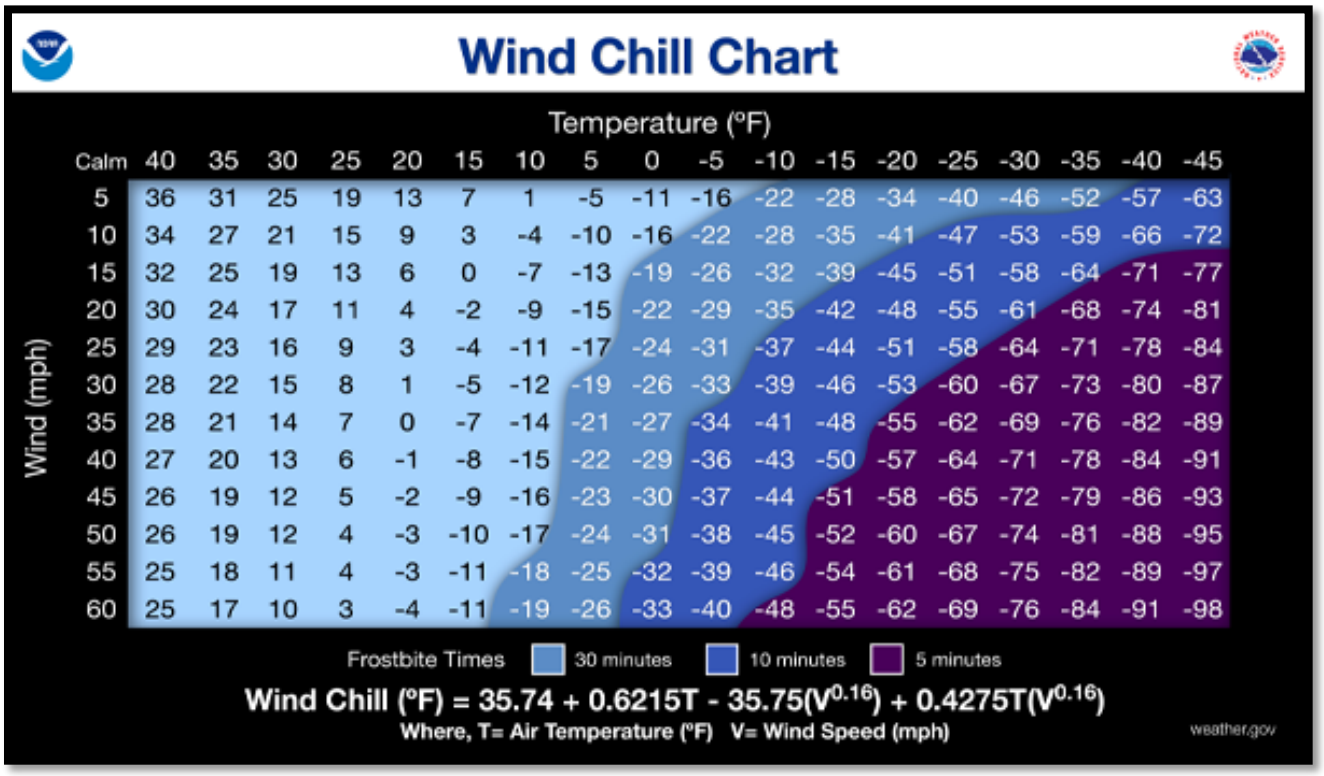
Within the District boundaries, these include: [41]

- Snow Load Index-
    - **Ground Snow Load, pg: 11 lb./ft^2**
        - → This is the maximum amount of snow that's expected to accumulate on the ground in a specific location. Light snow ranges from 5–20 lb./ft^2.
    - **20-year Mean Return Interval Value: 1.09 lb./ft^2**
        - → This represents the snow load that is statistically likely to occur once every 20 years at a given location, used primarily in structural engineering calculations to design buildings against snow loads.
    - **Winter Wind Parameter: 0.35**
        - → The percentage of time the wind speed is above 10 mph during October through April. Used to calculate snow drifting.
    - Mapped Elevation: 13.6 ft

- Ice Accumulation- Ice thickness 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: 1.07 in.**
        - → This refers to the total depth or layer of ice that builds up on a structure due to freezing rain or other icing conditions, which engineers must consider when designing buildings and infrastructure in areas prone to ice storms
    - Concurrent Temperature: 15°F
    - 3-s Gust Speed: 31 mph

A worst-case scenario for winter weather (ice storm, heavy snow, blizzard, or other related cold weather components) within the planning area would be like that of Winter Storm Uri in 2021, which brought snow, sleet, freezing rain, and consecutive days of extreme low temperatures. The planning area saw ice accumulations of .25", temperatures of 10°F with wind chill, and snow/sleet accumulations up to 1”. This resulted in multi-day road closures (3+ days within Galveston County) as roads and bridges throughout the county and through the city were covered with snow and ice from the previous night’s freezing rain, sleet, and plummeting temperatures. The increased demand for electricity across the state at this time led to extensive power outages, loss of heat, broken pipes, and other societal impacts for the region. Uri was the largest and most costly winter weather event in Galveston County’s history, causing $12,000,000 in reported property damage and a total of 9 deaths combined from inland and coastal communities within the county. Another winter storm event of this magnitude could, again, result in risks to life and property as well as result in secondary hazards from prolonged power outages, closure of roads, and the inability of residents to access critical facilities or resources.

NWS Wind Chill Chart



Wind Chill Chart

Temperature (°F)

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

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

weather.gov

The NWS Wind Chill Temperature uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. The wind chill temperature is how cold people and animals feel when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature. Therefore, the wind makes it feel much colder. If the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill temperature, exposed skin can freeze in 30 minutes.

Average temperatures for Galveston County during the months of November- February typically range from highs in the mid-60's to low 70's during the day and lows in the 50's at night, with the coldest month generally being January. Wind speeds during the months of November to January average 11 mph.[42] According to the NWS Wind Chill Chart above, this puts the planning area, on average, slightly above freezing. Winter weather events, while rare like the 2021 cold wave Winter Storm Uri, within the planning area occur rarely (once every 10 years)

A worst-case scenario for wind chill within Galveston County would be similar to that of Winter Storm Uri which occurred in February 2021. Every county across Texas was under a Winter Storm Warning and wind chill values were below zero as far south as the Rio Grande River and into

northeastern Mexico. This historic winter storm brought snow, sleet, freezing rain and prolonged extreme temperature lows that brought significant buildup of ice on roads and highway overpasses. [43] Impacts were extreme according to the NWS WSSI impact classifications seen above. Travel was not advised due to dangerous and continuously deteriorating conditions as the storm moved through the area. In the aftermath, there was extensive damage to public infrastructure due to frozen pipes and water line breaks, ice accumulations led to downed trees and power lines. This extensive damage to infrastructure led to prolonged power outages, closed roadways, and cut-off access to critical facilities and services due to dangerous travel conditions.

NOAA and the NWS 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 Freeze Warning expired at 9 am on Saturday, February 20th, 2021. While a winter weather hazard event of Uri's magnitude in southeast Texas is uncommon, winter weather is expected to affect the planning area yearly and annualized frequency for this hazard is expected to remain the same in the future. [44]

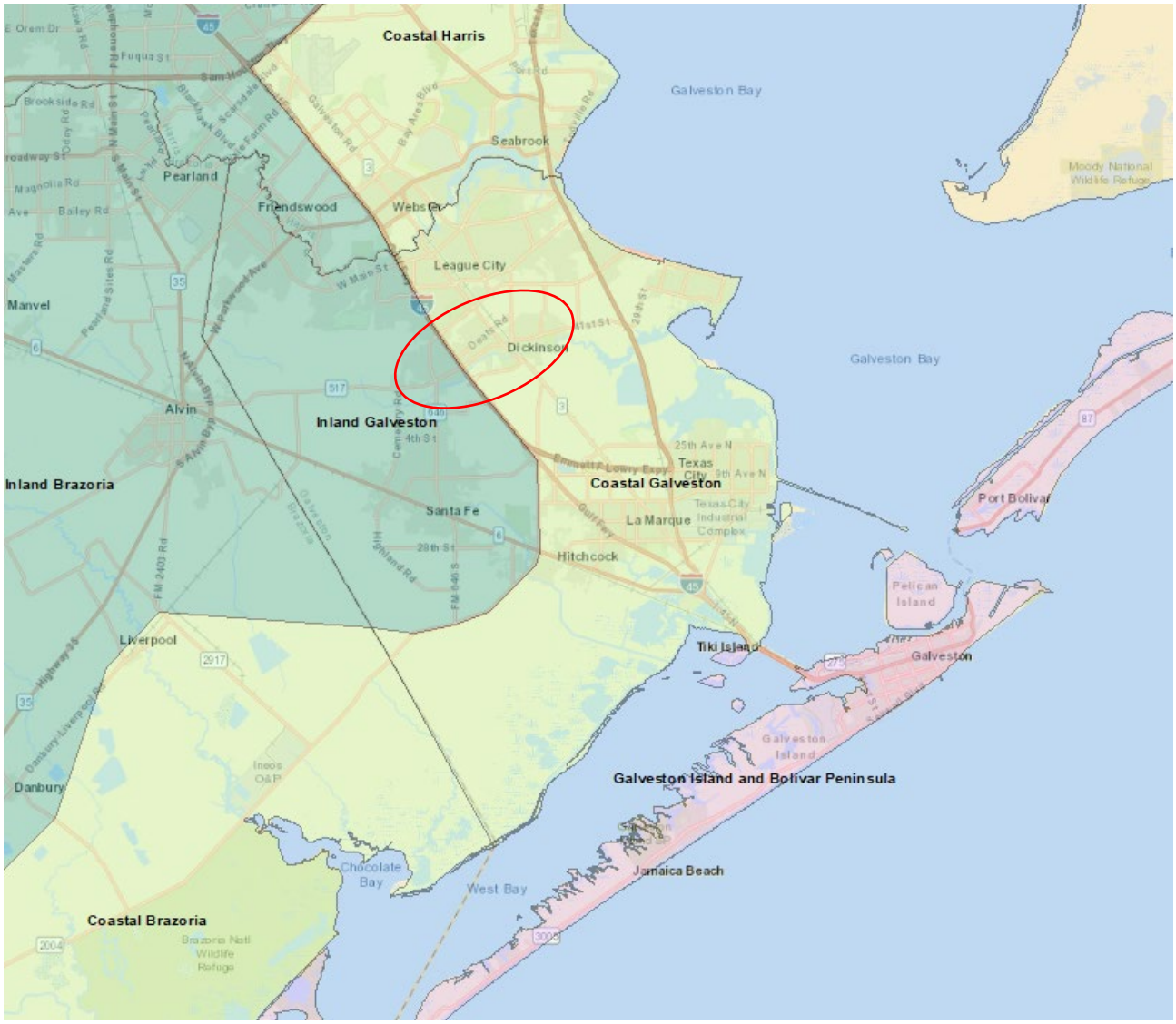
The table below describes the various winter weather warnings, watches, and advisories. [45]

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.)
Extreme Cold Watch (Previously Wind Chill Watch)	Issued when there is the potential for dangerously cold air with or without wind.
Freeze Watch	Issued when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours.
Winter Storm Warning	Issued when dangerously cold air, with or without wind, is expected. Conditions could lead to frostbite or hypothermia. Limit time outside.
Extreme Cold Warning (Previously 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.
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.
Cold Weather Advisory (Previously Wind Chill Advisory)	Issued when seasonably cold air temperatures or wind chill values, but not extremely cold values, are expected or occurring.
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 National Center for Environmental Information (NCEI) Storm Events Database. These events are primarily categorized by location at the county level; however, some NCEI entries reference a specific location, city, or zone. These changes took place in 2018. The Galveston Zone was divided into Inland Galveston, Coastal Galveston, as well as Galveston Island and Bolivar Peninsula zones. [46] The planning area is located within the Coastal Galveston and Inland Galveston zones. Events in the table below occurring after 2018 will include data to account for both zones.



The database currently contains data from January 1950 to March 2025, as entered by NOAA's NWS. Due to changes in data collection and processing procedures over time, there are unique periods of record available depending on the event type. [47]

The table below highlights events for this hazard that have occurred within Galveston County since the year 2000.

Historic Occurrences, Winter Weather

Event Date	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
12/24/2004	Heavy Snow	0	0	$0	$0
2/3/2011	Ice Storm	0	0	$0	$0
12/8/2017	Winter Weather	0	0	$0	$0
2/15/2021	Cold/Wind Chill	0	9	$12,000,000	$0
1/20/2025	Winter Storm	0	0	$0	$0
Totals:		**0**	**9**	**$12,000,000**	**$0**

Presidential Disaster Declarations

There have been two disaster declarations for this hazard within the planning area since reporting began in 1996.[5,6]

Federal Disaster Declarations, Winter Weather

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

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is an estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

The Gulf Coast and Southeast Texas region are generally not used to snow, ice, and freezing temperatures. 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. [48] These vulnerabilities are discussed in more depth below.

Populations at Risk

Populations at risk from this hazard include the entire planning area as this hazard has no set geographic boundaries. According to the CDC, populations at greater risk from the impacts of this hazard include: [49]

- **Older populations**- Older adults face the potential lack of access to critical facilities (which can provide food, water, medications, or other forms of medical assistance), lack of utilities (electricity and potable water), and can also face social isolation during disasters. Older adults are also more susceptible to winter weather-related illness (respiratory illnesses like colds, flu, bronchitis, and pneumonia). Cold weather can also cause or exacerbate conditions like hypothermia, frostbite, as well as worsen joint pain and dry skin.
- **Younger populations**- Winter Weather can disrupt schooling and the normal day-to-day routines they thrive on. This can not only jeopardize their academic success, but it can also cause mental and emotional stress. Children are more at risk and vulnerable to winter weather-related illness (respiratory illnesses like colds, flu, bronchitis, and pneumonia).
- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events.
- **Populations with disabilities**- Those with disabilities may require additional assistance to stay safe and prepare for these hazards.
- **Populations with chronic health conditions**- Those with chronic health conditions or who are immunocompromised may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to winter weather-related illness (respiratory illnesses like colds, flu, bronchitis, and pneumonia).and may face an even greater risk of exposure to these illnesses when utilizing a shelter or evacuation center in the event of a power outage.
- **Populations living in mobile homes or manufactured housing-** Those living in mobile homes or manufactured housing are also at greater risk of injury and death from these hazards. Despite mobile homes providing shelter, building materials utilized for mobile homes or manufactured housing are usually of a lower quality, and more susceptible to freezing temperatures and damage.

When heating systems or power outages can't adequately maintain a safe temperature, households may turn to using space heaters, fireplaces, or appliances that aren't meant for heating (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.

Critical Facilities

Winter weather and ice storms can cause dangerous driving conditions, falling trees, and power outages. Freezing temperatures can cause damage to homes and businesses in the form of burst pipes. The most notable vulnerabilities to critical facilities throughout the planning area to this hazard are frozen pipes and power outages as these would directly affect the district's ability to provide services to customers.

Economy

When cold air penetrates south across Texas and Florida, into the Gulf of Mexico, temperatures fall below freezing. This can cause pipes without adequate insulation to freeze, which then causes them to crack and results in water leaks. This can have a significant economic impact on the District due to increased water demands from leaks, including low water pressure. Water pressure is crucial for water suppliers as it directly impacts the ability to deliver water to customers efficiently and safely. Maintaining proper pressure ensures adequate water flow to homes and businesses, while also preventing damage to pipes and fixtures, as well as backflows and water stagnation.

National Risk Index

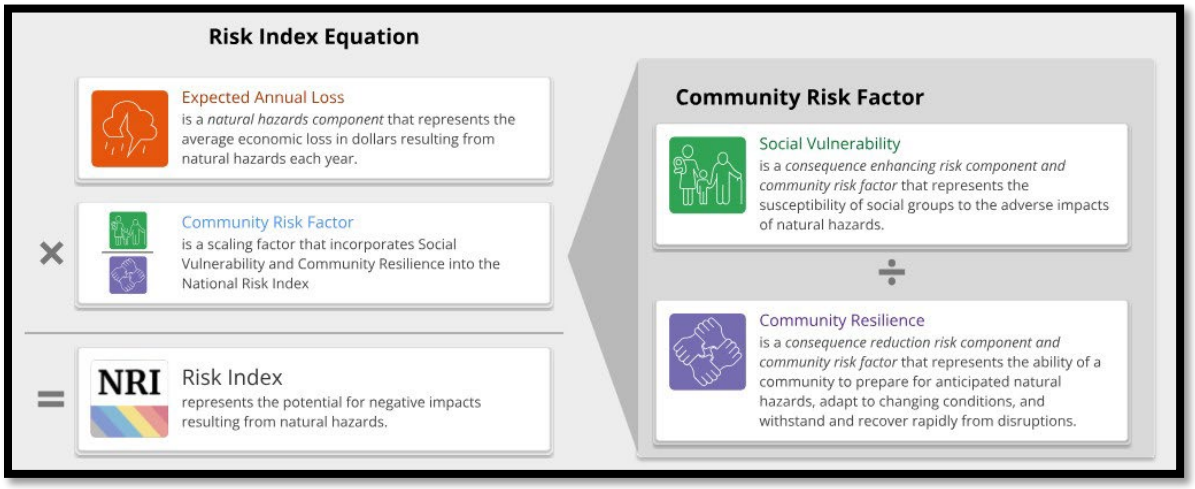
FEMA's National Risk Index (NRI) utilizes data from multiple sources, including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI accounts for winter weather in various formats, these are cold waves, ice storms, and winter weather.

- **Cold Wave-** a rapid fall in temperature within 24 hours and extreme low temperatures for an extended period. The temperatures classified as a cold wave are dependent on the location and defined by the local NWS weather forecast office. [50]
- **Ice Storm-** a freezing rain situation (rain that freezes on surface contact) with significant ice accumulations of 0.25 inches or greater. [51]
- **Winter Weather-** consists of winter storm events in which the main types of precipitation are snow, sleet, or freezing rain.

The NRI risk index equation includes 3 components:

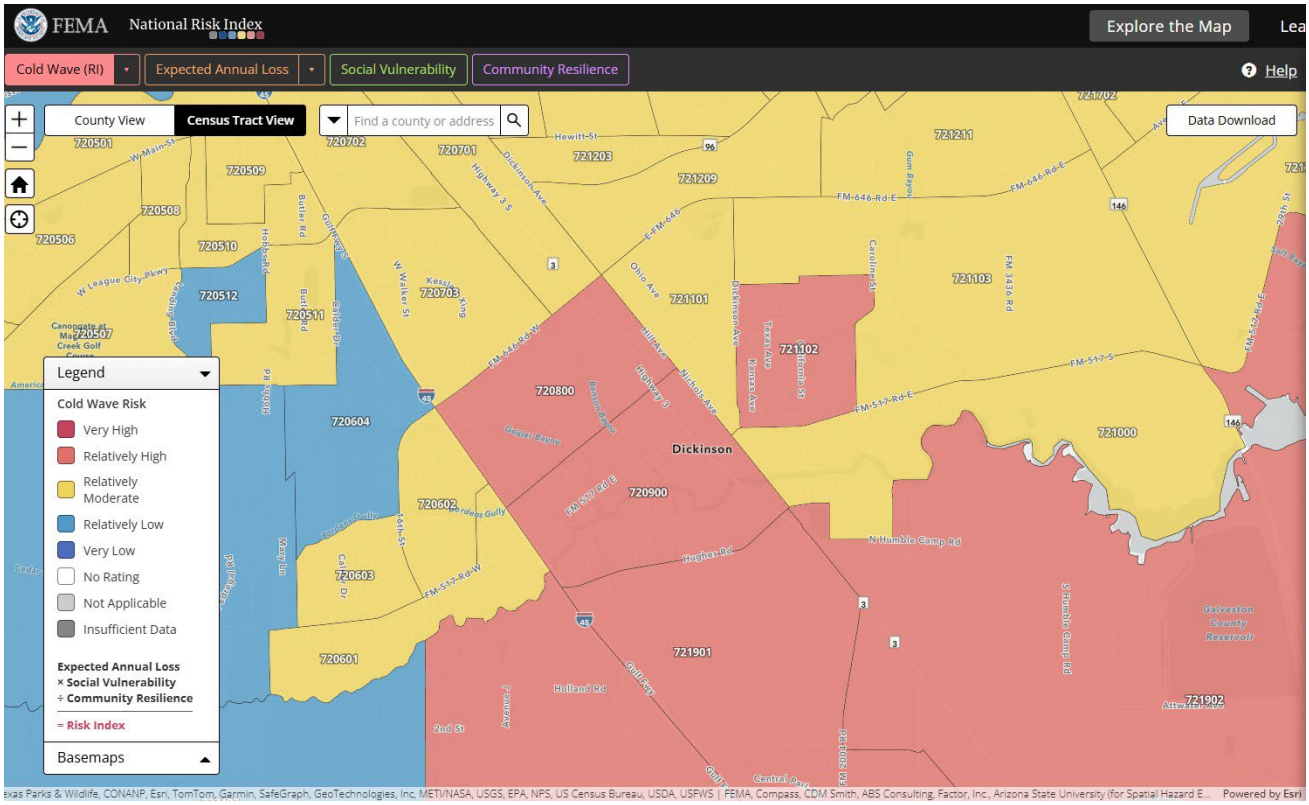
- **Expected annual loss (EAL)** represents the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S.
- The **Community Risk Factor** is a scaling factor that incorporates social vulnerability (the 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.



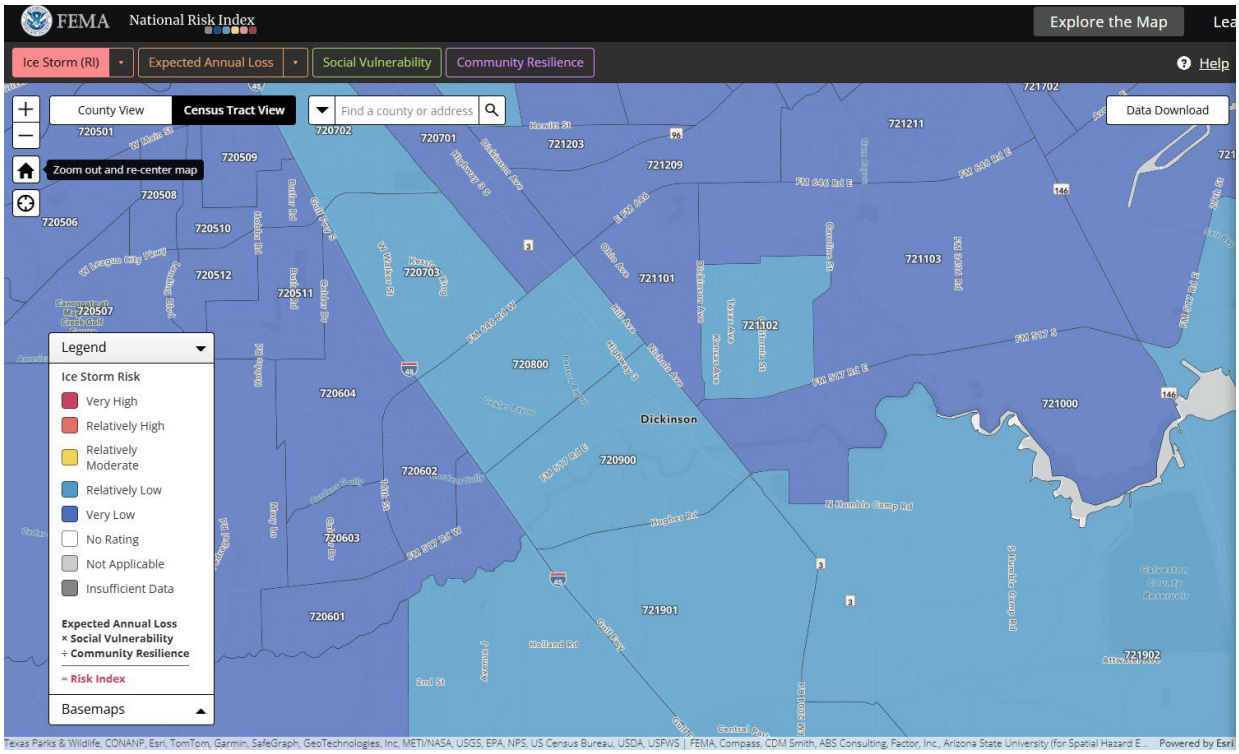
A community report for Galveston County and a comparison report for the census tracts that include the jurisdictional boundaries of the District are included in Appendix C, Reference Documents.

Risk index scores for these hazards by census tract are shown in the figures below. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

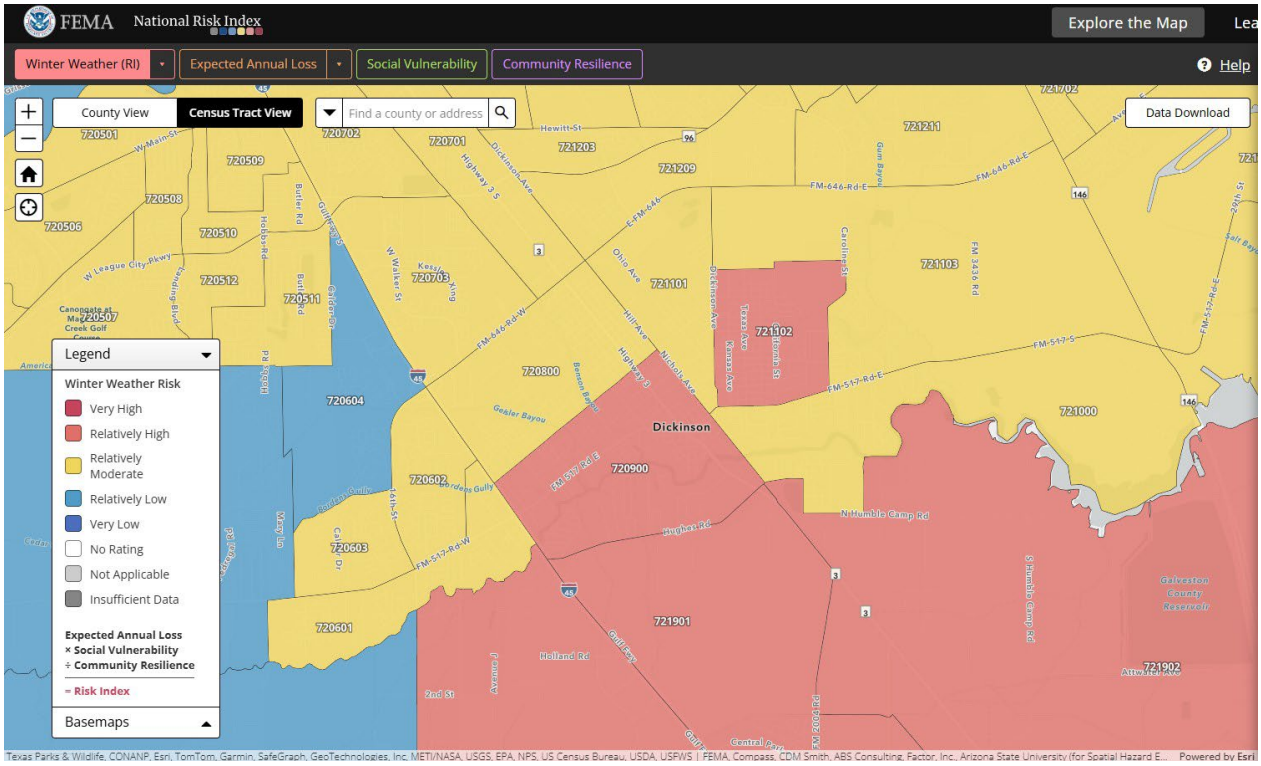
Risk Index by Census Tract, Cold Wave



Risk Index by Census Tract, Ice Storm



Risk Index by Census Tract, Winter Weather



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Value (Cold Wave, Ice Storm, Winter Weather), Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$56,746,974,030	$4,065,532,578,123 350,476.95	$10,592,645	$4,122,290,144,798

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

Hazard Type	Building Value ($)	Population Equivalence ($)/ Population (#)	Agriculture Value
Cold Wave	$16,405	$1,602,708/ 0.14	$5,950
Ice Storm	$4,497	$95,098/ 0.01	N/A
Winter Weather	$11,101	$464,489/ 0.04	$142

The FEMA NRI lists the historic loss ratio (HLR), a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. The source of data for HLRs for all hazards (except cold wave) is derived from Arizona State University's Center for Emergency Management and Homeland Security's Spatial Hazard Events and Losses Database for the United States (SHELDUS) loss data. SHELDUS provides county-level data that corresponds to nearly all the natural hazards represented by the NRI. HLR for cold wave within the NRI was determined using data from the NOAA NCEI Storm Events Database, which provides consequence estimates from hazard occurrences.

HLRs for cold waves and ice storms within the county and planning area are **very low**, while the HLR for winter weather is listed as **relatively moderate**.

Probability of Future Occurrences

To highlight the probability of future occurrence for most hazards within this LHMP, FEMA's annualized frequency values were used. Annualized frequency is defined as the expected frequency or probability of a hazard occurrence per year. A higher annualized frequency value results in higher EAL and Risk Index scores. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. Annualized frequency data sources were identified through public knowledge, guidance by subject matter experts, and research. Providers of frequency data include federal and state government agencies, intergovernmental organizations, academic institutions, and research organizations. [52]

Annualized Frequency **=** *# of Recorded Events or Event-Days / Period of Record*

The table below shows FEMA's NRI annualized frequency values for cold waves, ice storms, and winter weather hazards.

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	0.9 events per year	28	1946-2014 (67 years)
Winter Weather	0.6 events per year	7	2005-2021 (16 years)

Future Conditions

Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard in relation to population growth.
- **Future weather conditions**- According to the Office of the Texas State Climatologist, in the southern part of the state and in coastal regions, snow is rare, but nonetheless, large accumulations of snow are possible. Climate model projections for future weather conditions related to this hazard have shown the risk of snowfall consistently decreasing in climates like that of Texas.[53]

Future Weather Conditions Impact Summary, 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.

The District considers the overall vulnerability to this hazard as **high**, with a high likelihood of occurrence but having moderate impacts on the District and its assets.

4.2.3 Hurricane & Storm Surge

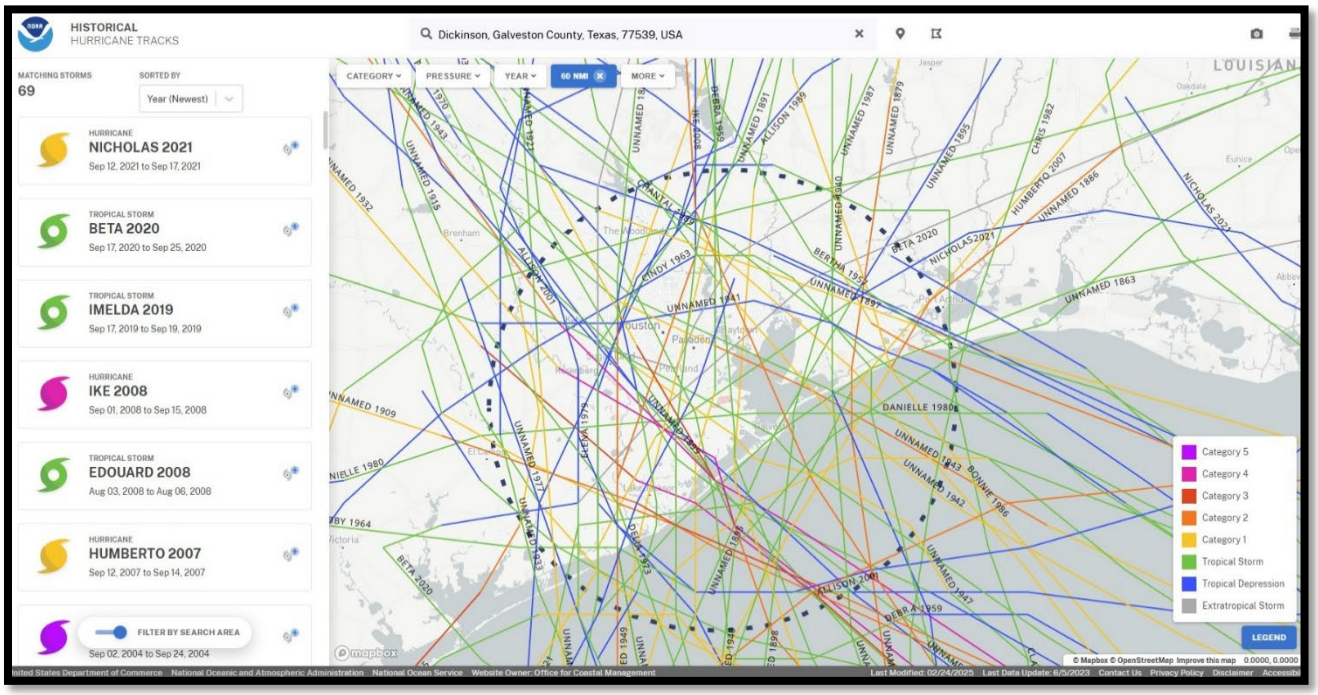
Hurricanes (including tropical storms and tropical depressions) form from the development of thunderstorms that are fueled by warm water and air over the ocean. Tropical waves and disturbances can lead to the formation of tropical cyclones. A tropical cyclone is a rotating, organized system of clouds 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 tornados. [54] Slower moving larger storms can produce more rainfall and more dangerous conditions. Classifications of tropical cyclones; tropical depressions, tropical storms, hurricanes, and major hurricanes are defined in the table below. [55]

Location

The planning area is located 18 miles inland from the Gulf of Mexico and is connected to Galveston Bay through Dickinson Bayou. Wind and rain generated by hurricanes can have a significant impact on flooding and windstorm-related damage within the planning area. Storm surge can exacerbate these flooding issues. The entire County is at risk from this hazard as it has no set geographic boundary and a wide area of impact.

Flooding is profiled in Section 4.2.5 of this HMP, while the Severe Weather (including windstorm) profile can be found in Section 4.2.6. The figures below, based on NOAA's Historical Hurricane Tracks interactive map, show the historical hurricane, tropical storms, and tropical depression tracks that have crossed into the planning area and Galveston County. It is important to remember that these storms, named or unnamed, do not have to cross the planning area boundaries for the risk of their impacts to be felt by customers. There has been a total of 69 of these storms that have occurred within 60 nautical miles (nmi) of Galveston County, with 29 being hurricanes. [56]

Historical Hurricane Tracks within 60 nmi of the District



Not shown: Hurricane Beryl made landfall as a Category 1 storm just 45 miles east in Matagorda County in July 2024.

Extent

Hurricane intensity is measured through the Saffir-Simpson Hurricane Wind Scale. The scale was originally developed by wind engineer Herb Saffir and meteorologist Bob Simpson. 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. General descriptions of the hurricane category and the related wind scale characteristics are described below. [57] 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 areas vulnerable to storm surges. [58]

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 the 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 the 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.
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 directly over Galveston County or through Galveston Bay. This could lead to catastrophic damage within the planning area. Tropical systems create an environment favorable for severe thunderstorm development that can lead to secondary hazards including widespread flooding, dangerous winds, lightning, hail, loss of communications, power outages, and extensive damage to buildings, critical facilities, and infrastructure. This type of scenario is similar to the events that took place in July 2024 when the Houston-Galveston area was struck by Hurricane Beryl during an active heat advisory. Hurricane Beryl produced tropical storm force winds across inland Galveston County, with wind gusts in excess of 60 mph measured by neighboring counties. Widespread damage to power lines, homes, trees, and businesses was observed across the county. Restoration and repairs for damaged infrastructure took up to 10 days to restore in some areas leading to the activation of cooling centers for residents to avoid dangerous heat related illness and complications. The storm also produced storm surge flooding generally between 4-6 feet above ground level (AGL), with a maximum of 8 feet measured by survey crews. There were 22 total fatalities attributed to Beryl, including 4 people killed by falling trees, 3 drownings, 1 death due to power loss in a medical device, 2 accidental deaths during debris cleanup, and 11 heat-related deaths due to power loss in the wake of the storm. [59]

Historic Occurrences

NOAA collects historic climate data for the entire nation via the NCEI storm events database. These events are shown at the county level, divided into zones, and contain data from January 1950 to March 2025, as entered by NOAA's NWS. The table below highlights events for this hazard that have occurred within Galveston County since the year 2000. [60]

Hurricane, Tropical Storms, and Tropical Depressions (2000-2023), Galveston County

Date	Area Impacted	Event Type	Injuries/ Deaths	Property Damage	Crop Damage
6/5/2001	GALVESTON (ZONE)	Tropical Storm	0/0	$31,740,000	$0.00
9/5/2002	GALVESTON (ZONE)	Tropical Storm	0/0	$0.00	$0.00
7/14/2003	GALVESTON (ZONE)	Hurricane	0/0	$8,300,000	$0.00
8/30/2003	GALVESTON (ZONE)	Tropical Storm	0/0	$7,000	$0.00
9/1/2003	GALVESTON (ZONE)	Tropical Storm	3/0	$7,000	$0.00
9/23/2005	GALVESTON (ZONE)	Hurricane	0/0	$15,000,000	$0.00

Date	Area Impacted	Event Type	Injuries/ Deaths	Property Damage	Crop Damage
9/12/2007	GALVESTON (ZONE)	Hurricane	0/0	$2,500,000	$0.00
8/5/2008	GALVESTON (ZONE)	Storm Surge	0/0	$95,000	$0.00
8/5/2008	GALVESTON (ZONE)	Tropical Storm	0/0	$0.00	$0.00
9/12/2008	GALVESTON (ZONE)	Hurricane	0/0	$1,000,000,000	$0.00
9/12/2008	GALVESTON (ZONE)	Storm Surge	0/12	$4,000,000,000	$0.00
6/15/2015	GALVESTON (ZONE)	Tropical Storm	0/0	$0.00	$0.00
6/21/2017	GALVESTON (ZONE)	Tropical Storm	0/0	$0.00	$0.00
8/26/2020	COASTAL GALVESTON	Storm Surge/tide	0/0	$0.00	$0.00
9/21/2020	COASTAL GALVESTON	Storm Surge	0/0	$0.00	$0.00
10/9/2020	COASTAL GALVESTON	Tropical Storm	0/0	$0.00	$0.00
7/8/2024	COASTAL GALVESTON	Tropical Storm	0/0	$0.00	$0.00
7/8/2024	INLAND GALVESTON	Tropical Storm	0/0	$0.00	$0.00
7/8/2024	COASTAL GALVESTON	Storm Surge	0/0	$0.00	$0.00
TOTALS:			3 injuries 12 deaths	$5,074,000,000	$0.00

Presidential Disaster Declarations

There have been 16 federally declared hurricanes, tropical storms, or tropical depression related disasters in Galveston County. [5,6] Included in the table below are 2 severe storms and 2 coastal storms that mentioned hurricane or tropical disturbances within their disaster declaration title.

Federal Disaster Declarations for Hurricanes and Tropical Storms

Date	Disaster Number	Declaration Type	Incident Type	Declaration Title
8/19/1983	689	Major Disaster Declaration	Hurricane	HURRICANE ALICIA
8/26/1998	1239	Major Disaster Declaration	**Severe Storm**	TROPICAL STORM CHARLEY
9/23/1998	1245	Major Disaster Declaration	**Severe Storm**	HURRICANE GEORGES- TEXAS
6/9/2001	1379	Major Disaster Declaration	**Coastal Storm**	TROPICAL STORM ALLISON
9/26/2002	1434	Major Disaster Declaration	**Coastal Storm**	TROPICAL STORM FAY
7/17/2003	1479	Major Disaster Declaration	Hurricane	HURRICANE CLAUDETTE
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
8/18/2007	3277	Emergency Declaration	Hurricane	HURRICANE DEAN
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
7/26/2020	3530	Emergency Declaration	Hurricane	HURRICANE HANNA
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

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk for this hazard include the entire planning area, as hurricanes have no set geographic boundaries. For storm surge, populations most at risk for impacts include those residing near creeks or streams that feed into Dickinson Bayou, those who live along Dickinson Bayou, and those who are near, or within, SFHAs.

Hurricanes can cause property damage, flooding, lack of access to critical facilities (which can provide food, water, medications, or other forms of medical assistance), and lack of utilities (electricity and potable water). The National Center for Healthy Housing (NCHH) includes at-risk populations for several hazards. For hurricanes, these include:

- **Older populations**- Older adults, in addition to potential lack of access to critical facilities and utilities, older adults can also face social isolation during disasters and are more susceptible to illness that can be caused by the resulting secondary hazards (flooding)..
- **Younger populations**- Hurricanes can disrupt schooling and the normal day-to-day routines they thrive on. This can not only jeopardize their academic success, but it 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/humidity.
- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events.
- Populations with disabilities- Those with disabilities may require additional assistance to stay safe and prepare for these hazards, like creating a support network, finding accessible transportation to evacuate or get medical attention
- **Populations with chronic health conditions**- 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 may face an increased risk of exposure to various other illnesses when utilizing a shelter or evacuation center. [61]

- **Populations living in mobile homes or manufactured housing**- Those living in mobile homes or manufactured housing are also at greater risk of injury and death from these hazards. Despite mobile homes providing shelter, tornadoes and dangerous winds produced by hurricanes can cause mobile homes, even those that utilize anchoring, to be seriously damaged or destroyed when winds gust over 80 mph. [62] Additionally, building materials utilized for mobile homes or manufactured housing are usually of a lower quality and more susceptible to damage than a site-built, slab-on-grade home.

Critical Facilities

This hazard has the potential to pose a direct impact on the District's existing building stock, critical facilities, and/or critical infrastructure owned or operated by the District. The most notable vulnerabilities to critical facilities throughout the planning area to this hazard include power outages and catastrophic flooding. This would directly affect the district's ability to provide services to customers.

Economy

A Hurricane and associated storm surges often have significant economic ramifications due to their potentially catastrophic impact and secondary hazards imposed on the planning area. Economic impacts to the District can include direct damage to infrastructure and properties, disruptions to essential services like water and sanitation, and long-term economic consequences stemming from business closures and supply chain issues. Additionally, when communities are unable to recover and return after disasters strike, it can lead to permanent revenue loss for the District due to lower water usage, a loss of homes within the District's service area (depending on the severity of the event), and a decline in the local tax base. These factors can create a ripple effect, leading to reduced funding for services and infrastructure maintenance, which further exacerbates the challenges faced by disaster-affected communities.

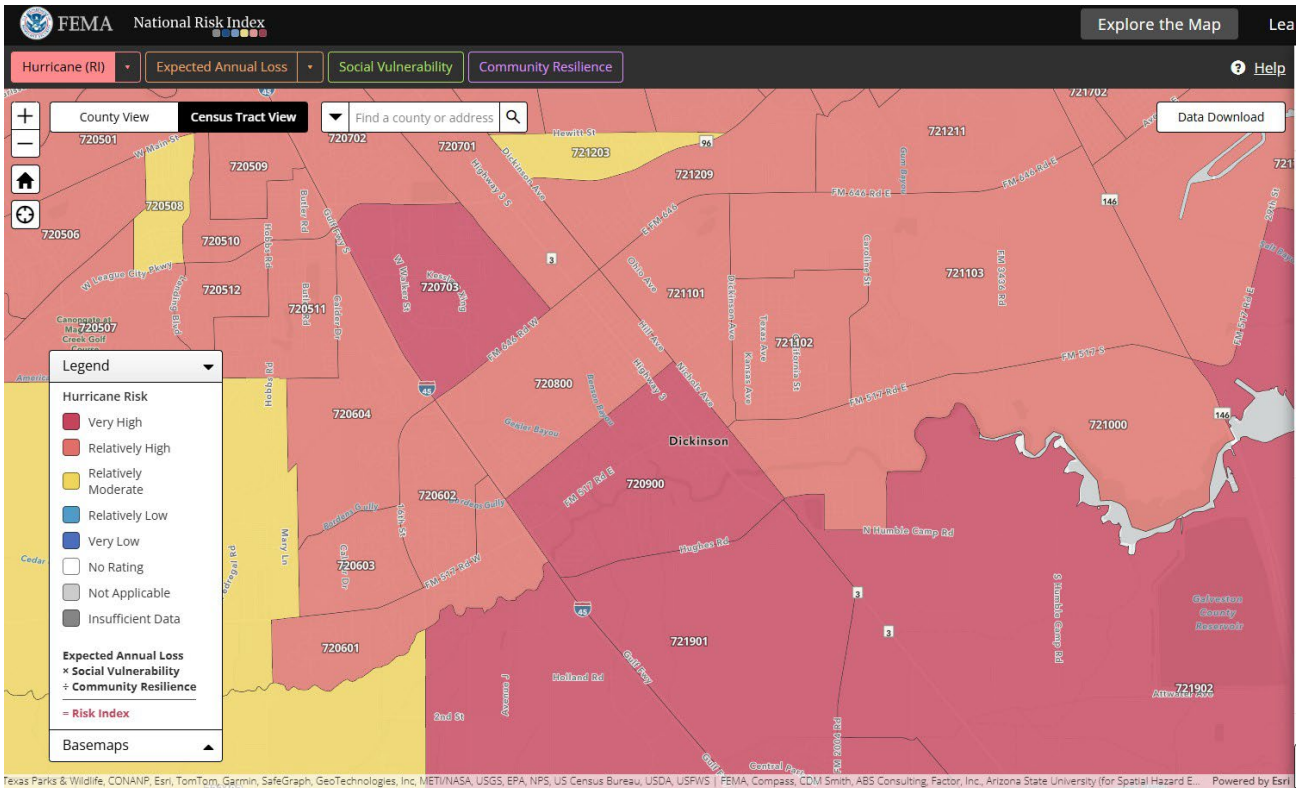
During Hurricane Harvey in 2017, the City of Dickinson experienced devastating flooding, with approximately 90% of the area submerged, 80% of homes flooded, and over 7,000 structures affected. While such disasters can wreak havoc and inflict significant damage within just a few days, the journey to rebuild and recover often spans years.

National Risk Index

FEMA's 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. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

Risk index scores for this hazard by census tract is shown in the figures below. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

Risk Index by Census Tract, Hurricane



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Hurricane, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$56,746,143,140	$4,065,437,544,091 350,468.75	$10,576,824	$4,122,194,264,055

Expected Annual Loss Values, Hurricane, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$123,172,087	$8,495,579 0.73	$38,105	$131,705,771

EAL for Galveston County due to hurricanes is **relatively high**.

The FEMA NR HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. The HLR for hurricanes within the planning area is categorized as **relatively high**.

Probability of Future Occurrences

The State of Texas HMP 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. [63] Additionally, to highlight the probability of future occurrence for this hazard, FEMA's annualized frequency values were used. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. The table below shows FEMA's NRI annualized frequency value for hurricanes. [64]

Annualized Frequency Values, Hurricane, Galveston County

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Hurricane	**0.3 events per year**	**43**	**1851-2021 (171 years)**

Future Conditions

Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard.
- **Future weather conditions**- 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 environmental conditions favorable for thunderstorm intensity rising, warmer temperatures becoming more frequent for longer durations of the year, and increasing ocean temperatures. As temperatures increase, the amount of energy available to fuel storms, especially those that form over warm tropical waters of the Atlantic Ocean and Gulf of Mexico, is expected to increase and fuel their intensity.[65]

Future Weather Conditions Impact Summary, Hurricanes and Storm Surge

Location	The location of hurricanes and storm surge is not expected to change.
Extent/Intensity	The extent and intensity of hurricanes and storm surge is expected to increase.
Frequency	There are no clear trends in hurricanes and storm surge frequency. This is due to considerable variability in conditions that lead to these hazards occurring. However, these hazards occur most frequently in warmer months. The greatest threat for these hazards occurs between June-October.
Duration	The duration of hurricanes and storm surge is not likely to change; however, their intensity is expected to increase due to rising temperatures and the proximity of the county and planning area to the Gulf of Mexico.

The District considers the overall vulnerability to this hazard as **high,** with a high likelihood of occurrence, with high to moderate impacts on the District and its assets. Potential impacts to the District are either already fully mitigated against for this hazard or addressed in the mitigation strategy for this HMP.

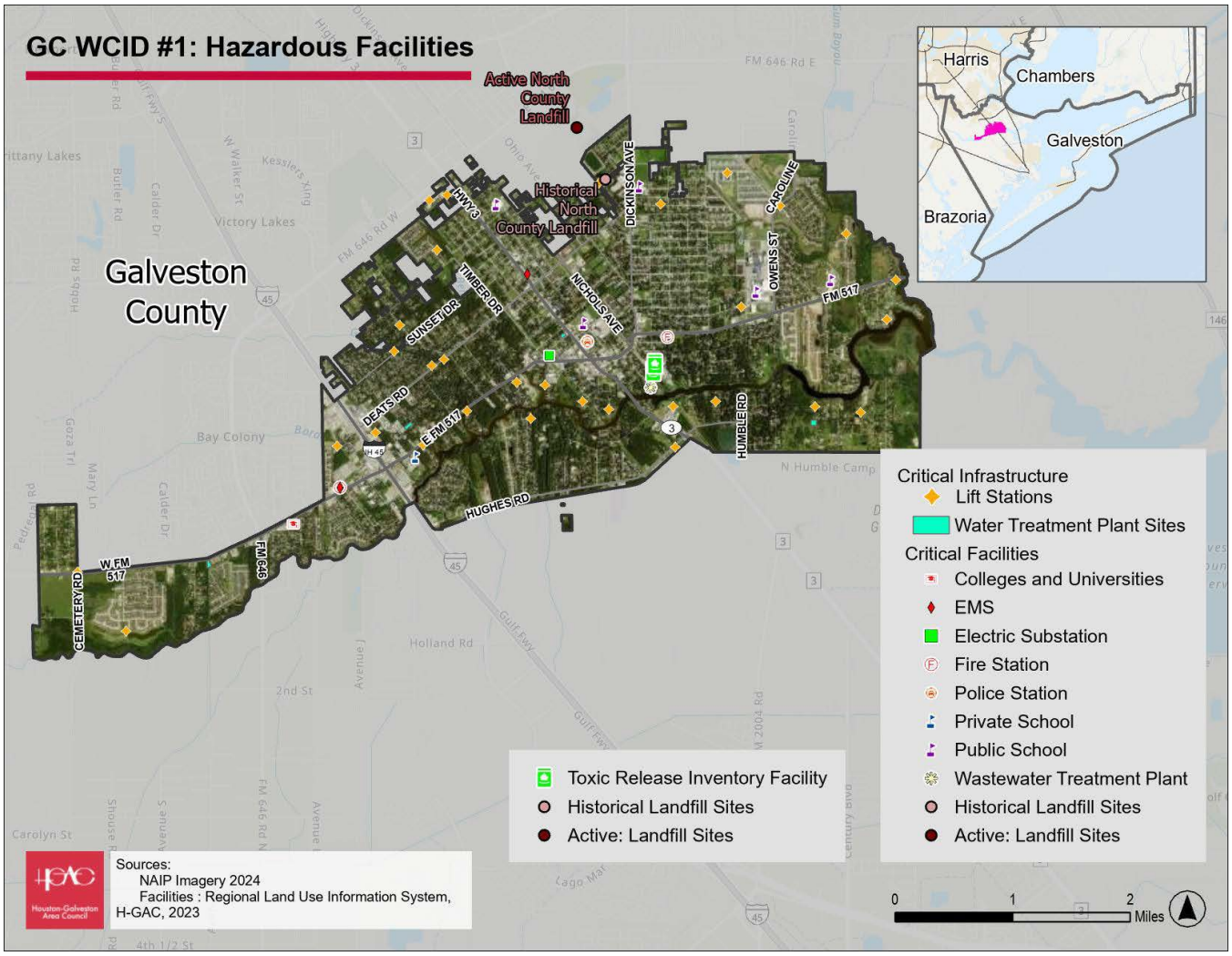
4.2.4 Hazardous Material Spill

The Occupational Safety and Health Administration defines hazardous materials (HAZMAT) 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." [66] 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 (cleaning supplies under a sink or a can of gasoline in a shed).

Location

The Toxics Release Inventory (TRI) is a publicly available database from the EPA that contains information on toxic chemical releases and other waste management activities reported annually by certain industry groups and federal facilities. [67] 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.


GC WCID #1: Hazardous Facilities
Active North County Landfill
Historical North County Landfill
Galveston County
Harris
Chambers
Galveston
Brazoria
DICKINSON AVE
CAROLINE
OWENS ST
FM 517
HWY 3
TIMBER DR
SUNSET DR
NICHOLS AVE
DEATS RD
E FM 517
HUMBLE RD
HUGHES RD
W FM 517
FM 646
CEMETERY RD
Bay Colony
Holland Rd
Critical Infrastructure
Lift Stations
Water Treatment Plant Sites
Critical Facilities
Colleges and Universities
EMS
Electric Substation
Fire Station
Police Station
Private School
Public School
Wastewater Treatment Plant
Historical Landfill Sites
Active: Landfill Sites
Toxic Release Inventory Facility
Historical Landfill Sites
Active: Landfill Sites
Sources:
NAIP Imagery 2024
Facilities : Regional Land Use Information System, H-GAC, 2023
0
1
2
Miles

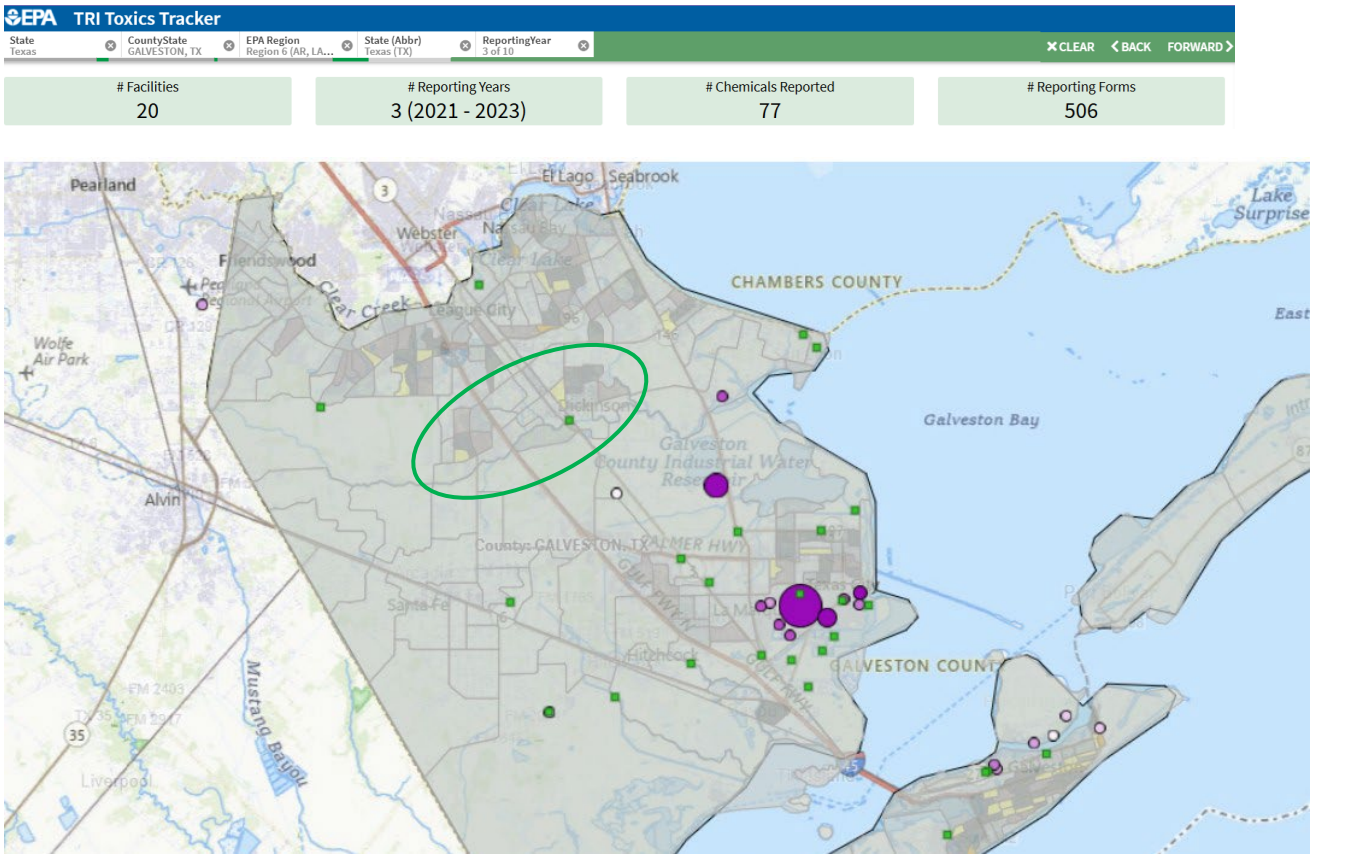
Galveston County contains 20 TRI facilities and various pipelines that transport these materials. Only 1 of these TRI facilities is located within the immediate planning area, as shown in the figures below (outlined by the green outline). [68]

Also shown on the images below (depicted by green squares,) are facilities that did not report to TRI but have permits or requirements under EPA's air, water, or hazardous waste programs and are expected to produce, release, or manage TRI-reportable chemicals. These facilities include:

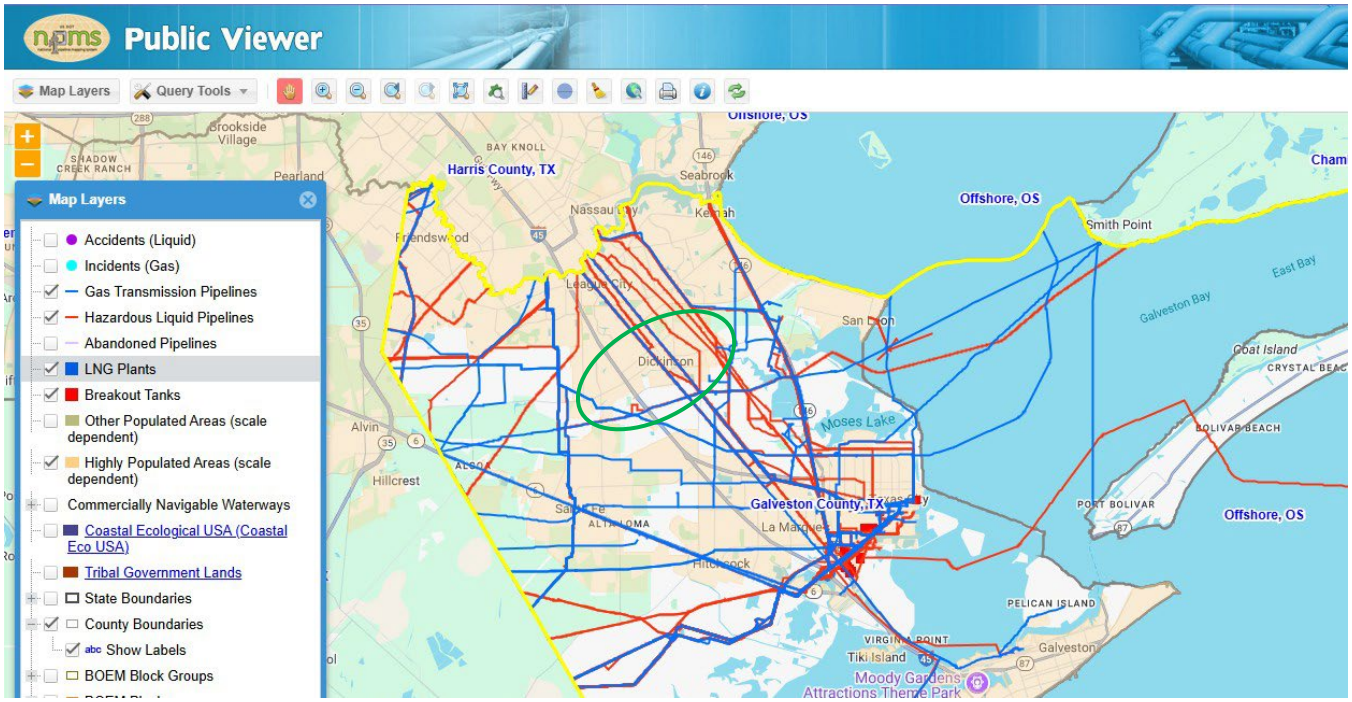
- Clean Air Act (CAA)-regulated facilities that release at least 20,000 pounds of a single hazardous air pollutant (HAP) or 50,000 pounds of multiple HAPs. (Most HAPs are TRI-reportable chemicals.)
- CWA-regulated facilities that discharge more than 25,000 gallons of wastewater per day containing at least one TRI-reportable chemical.
- Resource Conservation and Recovery Act-regulated facilities that generate or handle at least 2,200 pounds of hazardous waste within a month. (These wastes commonly contain TRI-reportable chemicals.)

The National Pipeline Mapping System (NPMS) Public Viewer enables one to view NPMS pipeline, liquefied natural gas plant, and breakout tank data by county. NPMS pipeline data does not contain gas gathering or distribution pipelines, such as lines that deliver gas to a customer's home. Therefore, not all pipelines in an area will be visible in the Public Viewer.

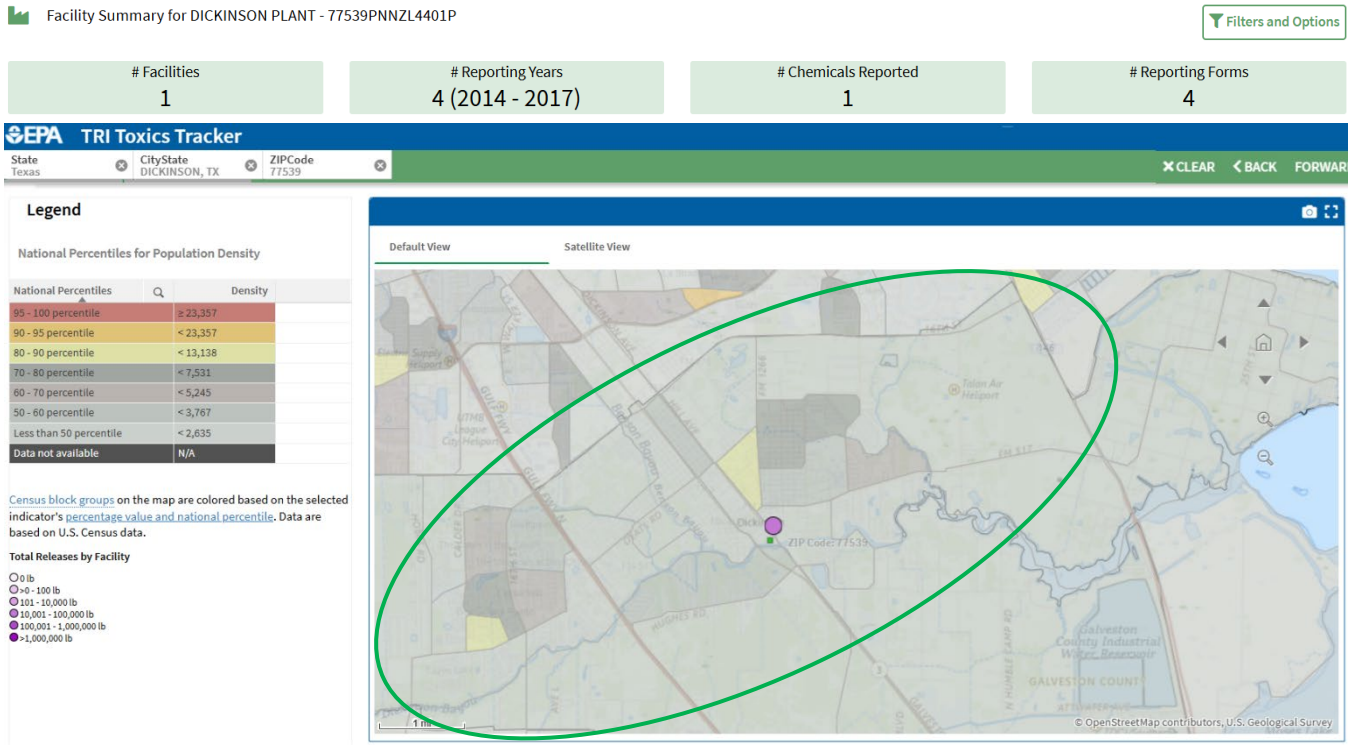
Toxic Release Inventory Facilities, Galveston County



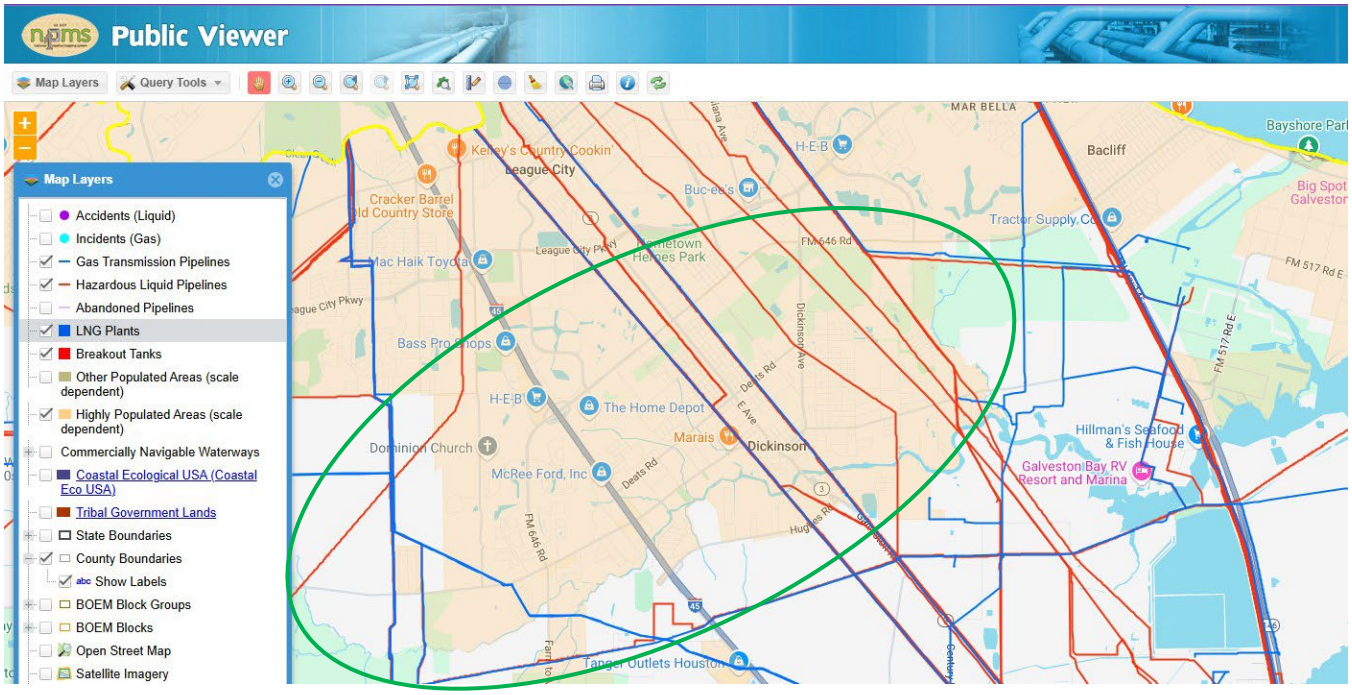
Pipelines Transporting Hazardous Materials, Galveston County



Toxic Release Inventory Facilities, Planning Area

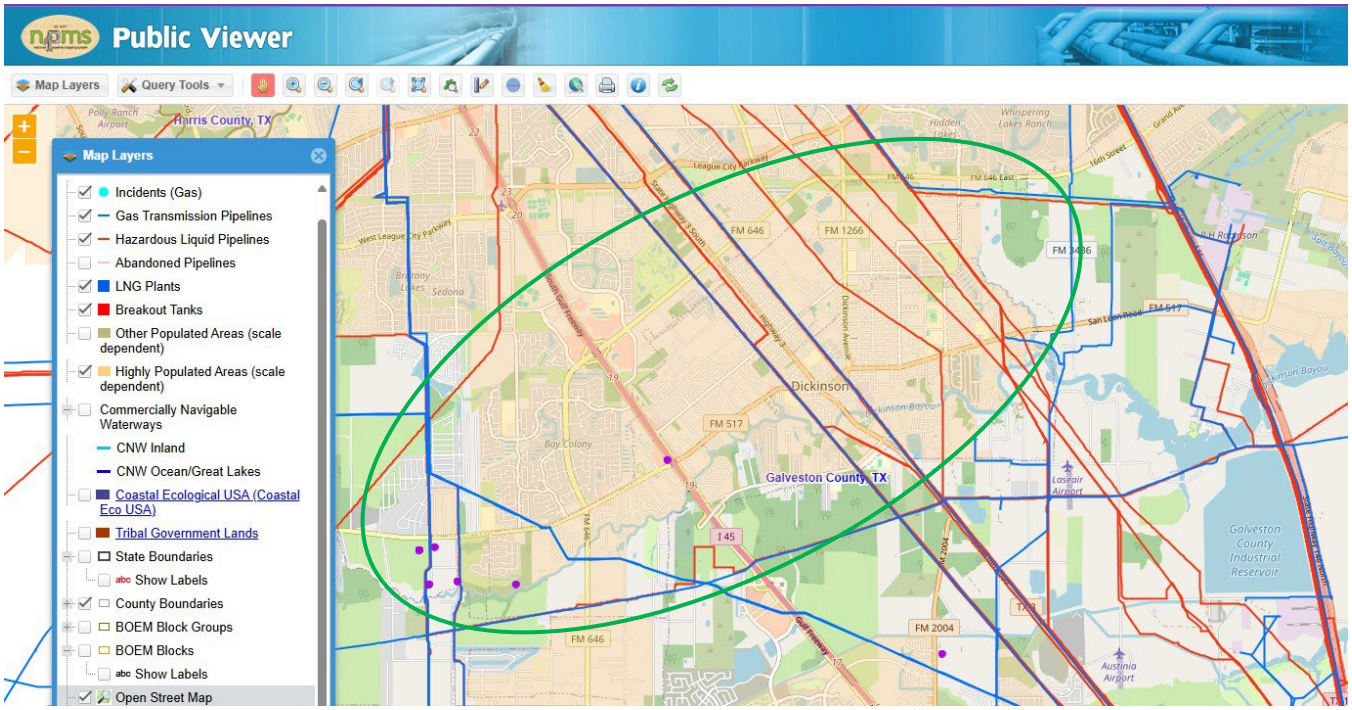


Pipelines Transporting Hazardous Materials, Planning Area



In the figure below, gas transmission and hazardous liquid pipeline accidents and incidents are shown going back to 2002.

Pipelines Transporting Hazardous Materials, Accidents near the Planning Area



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 its 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.

A worst-case scenario for this hazard would be any liquid chemical or petroleum-based substance that migrated above ground or underground into the District's sanitary sewer collection system. The collection system is vulnerable to rainwater infiltration on a regular basis, and would be no different if there were a liquid chemical release. Once inside the sanitary sewer system, this hazardous liquid would flow through the wastewater treatment plant untreated and uninhibited to pollute the outfall stream, leading to Dickinson Bayou.

Historic Occurrences

Presidential Disaster Declarations

There have been no federally declared hazardous material-related disaster declarations in Galveston County. [5,6]

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

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 can increase commercial and residential density near fixed-site hazardous materials facilities, which will also increase vulnerability. Populations considered most vulnerable to this hazard include: [69]

- **Older populations-** Older adults are more at risk and susceptible to the harmful effects of hazardous substances
- **Younger populations**- Like older adults, children are more susceptible to the harmful effects of hazardous substances due to their developing bodies.

- **Pregnant Women-** For those who are pregnant, exposure to a hazardous material release can be detrimental to the health of the mother and child.
- **Populations with disabilities-** Those with disabilities may require additional assistance to stay safe and prepare for these hazards, like creating a support network, finding accessible transportation to evacuate, or getting medical attention.
- **Chronic health conditions-** 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 compromised immune systems and may face an increased risk of exposure to various other illnesses when utilizing shelters or evacuation centers.

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 hazardous material releases that potentially impact potable water supplies, wildlife, and recreational activities.[70]

Critical Facilities

This hazard could have a direct impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

A hazardous materials spill could have significant economic and social ramifications for the District. Projected economic and societal impacts can include:

- Damage to District facilities that supply water to customers.
- Environmental damage, which can linger for decades and result in extensive remediation costs.[71]

Probability of Future Occurrences

Hazardous material releases can occur from two active sources: transportation accidents involving either liquid transport trailers or rail car derailments. The District encompasses 2.1 miles of IH-45 and State Hwy 3, both designated for hazardous material transport. The District also encompasses 2.5 miles of the Union Pacific Railroad. As development continues and populations increase, the risk of a hazardous material release and the potential impacts on the population, infrastructure, and environmental resources will increase. However, direct impacts to the District are not expected.

The number and types of hazardous chemicals stored in and transported through Galveston County and Texas will likely continue to increase. Based on the number of previous incidents within the planning area, the annualized frequency value for this hazard is 0.2 events per year.

Annualized Frequency Values, Hazardous Material Spill, Galveston County

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Hazardous Material Spill	**0.2 events per year**	**6**	**2002-2025 (23 years)**

Future Conditions

Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the District within its existing plans and procedures.
- **Future weather conditions**- Future weather conditions 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 future weather conditions. 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.

Future Weather Condition Impacts Summary, Hazardous Material Spill

Location	The location of Haz/Mat incidents is not expected to change.
Extent	The extent of future Haz/Mat incidents is not expected to change.
Frequency	The frequency of Haz/Mat incidents is not expected to change.
Duration	The duration of Haz/Mat incidents can vary; there is no clear trend in the duration of Haz/Mat incidents.

The District considers the overall vulnerability to this hazard as **medium**, with a low likelihood of occurrence but having severe impacts on the District and its assets. Potential impacts to the District from this hazard are fully mitigated through existing plans and procedures in place.

4.2.5 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 Special Flood Hazard Area (SFHA) that will be inundated by a 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. [72] 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 the planning area: coastal, riverine, flash flooding, and urban flooding.

Coastal flooding is when water inundates or covers normally dry coastal land as a result of high or rising tides or storm surges. [73]

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. [74] It 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 NWS 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." [75]

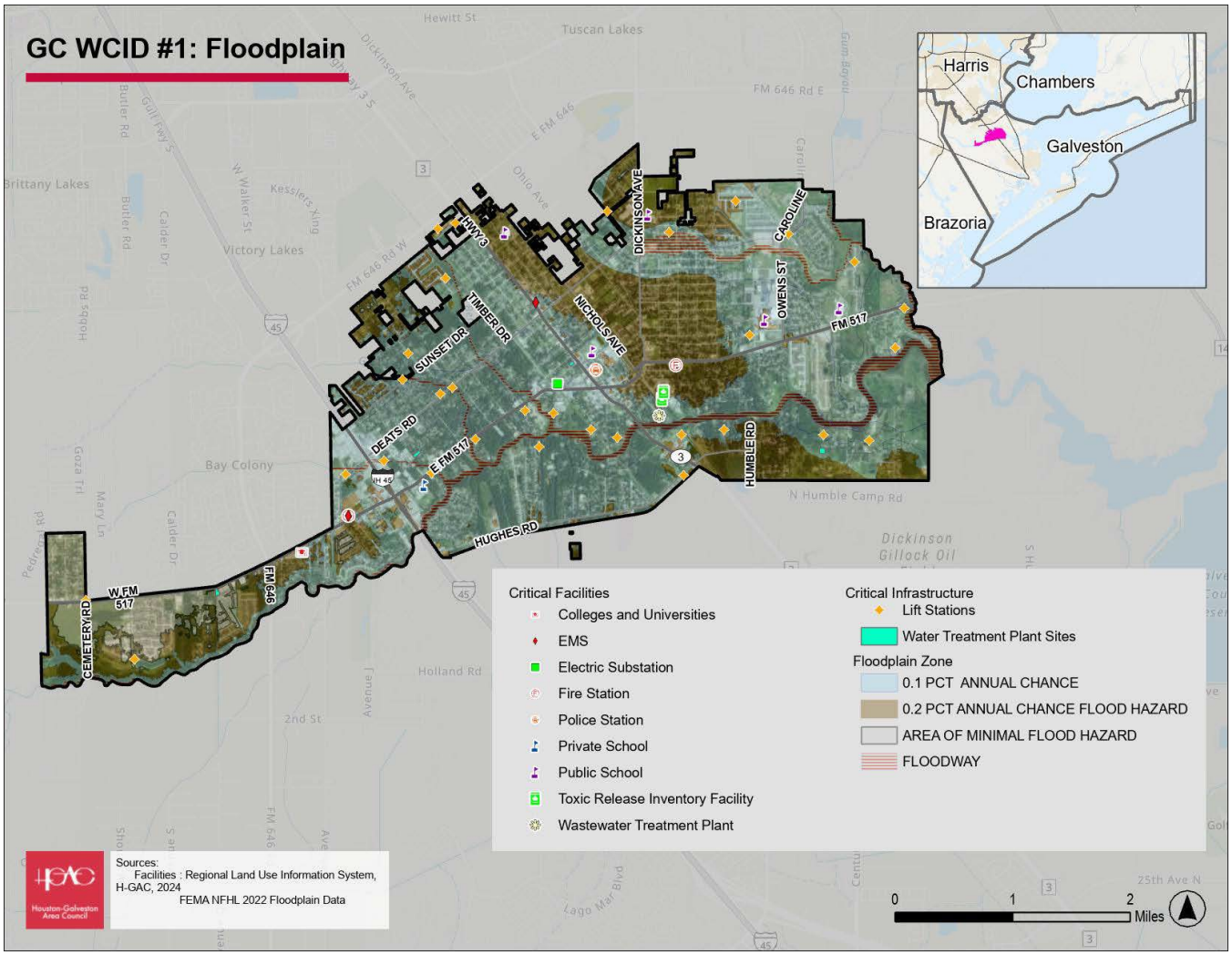
Urban flooding refers to flooding that occurs within developed areas and can be caused by a combination of factors, such as heavy rainfall combined with poor drainage or aging infrastructure.

Location

The potential for a given area to flood relies on many factors, including but not limited to elevation, weather patterns and climate, and topography. Areas within floodplains or adjacent to SFHAs are more susceptible to **riverine and flash flooding** during heavy rainfall events. **Urban flooding** is more likely to occur where existing development is already constructed, within known problem or low-lying areas, or where drainage is overwhelmed due to aging infrastructure.

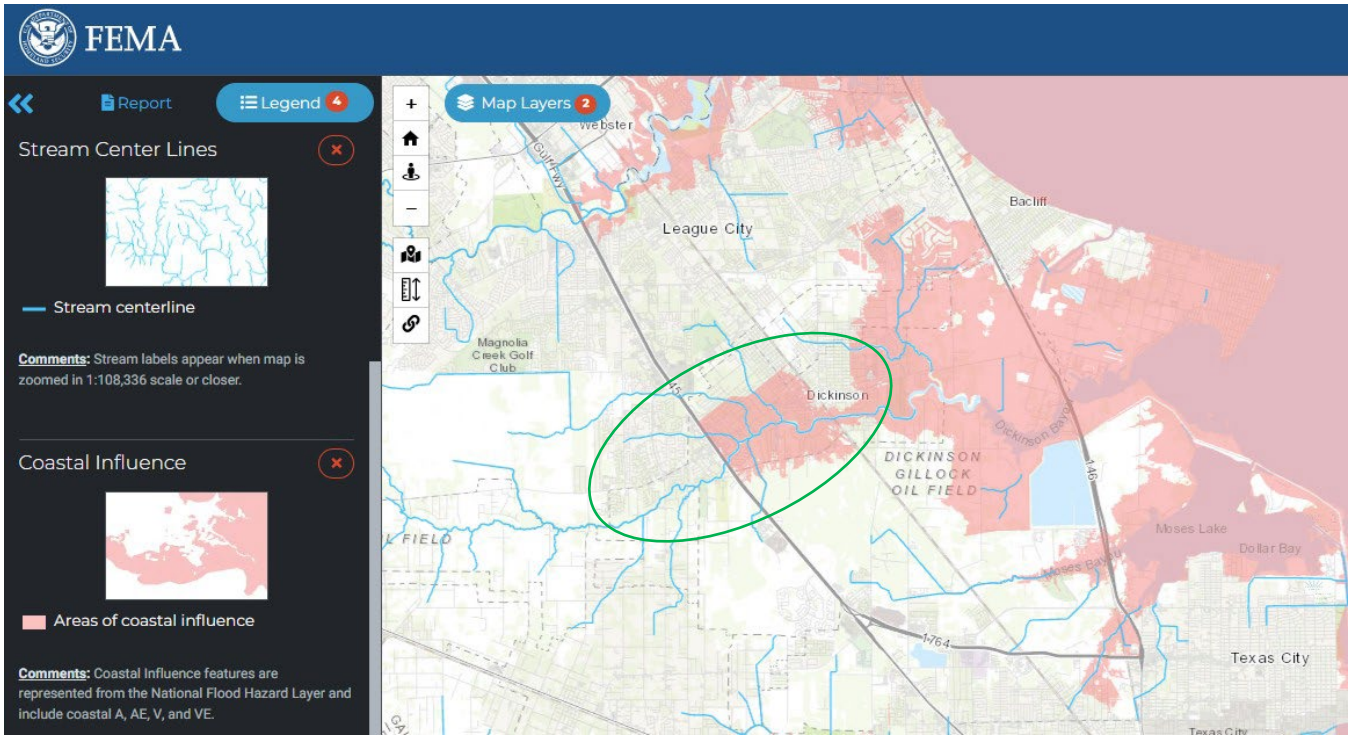
Areas shown on the figure below depict the 100 and 500-year floodplains within the planning area.

Floodplain Map, Planning Area



Coastal flooding and **storm surge** are most likely to affect the planning area closest to the tidally influenced sections of Dickinson Bayou (Segment 1103, as seen in Section 3) , which connects to Galveston Bay. Additionally, FEMA outlines areas of coastal influence represented from the National Flood Hazard Layer, as seen in the figure below. The planning area is represented by the green outline.

Areas of Coastal Influence



Extent

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 categories to describe flood severity and its characteristics. The NWS categorizes riverine flooding levels into four categories of severity: minor, moderate, major, and record flooding.

Flood Categories

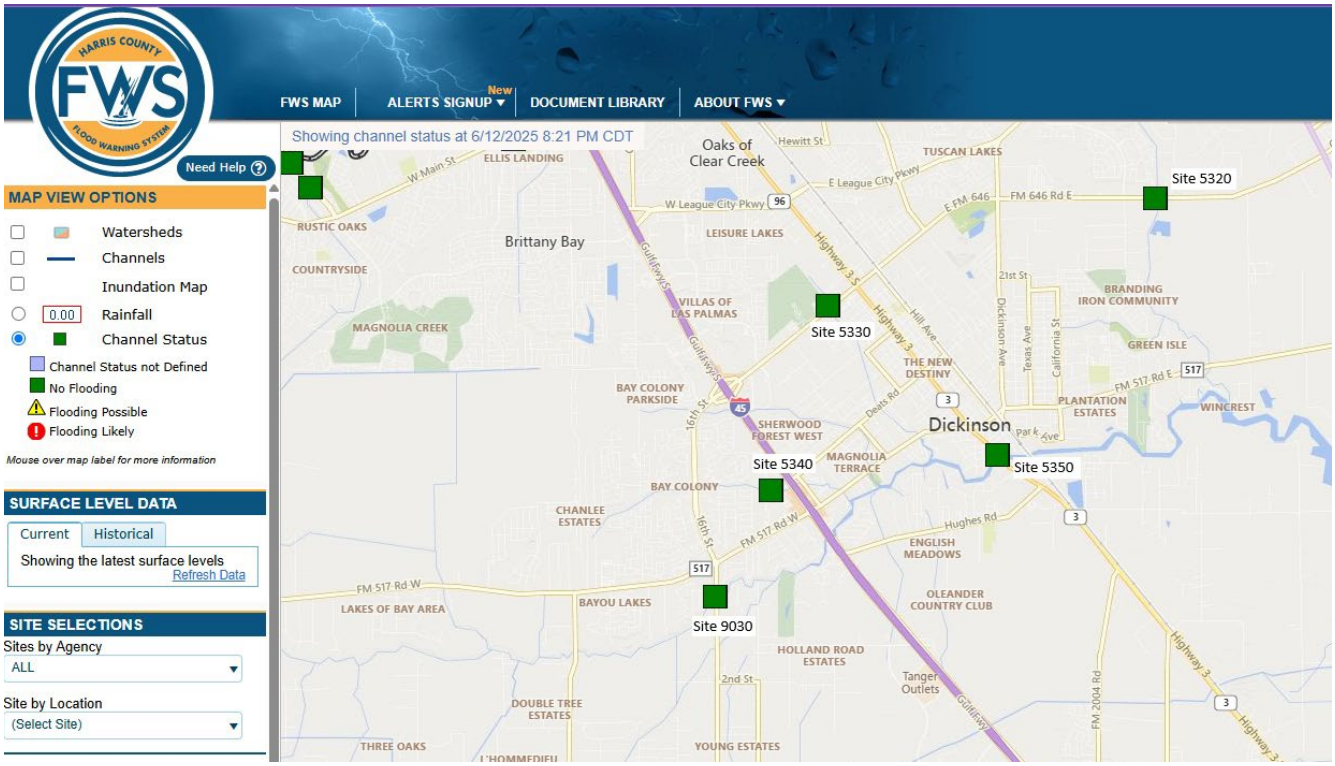
Flood Category	Description
Minor Flooding	Minimal or no property damage is expected, but the flooding could possibly cause some public threat or inconvenience.
Moderate Flooding	Some inundation of structures and roads near streams is expected. Some evacuations of people and or a transfer of property 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.

The USGS utilizes stream gages to determine the severity of a flood along different points on a river or other body of water. This allows officials to determine the need to issue evacuation orders in areas where moderate or more severe flooding could occur. There is one USGS stream gage (a structure installed beside a stream or river that contains equipment that measures and records the water level) located along Dickinson Bayou, upstream of the planning area. [76] Additionally, the Harris County Flood Control District's (HCFCD) Flood Warning System measures rainfall amounts and monitors water levels in bayous and major streams on a real-time basis. The system relies on a network of stream gage stations strategically placed throughout Harris County bayous and their tributaries. [77] The table and image below highlight these sites within the planning area and when flooding is possible or likely based on stream elevation readings.

Stream Gage Information

Sensor/ Site #	Site Name	Site Owner	Flooding Possible	Flooding Likely
08077640	Dickinson Bayou at SH 517 near Alvin	USGS	19 ft.	22 ft.
5353/ 5350	Dickinson Bayou at HWY 3 [78]	HCFCD	2.5 ft.	3.5 ft.
5339/ 5340	Borden Gully at Hughes Lane [79]	HCFCD	9 ft.	12 ft.
90307/ 9030	FM 646 at Dickinson Bayou [80]	HCFCD	7.7 ft.	10.8 ft.
5319/ 5320	FM 646 at Gum Bayou [81]	HCFCD	8.5 ft.	11.5 ft.
5329/ 5330	FM 646 at Bensen Bayou [82]	HCFCD	11.5 ft.	14.5 ft.

Stream gage Locations

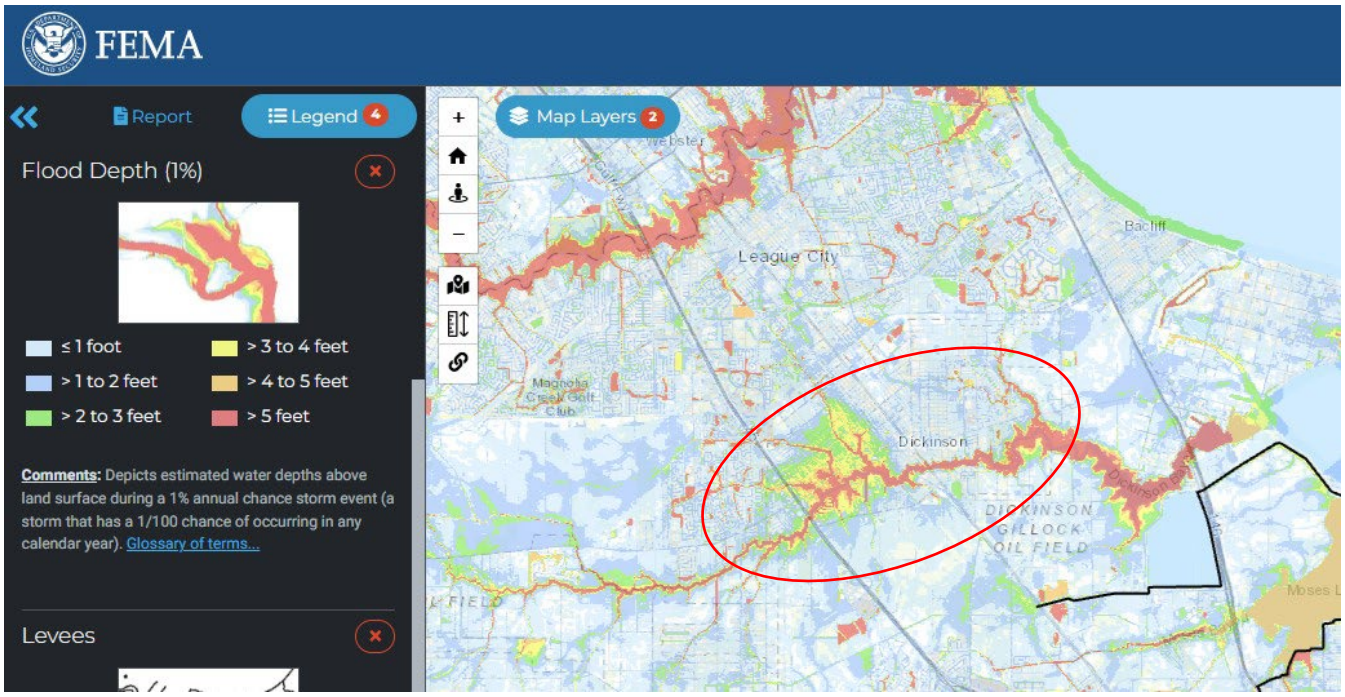


Flash Floods can be caused by several things, but they are most often caused due to extremely heavy rainfall from thunderstorms. The intensity of the rainfall, location and distribution of the rainfall, land use and topography, vegetation types and density, soil type, and soil water content all determine how quickly flooding may occur, and influence where it may occur. [83]

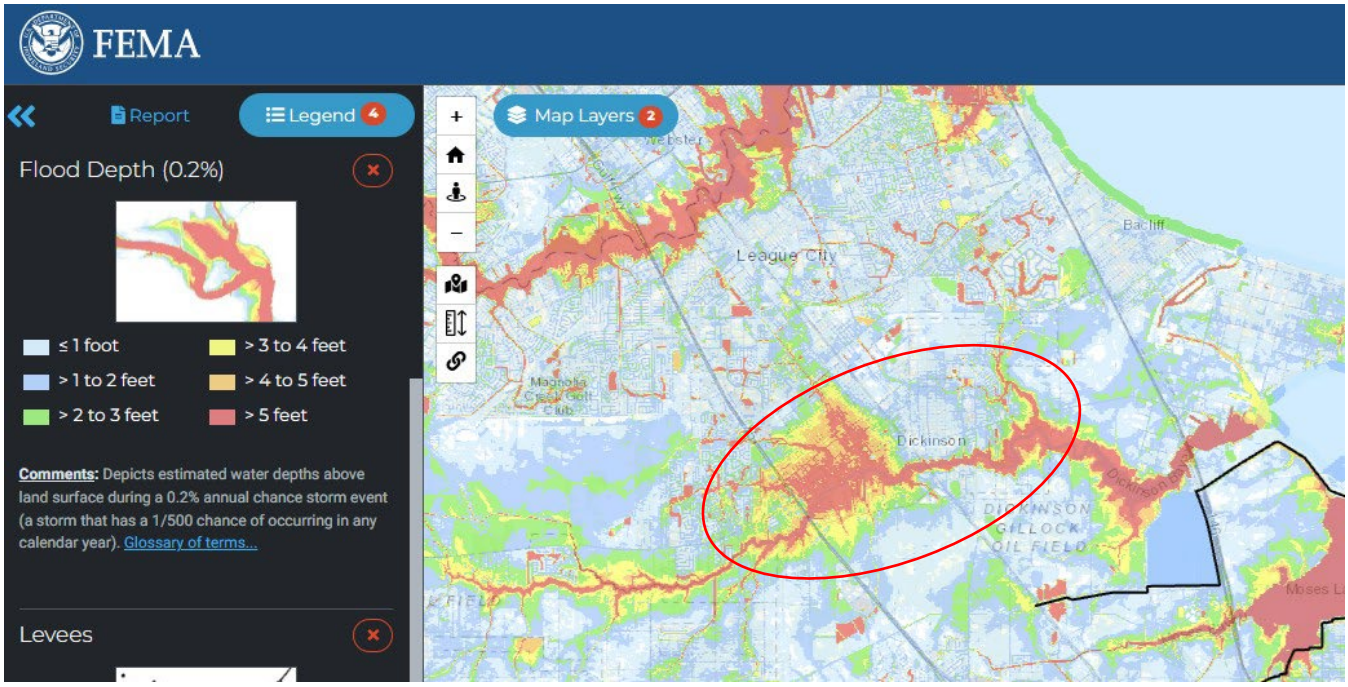
Flooding causes widespread and varying degrees of damage. *The magnitude or extent of flood damage is expressed by using the maximum depth of flood water during a specific flood event*. Structures inundated by 4 feet or more of flood water are considered an absolute loss. Other forms of loss include damage to roads and bridges, agricultural damages, loss of services, injury, or death. Flooding can also cut off access to utilities, emergency services, transportation, and evacuation routes, and may impact the overall economic stability of an area.

The figures below highlight expected flood depths for the planning area under 1% and 0.2% annual chance storm events, based on the best available data. Depicted below is the expected water depths (5+ feet over land surfaces) within the planning area for both the 1% and 0.2%. The planning area is depicted by the red outline.

Flood depth map, 100-year (1%)



Flood Depth map. 500-year (0.2%)



Historic Occurrences

NOAA collects historic climate data for the entire nation via the NCEI storm events database. These events are shown at the county level, divided into zones, and contain data from January 1950 to March 2025, as entered by NOAA's NWS. The table below highlights events for this hazard that have occurred within Galveston County since the year 2000. [84] Not shown are hurricane, tropical storm, and heavy rain events that contribute to flooding. A full list of the NCEI storm events for Galveston County can be found in Appendix C, Reference Documents

Historic Occurrences, Flooding

Date	Location	Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
10/16/2006	GALVESTON (ZONE)	Coastal Flood	0	0	$75,000	$0.00
8/5/2008	GALVESTON (ZONE)	Storm Surge/ Tide	0	0	$95,000	$0.00
9/12/2008	GALVESTON (ZONE)	Storm Surge/ Tide	0	12	$4,000,000,000	$0.00
11/8/2009	GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
12/1/2009	GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
1/9/2011	GALVESTON (ZONE)	Coastal Flood	0	0	$5,000	$0.00
10/31/2015	GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
12/27/2015	GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
5/9/2016	GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
12/3/2016	GALVESTON (ZONE)	Coastal Flood	0	0	$20,000	$0.00
8/26/2020	COASTAL GALVESTON (ZONE)	Storm Surge/Tide	0	0	$0.00	$0.00
9/21/2020	COASTAL GALVESTON (ZONE)	Storm Surge/Tide	0	0	$0.00	$0.00
6/19/2024	INLAND GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
6/19/2024	COASTAL GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
7/8/2024	COASTAL GALVESTON (ZONE)	Storm Surge/Tide	0	0	$0.00	$0.00
9/11/2024	COASTAL GALVESTON (ZONE)	Coastal Flood	0	0	$0.00	$0.00
Totals:			**0**	**12**	**$4,000,195,000**	**$0.00**

Presidential Disaster Declarations

There have been seven federally declared flood disasters in Galveston County. Additionally, five disaster declaration events mention flooding in their title but are categorized as severe storms for incident type. These are also included in the table below.[5,6]

Federally Declared Disasters, Flooding

Year	Incident Type	Incident Title	Disaster #	Declaration Type
1973	**Flood**	SEVERE STORMS & FLOODING	398	Major Disaster Declaration
1979	**Flood**	STORMS & FLASH FLOODS	595	Major Disaster Declaration
1979	**Flood**	SEVERE STORMS & FLOODING	603	Major Disaster Declaration
1992	**Flood**	SEVERE THUNDERSTORMS	930	Major Disaster Declaration
1995	**Flood**	SEVERE THUNDERSTORMS AND FLOODING	1041	Major Disaster Declaration
1999	**Flood**	TX-FLOODING 10/18/98	1257	Major Disaster Declaration
2016	**Flood**	SEVERE STORMS AND FLOODING	4272	Major Disaster Declaration
1991	Severe Storm	SEVERE STORMS, TORNADOES & FLOODING	900	Major Disaster Declaration
2003	Severe Storm	SEVERE STORMS, TORNADOES AND FLOODING	1439	Major Disaster Declaration
2015	Severe Storm	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS AND FLOODING	4223	Major Disaster Declaration
2016	Severe Storm	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	4245	Major Disaster Declaration
2024	Severe Storm	SEVERE STORMS, STRAIGHT-LINE WINDS, TORNADOES, AND FLOODING	4781	Major Disaster Declaration

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

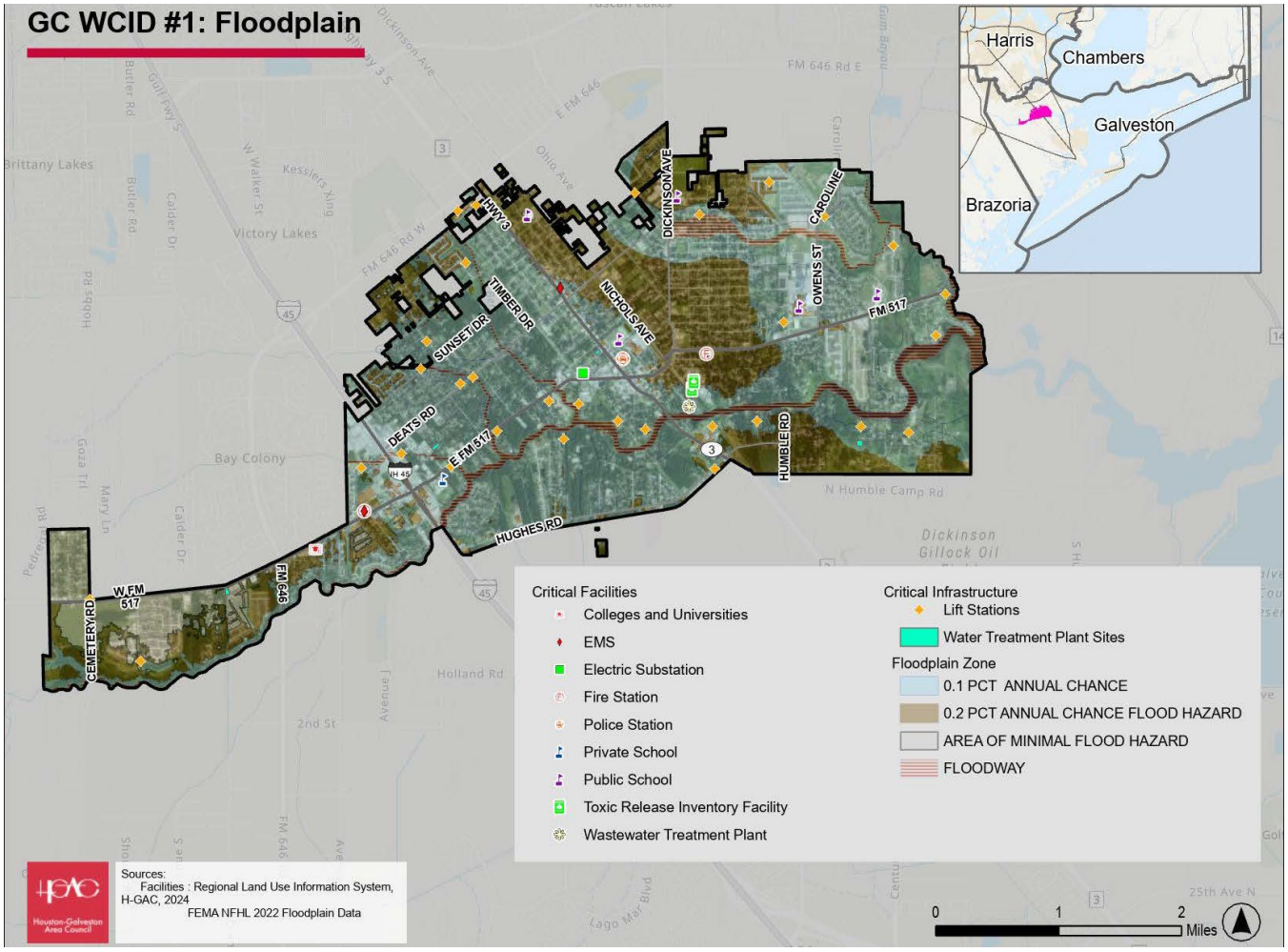
Populations living within or near SFHAs and floodways are at a higher risk of impacts from this hazard. Flooding can cause property damage, displacement, lack of access to critical facilities that provide food, water, medications, or other forms of medical assistance, and lack of utilities such as electricity and clean water. Lack of access to certain utilities of extended periods of time can increase the risk of illness, especially within vulnerable populations. The NCHH summarizes at-risk and vulnerable populations for several hazards. For flooding these include:

- **Older populations**- Older adults, in addition to potential lack of access to critical facilities (which can provide food, water, medications, or other forms of medical assistance), and lack of utilities (electricity and potable water) can also face social isolation during disasters.
- **Younger populations**- Hurricanes can disrupt schooling and the normal day-to-day routines they thrive on. This can not only jeopardize their academic success, but it 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/humidity.
- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events.
- **Populations with disabilities**- Those with disabilities may require additional assistance to stay safe and prepare for these hazards like creating a support network, finding accessible transportation to evacuate or get medical attention
- **Populations with chronic health conditions**- Those with chronic health conditions or who are immunocompromised may need similar assistance as those with disabilities. People with chronic health conditions also face exposure to diseases or illnesses from standing water and may face an increased risk of exposure to various other illnesses when utilizing a shelter or evacuation center. [lvi] 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.

Critical Facilities

The District has existing building stock, critical facilities, and critical infrastructure owned or operated within or near SFHAs. However, these facilities are either already fully mitigated against for this hazard or addressed in the mitigation strategy for this HMP.

Floodplain Map, Planning Area



Economy

Economic impacts to the District can include direct damage to infrastructure and properties, disruptions to essential services like water and sanitation, and long-term economic consequences stemming from business closures and supply chain issues. Additionally, when communities are unable to recover and return after disasters strike, it can lead to permanent revenue lost for the District due to lower water usage, a loss of homes within the District's service area (depending on the severity of the event), and a decline in the local tax base. These factors can create a ripple effect, leading to reduced funding for services and infrastructure maintenance, which further exacerbates the challenges faced by disaster-affected communities.

During Hurricane Harvey in 2017, the City of Dickinson experienced devastating flooding, with approximately 90% of the area submerged, 80% of homes flooded, and over 7,000 structures affected. After the storm, some residents and businesses did not return.

National Risk Index

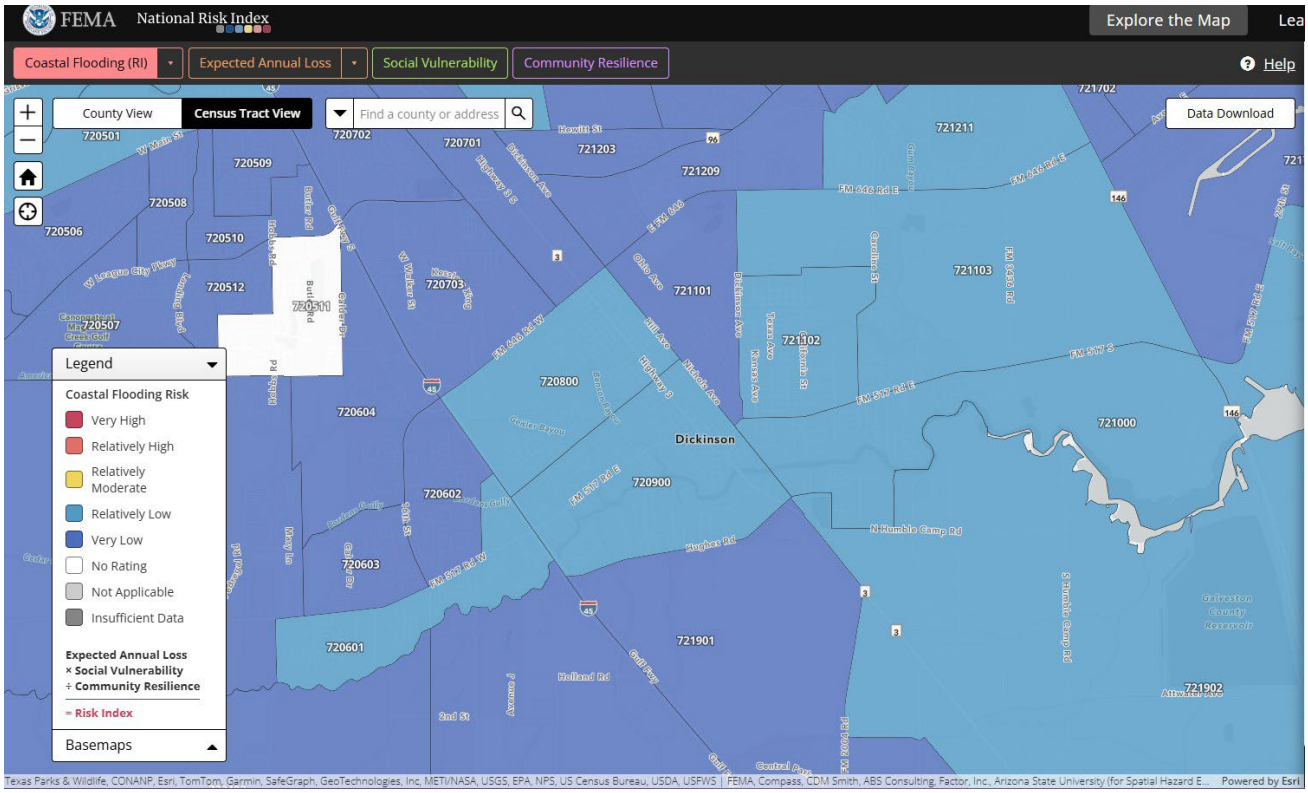
FEMA's NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI accounts for flooding in various formats, these are:

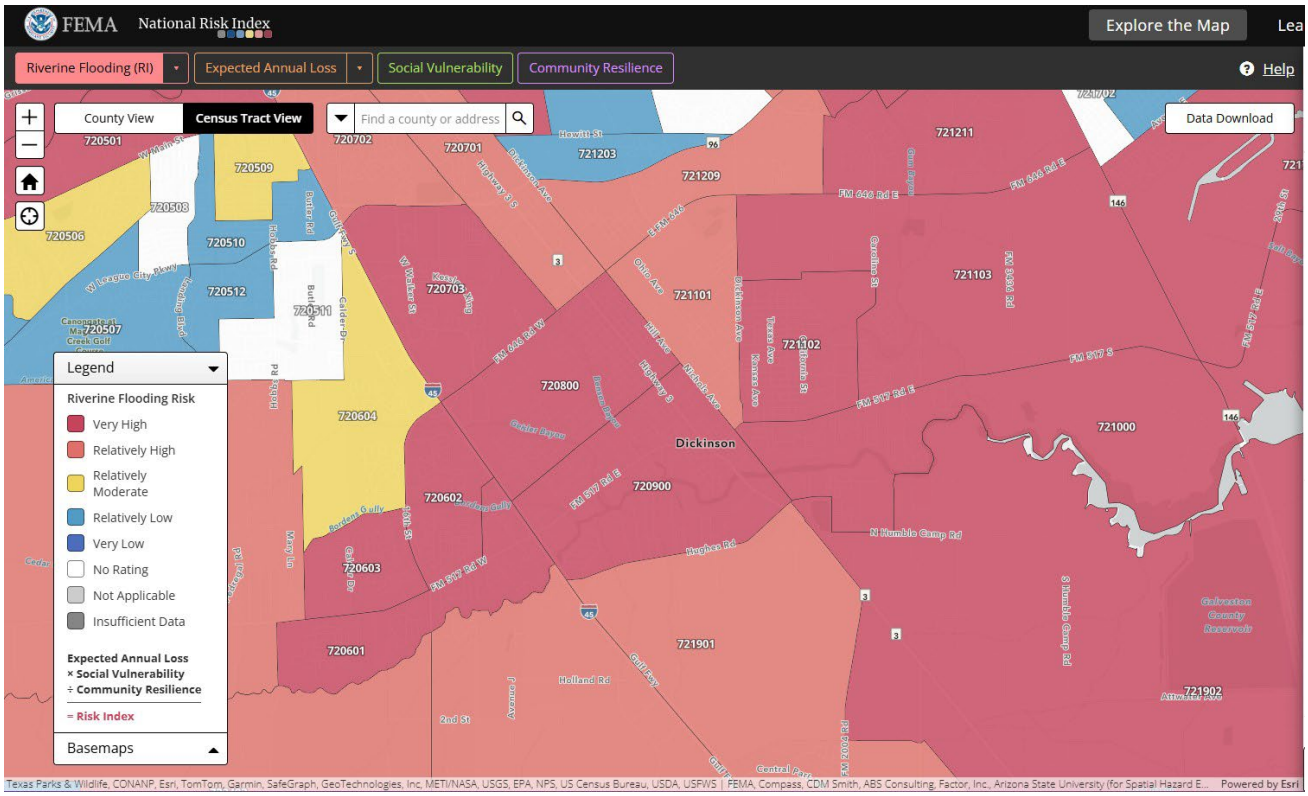
- **Coastal flooding-** when water inundates or covers normally dry coastal land as a result of high or rising tides or storm surges. [85]
- **Riverine flooding-** when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow and water overflows the banks, spilling out into adjacent low-lying, dry land. [86]

Risk index scores for this hazard is shown in the figures below by census tract. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

Risk Index by Census Tract, Coastal Flooding



Risk Index by Census Tract, Riverine Flooding



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Coastal Flooding, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$37,686,517,779	$2,639,278,021,677 227,523.97	N/A	$2,676,964,539,456

Expected Annual Loss Exposure Values, Riverine Flooding, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$19,721,070,775	$1,203,363,401,379 103,738.22	$3,038,636	$1,223,087,510,790

Expected Annual Loss Values, Coastal Flooding

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$234,980	$132,275 0.01	N/A	$367,255

Expected Annual Loss Values, Riverine Flooding

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$334,703,831	$2,569,197 0.22	$798	$337,273,825

EAL for Galveston County, due to coastal flooding, is **relatively low**. EAL for Galveston County due to riverine flooding is **very high**.

The FEMA NR HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. The HLR for coastal flooding within the planning area is categorized as **very low**. The HLR for riverine flooding within the planning area is categorized as **relatively low**.

Probability of Future Occurrences

To highlight the probability of future occurrence for this hazard, FEMA's annualized frequency values were used. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. The table below shows FEMA's NRI annualized frequency values for coastal and riverine flooding hazards. Coastal flooding does not record events on record, and the period of record calculation varies by location (see technical documentation under 7.1.1: Coastal Flooding Period of Record). 87

Annualized Frequency Values

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Coastal Flooding	**3.8 events per year**	**N/A**	**See NRI Technical Documentation**
Riverine Flooding	**3.2 events per year**	**76**	**24 years (1996-2019)**

Future Conditions

Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

Factors such as increasing precipitation and warmer sea surface temperatures may also affect the probability of future floods within Galveston County, the planning area, and the City of Dickinson. 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 increased evaporation, making more water available in the atmosphere for rain events. Increased sea surface temperatures can cause a greater intensity of hurricanes and precipitation. These rain events are also likely to be more severe. [88] Flooding can also occur outside of the identified floodplains due to drainage issues within the city.

The following factors were used to examine potential conditions that may affect hazard vulnerability:

- **Future development**- The District has no current plans for future development. The vulnerability to flooding increases as new developments and future construction increase the impervious surface area in a given location, especially if that location is within or near the SFHA, creeks, rivers, or bodies of water.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited

authority to mitigate this hazard in regard to projected population changes. However, increases in population will lead to more service connections and customers for the district.

- **Future weather conditions**- 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 infrastructure 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. [89]

Future Weather Conditions Impacts Summary, Floods

Location	The location of floods is not expected to change
Extent	The extent and intensity of flooding within the planning area may change due to increased precipitation, stronger storms, and rising surface and ocean 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.

The District considers the overall vulnerability to this hazard as **medium** with a moderate probability of occurrence, but having limited impacts on the District and its assets. Potential impacts to the District from this hazard are either already fully mitigated against or addressed in the mitigation strategy for this HMP.

4.2.6 Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)

The 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." [90] 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 shear. [91]

There are different types of thunderstorms with varying characteristics and degrees of severity. [92] Descriptions of these can be found below.

Types of Thunderstorms

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/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.

Type of Thunderstorm	Description
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 of 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.

NOAA's National Severe Storms Laboratory (NSSL) defines **hail** as "A form of precipitation consisting of solid ice that forms inside thunderstorm updrafts. Hailstorms can damage aircraft, homes and cars, and can be deadly to livestock and people." [93] Hail varieties are determined by how they grow and maximum size. These differentiating frozen precipitation types and their definitions from NOAA's NSSL can be seen in the table below. [94]

Types of Frozen Precipitation

	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.

	Description
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. [95]

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." [96] 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)[97], lightning kills about 20 people per year, while hundreds more are injured or suffer lifelong neurological damage. [98] There are different types of lightning with varying characteristics. Most lightning starts within a thunderstorm and travels through the clouds. Descriptions of these can be found below.

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. **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

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 up to 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]

Types of Damaging Winds

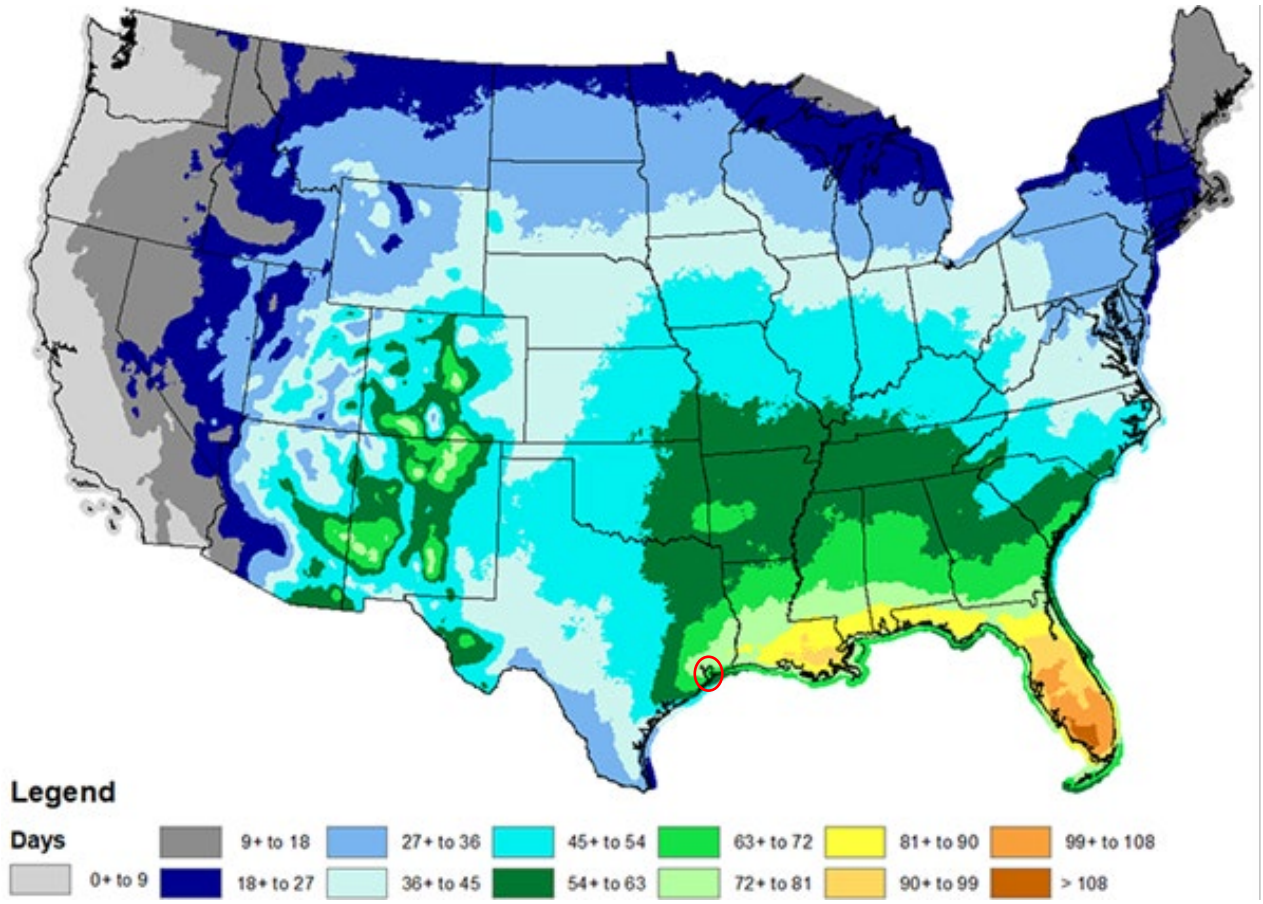
Damaging Wind Type	Description
Straight-line Wind	Used to define thunderstorm wind, which is not linked with rotation and is mainly used to differentiate from tornadic winds
Down Draft	A small-scale column of air that sinks toward the ground
Macroburst	An outward burst of strong winds that are more than 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 rain 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.

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." [101] Tornadoes are one of the most violent storms, with the strongest tornadoes being capable of massive destruction. In extreme cases, winds from a tornado may approach 300 miles per hour, with damaging paths that can be more than one mile wide and 50 miles long. These catastrophic tornadoes are often produced by supercell thunderstorms. [102]

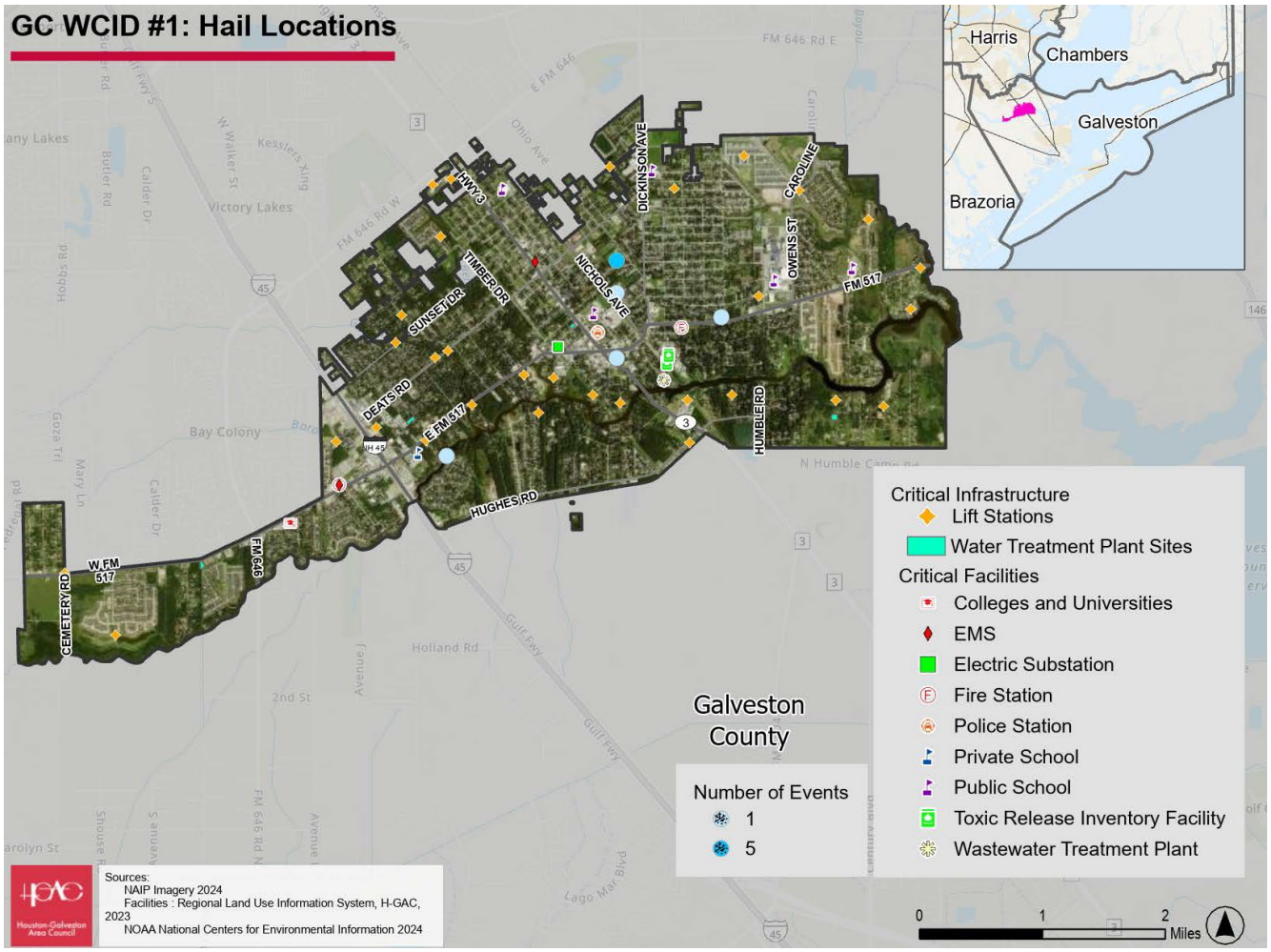
Location

Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado) is not confined to any geographic boundaries. These hazards can happen anywhere, at any time of the year. However, typically severe weather will occur in warmer months, Summer and Spring, and during the warmest parts of the day. Below, the image 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 the Atlantic Ocean are readily available to fuel atmospheric conditions that produce thunderstorms. The City of Dickinson and Galveston County are located in an area that can see anywhere from 72-81 thunderstorm days per year (as indicated by the red circled area).[103]

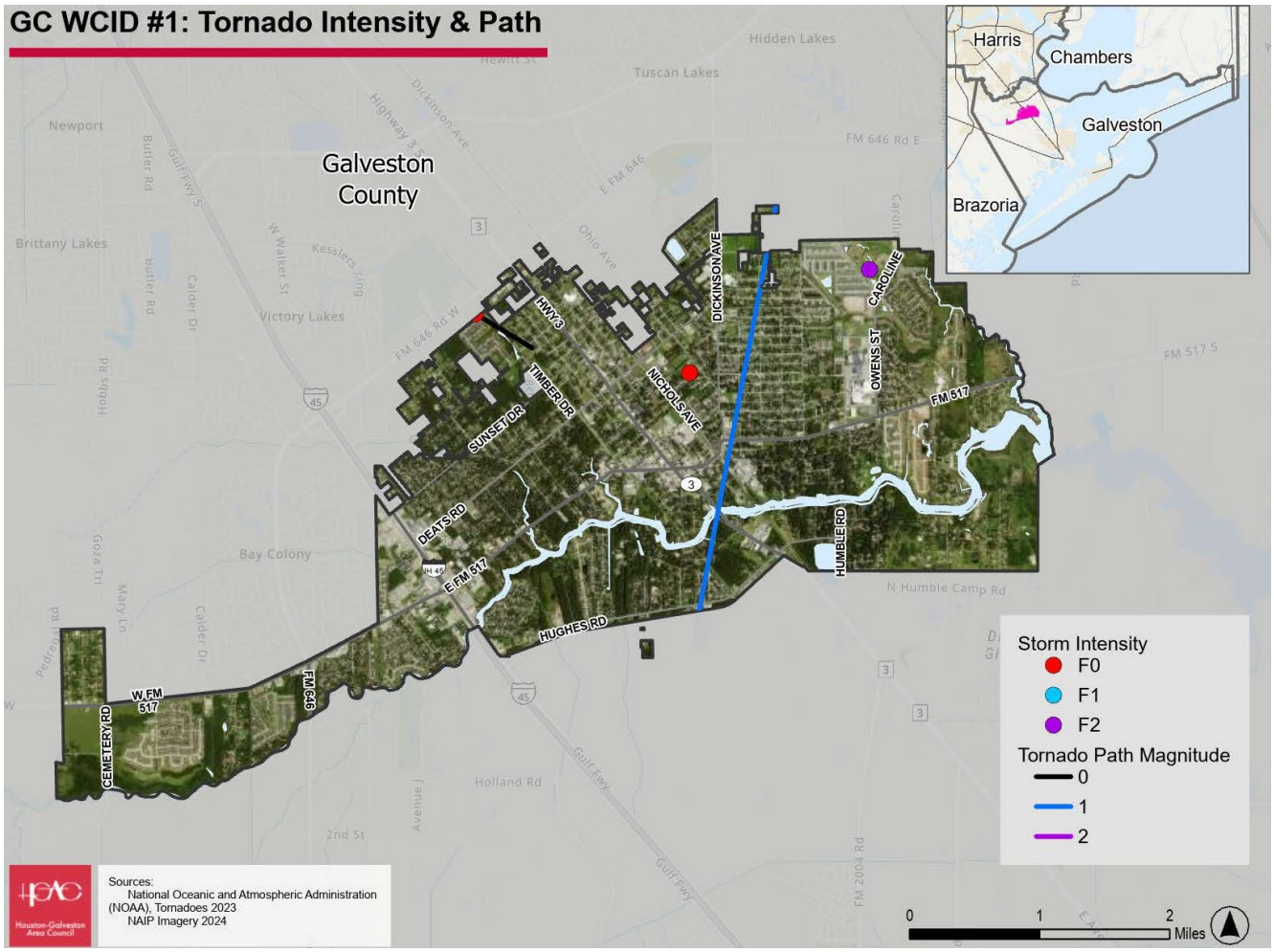
Annual Mean Thunderstorm Days (1993-2018)



Hail Events, Planning Area



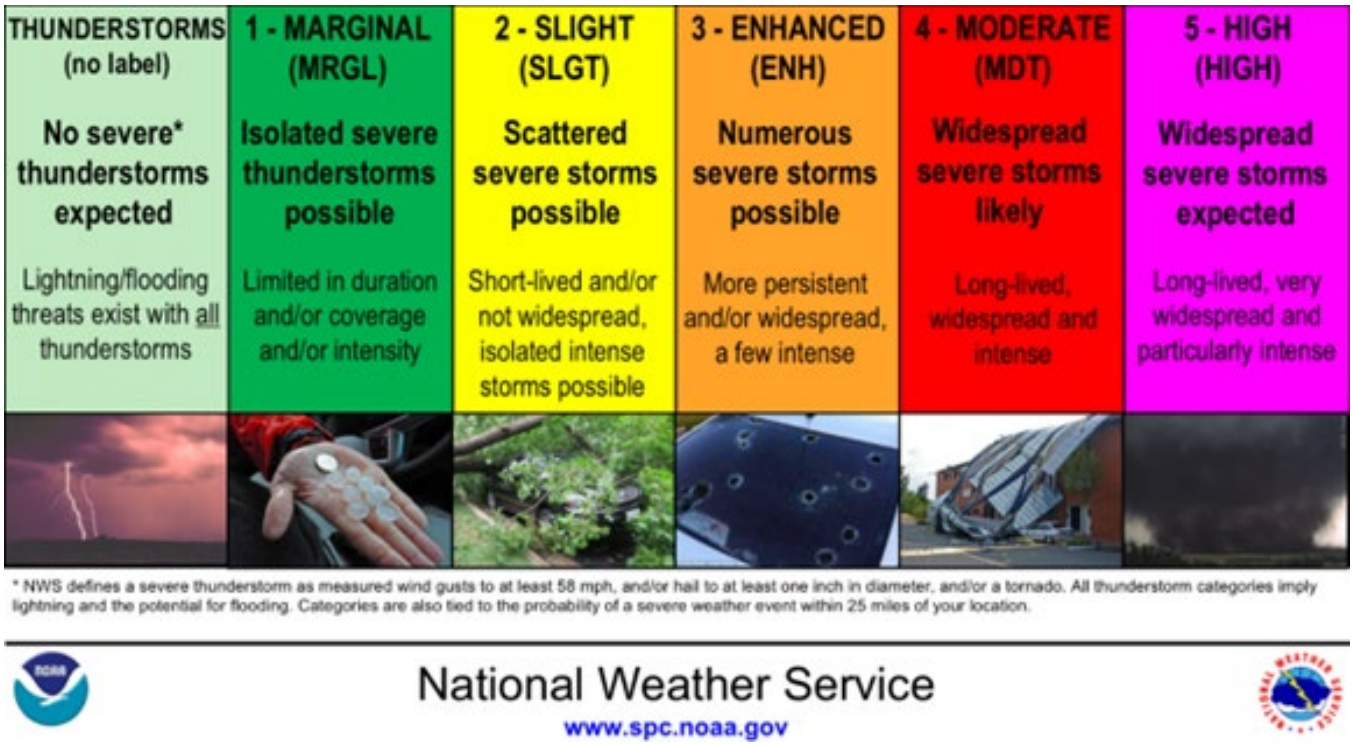
Tornado Events, Planning Area



Extent- Thunderstorm

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 U.S., 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. [104] Components of a severe thunderstorm include 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.

Thunderstorm Risk Categories



Extent- Hailstorm

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). [105]

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.

Hail intensity is measured by the TORRO scale. 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. [106]

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
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

Extent- Lightning

Lightning intensity is measured by the NWS's "Lightning Hazard Map" which 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. [107]

Types of Lightning

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. 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.

Extent- Windstorm

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. [108] The table below outlines the measurements used by the Beaufort Wind Scale for use on land.

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
10	55-63	Storm	Trees uprooted; considerable structural damage occurs.
11	64-72	Violent Storm	Accompanied by widespread damage.
12	72-83	Hurricane	Reference the Saffir-Simpson Hurricane Scale

Additionally, NOAA and the NWS issue watches, warnings, and advisories for wind events when wind speeds can pose a hazard or are life-threatening. The table below describes the various wind-related warnings, watches, and advisories below. [109]

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.

Extent- Tornado

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. [110]

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.

EF Rating	Wind Speed	Typical Damage
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.

EF-Scale Damage Indicators

	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

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

A worst-case scenario for these types of hazards could include a severe thunderstorm event in the high-risk category that can produce straight-line winds in excess of 62 mph (violent storm), an EF-2 or greater tornado, destructive hail (H5 or 1.6" in diameter or greater), and an extreme lightning threat level with frequent CG lightning resulting in dangerous and life-threatening conditions. This would be a severe event with buildings and homes damaged, vehicles becoming airborne, downed trees and power lines, debris on roadways, mobile homes destroyed, 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 these hazards that have occurred within the planning area (see Historic Occurrences below).

If a worst-case scenario event occurs during an excessive heat warning, secondary hazards will pose increased risks to citizens due to the heat and inability to keep homes and buildings cool if power outages are not addressed. This is similar to what occurred within the region during the 2024 derecho and Hurricane Beryl where power lines were destroyed by winds and debris in July when the region was under an excessive heat advisory. Restoration and repairs took longer to address than anticipated and led to the activation of emergency cooling centers. Prolonged power outages would put extra strain on the District by requiring the District to rely on its backup power sources and other emergency resources.

Historic Occurrences

NOAA collects historic climate data for the entire nation via the NCEI storm events database. These events are shown at the county level, divided into zones, and contain data from January 1950 to March 2025, as entered by NOAA's NWS. The table below highlights events for this hazard that have occurred within Galveston County since the year 2000. [111]

Historic Occurrences, Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)

Event Date	Event Type	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)	Magnitude
Thunderstorm, Windstorm						**Wind Speed (mph)**
3/14/2001	Thunderstorm	0	0	$0.00	$0.00	62 mph
5/8/2005	Thunderstorm	0	0	$43,000	$0.00	60 mph
4/21/2006	Thunderstorm	0	0	$20,000	$0.00	63.3 mph
4/21/2006	Thunderstorm	0	0	$5,000	$0.00	57.5 mph
7/18/2006	Thunderstorm	0	0	$2,000	$0.00	57.5 mph
3/14/2007	Thunderstorm	0	0	$12,000	$0.00	60 mph
10/20/2017	Thunderstorm	0	0	$0.00	$0.00	57.5 mph
4/7/2019	Thunderstorm	0	0	$0.00	$0.00	61 mph
5/9/2019	Thunderstorm	0	0	$0.00	$0.00	63.3 mph
4/10/2024	Thunderstorm	0	0	$10,000	$0.00	69 mph
4/10/2024	Thunderstorm	0	0	$0.00	$0.00	64.5 mph
4/10/2024	Thunderstorm	0	0	$0.00	$0.00	83 mph
4/10/2024	Thunderstorm	0	0	$100,000	$0.00	75 mph
12/28/2024	Thunderstorm	0	0	$0.00	$0.00	65.5 mph
	Total:	**0**	**0**	**$192,000**	**$0.00**	
Hailstorm						**Diameter (in)**
4/21/2006	Hail	0	0	$7,000	$0.00	1 in
2/1/2009	Hail	0	0	$2,000	$0.00	1in
2/26/2019	Hail	0	0	$0.00	$0.00	0.88 in
1/6/2021	Hail	0	0	$0.00	$0.00	1 in
6/8/2023	Hail	0	0	$0.00	$0.00	1 in
5/31/2024	Hail	0	0	$0.00	$0.00	2 in
5/31/2024	Hail	0	0	$0.00	$0.00	1 in
5/31/2024	Hail	0	0	$0.00	$0.00	2.75 in
	Total:	**0**	**0**	**$9,000**	**$0.00**	
Lightning						
5/16/2023	Lightning	0	0	$250,000	$0.00	
1/24/2024	Lightning	0	0	$25,000	$0.00	
	Totals:	**0**	**0**	**$275,000**	**$0.00**	
Tornado						**EF Scale**
11/17/2003	Tornado	0	0	$30,000	$0.00	EF0
10/20/2017	Tornado	0	0	$50,000	$0.00	EF0
12/28/2024	Tornado	0	0	$0.00	$0.00	EF1
	Totals:	**0**	**0**	$80,000	$0.00	

Presidential Disaster Declarations

There have been 3 federally declared severe weather-related disaster declarations in Galveston County since 1995.[5,6]

Federal Disaster Declarations for Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)

Date	Disaster #	Declaration Types	Incident Type	Declaration Title
8/26/1998	1239	Major Disaster Declaration	Severe Storm	TROPICAL STORM CHARLEY
9/23/1998	1245	Major Disaster Declaration	Severe Storm	HURRICANE GEORGES-TEXAS
11/25/2015	4245	Major Disaster Declaration	Severe Storm	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk for severe weather include the entire planning area, as this hazard has no set geographic boundaries. Severe weather can cause property damage, flooding, lack of access to critical facilities (which can provide food, water, medications, or other forms of medical assistance), dangerous and life-threatening conditions, and can result in the lack of access to utilities (electricity and potable water). Populations at the greatest risk from this hazard mirror that of earlier sections. These include:

- **Older populations**- Older adults, in addition to potential lack of access to critical facilities and utilities, can also face social isolation during disasters. Older adults may also have mobility issues, chronic health conditions, or cognitive impairments.
- **Younger populations**- 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/humidity after severe weather. Children rely on caregivers for safety and information.

- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events. Additionally, there has historically been a lack of access to emergency services or resources within this population.
- **Populations with disabilities**- Those with physical or cognitive disabilities may require additional assistance to stay safe and prepare for these hazards, like creating a support network, being prepared before a storm, and finding accessible transportation to evacuate or get medical attention. [112]
- **Chronic health conditions**- 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 may face an increased risk of exposure to various other illnesses when utilizing a shelter or evacuation center. [lvi]
- **Populations living in mobile homes or manufactured housing**- People living in mobile homes or manufactured housing are also at greater risk of injury and death from these hazards. Despite mobile homes providing shelter, tornadoes and dangerous winds produced by hurricanes can cause mobile homes, even those that utilize anchoring, to be seriously damaged or destroyed when winds gust over 80 mph.
- **Low-income communities**- Individuals in low-income areas often lack access to adequate housing, resources for emergency preparedness, or the means to evacuate during severe weather events.
- **Outdoor workers**- Those who work outdoors (farmers, construction workers) may be more likely to get caught in severe weather without adequate warning shelter.
- **First responders**- Those who respond to severe weather events also face increased risks.

Critical Facilities

This hazard could have a direct impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

Economic impacts to the District can include direct damage to infrastructure and properties, disruptions to essential services like water and sanitation, and long-term economic consequences such as permanent revenue lost for the District due to lower water usage, a loss of homes within the District's service area (depending on the severity of the event), and a decline in the local tax base. These factors can create a ripple effect, leading to reduced funding for services

and infrastructure maintenance, which further exacerbates the challenges faced by disaster-affected communities.

National Risk Index

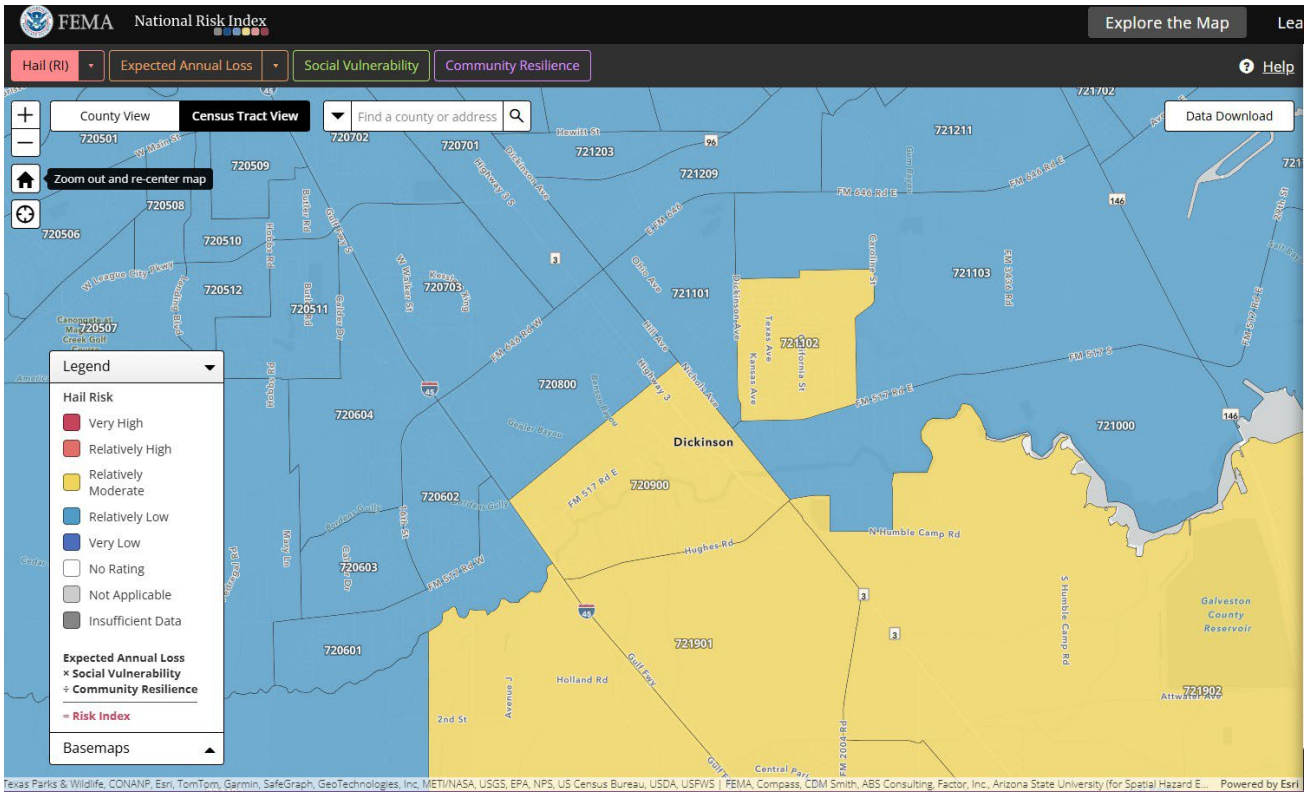
FEMA's NRI utilizes data from multiple sources including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI accounts for severe weather in various formats, these are:

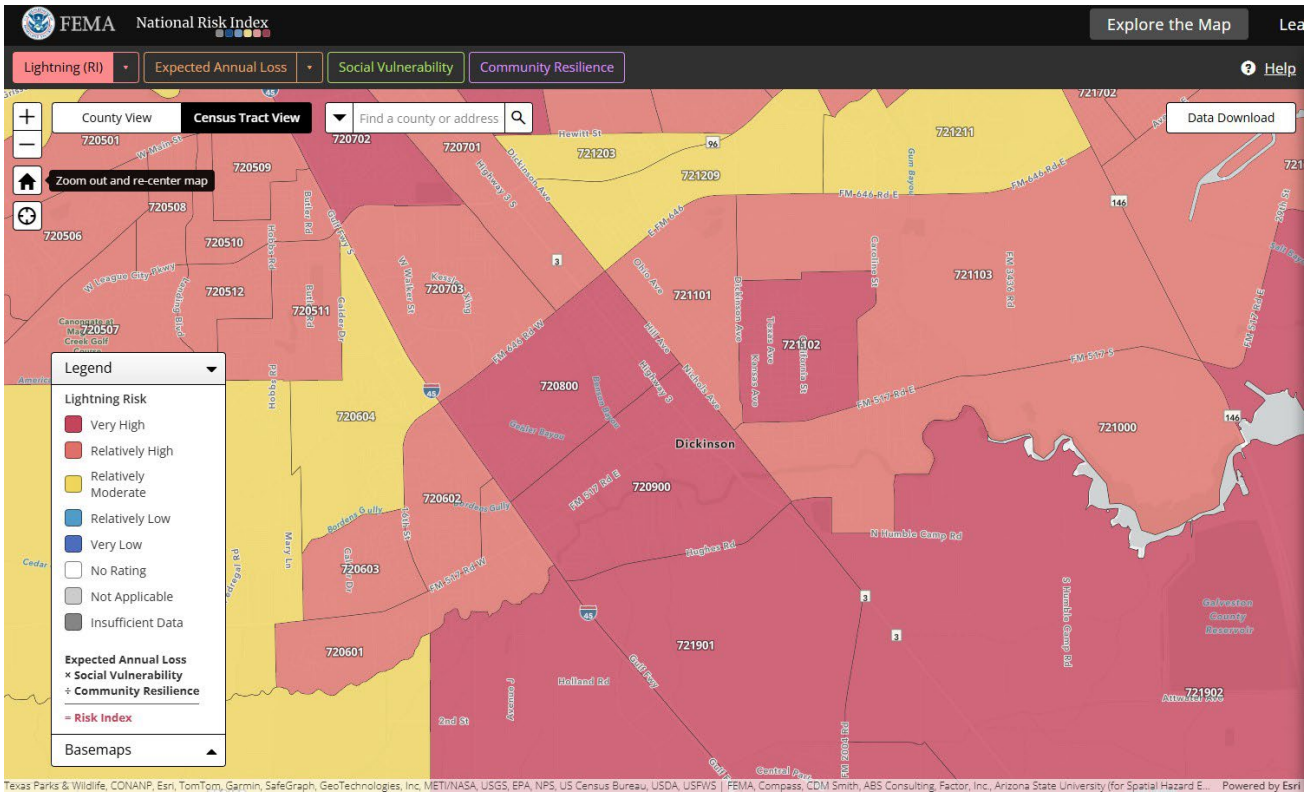
- **Hail-** a form of precipitation that occurs during thunderstorms when raindrops, in extremely cold areas of the atmosphere, freeze into balls of ice before falling towards the earth's surface. [113]
- **Lightning-** a visible electrical discharge or spark of electricity in the atmosphere between clouds, the air and/or the ground, often produced by a thunderstorm. [114]
- **Strong Wind-** consists of damaging winds, often originating from thunderstorms, that are classified as exceeding 58 mph. [115]
- **Tornado-** a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground and is visible only if it forms a condensation funnel made up of water droplets, dust, and debris. [116]

Risk index scores for these hazards are shown in the figures below by census tract. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

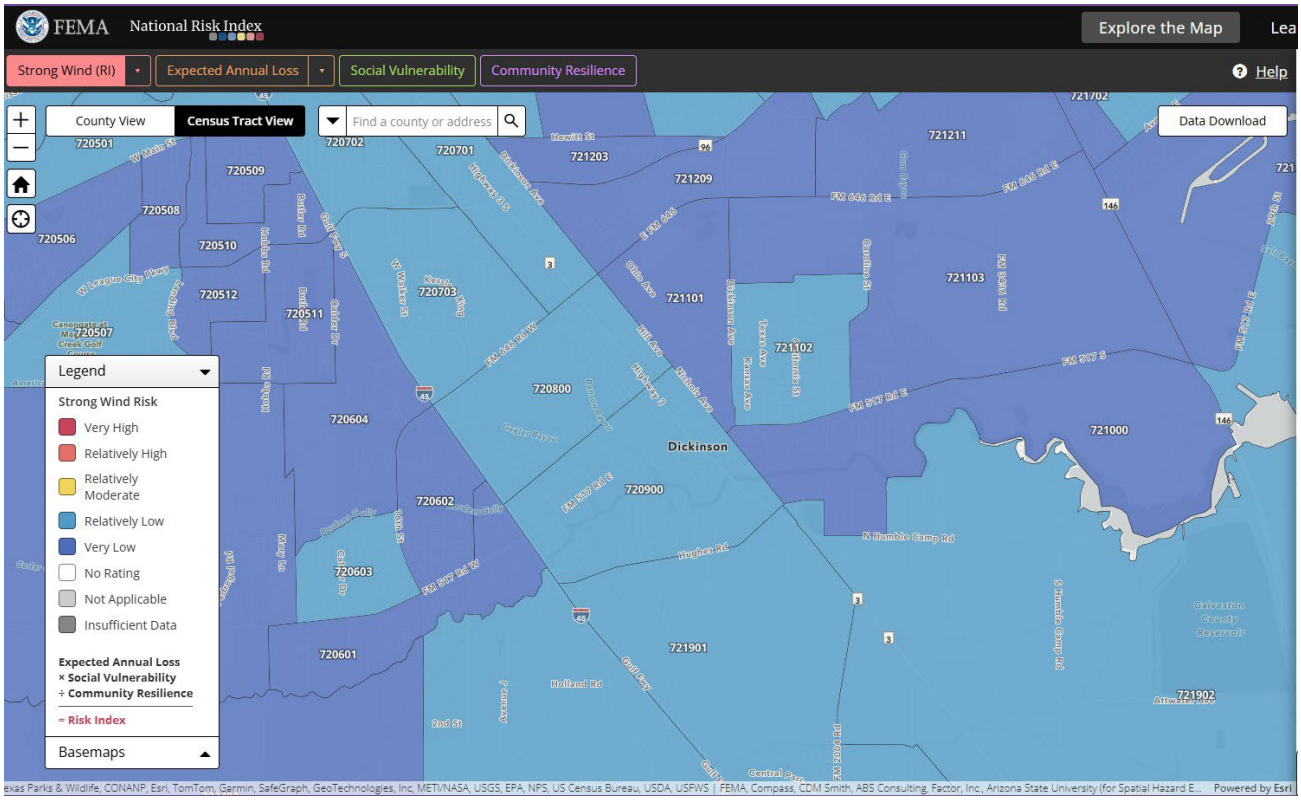
Risk Index by Census Tract, Hail (Hailstorm)



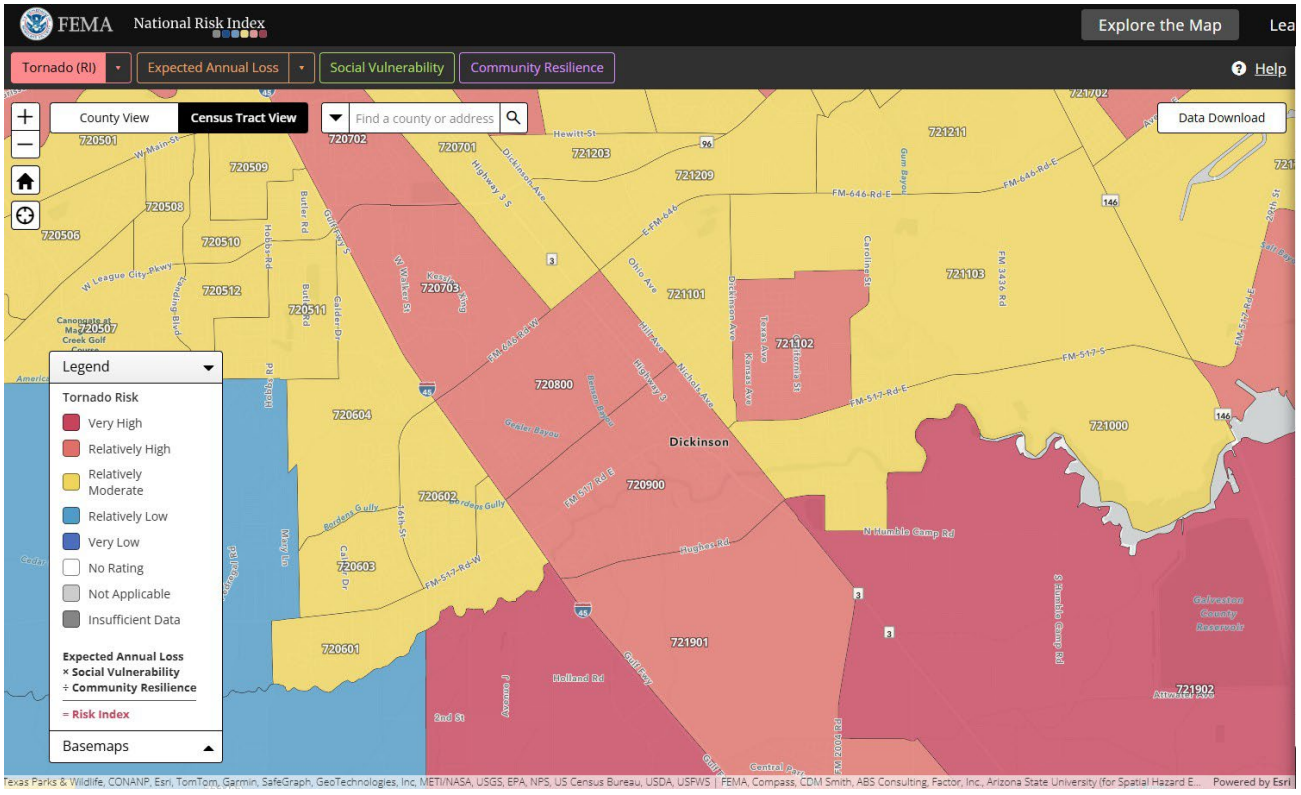
Risk Index by Census Tract, Lightning



Risk Index by Census Tract, Strong Wind



Risk Index by Census Tract, Tornado



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Severe Weather, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$56,746,974,030	$4,065,532,578,123 350,476.95	$10,592,645	$4,122,290,144,798

Expected Annual Loss Values, Severe Weather, Galveston County

Hazard	Building Value	Population Equivalence ($), Population (#)	Agricultural Value	EAL Total
Hailstorm	$283,285	$284,136, 0.02	$2,562	$569,984
Lightning	$70,878	$2,159,253, 0.19	N/A	$2,230,131
Strong Wind	$162,724	$83,654, 0.01	$202	$246,579
Tornado	$2,275,536	$14,438,688, 1.24	$243	$16,714,467

EAL for Galveston County due to hailstorm is **relatively moderate**.
EAL for Galveston County due to lightning is **very high**.
EAL for Galveston County due to strong winds is **relatively low**.
EAL for Galveston County due to tornadoes is **relatively high**.

The FEMA NR HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLRs for these hazards within the county and planning area are:

The HLR for hailstorms within the planning area is categorized as **relatively low**.
The HLR for lightning within the planning area is categorized as **relatively low**.
The HLR for strong winds within the planning area is categorized as **very low**.
The HLR for tornadoes within the planning area is categorized as **relatively moderate**.

Probability of Future Occurrences

To highlight the probability of future occurrence for this hazard, FEMA's annualized frequency values were used. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence

each year. While the NRI does not account for thunderstorms in its list of natural hazards, hailstorms, lightning, strong winds, and tornadoes are all included within the NRI's annualized frequency values, as seen in the table below.

Annualized Frequency Values, Severe Weather, Galveston County

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Hailstorm	2.2 events per year	35	1986-2021 (34 years)
Lightning	98 events per year	1,014	1991-2012 (22 years)
Strong Wind	1.3 events per year	22	1986-2021 (34 years)
Tornado	0.3 events per year	72	72 years (1950-2021)

Future Conditions

Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to this hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard in regard to population growth.
- **Future weather conditions**- According to the Office of the Texas State Climatologist, over the past few decades, the severe storm environment in 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. As temperatures increase, the amount of energy available to fuel these storms also rises. This results in an *overall increase in the number of days capable of producing severe thunderstorms*. There is low confidence in any ongoing trend in the overall frequency and severity of severe weather.[117]

Future Weather Conditions Impacts Summary, Severe Weather

Location	The location of severe weather is not expected to change.
Extent	The extent and intensity of severe weather within the planning area may change (increase) due to increased temperatures and energy available to fuel severe thunderstorm development and the accompanying hazards (wind, lightning, hail, and tornadoes).
Frequency	There are no clear trends in severe weather frequency due to considerable variability in conditions that lead to their occurrence. However, these hazards occur most frequently in warmer months, around May and June.
Duration	The duration of severe weather 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.

The District considers the overall vulnerability to this hazard as **medium,** with a high likelihood of occurrence but having limited to negligible impacts on the District and its assets. Potential impacts to the District are either already fully mitigated against this hazard or addressed in the mitigation strategy for this HMP.

4.2.7 Extreme Heat

Heat events, or extreme heat, are defined by the CDC as summertime temperatures that are much hotter and/or more humid than average. [118] 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. [119] 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. [120]

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

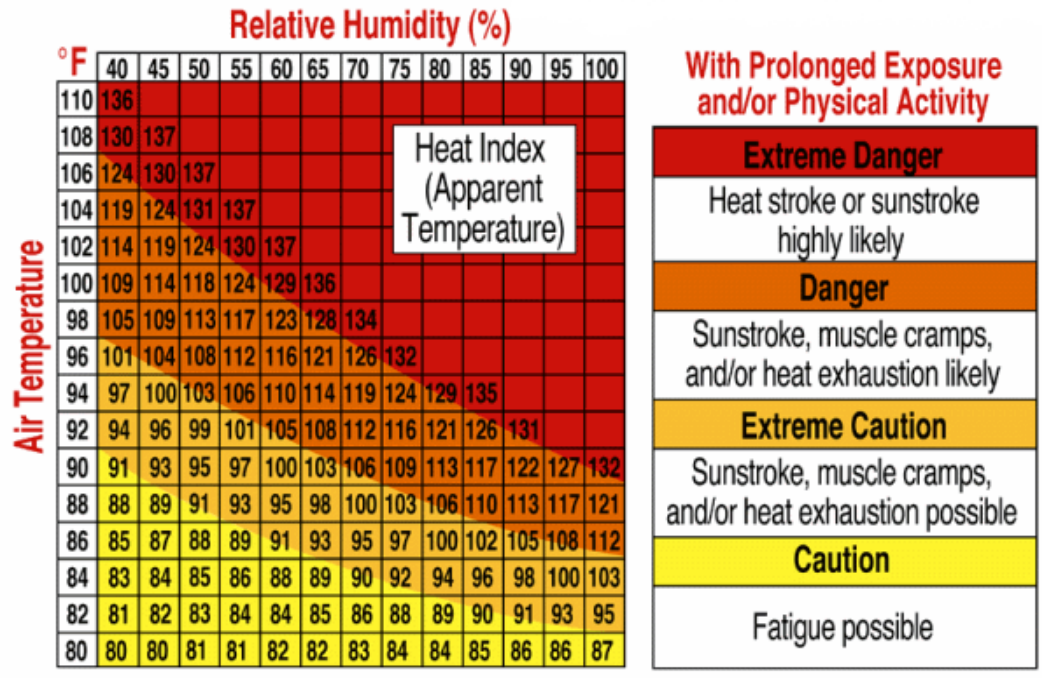
The risk of an extreme heat event occurring applies the same throughout the planning area. Galveston County experiences the highest temperatures in the months of June to August, with average temperatures between 90°F and 100°F. In areas that have more development and pavement, the “urban heat island” effect (increased air temperatures in urban areas in contrast to cooler surrounding rural areas) can occur due to higher concentrations of concrete and other materials. These materials absorb more heat during the day and radiate it at night, prohibiting temperatures from cooling as much compared in rural areas. [121]

Extent

As the temperature rises, the air can hold more moisture (humidity). 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 intensity of extreme heat events is measured by NOAA’s heat index, or the "Apparent Temperature.” It 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, heat index values can be increased by up to 15°F.

NOAA NWS Heat Index



Hazards from extreme heat are made worse when accompanied by high levels of humidity. At temperatures over 103°F, dangerous heat disorders can begin with prolonged exposure to the heat or increased physical activity in the heat. [122] The image below outlines various effects on the body with prolonged exposure to various heat index classifications.

Heat Index

Color	Classification	Heat Index	Effect on the body
	Caution	80°F - 90°F	Fatigue is possible with prolonged exposure and/or physical activity
	Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion are possible with prolonged exposure and/or physical activity
	Danger	103°F - 124°F	Heat cramps or heat exhaustion are likely, and heat stroke is possible with prolonged exposure and/or physical activity
	Extreme Danger	125°F or higher	Heat stroke is 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 113°F or above or maximum temperatures of 105°F or above). Secondary hazards from extreme heat that can affect the District would include a loss of power from the increased demands placed on the power grid as people attempt to stay cool and the activation of the DCP in the event of a prolonged extreme heat event.

Historic Occurrences

NOAA collects historic climate data for the entire nation via the NCEI storm events database. These events are shown at the county level, divided into zones, and contain data from January 1950 to March 2025, as entered by NOAA's NWS. The table below highlights events for this hazard that have occurred within Galveston County since the year 2000. [123]

Historic Occurrences, Extreme Heat

Event Date	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
7/6/2000	0	2	$0.00	$0.00
8/29/2000	0	0	$0.00	$0.00
9/1/2000	0	0	$0.00	$0.00
6/24/2009	0	0	$0.00	$0.00
7/9/2009	0	0	$0.00	$0.00
9/5/2023	0	0	$0.00	$0.00
9/5/2023	0	0	$0.00	$0.00
Total:	**0**	**2**	**$0.00**	**$0.00**

Presidential Disaster Declarations

There have been no federally declared heat-related disaster declarations in Galveston County or within the planning area. [5,6]

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk from this hazard include the entire planning area, as this hazard has no set geographic boundaries. According to the CDC, populations at greater risk from the impacts of this hazard include: [124]

- **Older populations**- Older adults, in addition to potential lack of access to critical facilities and utilities, can also face social isolation during disasters. Older adults may also have mobility issues, chronic health conditions, or cognitive impairments.
- **Younger populations**- Children are more at risk and vulnerable to heat-related illnesses, as it is harder for them to regulate body temperature. Children rely on caregivers for safety and information, and may not recognize the signs of heat stress.
- **Pregnant populations**- Pregnancy can impair thermoregulation, and high temperatures can pose risks not only to the mother but also to the developing fetus.
- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events. Additionally, there has historically been a lack of access to emergency services or resources within this population.
- **Populations with disabilities**- Those with physical or cognitive disabilities may require additional assistance to stay safe and prepare for these hazards, like creating a support network, being prepared before an event, and finding accessible transportation to evacuate or get medical attention. [125]
- **Populations with Chronic health conditions**- People with pre-existing medical conditions (like heart disease, diabetes, or respiratory issues) may experience exacerbated symptoms

during extreme heat, increasing their risk of heat-related complications. Those with chronic health conditions may need similar assistance as those with disabilities.

- **Populations living in sub-standard housing**- Inadequately insulated or poorly ventilated homes can exacerbate heat-related risks, particularly for those who may not have access to air conditioning or fans.
- **Low-income communities**- Residents in low-income areas may lack access to air conditioning, proper housing, or transportation, making it difficult to escape extreme heat conditions.
- **Outdoor workers and Athletes**- Those who work and play outdoors (farmers, construction workers, athletes) are directly exposed to high temperatures, increasing their risk of heat exhaustion or heat stroke without proper hydration or rest breaks.

Critical Facilities

The most notable vulnerabilities to critical facilities throughout the planning area to this hazard include infrastructure stress, operational challenges, and future investments. Extreme heat can put increased strain on infrastructure, may require increased hours of operation to increase treatment capacity (as water quality can lead to changes in chemistry) or address higher demands during extreme heat events, and to prepare for future heat events facilities may need to invest in new technologies (smart water saving meters).

Economy

Economic impacts to the district from this hazard could include higher operational costs, infrastructure maintenance and repairs, and potential increased treatment costs during extreme heat events.

National Risk Index

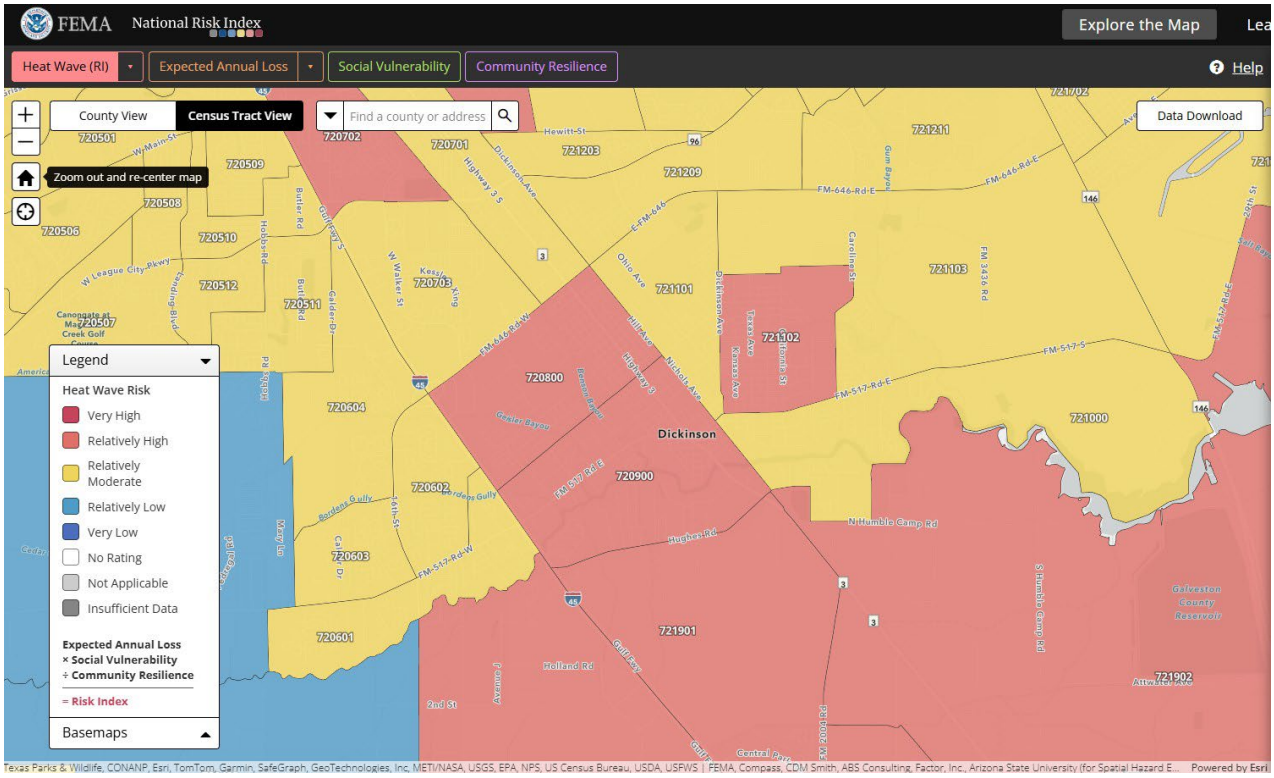
FEMA's NRI utilizes data from multiple sources, including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI accounts for extreme heat as:

- **Heat Wave-** a period of abnormally and uncomfortably hot and unusually humid weather typically lasting two or more days with temperatures outside the historical averages for a given area. [126]

Risk index scores for this hazard are shown in the figures below by census tract. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

Risk Index by Census Tract, Extreme Heat (Heat Wave)



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Extreme Heat

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$56,746,974,030	$4,065,532,578,123 350,476.95	$10,592,645	$4,122,290,144,798

Expected Annual Loss Values, Extreme Heat

Building Value	Population Equivalence ($), Population (#)	Agricultural Value	EAL Total
$301	$22,710,703, 0.23	$305	$2,711,005

EAL for Galveston County due to extreme heat is **relatively high**.

The FEMA NRI HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLRs for this hazard within the county and planning area are **relatively low**.

Probability of Future Occurrences

To highlight the probability of future occurrence for this hazard, FEMA's annualized frequency values were used. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. The table below shows FEMA's NRI annualized frequency values for extreme heat.

Annualized Frequency Values, Extreme Heat, Galveston County

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Extreme Heat	0.2 events per year	2	2005-2021 (16 years)

Future Conditions

Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. Changes in certain

conditions occurring in hazard-prone areas may affect the vulnerability of the District to the hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard in relation to population growth. The District has plans in place to address increased water demands.
- **Future weather conditions**- 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] 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. Conditions indicate that extreme heat events will be more frequent and intense in the coming decades. [127]

Future Weather Conditions Impact Summary, Extreme Heat

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.

The District considers the overall vulnerability to this hazard as **medium,** with a high likelihood of occurrence but having limited impacts on the District and its assets. Potential impacts to the District are either already fully mitigated against for this hazard or addressed in the mitigation strategy for this HMP.

4.2.8 Drought

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."[128] Drought can have several different classifications for monitoring purposes; these classifications and their definitions are outlined in the table below.

Drought Classifications

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

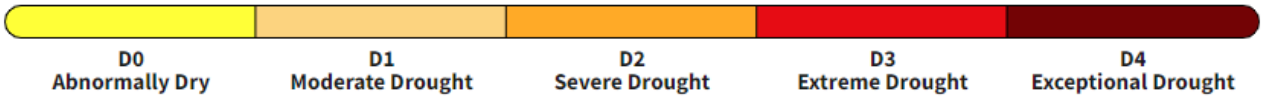
Location

Drought can lead to a wide range of impacts on agriculture, public health, water quality, ecosystems, transportation, and wildfire risk. This is a recurring 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.[129] The entire planning area, including the District, is susceptible to drought and its impacts.

Extent

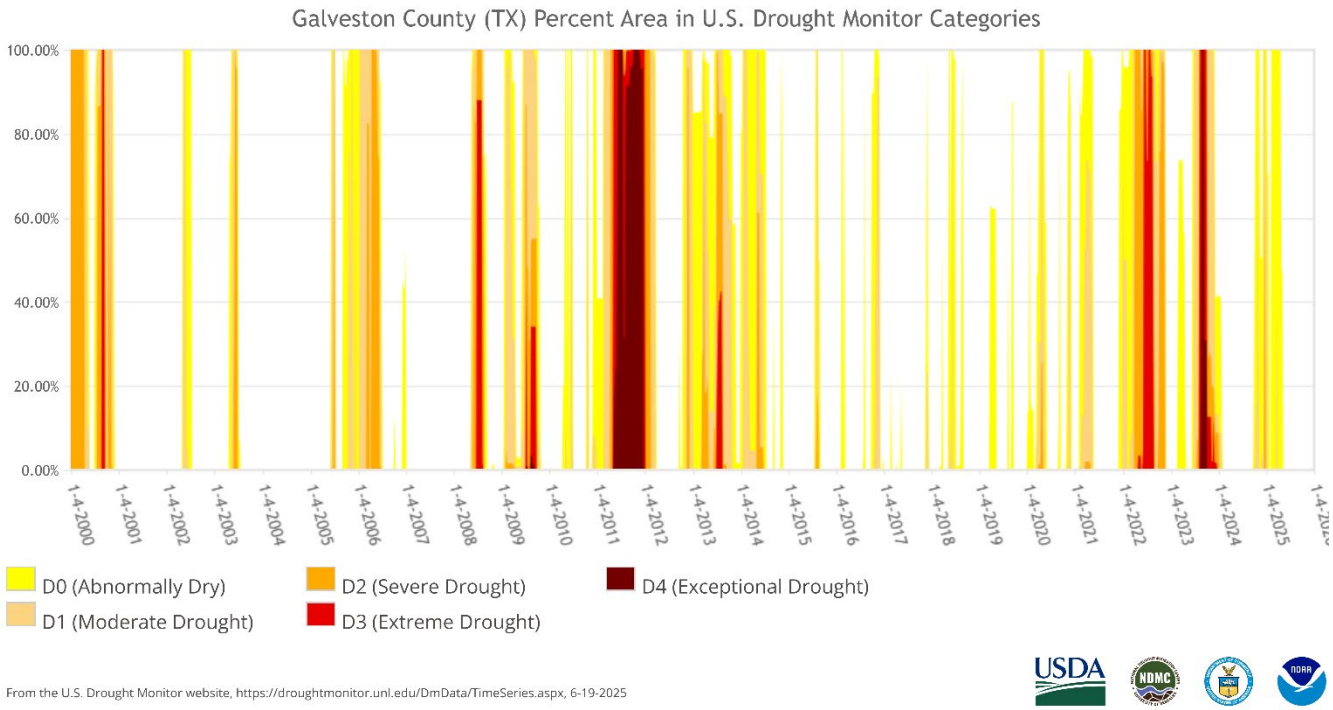
The U.S. Drought Monitor (USDM) is a map that is updated each Thursday to show the location and intensity of drought across the country. The USDM uses a five-category system to classify levels of drought. These categories, seen in the figure below, show experts' assessments of conditions related to dryness 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).[130]

Drought Monitor Categories



The figure below shows the USDM Drought Categories for Galveston County since the year 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.

U.S. Drought Monitor for Galveston County (2000-2025)



For the District, a worst-case scenario for drought would include a multi-year drought of D4, similar to what occurred in 2011-2013, and more recently in 2022-2024. The combination of excessive heat and dryness during times of drought can lead to a strain on resources, like the water supply, leading to water rationing for the District. Additionally, during times of drought when the soil has less moisture, it is more prone to shrinking (see expansive soils), leading to frequent and costly water line breaks as the ground shifts.

Historic Occurrences

NOAA collects historic climate data for the entire nation via the NCEI storm events database. These events are shown at the county level, divided into zones, and contain data from January 1950 to March 2025, as entered by NOAA's NWS. The table below highlights events for this hazard that have occurred within Galveston County since the year 2000. [131]

Historic Occurrences, Drought

Event Date	Injuries	Fatalities	Property Damage ($)	Crop Damage ($)
8/1/2000	0	0	$0.00	$0.00
9/1/2000	0	0	$0.00	$102,300,000
4/5/2022	0	0	$0.00	$0.00
5/1/2022	0	0	$0.00	$0.00
6/1/2022	0	0	$0.00	$0.00
7/1/2022	0	0	$0.00	$0.00
8/1/2022	0	0	$0.00	$0.00
9/1/2023	0	0	$0.00	$0.00
10/1/2023	0	0	$0.00	$0.00
Total:	**0**	**0**	**$0.00**	**$102,300,000**

Presidential Disaster Declarations

There have been no federally declared drought disasters within the planning area since 1950.[5,6]

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk from this hazard include the entire planning area, as this hazard has no set geographic boundaries. 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. [132]

During drought, there is an increased risk for wildfires and dust storms. Particulate matter suspended in the air from these events can irritate the bronchial passages and lungs. Chronic respiratory illnesses can become worse, and the risk for respiratory infections like bronchitis and pneumonia can increase. According to the CDC, populations at greater risk from the impacts of this hazard include: [133]

- **Agricultural workers**- Drought directly impacts crop yields and livestock, leading to economic instability, loss of income, and heightened stress for those reliant on agriculture for their livelihoods.
- **Older populations**- Older adults may have mobility issues, chronic health conditions, or cognitive impairments that make it difficult for them to access water or other emergency resources in times of drought. Additionally, these populations are more susceptible to changes in air and water quality.
- **Younger populations**- Children are more at risk and vulnerable to illnesses and changes in air and water quality.
- **Chronic health conditions**- People with pre-existing medical conditions (like heart disease, diabetes, or respiratory issues) may experience exacerbated symptoms during droughts.

Critical Facilities

This hazard has a negligible impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

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. 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. [134]

Economic impacts to the district from this hazard could include higher operational costs as this hazard can put increased strain on infrastructure, infrastructure maintenance and repairs, and potential increased treatment costs during droughts.

National Risk Index

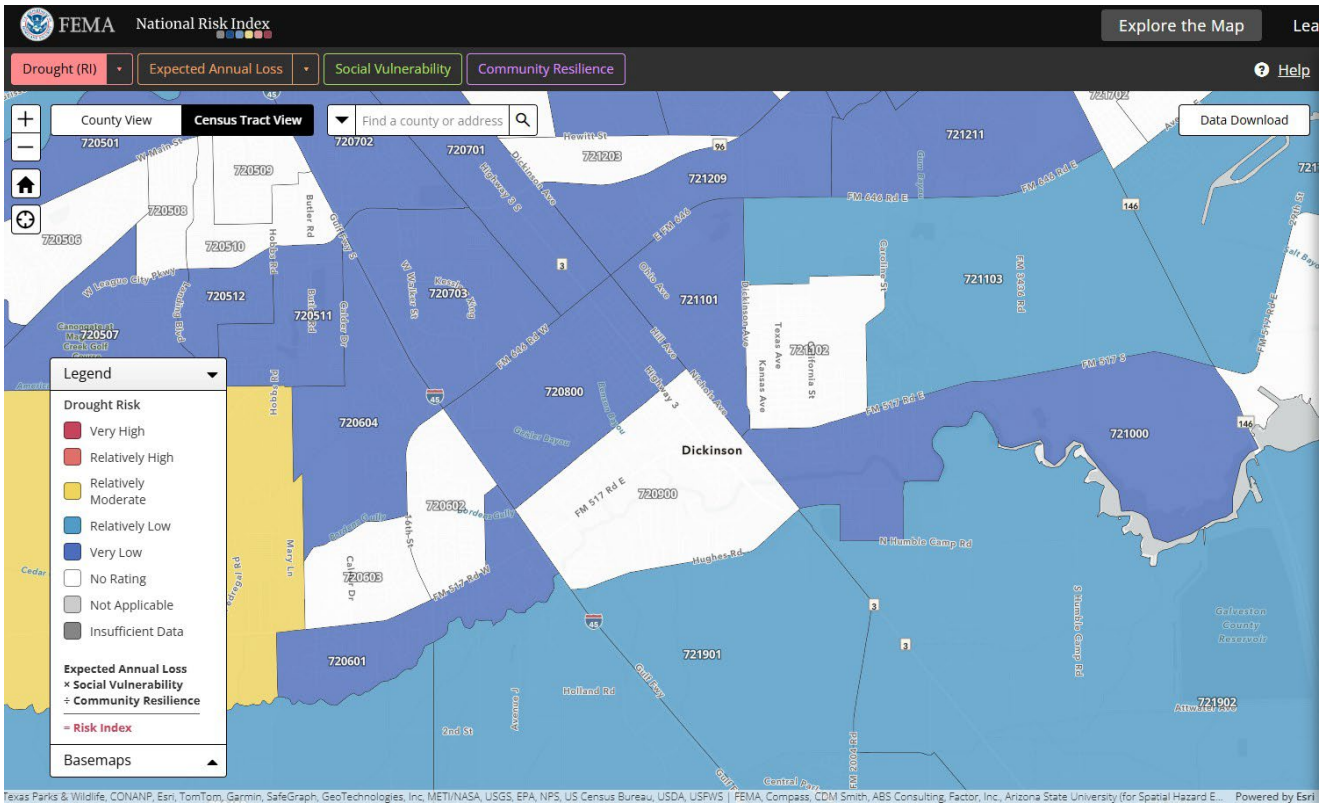
FEMA's NRI utilizes data from multiple sources, including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI characterizes drought as:

- **Drought-** a deficiency of precipitation over an extended period of time resulting in a water shortage. [135]

Risk index scores for this hazard are shown in the figures below by census tract. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

Risk Index by Census Tract, Drought, Galveston County



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Drought, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$4,944,231	N/A	N/A	$4,944,231

Expected Annual Loss Values, Drought, Galveston County

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$128,481	N/A	N/A	$128,481

EAL for Galveston County due to drought is **relatively low**.

The FEMA NR HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLRs for this hazard within the county and planning area are **relatively high**.

Probability of Future Occurrences

Droughts are more likely to occur in summer months when temperatures are higher and precipitation is less frequent. To highlight the probability of future occurrence for this hazard, FEMA's annualized frequency values were used. Annualized frequency is derived from either the number of recorded hazard occurrences each year over a given period or the modeled probability of a hazard occurrence each year. The table below shows FEMA's NRI annualized frequency values for drought within the planning area.

Annualized Frequency Values

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Drought	9 events per year	448	2000-2021 (22 years)

Future Conditions

Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to the hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development. As the County and City continue to attract new residents to the District's service area, future population changes could see an increase in water demands.
- **Projected changes in population**- as population increases within the planning area, there will be an increased demand for water resources and supplies, which can be exacerbated during a drought, leading to water restrictions and water shortages. Increased vulnerability to this hazard from population growth is addressed by the District via its DCP and WCP. These plans are updated every 5 years, with the latest updates occurring on April 19, 2024
    - The overall objective of the DCP is to conserve the available water supply and protect the integrity of water supply facilities.
    - The WCP sets uniform requirements, guidelines, and recommendations to minimize water use through the implementation of efficient water use practices.
    - **Future weather conditions**- According to the Office of the Texas State Climatologist, it is impossible to make a quantitative statewide projection of drought trends. However, most factors (rising surface and ocean temperatures and an increasing number of extreme heat days) point to an increase in drought severity. [136]

Future Weather Conditions Impacts Summary, Drought

Location	The location of drought is not expected to change.
Extent	The extent and intensity of drought may change (increase) due to rising surface temperatures, increasing number of 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.
Duration	The duration of drought events is not likely to change; however, the intensity of droughts is expected to increase.

The District considers the overall vulnerability to this hazard as **medium,** with a high likelihood of occurrence but having limited or negligible impacts on the District and its assets.

4.2.9 Geologic Hazards (Expansive Soils, Erosion, Land Subsidence)

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 upheaved 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.[137]

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.[138] 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 the table below.

Types of Erosion

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 the affected soil. 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.

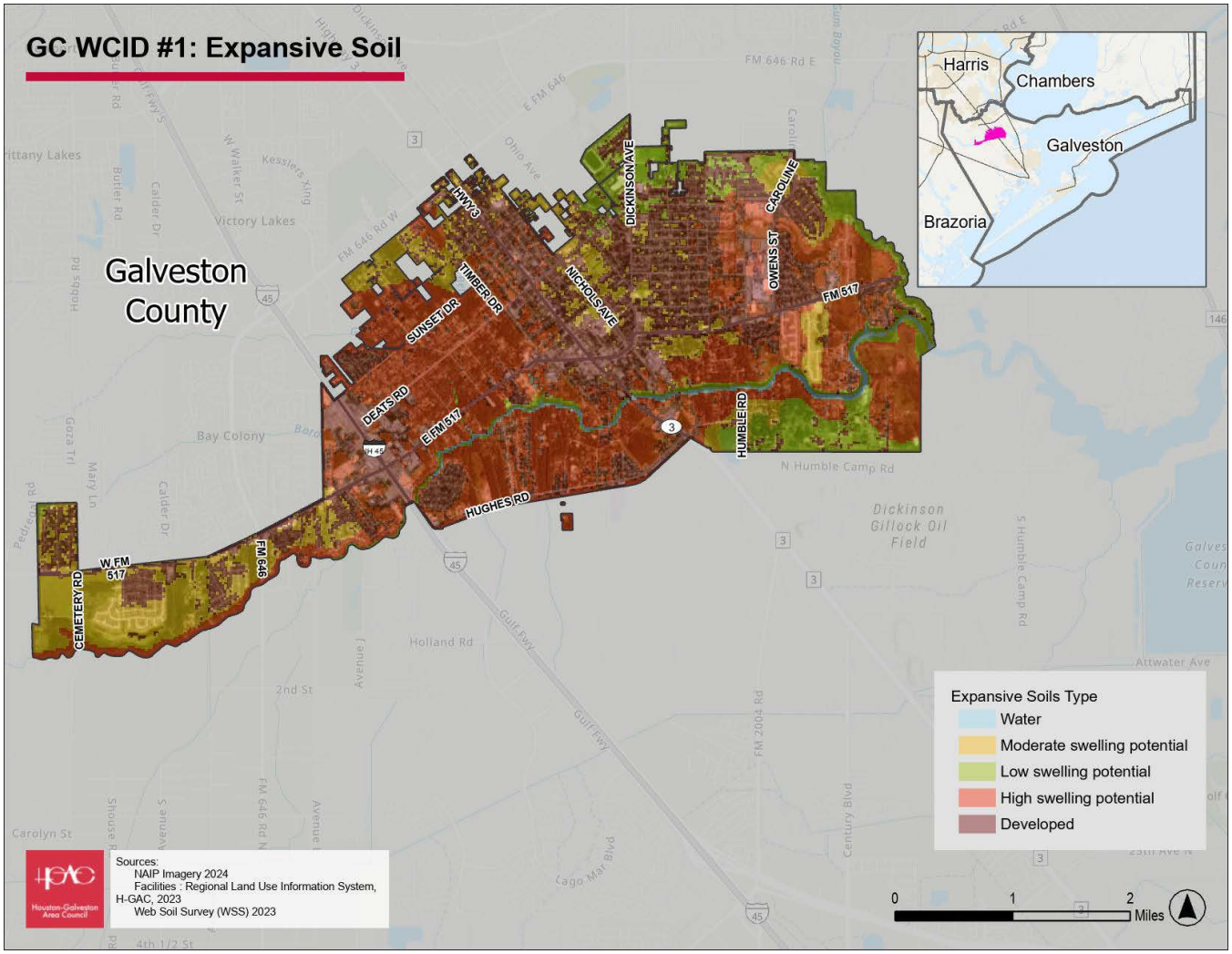
Land subsidence is the sinking of the Earth's surface due to subsurface movement. For the greater Houston-Galveston region, land subsidence is the decrease in land-surface elevation caused by aquifer compaction due to abundant, long-term groundwater withdrawals. [139]

Location

The figures below show the locations of the identified geologic hazards that pose a risk to the planning area.

Expansive soil locations shown in the figure below are categorized based on their shrink-swell potentials, determined by the Linear Extensibility Percent (LEP) and the Coefficient of Linear Extent (COLE) measurements of the soil. Areas with moderate to high shrink-swell ratings are at a greater risk for damage to critical infrastructure, foundations, and transportation structures, as these soils are more likely to contract and expand with changes in moisture. Most undeveloped land within the planning area falls into the moderate or high shrink-swell category, indicating a greater potential for soil movement and related structural impacts.

Expansive Soil Locations within the Planning Area

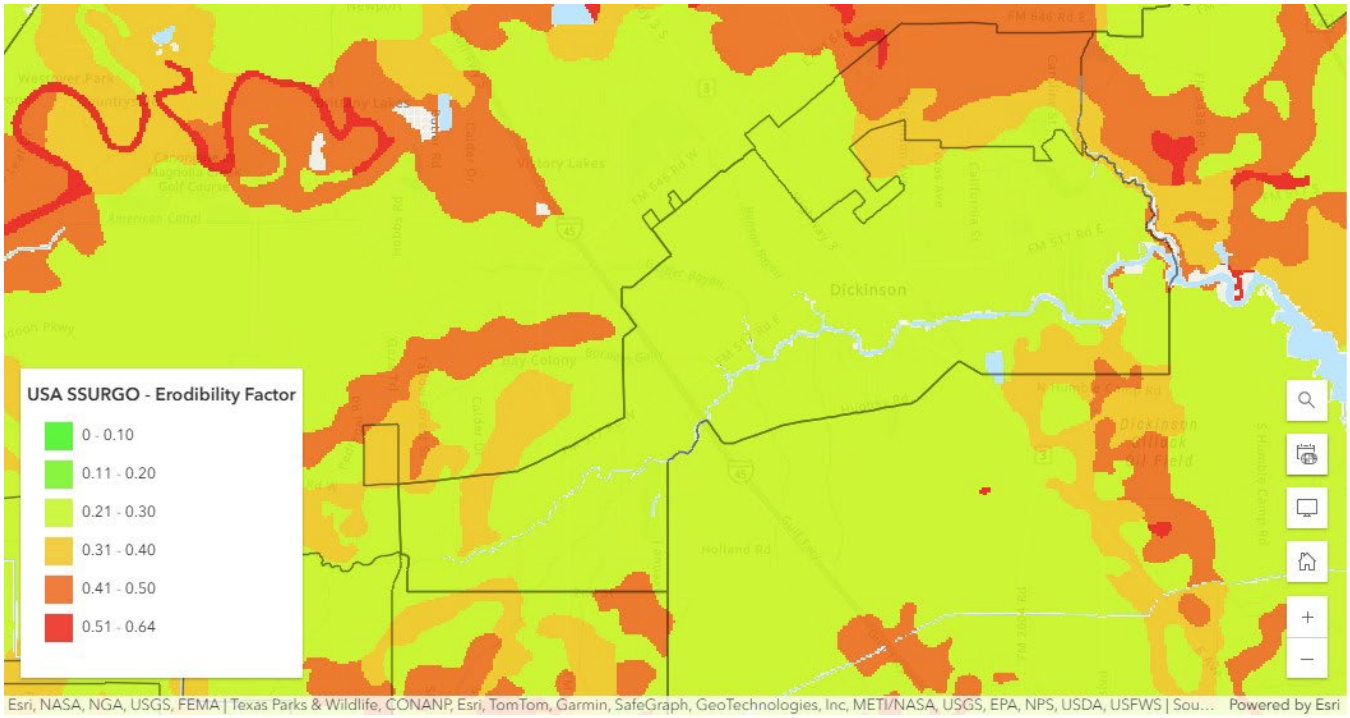


Soil **erosion** is typically measured in a variety of ways, both qualitative and quantitative. Within the planning area, inland erosion due to water is a concern. One method used to measure this erosion is the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE). 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.[140] Past management or misuse of soil by intensive cropping can increase a soil's erodibility. [141] The table below shows K factor scores, soil descriptions, and their associated soil erodibility. The following figure depicts these k-factors within the planning area. 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. A majority of the District's service boundaries sit in areas that are moderately susceptible to erosion.

K Factor, Soil Erodibility Scores

K-Factor	Soil Description	Erodibility
0.05 to 0.15	High in clay	Resistant to detachment
0.05 to 0.20	Coarse-textured soils, such as sandy soils	Low runoff, easily detached
0.25 to 0.40	Medium textured soils, such as the silt loam soils	Moderately susceptible to detachment and they produce moderate runoff
>0.40	Soils with a high silt content	Most erodible of all soils, easily detached; tend to crust and produce high rates of runoff

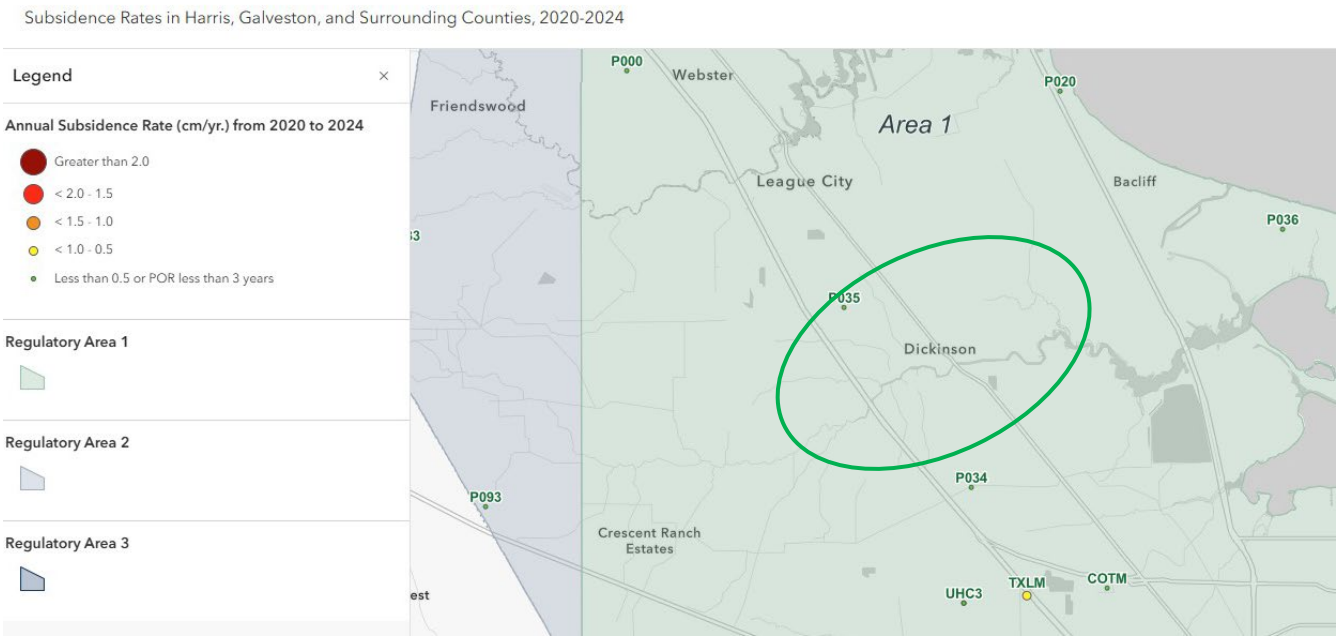
Soil Erodibility (K Factor) Scores within the Planning Area



Subsidence rates within the planning area are measured by the Harris-Galveston Subsidence District (HGSD), which protects lives and property within its regulatory boundaries from the impacts of future subsidence by providing reasonable groundwater regulation based on the best available science. [142] HGSD has divided various areas of the region into Regulatory Areas 1, 2, and 3, in which they track annual subsidence rates. The District resides entirely within Regulatory Area 1. HGSD measures the rate of subsidence using GPS stations (among other methods), with station P035 being directly North of the planning area. The HGSD compiles the processed data provided by the University of Houston into an interactive map for all GPS stations in the subsidence monitoring network.

The rate of subsidence for monitoring station P035 is listed as less than 0.5cm (0.2 in) per year. The station has been in operation for almost 14 years and has recorded a total vertical displacement of 3.92 cm (1.5 in) during this timeframe.

Subsidence Monitoring Station within the Planning Area



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. The rate of erosion due to sheet and rill within the planning area ranges from 0-0.5 tons per acre per year. [143]

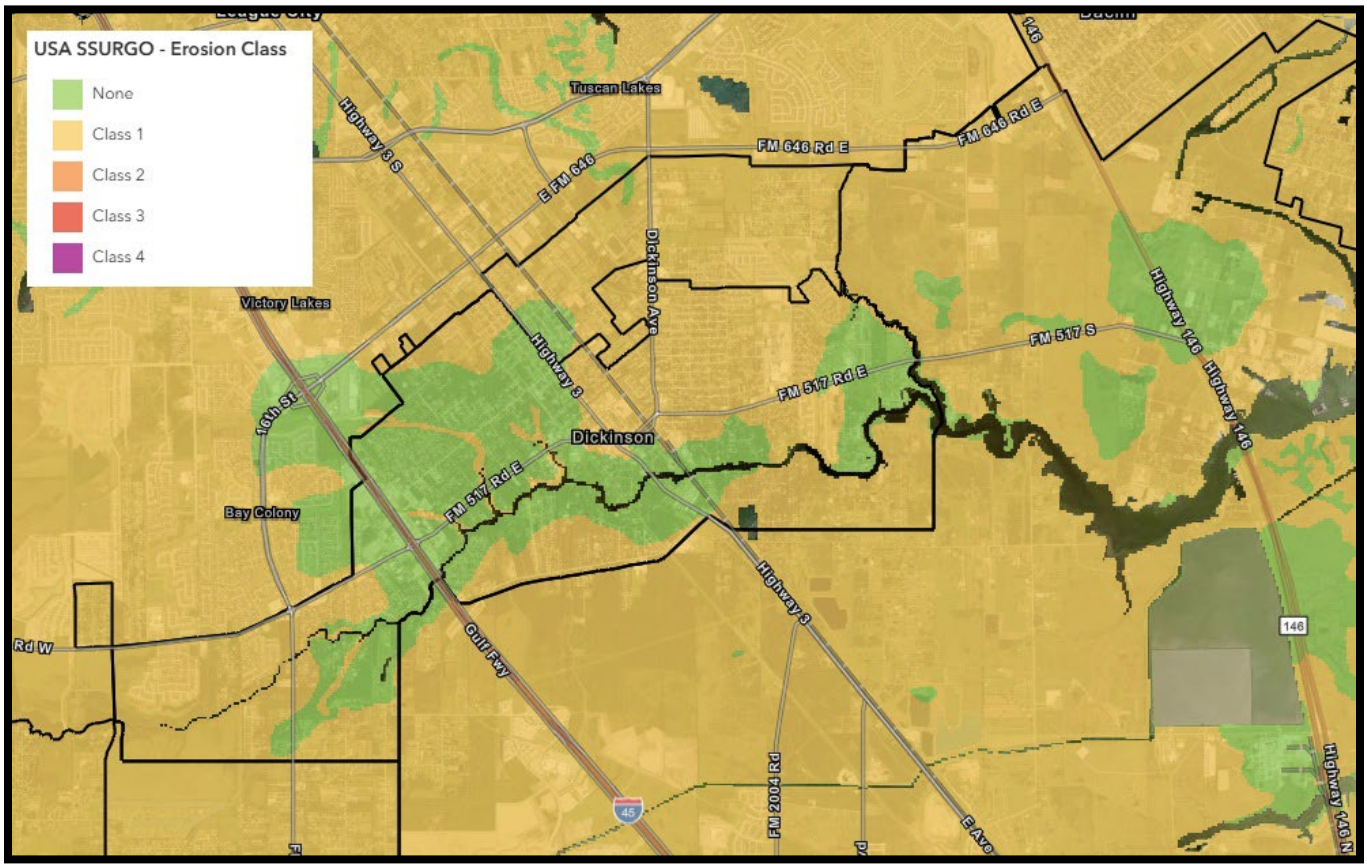
The map image below displays the proportion of topsoil lost to erosion. It is derived from the USDA NRCS SSURGO dataset, updated by Esri annually. The data shown classifies the amount of soil loss (the degree of erosion since the first time the soil was farmed) in the topsoil layers.

These 5 classes are:

- **None:** Area of soil deposition.
- **Class 1:** In this map unit,1 to 25 percent of the original topsoil has been lost to erosion.
- **Class 2:** In this map unit, 25 to 75 percent of the original topsoil has been lost to erosion.
- **Class 3:** In this map unit, 75 to 99 percent of the original topsoil has been lost to erosion.
- **Class 4:** In this map unit, all of the original topsoil has been lost to erosion.

Erosion classes within the planning area are mainly Class 1, or areas where soil has been deposited within areas that have been developed. This hazard can pose a higher risk to areas along Dickinson Bayou, creeks, and other hydrologic features whose banks can be more easily eroded during times of heavy rain or flooding.

Erosion Class



Expansive soils, and its risk of occurring can be measured by utilizing the soil LEP and COLE ratings, as mentioned above, to classify areas where expansive soils have low, moderate, high, and very high risk of occurring. The chart below shows the LEP and COLE measurements for the various Shrink-Swell Classes of **expansive soils**. COLE is a test frequently used to characterize expansive soils; it 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 a higher potential to contract and expand, leading to damage to critical infrastructure, foundations, and transportation structures. The District is located in areas with moderate and high shrink-swell potentials.

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

A worst-case scenario for these geologic hazards would be a heavy rainfall event that creates flooding conditions within the surrounding creeks, Dickinson Bayou, and other connected hydrologic features, causing stream bank erosion or sloughing from flooding, soils shifting, and causing foundation damage and infrastructure damage to underground pipes. Expansive soil risks are exacerbated during extreme heat, extreme weather, and during a drought, when temperatures are high and rainfall is scarce.

Historic Occurrences

Historic occurrences of erosion and related damages are not currently tracked or documented in any dataset from local, state, or national levels. 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 planning area. This has been noted as a data deficiency for this hazard within the Mitigation Strategy for this HMP.

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 planning area.

Historic occurrences of land subsidence are tracked and actively monitored through HGSD. As stated above, HGSD measures the rate of subsidence using GPS stations, with station P035 being directly North of the planning area. The HGSD compiles the processed data provided by the University of Houston into an interactive map for all GPS stations in the subsidence monitoring network. The rate of subsidence for monitoring station P035 is listed as less than 0.5cm (0.2 in) per year. The station has been in operation for almost 14 years and has recorded a total vertical displacement of 3.92 cm (1.5 in) during this timeframe.

Presidential Disaster Declarations

There have been no federally declared geologically related disaster declarations within the planning area or Galveston County. [5,6]

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk for these geologic hazards include:

- **Homeowners and commercial property owners**- Geologic hazards occur slowly over time and are often difficult to track. When impacts to these hazards are discovered, it often results in expensive repairs. Homeowners and businesses can be impacted by broken pipes, cracked foundations, and other costly structural repairs caused by these hazards.

Critical Facilities

Geologic hazards can have a direct impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

Economic impacts to the District from geologic hazards can include direct damage to infrastructure and properties, and disruptions to essential services like water and sanitation. Expansive soils, erosion, and subsidence can cause water line breaks and foundation issues that can be costly to repair.

National Risk Index

The NRI does not account for the specific geologic hazards of erosion, expansive soils, or land subsidence, and this hazard profile does not include a risk index score, EAL, HLR, or annualized frequency values as seen in other hazard profiles.

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 occurrences of this hazard due to a lack of data regarding previous erosion events through any formal system. Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. The following factors were used to examine potential conditions that may affect hazard vulnerability:

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard in regard to population changes.
- **Future weather conditions**- Impacts felt from geologic hazards due to longer periods of extreme heat and drier conditions can lead to an increase in wind erosion and wildfire events. Loss of vegetation and ground cover makes surfaces more prone to erosion by both wind and water. Additionally, more intense rainfall events following times of extreme heat or drought can cause soils to quickly expand as they rehydrate.

Future Weather Conditions Impacts Summary, Geologic Hazards (Expansive Soils, Erosion, Land Subsidence)

Location	The location of expansive soils, erosion, and land subsidence is not expected to change.
Extent	The extent and intensity of expansive soils, erosion, and land subsidence are not expected to change.
Frequency	The frequency of expansive soils may increase due to fluctuations in surface temperatures and severe weather intensity. The frequency of erosion has been steadily decreasing over time. The frequency of land subsidence within the planning area is expected to remain the same.
Duration	There are no clear trends for the duration of expansive soils, erosion, and land subsidence events.

The District considers the overall vulnerability to these hazards as **medium**, with a moderate likelihood of occurrence but having limited to negligible impacts on the District and its assets. Potential impacts to the District are either already fully mitigated against this hazard or addressed in the mitigation strategy for this HMP.

4.2.10 Pandemic

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." [144] An outbreak is a sudden rise in the presence of a disease or EID. An outbreak that can't be stopped or slowed, and in which the disease is spreading rapidly to many people within a localized community or region is called an epidemic.

The word pandemic refers to an epidemic that has gone international, typically infecting a large number of people in a short amount of time. [145] Pandemics are most often caused by viruses which can easily spread from person to person. [146] This hazard profile will use the 2019 coronavirus (SARS-CoV-2) pandemic to give a clearer picture of the risk and vulnerability of this hazard for the District as it is the most recent occurrence of this hazard.

Location

The risk of a pandemic occurring 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 that can create an outbreak, an epidemic, and lead to a pandemic.

Extent

The extent, or severity, of an infected population depends on how the illness is spread, 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 the spread of infection. A pandemic often has significant economic and social ramifications due to its global impact.

Historic Occurrences

According to the CDC, five pandemics have occurred in the U.S. since 1918. The table below outlines these pandemics, when they occurred, and their underlying cause. [147]

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

Pandemic Name	Estimated Deaths (US only)	Cause
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 pandemic-related disaster declarations in Galveston County listed under biological incidents. [5,6]

Federal Disaster Declarations for EID

Date	Disaster #	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

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Diseases can vary in severity for different populations based on age, underlying conditions, and how the disease is spread. The last five pandemics 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. [148]

Critical Facilities

This hazard has no direct impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

A pandemic often has significant economic and social ramifications due to its global impact. There are no projected economic impacts to the district from this hazard.

Probability of Future Occurrences

An EID that leads to a pandemic can emerge anywhere; it is difficult to predict when or where the next pandemic will occur. Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. The following factors were used to examine potential conditions that may affect hazard vulnerability:

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard in regard to changes in population.
- **Future weather conditions**- According to the CDC, milder winters, warmer summers, and fewer days of frost make it easier for infectious diseases to expand into new geographic areas and infect more people. As weather conditions continue to evolve, new infections may emerge that threaten human health or livelihood. [149]

Future Weather Conditions Impacts Summary, Pandemic

Location	The location of pandemics is not expected to change. However, there is an expected increase in EID occurrence within urban areas.
Extent	The extent of future EID and pandemics is expected to increase.
Frequency	The frequency of EID is expected to increase, while the frequency of pandemics is not expected to change.
Duration	There is no clear trend in the duration of pandemics or EID.

The District considers the overall vulnerability to this hazard as **low**, with the probability of occurrence being low and having limited to negligible impacts on the District and its assets.

4.2.11 Fire

Fire (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.[150] These fires 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 recurring natural hazard in every Texas county and has no set 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.[151] 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 (WUI), 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 ratings) areas that are most prone to wildfires.[152] Particularly vulnerable are the 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.

The table and figure below were derived from a Texas Wildfire Risk Assessment Summary Report created for the District using a .5 mile buffer around existing boundaries. The data below depicts the Functional Wildland Urban Interface (WUI). Functional WUI represents a classification of the land near buildings into zones that describe the wildfire risk mitigation activities appropriate for each zone.

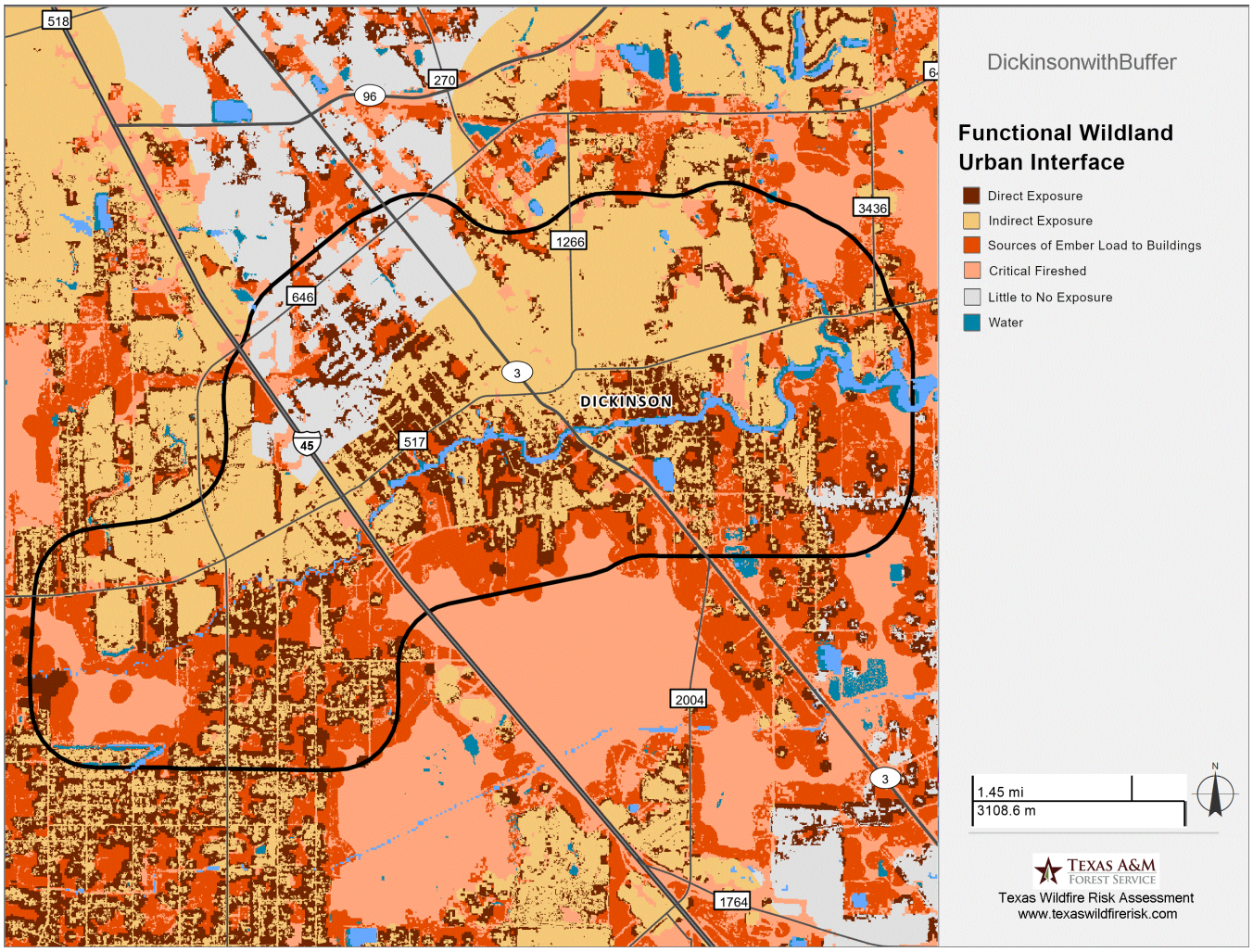
These zones are:

- **Direct Exposure**—The Direct Exposure zone is burnable land cover within 75 m of a structure. Reducing fire intensity and ember production in this zone would reduce the exposure of nearby buildings to heat and embers. **Buildings in this zone also require hardening of the structure to resist ignition.**
- **Indirect Exposure**—The Indirect Exposure zone is nonburnable land cover within 1500 m of burnable land cover that is within 75 m of a structure, meaning that embers and home-to-home spread could reach within this zone. **Indirectly exposed structures would benefit from the hardening of the structure to resist ignition from embers and nearby structures**, but defensible space is usually not required due to the heavily developed nature of the zone.
- **Critical Fireshed**—The Critical Fireshed is the unpopulated land within about 2.4 km of a group of structures. Fires that originate within or spread to the Critical Fireshed have an immediate threat of reaching the nearby structures; **fuel treatments that slow fire spread in this zone can reduce risk to these structures.**
- **Sources of Ember Load to Buildings**—These are areas of burnable land cover that produces embers capable of reaching nearby buildings. Ember production is a function of fire type and intensity, and ember travel is a function of wind speed and direction. **Fuel treatment in this zone is a priority for reducing ember load to the nearby buildings.**
- **Little-to-no Exposure**—The Little-to-no Exposure zone is nonburnable land that is within 75 m of a structure but greater than 1500 m from a large (500 ha) contiguous block of burnable land cover. Flames—even from home-to-home spread—and embers are unlikely to reach the Little-to-no-Exposure zone, but smoke and evacuations could still impact this area.

Functional WUI, Planning Area (including a .5-mile buffer)

	Functional WUI Category	Acres	Percent
	Direct Exposure	**2,403**	**19 %**
	Indirect Exposure	**4,658**	**37 %**
	Critical Fireshed	1,617	13 %
	Sources of Ember Load to Buildings	2,594	21 %
	Little to No Exposure	1,031	8 %
	Water	303	2 %
	Total	**12,605**	**100 %**

Functional WUI, Planning Area with Buffer



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.

Characteristic FIS Descriptions

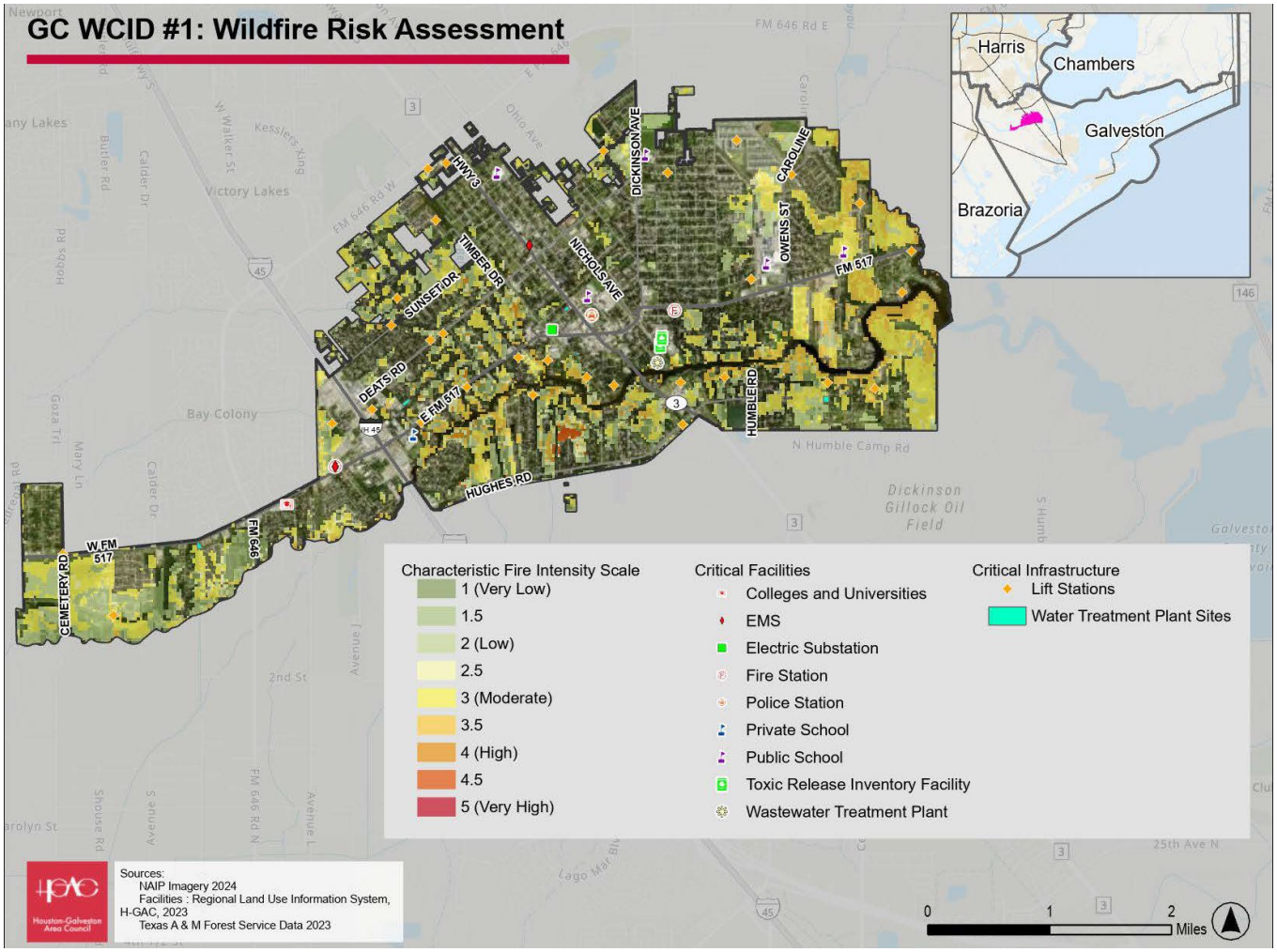
	Wildfire Intensity Class	**Description**
	1- Very Low	Very small, discontinuous flames, usually less than 1 foot in length; very low rate of spread; no spotting. Fires are typically easy to suppress by firefighters with basic training and non-specialized equipment.
	2- Low	Small flames, usually less 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 shows the class, acreage, and percent within each class within the planning area. The figures below show these wildfire intensity areas from TxWrap within the planning area in relation to critical facilities located within the planning area. To aid in interpretation, FIS is presented in 1/2 class increments. A majority of the land within the planning area falls within the low class, followed closely by non-burnable areas.

Fire Intensity Scale Acreage, Planning Area with Buffer

	Characteristic Fire Intensity Scale Category	Acres	Percent
	0	**6,906**	**55 %**
	1	531	4 %
	1.5	948	8 %
	2	**2,803**	**22 %**
	2.5	8	0 %
	3	127	1 %
	3.5	855	7 %
	4	414	3 %
	4.5	13	0 %
	5	0	0 %
	> 5	0	0 %
	Total	**12,605**	**100 %**

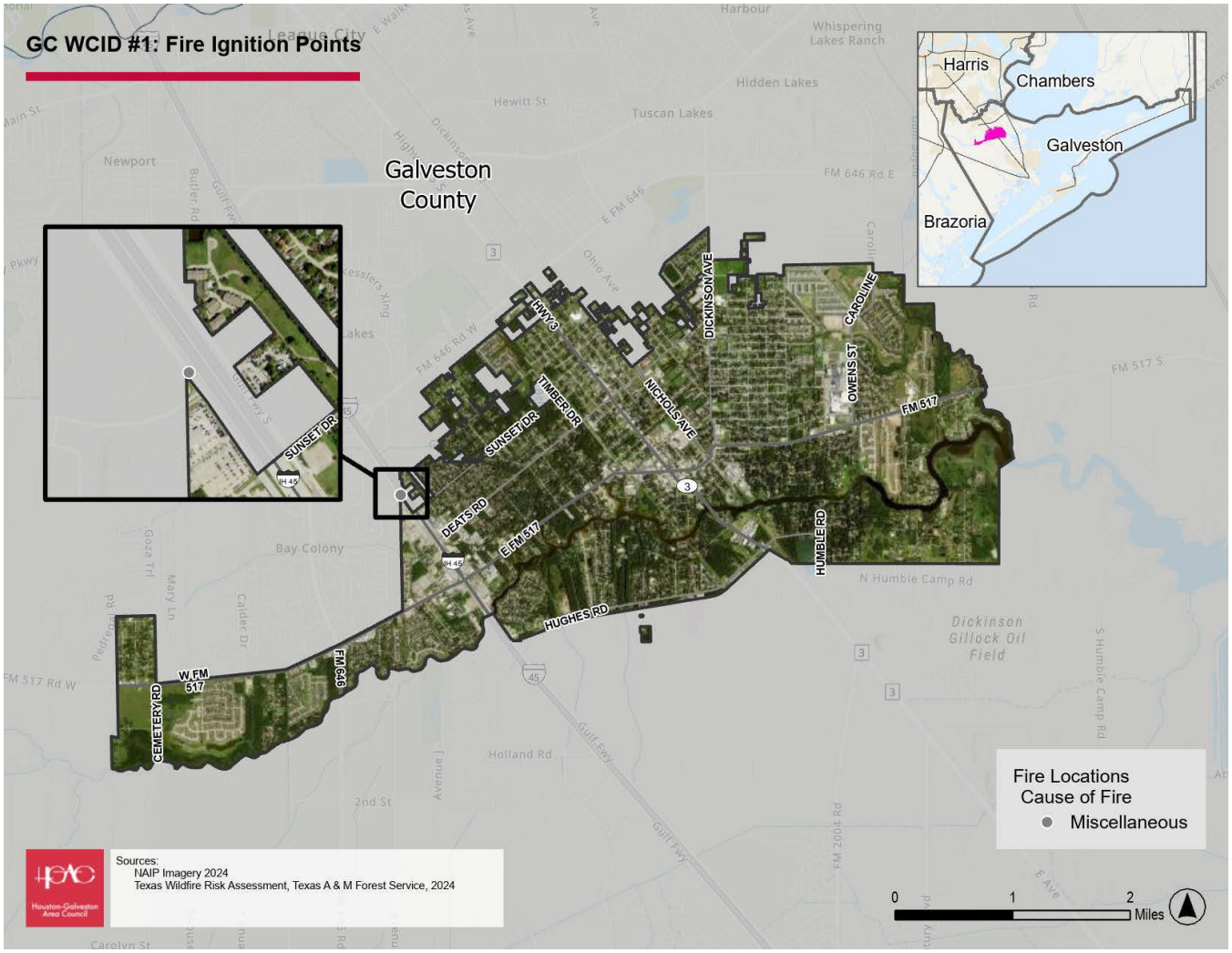
Wildfire Risk Assessment, Planning Area



Historic Occurrences

The Texas A&M Forest Service tracks wildfire events, acres destroyed, and the initial ignition cause of the fire. The figure below shows the historical data associated with ignitions that caused recorded damage from 2005-2021, symbolized by color to depict the cause of the fire. There is one fire ignition point located just outside the planning area.

Fire Ignition Points, Planning Area (2005-2021)



Presidential Disaster Declarations

There have been 3 federally declared fire-related disaster declarations in Galveston County. [5,6]

Federal Disaster Declarations, Fire

Date	Disaster #	Declaration Types	Incident Type	Declaration Title
9/1/1999	3142	Emergency Declaration	Fire	EXTREME FIRE HAZARDS
1/11/2006	1624	Major Disaster Declaration	Fire	EXTREME WILDFIRE THREAT
3/14/2008	3284	Emergency Declaration	Fire	WILDFIRES

Vulnerability Assessment

Vulnerability is the measurement of exposed structures, critical facilities, or populations (water customers) relative to the risk of the hazard identified. For most hazards, vulnerability is a best estimate. The vulnerability assessment is used to inform strategic decision-making by identifying the assets or portions of the planning area most vulnerable to natural hazards. These include:

- Populations at Risk
- Critical Facilities
- Economy

Populations at Risk

Populations at risk from this hazard include the entire planning area, as this hazard has no set geographic boundaries. According to the CDC, populations at greater risk from the impacts of this hazard include: [153]

- **Older populations**- older adults, in addition to potential lack of access to critical facilities and utilities, can also face social isolation during disasters. Older adults often have mobility challenges and may lack the physical capacity to evacuate quickly during a wildfire, making them particularly vulnerable to the dangers of fire and smoke.
- **Younger populations**- young children may be unable to recognize the dangers of wildfires, and their reliance on caregivers can put them at further risk if evacuation plans are not in place.
- **Populations experiencing homelessness**- For those who are homeless, adequate shelter is critical in keeping populations safe during these types of hazard events. Additionally, there has historically been a lack of access to emergency services or resources within this population.
- **Populations with disabilities**- Those with physical or cognitive disabilities may require additional assistance to stay safe and prepare for these hazards, like creating a support

network, being prepared before an event, and finding accessible transportation to evacuate or get medical attention. [154]

- **Populations with Chronic health conditions**- People with pre-existing medical conditions (like heart disease, diabetes, or respiratory issues) may experience exacerbated symptoms during a wildfire event.
- **Low-income communities** - Residents in low-income areas may lack access to emergency resources or transportation, making it difficult for them to evacuate.
- **Outdoor workers and Athletes**- Those who work and play outdoors (farmers, construction workers, athletes) can be directly exposed to decreased air quality from a wildfire event.

Critical Facilities

This hazard could have a direct impact on existing building stock, critical facilities, or critical infrastructure owned or operated by the District.

Economy

A fire could economically affect the District through increased water demand costs and potential damages sustained to infrastructure during a hazard event.

National Risk Index

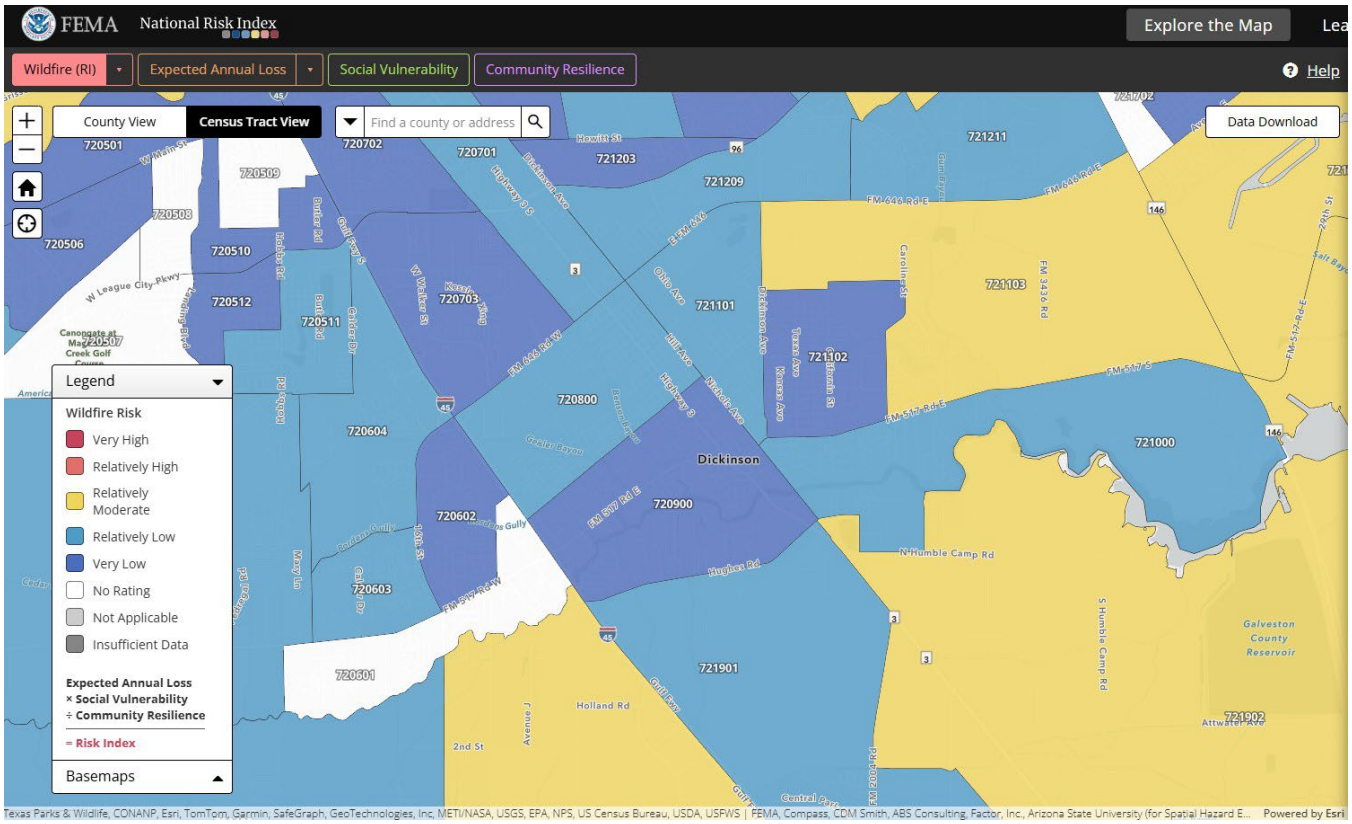
FEMA's NRI utilizes data from multiple sources, including historical hazard events, hazard intensity, exposure of people and property to hazards, socioeconomic factors, and community resilience indicators. The NRI also incorporates hazard data to determine the frequency and intensity of various natural hazards. This information helps assess the likelihood of specific hazards occurring in different regions. The results, a risk index score, range from five categories used to describe risk. These are "very low" to "very high", with variations for hazards or areas where there is insufficient data to support a risk index score, no rating, and includes visualizations where the hazard may not apply to the specified area. This helps to identify areas that may require additional resources and attention for mitigation and planning efforts.

The FEMA NRI accounts for fire as:

- **Wildfire-** an unplanned fire burning in natural or wildland areas such as forests, shrublands, grasslands, or prairies. [155]

Risk index scores for this hazard by census tract are shown in the figures below. Census tracts that include the jurisdictional boundaries of the District include 48167720900, 48167720800, 48167720601, 48167721000, 48167721101, 48167721102, and census tract 48167721103.

Risk Index by Census Tract, Fire (Wildfire)



Expected Annual Loss

The NRI EAL values, below, represent the average economic loss in dollars resulting from natural hazards each year (building, population, and agriculture losses) when compared to the rest of the U.S. EAL *exposure value* refers to the *representative value* for buildings, population, and agricultural assets *potentially* exposed to a hazard event.

Expected Annual Loss Exposure Values, Fire (Wildfire)

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	EAL Total
$56,746,974,030	$4,065,532,578,123 350,476.95	$10,592,645	$4,122,290,144,798

Expected Annual Loss Values, Fire(Wildfire)

Building Value	Population Equivalence ($) Population (#)	Agricultural Value	Total
$1,583,616	$106,965, 0.01	$132	$1,690,713

EAL for Galveston County due to fire is **relatively moderate**.

The FEMA NR HLR is a hazard- and county-specific estimate of the percentage of the exposed asset (building value, population, or agriculture value) expected to be lost due to a hazard occurrence. HLRs for this hazard within the county and planning area are **very low**.

Probability of Future Occurrences

FEMA's NRI lists annualized frequency values for hazards based on events on record and the period of record used for the NRI. The table below shows FEMA's NRI annualized frequency values for this hazard.

Annualized Frequency Values, Fire (Wildfire)*, Galveston County*

Hazard	Annualized Frequency Value	Events on Record	Period of Record
Fire	0.313% chance per year	n/a	2021 dataset

Future Conditions

Understanding what types of changes could impact the vulnerability to hazards helps to identify proper mitigation, planning, and preparedness actions the District can take. Changes in certain conditions occurring in hazard-prone areas may affect the vulnerability of the District to the hazard. This can include changes in priorities, development, population, and weather. Since this is the first iteration of a LHMP for the District, changes in priorities will be excluded, but will be referenced in future updates.

- **Future development**- The District has no current plans for future development.
- **Projected changes in population**- Increased vulnerability to this hazard from population growth is addressed by the City and County. The District has limited authority to mitigate this hazard.
- **Future weather conditions**- 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 drier conditions.[156] 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.

Future Weather Conditions Impact Summary, Fire

Location	The location of fires is not expected to change. Areas within or near the WUI are at the greatest risk.
Extent	The extent and intensity of fires within the planning area may change (increase) due to rising surface temperatures, heat events, and increases in drought severity.
Frequency	The frequency of fires may increase as conditions that can lead to a fire (rising surface temperatures, heat events, and increases in drought severity) are also expected to increase.
Duration	There is no clear trend regarding the duration of fire events.

The District considers the overall vulnerability to this hazard as **low**, with a low likelihood of occurrence and having limited to negligible impacts on the District and its assets. Potential impacts to the District are either already fully mitigated against this hazard or addressed in the mitigation strategy for this HMP.

Section 5: Mitigation Strategy

C4. (Requirement 44 CFR § 201.6(c)(3)(ii))
C5. (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

The mitigation strategy explains the projects (actions), programs, and policies that the District intends to implement to reach its HMP goals and objectives (identified in Section 1). The mitigation strategy provides the details of each mitigation action, including which department will oversee implementation (responsible entities), funding resources, cost estimate, priority rating, and an estimation of qualitative losses avoided and timeframe.

The PT, with review from the HMSC, identified 6 mitigation action items for this HMP. These actions were prioritized by the District's vulnerability to hazards identified, feasibility and need, long-term vision, and HMP goals. Actions identified below were given a priority rating of **1**- high, **2**- medium, or **3**- low.

Action item #	Name	Priority Rating	Status
1	WWTP Alternatives, Flood Mitigation Study	High	Not started
2	Improved Redundancy	High	Not started
3	Elevate Primary Potable Water Supply Facilities	High	Not started
4	Floodwall for Primary Potable Water Supply Facilities	High	Not started
5	Public Education and Awareness	Medium	Not started
6	Program Participation	Medium	Not started
7	Data Improvements	Low	Not started

1. WWTP Alternatives, Flood Mitigation Study

The District's Wastewater Treatment Plant is located along Dickinson Bayou and treats 1.8 MGD of sewage a day (with the capacity to treat up to 4.8 MGD). The District also operates and maintains 34 sewer lift stations and 100 miles of sanitary sewer lines.

The WWTP's location, as well as multiple lift stations within the Dickinson Bayou Watershed, are located within SFHAs, creating vulnerable conditions during hurricanes or other large-scale events that can result in flooding. When floodwaters rise at pump locations, the elements needed to ensure the ongoing operation of wastewater treatment systems become at risk for sustaining damage (a result that threatens to compromise the entire wastewater treatment system). If the pump at the WWTP were to fail, a potential breach could infiltrate Dickinson Bayou, traveling downstream and entering Galveston Bay. This is particularly problematic for the WWTP, the Dickinson community, and to the downstream natural resources and essential habitat within Dickinson Bayou and Galveston Bay.

Jurisdiction:	Dickinson WCID	**Action:**	# 1
Priority Rating:	1- High	**Status:**	Not Started
Cost Estimate:	$75,000,000	**Timeframe:**	5 years
Hazard(s) Addressed:	Hurricane & Storm Surge Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)		
Project Title:	Flood Mitigation Study & WWTP Alternatives		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Discharging untreated wastewater into Dickinson Bayou, structural damage from major flooding events		
Partners:	None		
Potential Funding Sources	General Obligation Bonds, HMGP, TWDB		
Benefit-Cost Analysis	Qualitative Benefits: protection of aquatic and marine life of Dickinson Bayou; adverse quality of life caused by polluted waterway; elimination of recreational activity on Dickinson Bayou.		
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	

2. Evaluate the need for improved redundancy at district facilities

Redundancy in wastewater design is a safeguard to ensure that treatment plants can provide consistent, reliable, and effective operation not only when the system is working correctly, but also in the event of unpredictable circumstances such as equipment failure, higher-than-anticipated flows or loading, or natural disasters. Typical redundancy requirements ensure that wastewater systems can continue to process peak flows with the largest unit out of service and that the system can store influent peak flows to prevent spilling or discharging untreated effluent.

This action aims to address the hardening of critical facilities and infrastructure owned and maintained by the District through purchasing equipment and installing alternative energy sources for all District facilities. This includes but is not limited to the District's WWTP, lift stations, and water pumping plants.

Alternative energy sources, or backup power, allow the District to operate as normal and provide continuous utility service to all structures.

Jurisdiction:	Dickinson WCID	**Action:**	# 2
Priority Rating:	1- High	**Status:**	Not Started
Cost Estimate:	$65,000,000	**Timeframe:**	1-5 years
Hazard(s) Addressed:	Cyber Threats Winter Weather (Ice Storm, Heavy Snow, Blizzard) Hurricane & Storm Surge Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado) Extreme Heat Fire		
Project Title:	Improved Redundancy		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Discharging untreated wastewater into Dickinson Bayou; structural damage from major flooding events		
Partners:	None		
Potential Funding Sources:	General Obligation Bonds, HMGP, TWDB,		
Benefit-Cost Analysis:	Qualitative Benefits: protection of aquatic and marine life of Dickinson Bayou; adverse quality of life caused by polluted waterway; elimination of recreational activity on Dickinson Bayou.		
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	

3. Elevate Primary Potable Water Supply Facilities

The District currently has essential infrastructure, specifically a pump house, located within a SFHA. To address potential flooding and related hazards, the District is examining various mitigation options (Action items #3 and #4). This includes considering the elevation of the primary water supply pumping station to alternative locations adjacent to Dickinson Bayou that are outside of any SFHAs.

Elevation involves raising a building to reduce its risk of flooding while keeping the building at or near its existing location. Elevation is easiest with smaller or lighter buildings; larger buildings generally are more difficult to raise. Buildings that cannot be relocated may be candidates for elevation.[157]

Jurisdiction:	Dickinson WCID	**Action:**	# 3
Priority Rating:	1- High	**Status:**	Not Started
Cost Estimate:	$7,000,000	**Timeframe:**	5 years
Hazard(s) Addressed:	Hurricane & Storm Surge Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)		
Project Title:	Elevate Primary Potable Water Supply Facilities		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Potable water for public use, water for firefighting		
Partners:	None		
Potential Funding Sources:	General Obligation Bonds, HMGP, TWDB		
Benefit-Cost Analysis:	Qualitative Benefits: Continuity of service for potable water		
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	

4. Floodwall for Primary Potable Water Supply Facilities

The District currently has essential infrastructure, specifically a pump house, located within a SFHA. To address potential flooding and related hazards, the District is examining various mitigation options (Action items #3 and #4). This includes considering the construction of dry floodproofing methods, such as a floodwall, to protect the primary water supply pumping station.

A dry-floodproofed building is watertight below the design flood elevation as required by ASCE 24 and state or local codes and standards. This mitigation method is designed to prevent floodwater entry and is best applied to small public buildings or sections of large public buildings with slab-on-grade foundations and reinforced masonry or concrete walls.

Jurisdiction:	Dickinson WCID	**Action:**	#4
Priority Rating:	1- High	**Status:**	Not Started
Cost Estimate:	$7,000,000	**Timeframe:**	5 years
Hazard(s) Addressed:	Hurricane & Storm Surge Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado)		
Project Title:	Floodwall for Primary Potable Water Supply Facilities		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Potable water for public use, water for firefighting		
Partners:	None		
Potential Funding Sources:	General Obligation Bonds, HMGP, TWDB		
Benefit-Cost Analysis:	Qualitative Benefits: Continuity of service for potable water		
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	

Dry floodproofing can be a good option for all or part of public buildings subject to shallow flooding if building relocation or elevation is not technically feasible or cost-effective.[158]

5. Public Education and Awareness

The District shall display hazard preparedness literature and brochures at its main office and on the District's website. Upon new service connections, new customers shall receive a water conservation package.

Jurisdiction:	Dickinson WCID	**Action:**	# 5
Priority Rating:	2- Medium	**Status:**	Not Started
Cost Estimate:	$500,000	**Timeframe:**	6-12 months
Hazard(s) Addressed:	Cyber Threats Winter Weather (Ice Storm, Heavy Snow, Blizzard) Hurricane & Storm Surge HazMat / Toxic Release Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado) Extreme Heat Drought Geologic (Expansive Soils, Erosion, Land Subsidence) Pandemic Fire		
Project Title:	Public Education & Awareness		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Preservation of property, decreased financial losses due to natural hazards, and mitigating the loss of human life and injuries		
Partners:	Dickinson ISD, City of Dickinson, Galveston County Office of Emergency Management		
Potential Funding Sources:	General funds, HMGP		
Benefit-Cost Analysis:	Qualitative Benefits: Increased awareness of all hazards that affect the planning area to avoid potential loss of life and/or property damage from hazards.		
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	

Contents to include water conservation tips and description of retrofitted water-conserving devices for house plumbing. In addition, the District shall provide public education programs using one or more of the following methods:

1. Annual direct mailings or information provided via the back of customers' water bills, such as brochures or newsletters concerning the HMP and any subsequent updates, hazards, and preparedness actions customers can take.
2. Participate in and provide HMP-related updates to public and civic organization meetings;
3. Develop content (flyers/infographics) to assist with public education/awareness of hazards, and how customers can prepare for hazards.

4. Partner with local schools (informational content can be provided to local schools through materials sent home with students (backpack stuffing), art contests, coloring books, etc.) and churches (handouts can be provided before or after service) to provide relevant hazard information at appropriate times of the year.
    a. Before hurricane season (hurricanes, storm surge, severe weather hazards)
    b. Summer (drought, heat, geologic hazards, water conservation info)
    c. Winter (winter weather hazard)
5. Website updates and regular site maintenance for hazard-related information

6. Participate in programs that promote hazard mitigation strategies

Actively engage in initiatives, workshops, or community projects designed to reduce the risks associated with natural disasters by taking preventative measures like infrastructure improvements, public education campaigns, and community preparedness planning.

Jurisdiction:	Dickinson WCID	**Action:**	#6
Priority Rating:	2-Medium	**Status:**	Not Started
Cost Estimate:	$500,000	**Timeframe:**	6-12 months
Hazard(s) Addressed:	Cyber Threats Winter Weather (Ice Storm, Heavy Snow, Blizzard) Hurricane & Storm Surge HazMat / Toxic Release Flooding Severe Weather (Thunderstorm, Hailstorm, Lightning, Windstorm, Tornado) Extreme Heat Drought Geologic (Expansive Soils, Erosion, Land Subsidence) Pandemic Fire		
Project Title:	Program Participation		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Loss of life and property damage.		
Partners:	Texas A&M AgriLife Extension Service, Dickinson ISD, City of Dickinson, Galveston County Office of Emergency Management		
Potential Funding Sources:	General Revenues, HMGP		
Benefit-Cost Analysis:			
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	

7. Data Improvements

Accurate and comprehensive data are essential for effective hazard mitigation planning. Data improvements, such as obtaining the best available hazard data and using GIS to map geologic risks, enables the District to better identify the extent, vulnerability, historic occurrences, and potential impacts on the District.

Jurisdiction:	Dickinson WCID	**Action:**	# 7
Priority Rating:	3- Low	**Status:**	Not Started
Cost Estimate:	$120,000	**Timeframe:**	12-36 months
Hazard(s) Addressed:	Geologic (Expansive Soils, Erosion)		
Project Title:	Data Improvements		
Responsible Entity:	Dickinson WCID, General Manager or designated appointee		
Losses avoided:	Preservation of property, decreased financial losses due to natural hazards, and mitigating the loss of human life and injuries.		
Partners:	None		
Potential Funding Sources:	HMGP, USACE, USGS FIM, TWDB, TCEQ, General Funds		
Benefit-Cost Analysis:	Qualitative Benefits: Increased awareness of all hazards that affect the planning area to avoid potential loss of life and/or property damage from hazards.		
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?		yes	
Does mitigation action identify, analyze, and prioritize actions related to continued compliance with NFIP?		no	

Section 6: Plan Maintenance and Implementation

D2. (Requirement 44 CFR § 201.6(c)(4)(i))

To remain an effective tool, this HMP will undergo continuous review and updates. This practice is known as plan maintenance and requires monitoring, evaluating, updating, and implementing the entirety of the written plan and planning process. To accomplish this, a PMT has been determined and comprises representatives from the District and the HMSC, or their designated appointee.

The PMT Leader shall be the WCID #1 General Manager or their designated appointee.

Plan Maintenance Role	Organization	Title
PMT Leader	WCID	General Manager
PMT Member	WCID	Operations Supervisor
PMT Member	City of Dickinson Volunteer Fire Department	Fire Chief
PMT Member	Galveston County Office of Emergency Management	Emergency Management Coordinator
PMT Member	Galveston County Sheriff's Office	District Supervisor
PMT Member	City of Dickinson	Emergency Management Coordinator
PMT Member	GCWA	General Manager
PMT Member	H-GAC	Community & Environmental Department

Public Participation

D1. (Requirement 44 CFR § 201.6(c)(4)(iii))

Continued public involvement will remain a vital component of the HMP and any subsequent updates. The HMP will be accessible online via the District and H-GAC websites. Public comments regarding the plan can be submitted at any time to the listed contacts. The PMT Leader is responsible for documenting public feedback and presenting these comments for discussion at each annual plan maintenance meeting.

The PMT Leader will invite the public to the annual HMP maintenance meetings. The PMT Leader will notify the public of all annual meetings by posting meeting flyers and agendas online via the District website and social media. Additionally, the District will provide a printed copy of the meeting agenda at the City of Dickinson City Hall 14 days before the meeting.

The District will seek input from the public on the status of existing hazards, emerging vulnerabilities, and evaluate the HMP's mitigation strategy. During annual HMP maintenance meetings, 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 Leader, PMT, and public participants.

The District will provide a copy of this Plan to such regional water planning group within ninety (90) days following its adoption.

Procedures and Schedule

D2. (Requirement 44 CFR § 201.6(c)(4)(i))

The plan maintenance process includes a schedule for monitoring and evaluating the HMP annually and ensuring it is updated every five years. The task of the annual HMP team meeting will be the evaluation of the progress of the plan and projects identified as part of the mitigation strategy, reviewing the risk assessment and hazards, reviewing the mitigation strategy, and keeping key stakeholders and the public informed and involved.

This review will include:

- Review of the identified hazards and risk assessment scoring for updates.
- Summarization of any hazard events that occurred during the previous year, including their impact on the district and community.
- Review of mitigation actions identified in the plan, notating actions that were completed or are in progress, and identifying actions that need to be removed, with a justification provided for the removal.
- Review mitigation actions that were not completed to identify barriers (e.g., financial, technical, timeline, priorities, etc.)
- Recommendation for the addition of new mitigation actions, funding sources, costs, partners, or timeline updates.
- Updates to maps and data.
- Review of the planning process to ensure key members are involved and invited to participate in the HMSC and updates, including stakeholders and the public
- Review of the HMP goals and objectives to ensure they are relevant and current

On the recommendation of the PMT Leader or on its own initiative, the District Board may initiate a Plan review at any time. Should the District need to revise the HMP prior to the annual review, plan revisions should be considered, such as:

- After natural hazard events that appear to significantly change the apparent risk to District assets, operations, and/or citizens.
- When activities of the District, County, or the State significantly alter the potential effects of natural hazards on District assets, operations, and/or citizens (e.g., completed mitigation projects that reduce risk, or actions that increase risk).
- When new mitigation opportunities or sources of funding are identified.
- When current mitigation opportunities require revisions.

The HMSC will be reconvened for a comprehensive evaluation and revision of this HMP during its next update cycle in 2028, with adoption of that update in 2030.

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