VOLUME 1

REGION 5 NECHES 2023 REGIONAL FLOOD PLAN

JULY 2023

PREPARED FOR THE

REGION 5 NECHES FLOOD PLANNING GROUP

2023 REGIONAL FLOOD PLAN

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES (VOLUME 2)

LIST OF ACRONYMS AND DEFINITIONS

Acronym	Name	Definition
ASCE	American Society of Civil Engineers	Organization of professionals in civil engineering. ASCE releases state and national Report Cards for infrastructure examining current conditions and needs.
ACE	Annual Chance Exceedance	The estimated mean probability that a flood event will occur in any given year. For example, the 1% ACE has a 1 percent chance of occurring in any given year. A 1% ACE event is sometimes also referred to as a 100-year flood event while a 0.2% ACE event is sometimes referred to as a 500-year flood event.
ASDSO	Association of State Dam Safety Officials	National non-profit organization serving state dam safety programs and the broader dam safety community.
	Atlas-14	Recently developed record of precipitation frequency estimates for the United States that is produced by the National Weather Service and the National Oceanic and Atmospheric Administration.
ARPA	American Rescue Plan Act	Act signed in 2021 that provided a substantial amount of funding to eligible state, local, territorial, and tribal communities to support their response to and recovery from the COVID-19 pandemic.
BCA	Benefit-Cost Analysis	An analysis that is used to ascertain the future risk reduction benefits of a project and compares those benefits to the project's costs. Yields the benefit-cost ratio, a value that represents the project's benefits over the project's costs.
BFE	Base Flood Elevation	Regulatory term meaning the elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year.
BLE	Base Level Engineering	BLE is a high-level process using best available data and automated techniques to produce approximate, regulatory-quality flood hazard extents.

BCR	Benefit Cost Ratio	Numerical expression of the "cost-effectiveness" of a project, calculated by a project's total benefits divided by its total costs.
BRIC	Building Resilient Infrastructure and Communities	Federal funding program run by FEMA. This program supports communities as they undertake hazard mitigation projects to reduce risk from natural hazards.
CAP	Continuing Authorities Program	Group of nine legislative authorities under which USACE can plan, design, and implement certain types of water resources projects without specific congressional authorization. The program is intended to plan and implement projects of limited size, cost, scope, and complexity.
CDBG-MIT	Community Development Block Grant - Mitigation	Funding program that provides funds for grantees to use in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses.
CDBG-DR	Community Development Block Grant - Disaster Recovery	Funding program that provides funds for grantees to use in areas impacted by recent disasters to aid in recovery efforts; this assistance is not permanently authorized.
CDC	Centers for Disease Control and Prevention	Federal agency focused on protecting public health including emergency preparedness.
CDR	Community Development and Revitalization	Division of Texas GLO that is responsible for administering funding from CDBG-MIT and CDBG-DR following presidentially declared major disasters.
CFR	Code of Federal Regulations	Codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.
COG	Council of Government	Voluntary associations often comprised of various local governments with the intention of fostering coordination and cooperation between governments on issue of mutual concern that cross jurisdictional lines.
CRS	Community Rating System	FEMA program to provide incentives for those communities that have gone beyond the minimum

		floodplain management requirements to develop extra measures to provide protection from flooding.
CSRM	Sabine Pass to Galveston Bay Coastal Storm Risk Management Program	A comprehensive flood infrastructure project along the Texas coastline with three separate components near Freeport, near Port Arthur, and in Orange County. Region 5 includes part of the Orange County project and the entirety of the Port Arthur project.
CTP	Cooperating Technical Partners	Program intended to create partnerships between FEMA and NFIP-participating communities with the intent of incorporating in the future additional regional/state agencies, tribes, territories, and universities that can become more active participants int he FEMA flood hazard mapping program.
CWSRF	Clean Water State Revolving Fund	Federal-state partnership that provides communities low-cost financing for a wide range of water quality infrastructure projects.
-	Critical Facilities	A critical facility provides services and functions essential to a community, especially during and after a disaster. Typical critical facilities include hospitals, fire stations, police stations, storage of critical records, and similar facilities.
-	Dam Safety Program	The Dam Safety Program monitors and regulates both private and public dams in Texas. The program periodically inspects dams that pose a high or significant hazard.
DCM	Drainage Criteria Manual	A DCM establish the drainage design standards and methods for a community.
DD	Drainage Districts	Special purpose districts charged with maintaining existing drainage and flood control infrastructure to ensure they maintain their level of service.
DETCOG	Deep East Texas Council of Governments	Regional council of governments founded to facilitate planning, eliminate duplication, and promote economy and efficiency in the coordinated development of the region. Members include representatives from Angelina, Houston, Nacogdoches, Newton, Polk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, and Tyler Counties.

Dfund	Texas Water Development Fund	State loan program that provides financing for various types of infrastructure projects. This program enables the TWDB to fund projects with multiple purposes in one loan.
EAP	Emergency Action Plan	An EAP is a written document that identifies potential emergency conditions and specifies pre-planned actions to be followed to minimize property damage, potential loss of infrastructure, and potential loss of life.
EOC	Emergency Operation Centers	Centralized location of emergency response and recovery operations during and in the immediate aftermath of incidents.
EOP	Emergency Operations Plan	Plan used by entities to detail courses of action during disasters.
EPA	Environmental Protection Agency	Federal Agency that monitors environmental conditions including a number of topics related to water.
EWP	Emergency Watershed Protection	Federal emergency recovery program that offers technical and financial assistance to help local communities relieve imminent threats to life and property caused by floods and other natural disasters that could adversely impact a watershed.
FEMA	Federal Emergency Management Agency	Federal Agency responsible for emergency management activities before, during, and after disasters. FEMA manages several flood related grant programs and is responsible for the NFIP and maintains FIRM maps.
FAFDS	First American Flood Data Services or Fathom	Flood risk data generated by a large, state-wide model and is based entirely on the expected rainfall in a given area. It is considered the least-accurate of the floodplains available to the Regional Flood Planning Group.
FCD	Flood Control District	Special districts that have authority and provide control over rivers, streams, tributaries, and related structures within their jurisdictions to protect people and property from negative flood impact.
FDPO	Flood Damage Prevention Ordinance	Ordinance enacted by local government entities with the purpose of minimizing public and private losses due to flood conditions; often involve floodplain protection and

		increased enforcement of new construction so as to not exacerbate flood conditions.
-	Flood Exposure	For the purposes of flood planning, flood exposure analyses will identify who and what might be harmed by flood including each structure located in flood hazard area.
-	Flood Hazard	For the purposes of flood planning, flood hazard analyses will determine the location, extent, magnitude, and frequency of flooding.
FHBM	Flood Hazard Boundary Maps	Maps that depict areas of flood hazard; used by communities that participate in the NFIP.
FIF	Flood Infrastructure Fund	Financial assistance program in the form of loans and grants for flood control, flood mitigation, and drainage projects and is administered by the TWDB.
FIRM	Flood Insurance Rate Map	Official map of a community on which FEMA has delineated the Special Flood Hazard Areas (SFHAs), the BFEs, and the flood zones applicable to the community.
FIS	Flood Insurance Study	A compilation of flood risk data within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS.
FIUP	Flood Intended Use Plan	A document adopted by TWDB that identifies the uses of funds for flood projects.
FMA	Flood Mitigation Assistance Grant Program	Competitive grant program that provides funding to states, local communities, and federally recognized tribes and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP.
FME	Flood Management Evaluation	A FME is a proposed flood study of a specific, flood-prone area that is needed in order to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs.
FMP	Flood Management Project	A FMP is a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring cost and when implemented will reduce flood risk, mitigate flood hazards to life or property.

FMS	Flood Management Strategy	A FMS is a proposed plan to reduce flood risk or mitigate flood hazards to life or property. FMSs include any proposed action that the RFPG would like to identify, evaluate, and recommend that does not qualify as either a FME or FMP.
FPR	Flood Planning Region	
-	Flood Readiness and Resilience	Non-structural projects/programs aimed at improving flood preparedness and response to flood events including: plan activation, chain of command, emergency functions, evacuation procedures, flood early warning systems, and/or resilience measures to be implemented to reduce flood damage.
-	Flood Risk	For the purposes of regional flood planning, flood risk analyses will comprise a three-step process of flood hazard, flood exposure, and vulnerability analyses
FRMP	USACE Flood Risk Management Program	Program established by USACE to identify and assess flood hazards posed by all flood risk reduction infrastructures.
-	Flood Vulnerability	For the purposes of flood planning, vulnerability analyses will identify vulnerabilities of communities and critical facilities located within the region.
-	Freeboard	An additional amount of height above the BFE used as a factor of safety in determining a structures elevation.
GCPD	Gulf Coast Protection District	The non-federal sponsor of the Orange County component of the Sabine Pass to Galveston Bay CSRM program; includes Harris, Chambers, Galveston, Jefferson, and Orange counties.
GIS	Graphic Information System	GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there).
GLO	General Land Office	State agency in Texas responsible for managing lands and mineral rights properties that are owned by the state.

HEC	Hydrologic Engineering Center	Developers of various modeling software for USACE that are often utilized for conducting hydrologic and hydraulic analysis.
HHPD	High Hazard Potential Dam Grant Program	Program that provides grants for technical, planning, design, and construction assistance regarding rehabilitation of eligible high hazard potential dams.
HGAC	Houston-Galveston Area Council	Regional organization through which local governments consider issues and cooperate in solving area wide problems. Local governments can initiate efforts in anticipating and preventing problems through this organization.
HMAP	Hazard Mitigation Action Plan	HMAP reduces loss of life and property by minimizing the impact of disasters. Communities identify natural disaster risks and vulnerabilities in the area.
HMGP	Hazard Mitigation Grant Program	Program established by FEMA to provide funding to state, local, tribal, and territorial governments to spur the development of hazard mitigation plans and rebuild in a way that reduces, or mitigates, future disaster losses in their communities.
H&H	Hydrology and Hydraulic(s)	
HUC	Hydrologic Unit Code	A hierarchical sequence of numbers that defines a hydrologic unit. The sequence is divided into different classifications with two digits used to represent major geographic areas in the United States and twelve digits used to describe different subwatersheds included in a select geographic area.
HUD	Department of Housing and Urban Development	Executive department of the federal government that administers urban housing and urban development laws.
HWM	High Water Mark	The highest level a body of water reaches at a specific location.
ICS	Incident Command System	A standardized on-scene emergency management hierarchical construct specifically designed to provide an integrated organizational structure that reflects the

		complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.
IIJA	Infrastructure Investment and Jobs Act	Act passed in 2021 intended to provide funding to modernize much of the existing infrastructure in the United States and address deficient water infrastructure and local water quality challenges.
LiDAR	Laser Imaging, Detection, and Ranging	Method for measuring distances and ranges utilizing lasers; often used in surveying to make three-dimensional representations of an area to aid in mapping.
LNVA	Lower Neches Valley Authority	River district charged with the oversight, use, and conservation of the water within the lower Neches River valley. LNVA is the planning group sponsor for Region 5.
LOS	Level of Service of Asset	A measure of the level of protection a flood infrastructure asset provides in terms of annual exceedance probability.
LWC	Low Water Crossing	A roadway creek crossing that is subject to frequent inundation during storm events or subject to inundation during a 50% ACE (2-year) storm event. During the first planning cycle, the RFPGs have the flexibility to utilize the community's discretion to identify a roadway creek crossing as LWC.
MSC	Map Service Center	Online public source for flood hazard information and maps produced by FEMA in support of the NFIP.
MS4	Municipal Separate Storm Sewer System	A conveyance or system of conveyances that is owned by a public entity that discharges to waters of the U.S., designed to collect or convey stormwater, is not a combined sewer, and not part of a sewage treatment plant.
MUD	Municipal Utility District	Districts that provide water, wastewater (sewage), drainage, and other services within the district's boundaries to include water conservation, irrigation, firefighting, solid waste collection and disposal, and recreational facilities.
NFHL	National Flood Hazard Layer	NFHL is a geospatial database that contains current effective flood hazard data. FEMA provides the flood

		hazard data to support the National Flood Insurance Program.
NFIP	National Flood Insurance Program	NFIP is managed by FEMA and provides insurance to help reduce the socio-economic impact of floods.
NHD	National Hydrologic Dataset	Comprehensive hydrography dataset that represents the water drainage network of the United States with features such as rivers, streams, canals, lakes, ponds, dams, and stream gages.
NIMS	National Incident Management System	System that guides all levels of government, nongovernmental organizations, and the private sector to work together to prevent, protect against, mitigate, respond to, and recover from incidents.
NOAA	National Oceanic and Atmospheric Administration	Federal Agency that monitors and forecasts weather and climate conditions.
NRC	National Research Council	Operating arm of the United States National Academies of Sciences, Engineering, and Medicine; produces reports that advance development in science, engineering, and medicine.
NRCS	National Resource Conservation Service	An agency under the United States Department of Agriculture that collaborates with farmers, ranchers, communities, and other individuals and groups to protect natural resources on private lands. Formerly known as the Soil Conservation Service (SCS).
NWS	National Weather Service	Federal agency responsible for providing weather forecasts, warnings of hazardous weather, and other weather-related products to organizations and the public for the purposes of protection, safety, and general information.
OEM	Office of Emergency Management	An agency often attached to a governing entity that is responsible for planning for and coordinating response to disasters that negatively impact their area.
O&M	Operations and Maintenance	

QAQC	Quality Assurance and Quality Control	
PA	Public Assistance	Program administered by FEMA that provides supplemental grants to state, tribal, territorial, and local governments so communities can swiftly respond to and recover from major disasters or emergencies.
PED	Pre-construction Engineering and Design	Phase of a project where the detailed engineering, technical studies, and design behind a project is completed to prepare for construction.
RAS	River Analysis System	Modeling software created by HEC that is used extensively for hydraulic analysis.
RFC	River Forecast Center	Centers operated by NWS that prepare daily river forecasts for the protection of lives and property.
RFP	Regional Flood Plan	
RFPG	Regional Flood Planning Group	The generic term for the planning groups that oversee the regional flood plan development in each region in the State of Texas.
Risk MAP	Risk Mapping, Assessment, and Planning Program	Program administered by FEMA that involves coordination with federal, state, tribal, and local partners across the nation to identify flood risk and promote informed planning and development practices to reduce that risk.
RSLC	Relative Sea Level Change	Change in sea level that is observed with respect to the land surface at a particular location.
SB	Senate Bill	
SETRPC	South East Texas Regional Planning Commission	Voluntary association of local governments in Hardin, Jasper, Jefferson, and Orange Counties; utilizes a 9-1-1 Emergency Network that addresses calls from residents within all four counties.
SE Texas R.A.I.N.	Southeast Texas Regional Alerting & Information Network	Web-based public informational resource which compiles and presents information necessary to make important decisions during threatening weather conditions; covers the southern portion of the Neches and Sabine watersheds.

STAN	Southeast Texas Alerting Network	Network used by local entities to send emergency and outreach messages to the public; serves residents in Jefferson, Orange, Hardin, and Jasper Counties.
STORM	Safeguarding Tomorrow through Ongoing Risk Mitigation	An Act signed into law on Jan 1, 2021 that authorizes FEMA to provide capitalization grants to states or eligible tribal governments to establish revolving loan funds to provide hazard mitigation assistance to local governments to reduce risks to disasters and natural hazards.
SLFRF	Coronavirus State and Local Fiscal Recovery Funds	Part of the American Rescue Plan, allocated $350 billion to state, local, and tribal governments to support their response to and recovery from the COVID-19 pandemic. Can be used to invest in water, sewer, and broadband infrastructure.
SLR	Sea Level Rise	
SFHA	Special Flood Hazard Area	Regulatory term for an area having special flood, mudflow, or flood-related erosion hazards, and shown on an FHBM or FIRM.
SUD	Special Utility District	Districts created under Article XVI, Section 59 of the Texas Constitution that can provide water, wastewater, and firefighting services but cannot levy taxes.
SVI	Social Vulnerability Index	SVI ranks each Census tract on 15 social factors that influence a community's ability to prepare for, respond to, and recover from a disaster. High SVI scores indicate a higher degree of vulnerability for a community.
SWCD	Soil and Water Conservation District	Districts that work with public and private organizations and agencies to mitigate soil and water erosion and enhance water quality and quantity in the state.
SWP	State Water Plan	Plan developed by TWDB that addresses the needs of all water user groups in the state during a repeat of the drought of record that the state suffered in the 1950s.
TAC	Texas Administrative Code	The development of the regional flood plan must follow specific criteria as outlined in the Texas Administrative Code (TAC). The flood plan requirements may be found at 31TAC, Chapter 361, Subchapter C, Regional Flood Plan Requirements and 31 TAC, Chapter 362, State Flood

		Planning Guideline Rules, Subchapter A, State Flood Plan Development. These rules contain procedures and guidelines for the development of the regional flood plan.
TC	Technical Consultant	
TCEQ	Texas Commission on Environmental Quality	Environmental agency for the state of Texas responsible for maintaining water quality and availability and the Texas Dam Safety Program.
TDA	Texas Department of Agriculture	State agency responsible for matters relating to agriculture, rural community affairs, and other related matters.
TDEM	Texas Division of Emergency Management	Division of TxDPS charged with coordinating state and local responses to natural disasters and other emergencies in Texas.
TFMA	Texas Floodplain Management Association	An organization of professionals involved in floodplain management, flood hazard mitigation, the NFIP, flood preparedness, warning and disaster recovery.
TNRIS	Texas Natural Resources Information System	TNRIS is a division of the TWDB that maintains historic and current geospatial data products.
TPDES	Texas Pollutant Discharge Elimination System	Regulatory program to control discharges of pollutants to surface waters; the statewide program is administered by TCEQ.
TP-40	Technical Paper Number 40	Technical document published in 1961 historically used as the rainfall frequency atlas of the United States.
TSSWCB	Texas State Soil & Water Conservation Board	State agency that administers Texas's soil and water conservation laws and coordinates conservation and nonpoint source water pollution abatement programs throughout the state.
TWDB	Texas Water Development Board	Texas Agency with oversight of regional flood plan development.
TXARNG	Texas Army National Guard	Component of the United States Army; often conduct duties relating to disaster relief and emergency preparedness.

TxDOT	Texas Department of Transportation	State agency in Texas charged with providing construction oversight and maintenance of road infrastructure within the state.
TxDPS	Texas Department of Public Safety	State agency responsible for statewide law enforcement and driver license administration.
USACE	US Army Corps of Engineers	Federal agency responsible with providing oversight for several water resource projects in the region to include administering operations at Sam Rayburn Reservoir and managing coastal flood infrastructure projects.
USDA	United States Department of Agriculture	Federal department charged with executing laws on food, agriculture, natural resources, and other related issues. Provides oversight for the Risk Management Agency, which supervises the Federal Crop Insurance Corporation.
USFS	United States Forest Service	Agency of the USDA that oversees the nation's national forests and grasslands.
USGS	United States Geological Survey	Scientific agency of the federal government that studies the landscape of the United States, its natural resources, and the natural hazards that threaten it.
WCID	Water Control and Improvement District	Districts that have authority to supply and store water for domestic, commercial, and industrial use. Some districts may operate sanitary wastewater systems and provide irrigation, drainage, and water-quality services.
WRDA	Water Resources Development Act	Legislation passed typically in two-year intervals to authorize USACE activities for flood control, navigation, and ecosystem restoration.
WSEL	Water Surface Elevation	
WUG	Water User Group	Accounting unit utilized by TWDB for Regional Water Planning processes; often defined as entities serving more than 100 acre-ft per year (ac-ft/yr) for municipal use.

EXECUTIVE SUMMARY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 0. EXECUTIVE SUMMARY

In 2019, the 86th Texas Legislature passed Senate Bill 8 that authorized and established the regional and state flood planning processes. The legislature assigned the responsibility of the regional and state flood planning process to the Texas Water Development Board (TWDB). This report presents the Final Region 5 Neches Regional Flood Plan, which represents the first-ever regionwide flood plan for the Neches Region. Region 5 is one of 15 Regional Flood Planning Groups across the State of Texas tasked with developing a regional flood plan. The plan consists of ten tasks, which are summarized below.

Given the diverse geography, culture and population of the state, the planning effort is being carried out at a regional level in each of the state's 15 major river basins. The Neches Regional Flood Planning Area (Region 5) is one of these regions for which a plan was developed. A summary of project milestones is presented in **Table 0-1.** The first RFP was submitted to the TWDB on January 10th, 2023, and an amended RFP that includes the execution of additional flood studies will be submitted on July 14th, 2023.

The TWDB will compile these regional plans into a single statewide flood plan and will present it to the legislature in 2024. An updated version of the RFP will be due every five years thereafter. In this first planning cycle, the TWDB allocated additional funding to each of the 15 regions to perform additional tasks. These tasks were outside of the original scope of the flood plan due in January 2023; thus, they will be part of the amended regional flood plans which are due July 2023.

TABLE 0-1: REGIONAL FLOOD PLAN MILESTONE DATES

Plan Deliverable	Milestone Date
Draft Regional Flood Plan	August 1, 2022
Final Regional Flood Plan	January 10, 2023
Amended Regional Flood Plan	July 14, 2023
State Flood Plan	September 1, 2024

The TWDB has appointed a Regional Flood Planning Group (RFPG) for each region. The Region 5 RFPG was established by the TWDB on October 1, 2020, to manage the flood planning efforts for the Neches Flood Planning Region. **Table 0-2** lists the voting membership of the RFPG while **Table 0-3** lists the non-voting membership of the RFPG**.** The TWDB administers the regional planning process through a contract with the planning group's sponsor, who is selected by the RFPG.

The RFPG's responsibilities include directing the work of their technical consultant, soliciting and considering public input, identifying specific flood risks, and identifying and recommending flood management evaluations, strategies, and projects to reduce risk in their regions. To promote input from diverse perspectives, voting members represent a wide variety of stakeholders potentially impacted by flooding, including:

- Agriculture
- Counties
- Electric Generation Utilities
- Environmental Interests
- Flood Districts
- Industries
- Municipalities
- Public
- River Authorities
- Small Businesses
- Water Districts
- Water Utilities

In addition to voting members, non-voting members increase the diversity of the group for input on the plan and include the following agencies:

- Texas General Land Office (GLO)
- Texas Water Development Board (TWDB)
- Texas Commission on Environmental Quality (TCEQ)
- Texas Division of Emergency Management (TDEM)
- Texas Parks and Wildlife Department (TPWD)
- Texas Department of Agriculture (TDA)
- Texas State Soil and Water Conservation Board (TSSWCB)
- Texas Department of Transportation (TxDOT)
- Sabine-Neches Navigation District

To fund projects identified by these plans, the Legislature created a new Flood Financial Assistance Fund and charged the TWDB with administering the fund. The Texas Infrastructure Resiliency Fund, as approved by Texas voters in November 2019, is being used to finance the preparation of these plans and will also be used to finance flood-related projects. Entities with identified flood mitigation solutions that are included in the RFP may be eligible for future financial assistance in the form of grants and/or loans from the TWDB.

TABLE 0-2: VOTING MEMBERSHIP OF THE REGION 5 FLOOD PLANNING GROUP

Stakeholder Category	Member	Entity
Counties (Chair)	Judge Jeff Branick	Jefferson County
Water Districts (Vice Chair)	Joseph Majdalani, Ph.D., P.E.	Jefferson County Drainage District 6
River Authorities (Secretary)	Scott Hall, P.E.	Lower Neches Valley Authority
Agricultural Interests	Brent Heironimous	Donna's Farm
Electric Generating Utilities	Liv Haselbach, Ph.D., P.E.	Lamar University
Environmental Interests	Ellen Buchanan	Big Thicket National Heritage Trust
Flood District	Phil Kelley	Jefferson County Drainage District 7
Industries	Steve Moon	Motiva Enterprises, LLC
Municipalities	Kyle Kingma, AICP, CFM	City of Tyler
Public	John Beard, Jr.	Public
Small Business	Brian E. McDougal	Small Business
Water Utilities	Robb Starr	Lumberton Municipal Utility District

TABLE 0-3: NON-VOTING MEMBERSHIP OF THE REGION 5 FLOOD PLANNING GROUP

Non-Voting Membership	
Member	**Organization**
Bregan Brown	Texas Parks and Wildlife Department
Natalie Johnson.	Texas Division of Emergency Management
Manual Martinez	Texas Department of Agriculture
Trey Watson	Texas State Soil and Water Conservation Board
Colleen Jones, Ph.D.	General Land Office
Richard Bagans	Texas Water Development Board
Jonathan Walling	Texas Commission on Environmental Quality

ES 1. Planning Area Description

Texas Flood Planning Region 5 - Neches River Basin is located in eastern Texas and is one of 15 flood planning regions defined by the TWDB. Region 5 includes a drainage area covering approximately 11,542 square miles, which is roughly 4.3% of the total land area of Texas. Region 5 encompasses a wide variety of landscapes and communities, intersecting portions of 24 of the 254 counties in Texas.

The Neches River originates in Van Zandt and Smith counties near Lake Palestine and runs generally southward through the Piney Woods of East Texas. There are 12 major reservoirs in this region. In the middle reaches of this basin, the Angelina River enters Sam Rayburn Reservoir, which feeds the lower Neches as it crosses through the Angelina National Forest and the Big Thicket National Preserve. After continuing through the northeastern portion of Beaumont, the Neches River merges with the Sabine River at Port Arthur on Sabine Lake and enters the Gulf of Mexico through the Texas Point National Wildlife Refuge. The Neches River Basin contains approximately 9,673 stream miles. A geographic overview of the Neches River Basin is shown in **Figure 0-1.**

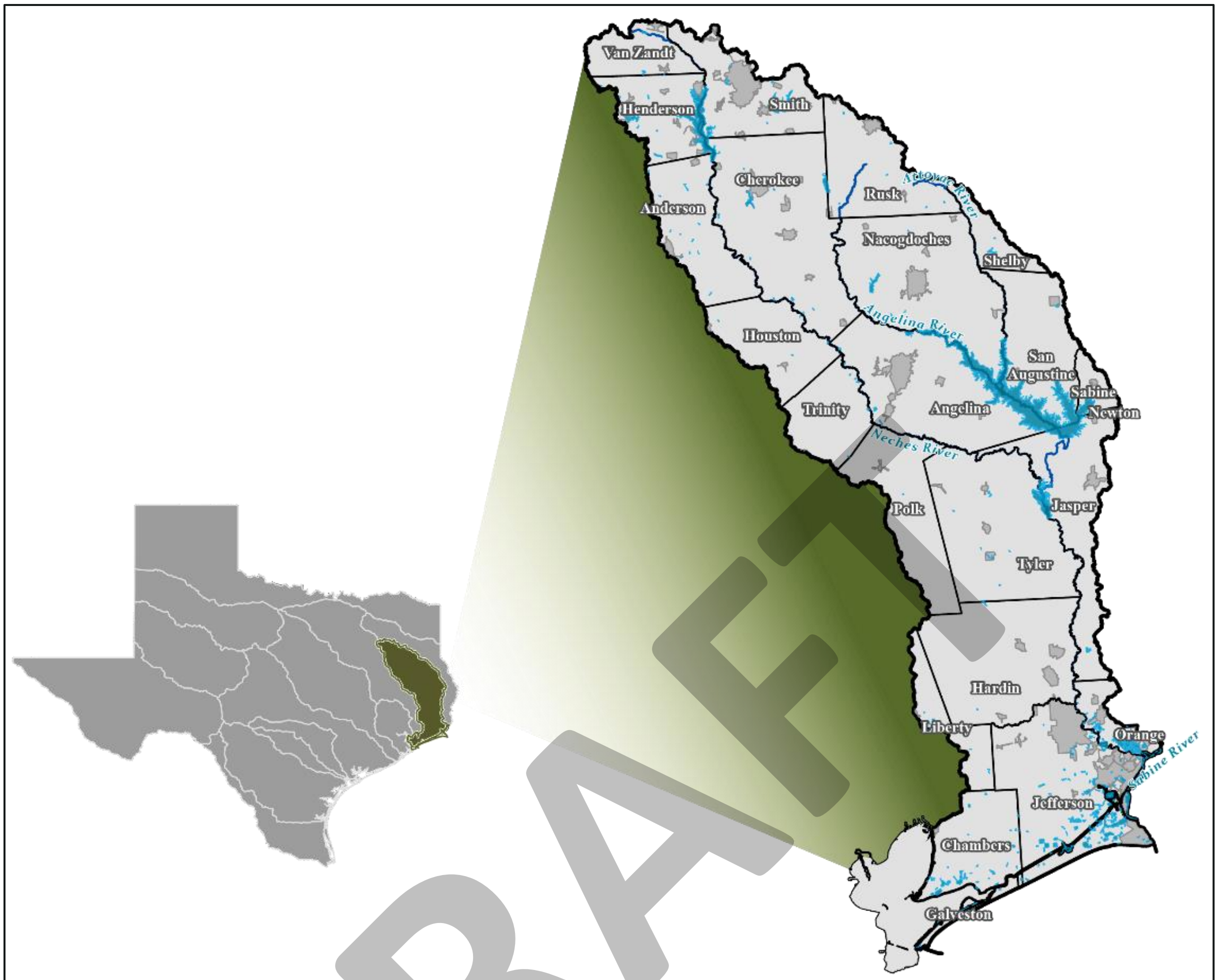


FIGURE 0-1: REGION OVERVIEW

The region experiences abundant annual precipitation which can lead to destructive flooding. Climate characteristics for the planning area are typified by high rainfall. Typical annual precipitation ranges from 38 inches per year near the basin headwaters to 60 inches per year at the mouth. By area, Region 5 is the 8th largest river basin in Texas. Comparing flow volume relative to basin area for the major river basins of Texas, Region 5 has the 2nd highest average annual flow per basin area in the state.

Region 5 has an estimated population of 963,000 people living in the area (U.S. Census Bureau). The region is comprised of areas from 24 counties and includes 79 municipalities. The Neches Region is a large, geographically diverse region where the needs of rural stakeholders must be balanced with those of the urban population centers. The flood risks faced by communities and landowners also vary in coastal and non-coastal communities.

Major patterns of land use in the region include forestry, agriculture (farming and ranching), and urban development. Most of the population is concentrated in the lower basin near the cities of Beaumont, Port Arthur, Nederland, Port Neches, and Groves in Jefferson County. The city of Tyler, the second most populous city in the region, is in the northern portion of the basin in Smith County. The remaining population is distributed in predominantly smaller communities and rural areas across the central portion. Cities larger than 10,000 population are listed in **Table 0-4**.

TABLE 0-4: CITIES IN THE NECHES RIVER BASIN WITH POPULATION GREATER THAN 10,000

City	Population
Beaumont	115,282
Tyler	105,995
Port Arthur	56,039
Lufkin	34,143
Nacogdoches	32,147
Nederland	18,856
Groves	17,335
Jacksonville	13,997
Port Neches	13,692
Lumberton	13,554

Source: 2020 Census Redistricting (census.gov)

The population projections adopted by the Neches Region were completed in the 2022 State Water Plan. These projections show the highest anticipated population growth in the region as being concentrated in the heavily urbanized area in Jefferson County that includes the cities of Beaumont and Port Arthur. Significant population growth is also expected in the cities of Tyler and Nacogdoches in the north.

Oil and gas production is an integral component of Texas industry, and the Neches River Basin is no exception. The upper portions of the planning area known as the East Texas Oil Field possess the highest percentage of oil production for the Neches region, primarily in western Rusk, northeastern Cherokee, and southeastern Smith Counties. In the central portion of the basin, gas wells associated with the Texas-Louisiana Salt Basin are more common, primarily located in San Augustine, Nacogdoches, Rusk, and Shelby Counties.

In the southern portion of the region, some of the state's earliest examples of commercial petroleum production derive from the Sour Lake and Spindletop Oil Fields. Additionally, pipeline networks connecting national trunk systems to refineries on the Gulf Coast are concentrated in the southern Neches River Basin along with associated petrochemical manufacturing industries. Jefferson County in particular hosts many major petroleum refineries with facilities located in the Beaumont, Port Arthur, and Port Neches areas.

A large portion of the agricultural revenue in Region 5 is generated by livestock operations, primarily poultry production in the counties of Shelby and Nacogdoches. Crops generate roughly 15 percent of the basin total agriculture revenue. Over half of the land in the planning region is used for forestry. While the majority of these forests are privately owned, notable tracts of forest land are included in the Big Thicket National Preserve and are federally managed by the U.S. National Park Service.

ES 2. Flood Risk Analysis

The objective of this task was to perform a comprehensive and cohesive flood risk analysis for the region. Flood risks were assessed for the 1 percent annual chance and 0.2 percent annual chance events. The analysis was performed for existing conditions of the basin, as well as a future condition scenario that considers changes in flood hazards over the 30-year planning horizon.

The region is subject to both the danger of swift-moving flood waters in riverine areas in addition to both pluvial and coastal flooding. Much of the flood risk in Region 5 is based on outdated or approximate maps. As a result, most of the flood risk across the region is not well quantified, meaning that people and their property may be unknowingly in harm's way.

To assist RFPGs with the flood hazard analysis, the TWDB prepared a statewide, geographic information system (GIS) dataset that is comprised of the most recent flood hazard data in Texas, referred to as the "floodplain quilt". The floodplain quilt is comprised of data from several sources, including from the National Flood Hazard Layer (NFHL), Base Level Engineering (BLE) studies, and from First American Flood Data Services (FAFDS).

In a related effort, the TWDB is making an aggressive push to expand the availability of floodplain mapping information in Texas through the development of FEMA Base Level Engineering (BLE) data. BLE was present in much of the region and was utilized for this iteration of the regional flood plan.

The existing flood hazard was utilized to prepare a flood hazard analysis to identify who and what might be harmed within the region. A regional summary of flood exposure by feature type for the 1 percent and 0.2 percent annual chance events (ACE) is presented in **Table 0-5**.

TABLE 0-5: EXISTING FLOOD EXPOSURE SUMMARY

Exposure Feature Type	Number of Features by Flood Hazard Area	
	1% ACE	0.2% ACE
Structures (#)	34,728	77,717
Residential Structures (#)	25,145	60,321
Population (#)	65,717	158,275
Critical Facilities (#)	479	2,082
Roadway Segments (mi.)	1,505	2,454
Roadway Stream Crossings (#)	3,558	4,275
Agricultural Areas (sq. mi.)	119	167

History has demonstrated that flood hazards tend to increase over time in populated areas due to projected increases in impervious cover, anticipated sedimentation in flood control structures, and additional factors that result in increased or altered flood hazards. Changing rainfall patterns in the basin is a significant contributor to increased flood risk. Two major rainfall atlases have been completed in the planning region, which ultimately cover the entire country. Technical Paper Number 40 (TP-40) was released in 1962 and NOAA Atlas 14, an update to TP-40, was released in 2018. In the more than 50 years between both publications, the lower end of the basin experienced increases of 10 – 40 percent in rainfall associated with a 1 percent, 24-hour annual chance rainfall event. The portions of Jefferson, Chambers, Galveston, Orange, Tyler, Polk, and Jasper Counties contained in the region experienced the most significant change between TP-40 and Atlas 14 rainfall.

Estimated future changes in flood hazard extents are meant to represent the "30-year, no action" scenario for the purpose of evaluating the potential magnitude for future flood risk. This information will in no way be used for floodplain mapping for regulatory purposes, such as local (municipal) floodplain management and development regulation, or in any way by Federal Emergency Management Agency (FEMA) or the National Flood Insurance Program (NFIP). This is simply a planning level analysis for the purpose of supporting the regional flood planning process.

To determine the extents of the future 1 percent annual chance flood hazard, the existing 0.2 percent annual chance flood hazard extents was used as a proxy, consistent with Method 2 described in the *Technical Guidance for Regional Flood Planning (Exhibit C)*. For the future 0.2 percent annual chance event extent, the RFPG proposed to use Cursory Floodplain mapping data associated with the 1 percent annual chance event. An additional buffer was created to supplement the Cursory Floodplain data; this buffer was consistent with the difference between the existing 1 percent and 0.2 percent annual chance water surface elevation or inundation extent, depending on the best available data present in the area. A special note is that the segment of the Neches River downstream of the Sam Rayburn Reservoir had its flood hazard extents maintained between existing and future conditions due to the river segment being less susceptible to localized increases.

A comparison of the existing and future flood hazard area is presented tabularly in **Table 0-6**. The combined 1 percent and 0.2 percent annual chance flood hazard area was chosen to estimate the extents for the future 1 percent annual chance flood save for the segment of the Neches River downstream of Sam Rayburn Reservoir. An additional 354 square miles of flood hazard area was added to estimate the extents of 1 percent flooding while 409 square miles of flood hazard area was added to estimate the extents of 0.2 percent flooding.

TABLE 0-6: FLOOD HAZARD AREA COMPARISON

Flood Frequency	Existing Conditions Area (Sq. Mi)	Future Conditions Area (Sq. Mi)	Increase (Sq. Mi)	% Increase
1% Annual Chance	3,079	3,433	354	11.5%
0.2% Annual Chance	3,453	3,862	409	11.8%

A regional summary of the increase in flood exposure by feature type for the 0.2 percent ACE of future conditions compared to existing conditions is presented in **Table 0-7**.

TABLE 0-7: FUTURE FLOOD EXPOSURE SUMMARY

Exposure Feature Type	Existing Conditions 0.2% ACE	Future Conditions 0.2% ACE	Increase
Structures (#)	77,717	127,952	50,235
Residential Structures (#)	60,321	100,524	40,203
Population (#)	158,275	288,931	130,656
Critical Facilities (#)	2,082	3,389	1,307
Roadway Segments (mi.)	2,454	3,610	1,156
Roadway Stream Crossings (#)	4,275	5,082	807
Agricultural Areas (sq. mi.)	167	222	55

ES 3. Floodplain Management Practices and Flood Protection Goals

In Texas, authority for enforcing floodplain management regulations lies with local governments such as cities and counties. It is important to note that RFPGs themselves do not have the authority to enact or enforce floodplain management, land use, or other infrastructure design standards. Any standards recommended by the RFPG in this task are encouraged to be implemented by all entities in the region that regulate development within the floodplain . The RFPG encourages cities and counties without floodplain ordinances or court orders to develop, adopt, implement, and enforce floodplain regulations that at least meet the NFIP minimum standard and where appropriate consider adopting higher standards to provide higher levels of protection against loss of life and property due to flooding. Additionally, floodplain management regulatory practices could benefit by being more clear, easily interpretable, broadly understood, realistic, and consistently enforced. Doing so would provide forward guidance on new development expectations. The flood management practices and standards recommended by the Neches RFPG are listed in **Table 0-8.**

TABLE 0-8: RECOMMENDED FLOOD MANAGEMENT PRACTICES AND STANDARDS

Category	Type	Recommended Standard
Floodplain Management Practices	Minimum Regulations	All municipalities should adopt minimum requirements outlined by FEMA for NFIP participation. Where appropriate, municipalities should consider adopting higher standards to provide higher levels of protection against loss of life and property due to flooding.
		All communities should enforce floodplain regulations.
	Property Acquisition	All communities should adopt a property acquisition program for repetitive loss structures which can be used as beneficial use area (i.e. pocket park) for the local community.
	Operations & Maintenance	Entities should create a maintenance plan for drainage infrastructure in order to prevent more expensive replacement costs.
		Communities should create a drainage infrastructure maintenance strategy following complaints or damages after a storm.
Emergency Preparedness	Flood Awareness	All communities should create and maintain a website or webinars on public flood risk awareness.
	Flood Risk Information	All communities should use the best available precipitation data for regulatory and design criteria/standards.
	Flood Response	All communities should have a Hazard Mitigation Plan for significant storm events.
		All communities should have a warning system to contact citizens before and during storm events.
New Development	Roadways	Roadways designated as major thoroughfares are designed such that the 100-year inundation extent is contained within the right-of-way and at least one navigable lane is maintained in each direction.
		Roadways should be designed to cause no adverse impacts up to and including the 100-year storm event.
	Culverts and Bridge Crossings	Culverts should demonstrate no adverse impact for 100-year storm event.
	Detention	Communities should require compensatory storage for all fill in the 100-year floodplain.
		Communities should require all new development in Zone A or unmapped areas provide a hydrologic and hydraulic study and demonstrate no adverse impacts downstream.
	Habitable Structures	All habitable structures in coastal communities should be designed such that finished floor elevations are 3 feet above the BFE including the combined riverine and coastal effects.

Category	Type	Recommended Standard
		All habitable structures in non-coastal communities are designed such that finished floor elevations are 2 feet above the riverine 100-year WSE, EXCEPT where stricter local standards apply.
	Critical Facilities	All critical facilities in coastal communities should be designed such that finished floor elevations are 2 feet above the highest elevation of either the riverine 500-year or coastal 100-year WSE including the combined riverine and coastal effects.
		All critical facilities in non-coastal communities should be designed such that finished floor elevations are 2 feet above the riverine 100-year WSE.
	Nature-Based Solution	All new construction should consider nature-based solutions, low impact development, or green stormwater infrastructure.

The Neches RFPG discussed potential goals for the regional flood plan over a series of monthly meetings from October 2021 to March 2022. The adopted goals are listed in **Table 0-9.**

TABLE 0-9: SUMMARY OF ADOPTED FLOOD MITIGATION AND FLOODPLAIN MANAGEMENT GOALS

Short Term (10 year)	Long Term (30 year)
An average of 10% of the new regional infrastructure projects between 2023 – 2033 will utilize larger storm events (>100-year) as the basis of their design.	An average of 25% of the new regional infrastructure projects between 2033 – 2053 will utilize larger storm events (>100-year) as the basis of their design.
RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 10% of their new flood risk reduction projects between 2023 - 2033.	RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 25% of their new flood risk reduction projects between 2033 - 2053.
Reduce the number of critical facilities in the 100-year flood risk inundation extents by 15%.	Reduce the number of critical facilities in the 100-year flood risk inundation extents by 25%.
Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 10% of structures.	Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 30% of structures.
Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 25%.	Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 75%.
Increase percentage of areas with dedicated funding sources for operations and maintenance for storm drainage system to 50% of communities.	Increase percentage of areas with dedicated funding sources for operations and maintenance for storm drainage system to 75% of communities.
50% of the region's population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.	75% of the region's population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.
Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 75% of areas identified as having current gaps in flood mapping.	Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 100% of areas identified as having current gaps in flood mapping.
Increase the number of gages across the Neches basin to cover 50% of the region's HUC10s.	Increase the number of gages across the Neches basin to cover 100% of the region's HUC10s.
Develop and maintain critical infrastructure database	N/A

Short Term (10 year)	Long Term (30 year)
Give notice to 100% of affected units of local government and improve 50% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.	Give notice to 100% of affected units of local government and improve 100% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.
Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 25% of Low Water Crossings identified in the latest Regional Flood Plan.	Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 80% of Low Water Crossings identified in the latest Regional Flood Plan.
100% of counties to perform public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.	Maintain 100% participation of counties performing public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.

ES 4. Assessment and Identification of Flood Mitigation Needs

The RFPG conducted a flood mitigation needs analysis which considered a variety of criteria that are listed in **Table 0-10.**

TABLE 0-10: FLOOD MITIGATION NEEDS ANALYSIS FACTORS

Categories	Factors Considered
Flood-prone Areas Threatening Life and Property	• Buildings • Low Water Crossings • Agricultural Areas • Critical Facilities
Current Floodplain Management and Land Use Policies	• Communities Participating in NFIP • Communities Not Participating in NFIP
Areas Identified as Flood Map Gaps	• Approximate NFHL Data • Detailed NFHL Data based on Study Older than 10 Years • Atlas 14 Update Required
Historical Flood Events	• Disaster Declarations • FEMA Claims
Other Factors	• Social Vulnerability Index (SVI)

The factors included were discussed with the RFPG over the course of several meetings. **Figure 0-2** summarizes the results of the flood mitigation needs analysis on a watershed basis. The Neches RFPG reviewed within areas of high "flood need score" and identified potential flood management evaluation (FMEs) to address the needs of each community.

The flood mitigation needs scoring process was conducted at the HUC12 watershed level of detail due to the advantage that utilizing hydrologic boundaries to address flood risk and knowledge gaps complies with the overarching plan goal of proposing regional solutions. The factors in **Table 0-10** were selected due to being previously compiled in earlier components of the Regional Flood Plan; as such, the factors were deemed to provide accurate measures of flood exposure and vulnerability within the region.

All numerical categories for each HUC12 were assigned a score of 1-5 based on a percentile ranking system; the top 20% of values (80^{th} percentile) were given the highest needs score (5), while the bottom 20% of all values were given the lowest score of 1. Non-numerical scoring categories for the HUC12s included NFIP participation, availability of floodplain mapping, and presence of critical facilities. For NFIP participation, if a HUC12 was found to have a community not participating in the National Flood Insurance Program, the HUC12 was automatically assigned a 5 for the category. Likewise, if a HUC12 was found to contain at least one critical facility in its area, it was automatically assigned a score of 5. Finally, HUC12s were assigned scores of 1, 3, or 5 for the best available floodplain mapping category depending on if the HUC12 had approximate mapping data (1), had a detailed study older than 10 years (3), or was in need of an update to Atlas 14 data (5).

The scores from each category were summed together for each HUC12 before being divided by their respective HUC12 watershed's area to normalize the score to foster better comparison with one another.

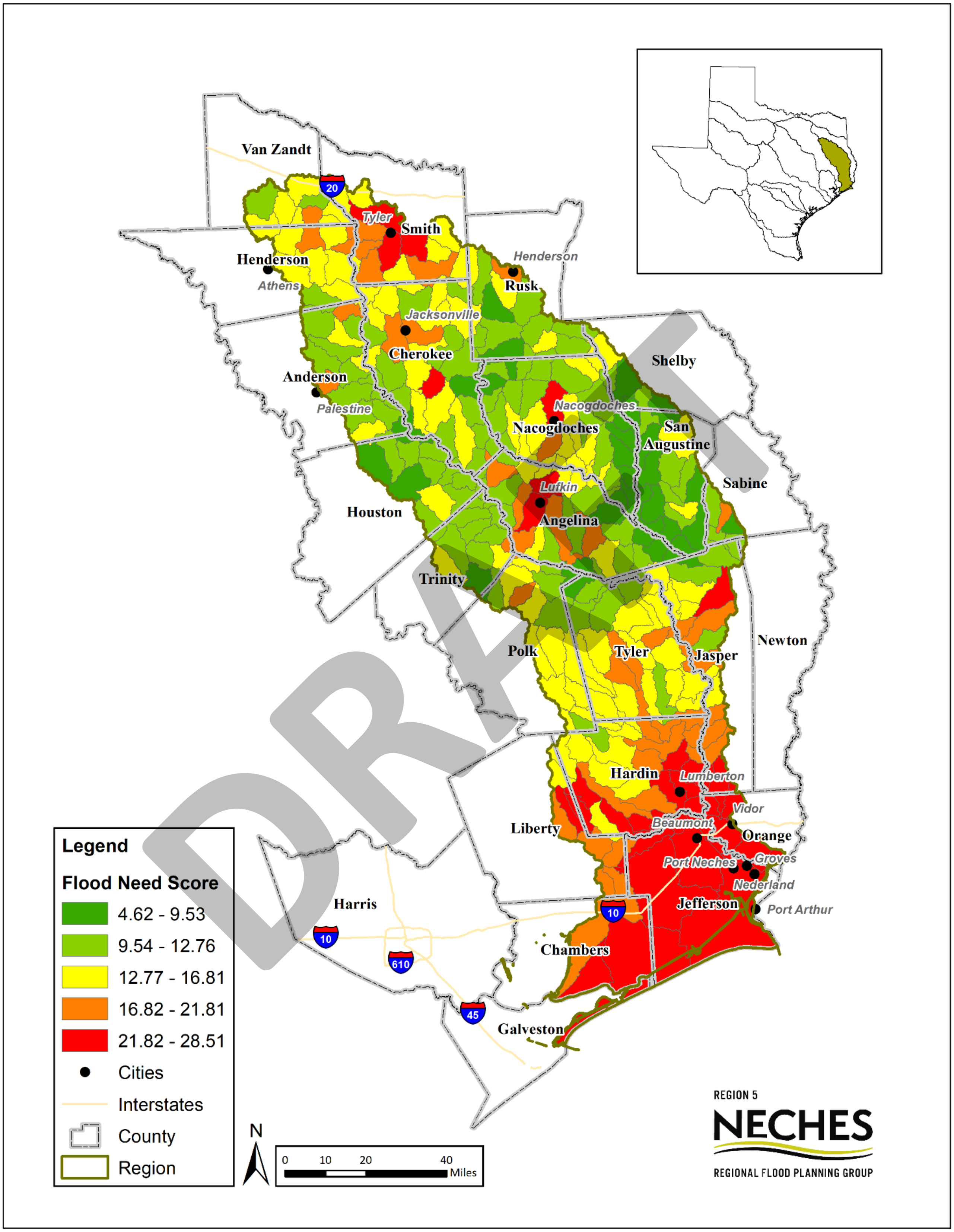


FIGURE 0-2: FLOOD MITIGATION NEED BY HUC12 WATERSHED

The Neches RFPG defined and evaluated a wide range of potential actions to identify and mitigate flood risks across the basin. These actions have been broadly categorized into three distinct types, as defined below:

- **Flood Management Evaluation (FME)**: a proposed flood study of a specific, flood prone area that is needed in order to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs.
- **Flood Mitigation Project (FMP)**: a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring cost and, when implemented, will reduce flood risk or mitigate flood hazards to life or property.
- **Flood Management Strategy (FMS)**: a proposed plan to reduce flood risk or mitigate flood hazards to life or property.

Based on the results of the flood mitigation needs analysis, several sources of data were used to develop a list of potential flood risk reduction actions that may address the basin's needs. The data includes information compiled under previous tasks, including:

- Existing flood infrastructure, flood mitigation projects currently in progress, and known flood mitigation needs
- Existing and future flood risk exposure and vulnerability
- Floodplain management and flood protection goals and strategies developed by the RFPG for the region
- Stakeholder input

These actions were identified and evaluated through initial screening and data gathering detailed in **Chapter 4**. This first Regional Flood Planning cycle relies primarily on compiling readily available information to determine appropriate flood mitigation actions to recommend for inclusion in the final plan, rather than performing technical analysis to identify new actions. The list of potential FMEs and potentially feasible FMSs and FMPs for the Final Regional Flood Plan were compiled based on contributions from the RFPG and other regional stakeholders from sources including previous flood studies, drainage master plans, flood protection studies, and capital improvement plans.

ES 5. Evaluation and Recommendation of Flood Management Evaluations, Flood Management Strategies, and Associated Flood Mitigation projects

FMEs, FMSs, and FMPs were further evaluated in order to compile the necessary technical data for the RFPG to decide whether to recommend these actions or a subset of these actions. The RFPG considered recommendations on flood mitigation actions through a multi-step process. The general methodology included a screening of all potential flood mitigation actions considering TWDB requirements for inclusion in the Regional Flood Plan. The reasons for not recommending a particular flood mitigation action were clearly documented as part of the evaluation and recommendation process.

FMEs were recommended to make clear what additional studies, and funds to support them, are needed to adequately evaluate all flood prone areas within a region. FMEs are studies that are required to identify and determine what FMPs can be recommended. Some areas of the region began the regional flood planning process with more flood risk, flood planning, and flood project information than others. The recommended FMEs of areas with less prior information will serve to inform future planning cycles.

FMSs and FMPs were recommended based upon the identification, analysis, and comparison of alternatives that the RFPG determined to provide measurable reductions in flood impacts in support of the RFPG's specific flood mitigation and floodplain management goals. The RFPG set criteria to determine which identified potential FMSs and FMPs would be recommended in the regional plan in order to ensure that the recommended FMSs and FMPs are sensible so that resources can be directed efficiently and accordingly to implement those flood studies and associated technical evaluations. The Neches RFPG considered the following criteria when recommending FMSs and FMPs:

- No Adverse Impact
- High Existing Flood Need
- Quantifiable Flood Risk Reduction Benefits
- Regional Benefit (1.0 square mile)
- Existing Flood Risk to Critical Facilities
- Align with RFPG Goals

Table 0-11, Table 0-12, and **Table 0-13** show the recommended FMEs, FMSs, and FMPs and the distribution by type.

TABLE 0-11: RECOMMENDED FMES BY EVALUATION TYPE

FME Type	Description	Count
Flood Mapping Updates	Updates to floodplain mapping to include new hydrologic and hydraulic modeling for defining flood hazard areas.	22
Master Drainage Plan	An assessment of a watershed or community to estimate flood risk and recommend flood management and flood mitigation projects.	37
Feasibility Assessments	Develop flood mitigation project alternatives for a discrete high flood risk area, estimate construction costs for alternatives, and determine flood reduction benefit for alternatives. Evaluation may require creation of H&H modeling.	7
Project Design Development	Evaluate identified potential flood mitigation projects to define costs, quantify flood reduction benefits, demonstrate no adverse impacts, and evaluate design alternatives. Evaluation may require the creation or updating of hydrologic and hydraulic models.	91
	TOTAL	**157**

TABLE 0-12: RECOMMENDED FMSS BY STRATEGY TYPE

FMS Type	Description	Count
Education and Outreach	Programs or initiatives that aim to educate the public on the hazards and risks of flooding.	25
Flood Measurement and Warning	Installation and operation of stream gages, monitoring stations, and alert systems to provide flood hazard information.	17
Property Acquisition and Structural Elevation	Administration of program to acquire and demolish structures and convert the land to open space to mitigate flooding.	18
Regulatory and Guidance	Development of ordinances, development criteria, building codes, and design standards to prevent new flood risk.	31
Infrastructure	Establish program, plan, or standards to facilitate future infrastructure improvements.	54
Other	Maintenance and inspection of flood infrastructure to ensure its design level of service is maintained.	2
	TOTAL	**147**

TABLE 0-13: RECOMMENDED FMPS BY PROJECT TYPE

FMP Type	Description	Count
Channel	Channel extensions and upgrades to increase capacity of water conveyance.	6
Comprehensive	Improve existing levees, build new pump stations, construct/reconstruct floodwalls to higher elevations.	16
Detention	New detention pond construction	4
	TOTAL	**26**

ES 6. Impacts of the Regional Flood Plan

The goal of **Chapter 6** is to summarize the overall impacts of the Regional Flood Plan. This includes potential impacts to areas at risk of flooding, structures and populations in the floodplain, number of low water crossings impacted, impacts to future flood risk, impact to water supply and overall impact on the environment, agriculture, recreational resources, water quality, erosion, sedimentation, and navigation. The benefits from the recommended FMPs to structures and population are summarized in **Table 0-14**.

TABLE 0-14: SUMMARY OF IMPACTS FROM FMPS

Flood Exposure	Existing Conditions		After FMP Implementation		Exposure Reduction from FMPs	
	1% ACE	0.2% ACE*	1% ACE	0.2% ACE*	1% ACE	0.2% ACE*
Total Structures	34,728	77,717	28,686	69,821	6,042	7,896
Residential Structures	25,145	60,323	20,604	53,929	4,541	6,394
Critical Facilities	479	2,082	390	1,872	89	210
Population	65,717	158,275	49,137	135,703	16,580	22,572
Low Water Crossings	165	173	165	173	0	0
Road Length (Miles)	1,505	2,454	1,429	2,418	76	36

The impacts from FMSs are more qualitative in nature and are summarized in **Chapter 6**. Based on the future flood hazard analysis, almost 88,000 new residential structures are projected to be constructed across the region to accommodate population growth over the next 30 years. The potential flood risk of new structures can be reduced, and resiliency could be increased for many of these structures by communities adopting higher floodplain management criteria and standards. Regulation of development, implementation of higher standards, and use of best available data are all interdependent strategies for avoiding potential increases in flood exposure over time. Through these development regulations, the Regulatory and Guidance FMSs have the potential to reduce flood risk for newly constructed buildings in the Neches River Basin.

In **Chapter 2**, the entire area of the region was identified as being in need of flood risk identification or updates to existing flood risk information. After the completion of recommended FMEs, four FMEs were promoted to FMPs as part of the amended plan, and it is very possible for additional FMSs and FMPs to be identified that could potentially be incorporated in future planning cycles. The avoidance of future flood risk begins with identifying flood risk exposure through new studies. Beyond addressing the immediate need of closing knowledge gaps, execution of regional watershed studies created by the region will provide a foundation for effective FMP identification and recommendation in future planning cycles.

Impacts to water supply were also evaluated as part of **Chapter 6**. The TWDB established 16 regional water planning areas (RWPA) and appointed members who represent key public interests to the regional water planning groups (RWPG). This grassroots approach allows planning groups to evaluate region-specific risks, uncertainties, and potential water management strategies. Region 5 primarily covers the East Texas (Region I) RWPA region with partial coverage of Region C. None of the recommended flood management actions have an impact on water supply.

ES 7. Flood Response Information and Activities

This chapter provides an overview of flood emergency management and focuses on the preparedness, response, and recovery phases of flood emergencies specific to the Neches Region. The summarized information in this chapter relies upon survey responses, oral testimony of entities and citizens from the region, and local knowledge of the technical consultants with the ideal that the presented flood response information and activities are specific to this region.

The southeastern area region makes use of several systems including the Southeast Texas Regional Alerting & Information Network (SE Texas R.A.I.N.) and the Jefferson County Drainage District 6 Alert II – Early Flood Detection System to aid in flood preparedness activities. Community officials largely rely on publicly available data from NOAA, NWS, USGS, and TxDOT when preparing for flood events. Cities and counties carry most of the burden for flood response including road closures and evacuations among other activities. The most common flood recovery activity within the region is debris removal at culvert entrances and bridges, which, if not remedied, compounds the next flood emergency. This activity is primarily conducted by cities, counties, and TxDOT. A lack of coordination between the responsible entities for debris removal at these facilities is a commonly reported problem by cities and counties.

ES 8. Administrative, Regulatory, and Legislative Recommendations

The task (Task 8) behind this chapter provides an opportunity for the Neches RFPG to make recommendations to the State of Texas to improve floodplain management and mitigation within the region. The Neches RFPG discussed draft recommendations during the May 2022 meeting. A total of 23 recommendations were developed and are summarized below.

Legislative Recommendations

- Continue biennial appropriations to the Flood Infrastructure Fund (FIF).
- Increase state funding for technical assistance to develop accurate watershed models and floodplain maps.
- Allow counties the opportunity to establish drainage utilities and to collect drainage utility fees in unincorporated areas.
- Incentivize jurisdictions to work together to provide regional flood mitigation.
- Incentivize buy-out programs to convert frequently flooded properties/neighborhoods into natural beneficial use areas.
- Incentivize conservation easements for land in the 100-year floodplains.
- Establish grant programs for the ongoing operations and maintenance (O&M) of existing flood mitigation and other drainage infrastructure.

Regulatory and Administrative Recommendations

- Develop model floodplain management standards and ordinances.
- Provide support for ongoing education/training for floodplain management.
- Provide technical assistance to smaller jurisdictions.
- Increase public education efforts.
- Establish a process to take BLE data to regulatory information.
- Establish a process to utilize BLE data for evaluation of FMPs.
- Review and Update TxDOT design criteria.

Flood Planning Recommendations

- Promote nature-based projects.
- Utilize alternative statewide Social Vulnerability Index (SVI) than the one developed by the U.S. Center for Disease Control (CDC).
- Reassess requirements for potentially feasible Flood Mitigation Projects (FMP) that present challenges for inclusion of FMPs in regional flood plans.
- Develop publicly available, statewide database of all the GIS deliverables associated with the development of the State Flood Plan.
- Incorporate FEMA in the Regional Flood Planning process as a nonvoting RFPG member.
- Adjust population estimates to include transient population within each region.
- Update Future Population Projections.
- Expand scope of flood mitigation needs analysis.
- Establish flood responses and flood warning activities that consider the needs of the disabled community.

ES 9. Flood Infrastructure Financing Analysis

The Neches RFPG has recommended a total of 330 flood mitigation actions to address flood risk across the planning region. Combined, these flood mitigation actions are anticipated to cost $4.6 billion to implement, as shown in **Table 0-15**. Much of the total cost is associated with the Sabine Pass to Galveston Bay Coastal Storm Risk Management Project in Orange County. The complete cost of this project is split between the Sabine and Neches RFP, as the project will benefit communities in both regions. Another large contributor to the total cost is the Willow Marsh Main project in Jefferson County Drainage District No. 6, which proposes four new stormwater detention basins.

TABLE 0-15: TOTAL COST OF RECOMMENDED FLOOD MITIGATION ACTIONS

Flood Mitigation Action	Number of Recommended Actions	Total Flood Mitigation Action Cost
FME	157	$89,895,824
FMS	147	$175,036,700
FMP	26	$4,326,840,085
Total	**330**	**$4,590,772,609**

Stormwater infrastructure and floodplain management activities are historically underfunded programs compared to other infrastructure types, and this is a continued challenge that local entities documented through their initial survey responses. Lack of funding was indicated as a primary cause of inadequate or deficient drainage infrastructure in nearly all of the surveys received. The Neches RFPG surveyed sponsors to determine how much local funding is available to contribute to these actions. Overall, there is an estimated $4.2 billion of funding needed to implement the recommended FMEs, FMSs, and FMPs in this RFP, beyond what is anticipated to be funded by local sponsors. This figure represents 91 percent of the total cost of the flood mitigation actions identified in this plan.

This number does not represent the amount of funding needed to mitigate all risks in the region nor to solve flooding problems in their totality. This number simply represents the funding needs for the specific identified studies, strategies, and projects in this cycle of regional flood planning. Future cycles of regional flood planning will continue to identify more projects and studies needed to further flood mitigation efforts in the region.

ES 10. Public Participation and Plan Adoption

The Neches RFPG has employed multiple methods to engage the public and stakeholders in this initial plan development. The Neches RFPG has given the public access to a survey through their project webpage (https://nechesfloodplanning.org/).The public also has access to an interactive map hosted on the website where they may identify areas of flood risk in their region and a portal to upload their own data to contribute to the planning process. An interactive data dashboard was also hosted on the website that displayed the GIS data developed during the planning process.

Throughout the planning process, the Neches RFPG held regular Planning Group meetings in addition to Technical Committee meetings when the time required. Quorum was met at each of these meetings by the voting members with sufficient attendance from the non-voting members and other attendees as well. The Neches RFPG meetings were conducted both online via Zoom and in-person at the LNVA office in Beaumont, TX. Frequency of the formal Planning Group meetings averaged at one per month; all meetings were conducted in accordance with the Texas Open Meetings Act. Public attendance and comments were encouraged at each meeting.

The plan was prepared in accordance with the guidance principles provided by the TWDB. A table is included in **Chapter 10** that indicates which portion of the plan addresses each guidance principle.

CHAPTER 1
PLANNING AREA DESCRIPTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

CHAPTER 1. PLANNING AREA DESCRIPTION

Texas Flood Planning Region 5 Neches River Basin (Neches FPR) is located in eastern Texas and is one of 15 flood planning regions defined by the TWDB. Region 5 includes a drainage area covering approximately 11,542 square miles, which is roughly 4.3% of the total land area of Texas. Region 5 encompasses a wide variety of landscapes and communities, intersecting portions of 24 of the 254 counties in Texas.

The Neches River originates in Van Zandt and Smith counties near Lake Palestine and runs generally southward through the Piney Woods of East Texas. There are 12 major reservoirs in this region. In the middle reaches of this basin, the Angelina River enters Sam Rayburn Reservoir, which feeds the lower Neches as it crosses through the Angelina National Forest and the Big Thicket National Preserve. After continuing through the northeastern portion of Beaumont, the Neches River merges with the Sabine River at Port Arthur on Sabine Lake and enters the Gulf of Mexico through the Texas Point National Wildlife Refuge. The Neches River Basin contains approximately 9,673 stream miles. A geographic overview of the Neches River Basin is shown in **Figure 1-1**.

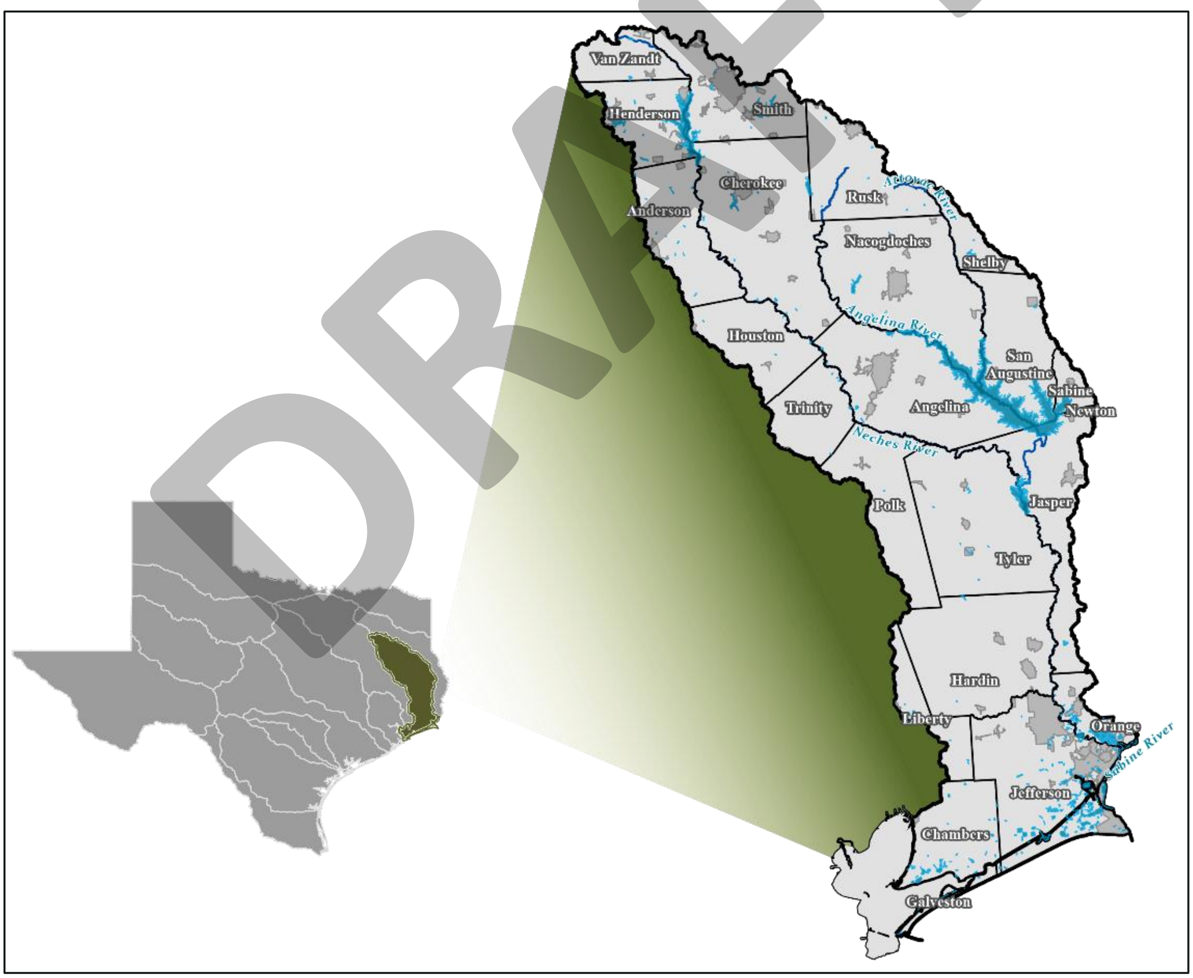


FIGURE 1-1: REGION OVERVIEW

The region experiences abundant annual precipitation which can lead to destructive flooding. Floodplain degradation throughout the region has also served to exacerbate flooding impacts, most notably in areas of high development. Climate characteristics for the planning area are typified by high rainfall rates. Typical annual precipitation ranges from 38 inches per year near the basin headwaters to 60 inches per year at the mouth.

By area, Region 5 is the 8th largest river basin in Texas. Comparing flow volume relative to basin area for the major river basins of Texas, Region 5 has the 2nd highest average annual flow per basin area in the state, as shown in **Table 1-1**. It should be noted that the total basin area reported below includes areas outside of state limits.

TABLE 1-1: COMPARATIVE STATISTICS OF MAJOR TEXAS RIVERS

River Basin	Basin Area	Basin Area	Annual Average Flow (Acre-Feet)	Annual Average Flow	Average Annual Flow per Basin Area (Acre-Feet/ Sq. Mi.)	Average Annual Flow per Basin Area
Sabine	9,756	9	5,864,000	2	601	1
Neches	**9,937**	**8**	**4,323,000**	**4**	**435**	**2**
San Jacinto	3,936	12	1,365,000	8	347	3
Trinity	17,913	6	5,727,000	3	320	4
Sulphur	3,767	13	932,700	9	248	5
Guadalupe	5,953	10	1,422,000	7	239	6
Cypress	3,552	14	493,700	13	139	7
San Antonio	4,180	11	562,700	11	135	8
Brazos	45,573	4	6,074,000	1	133	9
Lavaca	2,309	15	277,000	14	120	10
Colorado	42,318	5	1,904,000	6	45	11
Red	93,450	2	3,464,000	5	37	12
Nueces	16,700	7	539,700	12	32	13
Canadian	47,705	3	196,000	15	4	14
Rio Grande	182,215	1	645,500	10	4	15

Source: Texas Water Development Board (data); Region 5 Flood Planning Group (analysis); https://www.twdb.texas.gov/surfacewater/rivers/river_basins/index.asp
**Note: Basin areas calculated as entire watershed, in certain cases including areas of other states.*

The following sections describe the social and economic character of the region and provide a high-level evaluation of the flood infrastructure protecting communities from the adverse effects of flooding.

Chapter 1.A. Social and Economic Character of the Neches River Basin

1.A.1. Population and Future Growth

Region 5 in its entirety encompasses over 11,500 square miles. As of the 2020 Census, the population of Region 5 was reported to be 1,019,984, which is roughly 3.5% of the total Texas population. The region contains all or portions of 24 counties as well as 79 municipalities.

The Neches River basin is a large, geographically diverse region where the needs of rural stakeholders must be balanced with those of the urban population centers. The flood risks faced by communities and landowners also vary across the region. To better understand the nature of these various flood risks, this section discusses the people, type and location of development, economic activities, and sectors at greatest risk of adverse flood impact within the planning region.

1.A.1.a. Current Conditions

The population by census tract is shown in **Figure 1-2**. The highest population density and industrialization occurs in the northern and southern portions of the Neches River Basin, with lower density in the central portion. According to the 2020 Census population estimates, the largest metropolitan statistical area (MSA) is the Beaumont-Port Arthur MSA with 392,563 residents, followed by the Tyler MSA with 232,751 residents. These two MSAs comprise approximately 61.3% of the region's population.

Smaller towns and unincorporated communities are vital to the character of the region, with several located along the major transportation corridors of US Highway 287 and US Highway 59. Only 10 cities in the region have populations exceeding 10,000, as listed in **Table 1-2**.

TABLE 1-2: CITIES IN THE NECHES RIVER BASIN WITH POPULATION GREATER THAN 10,000

City	Population
Beaumont	115,282
Tyler	105,995
Port Arthur	56,039
Lufkin	34,143
Nacogdoches	32,147
Nederland	18,856
Groves	17,335
Jacksonville	13,997
Port Neches	13,692
Lumberton	13,554

Source: 2020 Census Redistricting (census.gov)

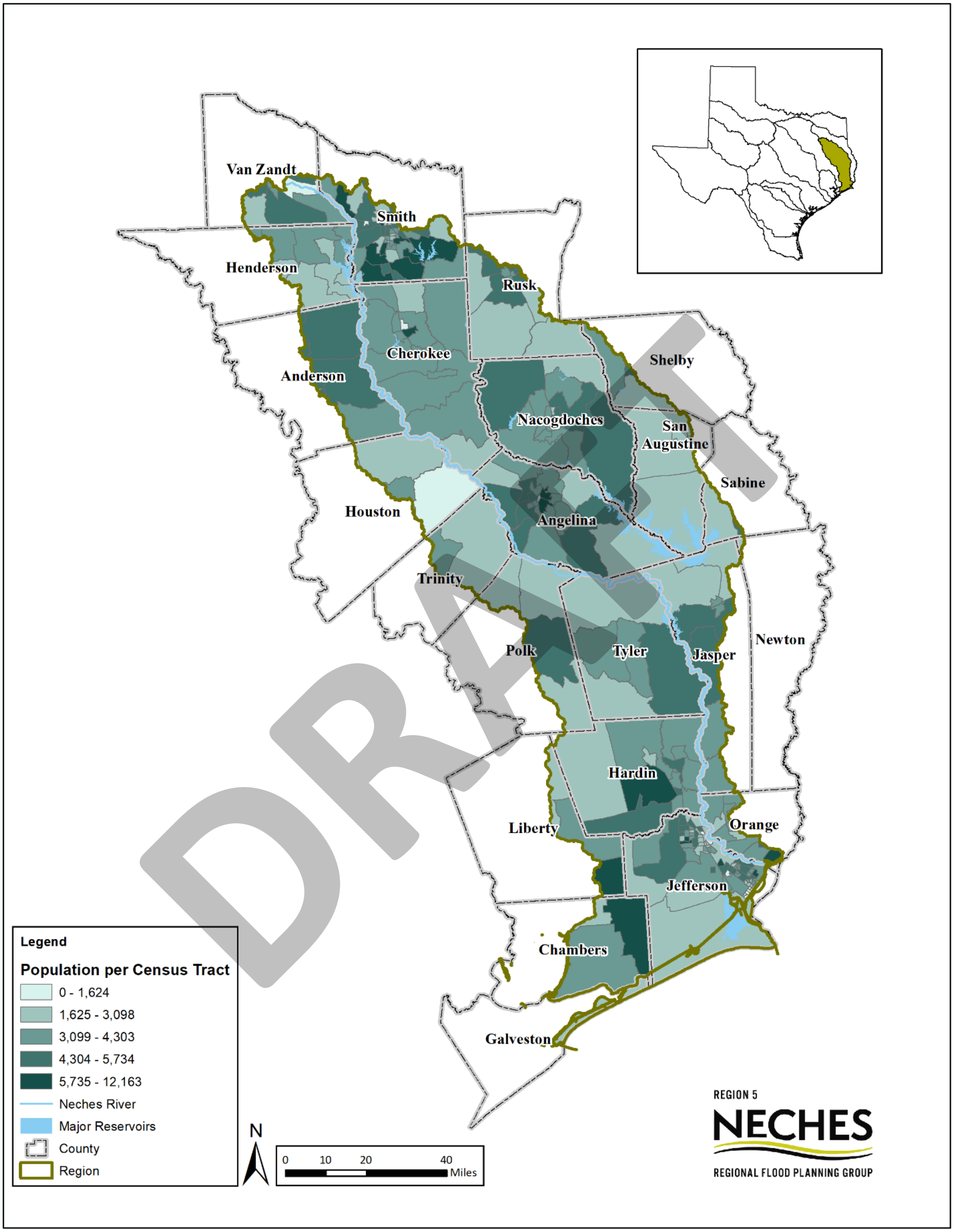


FIGURE 1-2: REGION 5 POPULATION BY CENSUS TRACT

1.A.1.b. Economic Activity

In order to understand the economic risks that the region faces from flood events, the RFP analysis identifies the most significant industries within the region by three factors:

- Number of establishments
- Payroll
- Total revenue

The analysis utilized data from the Economic Census. Industries were divided in accordance with the North American Industry Classification System (NAICS), which classifies all business establishments to facilitate the publication of statistical data related to the United States economy. This section of the report identified the largest industry per county, as measured by the three factors above. By identifying the dominant industries in each category, the figures within this section identify the economic sector with the highest potential economic impact in the event of a flood. The largest industry for all the counties within the basin is aggregated by each of the different measures in order to give a concise summary of the magnitude of potential flood impact for each of the identified sectors of the economy as shown in **Table 1-3**. **Figure 1-3** shows the number of establishments per industry type present in the region.

The following table shows the annual payroll and number of establishments per county for the region. The median annual county payroll was $99 million with a median of 816 establishments per county.

TABLE 1-3: LEADING INDUSTRY BY COUNTY

County	Leading Trade/Industry	Number of Establishments of Leading Industry	Leading Industry Annual Payroll
Jefferson	Manufacturing	180	$1,426,854,000
Smith	Health Care and Social Assistance	682	$1,156,245,000
Orange	Manufacturing	71	$447,185,000
Chambers	Manufacturing	30	$289,048,000
Angelina	Health Care and Social Assistance	296	$277,758,000
Nacogdoches	Manufacturing	57	$158,530,000
Henderson	Health Care and Social Assistance	123	$151,747,000
Liberty	Construction	127	$132,309,000
Anderson	Transportation and Warehousing	35	$112,504,000
Jasper	Manufacturing	25	$108,029,000
Cherokee	Manufacturing	65	$102,117,000
Hardin	Construction	107	$96,397,000
Polk	Manufacturing	21	$74,484,000
Shelby	Manufacturing	14	$73,668,000
Van Zandt	Construction	132	$67,762,000
Rusk	Mining	42	$62,564,000
Houston	Manufacturing	15	$43,749,000

County	Leading Trade/Industry	Number of Establishments of Leading Industry	Leading Industry Annual Payroll
Sabine	Manufacturing	4	$25,224,000
Tyler	Health Care and Social Assistance	32	$17,344,000
San Augustine	Health Care and Social Assistance	18	$11,964,000
Trinity	Health Care and Social Assistance	17	$10,172,000

Source: U.S. Census Bureau, County Business Patterns (Payroll and Establishments, by County, 2020); https://www.census.gov/programs-surveys/cbp/data.html; 4/21/2022
Note: Harris, Galveston, and Newton Counties not included due to lack of significant geographic area within the Neches Flood Planning Region.

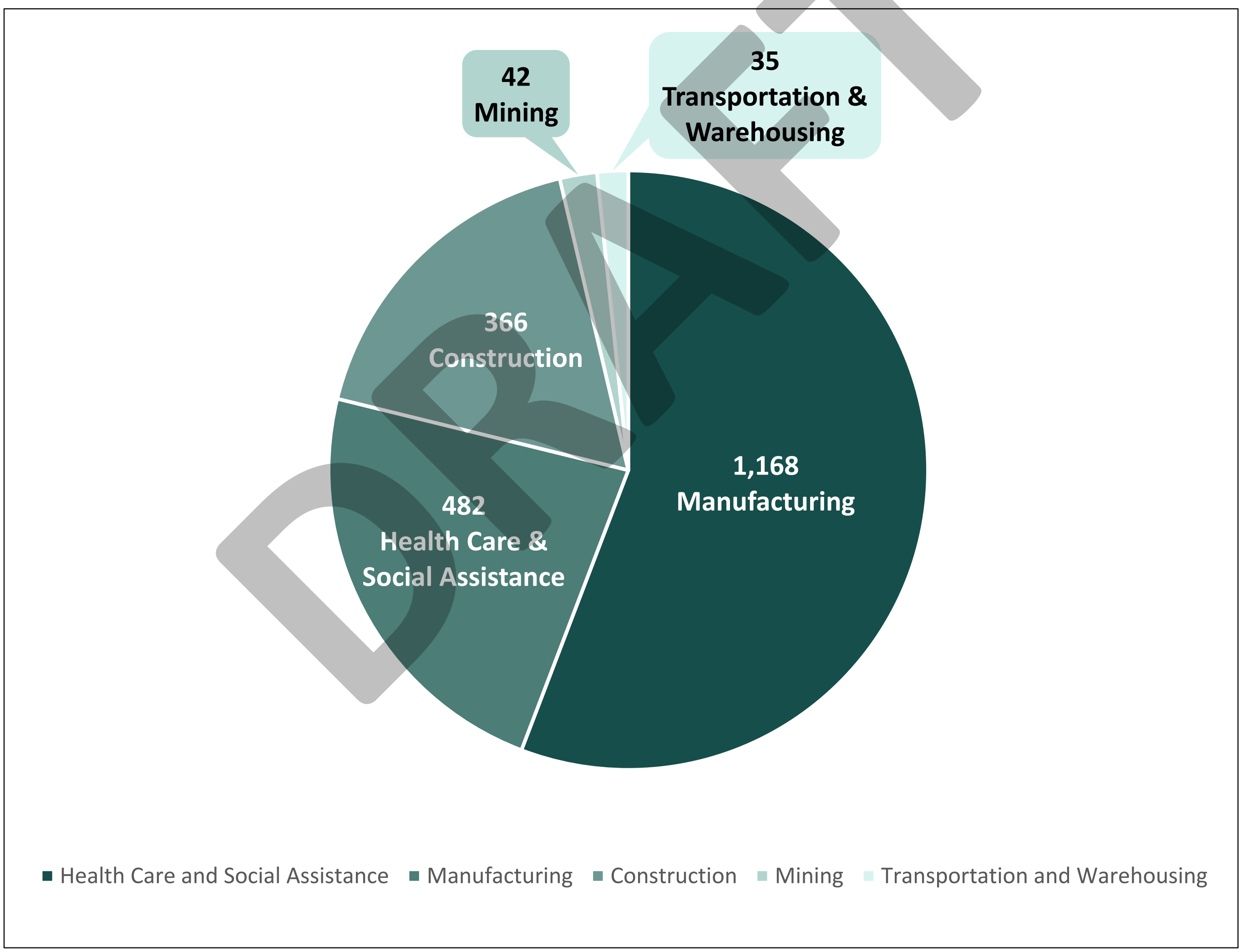


FIGURE 1-3: MAJOR INDUSTRY BY NUMBER OF ESTABLISHMENTS

Source: U.S. Census Bureau, County Business Patterns (Payroll and Establishments, by County, 2020); https://www.census.gov/programs-surveys/cbp/data.html; 4/21/2022

According to data provided by the U.S. Bureau of Economic Analysis, the combined total gross domestic product (GDP) for Neches River Basin counties in 2020 was over $61 billion with a per county GDP of $1.3 billion. It should be noted this total excludes Harris, Newton, and Galveston Counties due to the counties having minimal geographical presence within the confines of the region. **Figure 1-4** details the GDP by county in the Neches region while **Figure 1-5** displays the same information in a map of the region's extents.

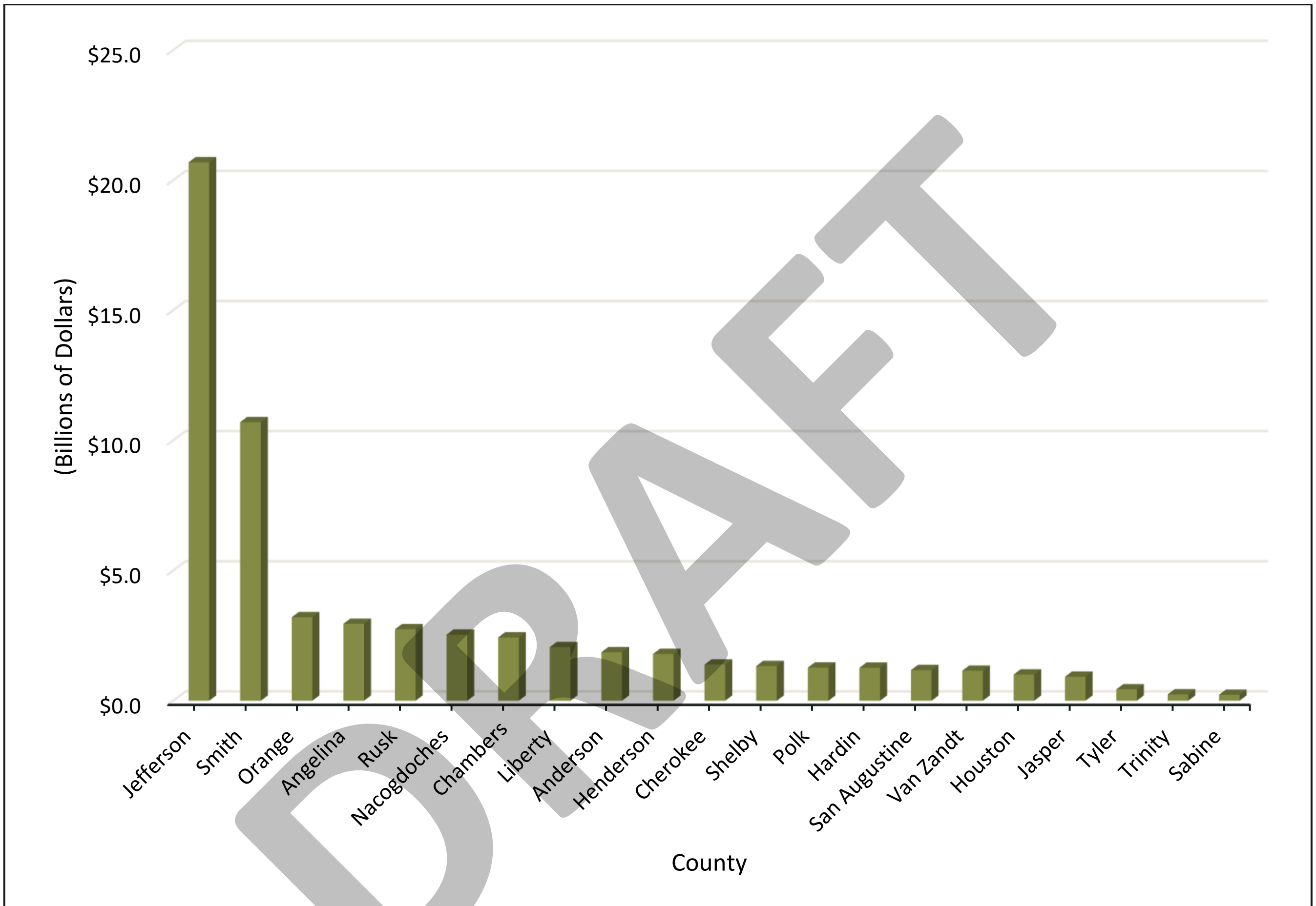


FIGURE 1-4: GDP BY COUNTY IN REGION 5

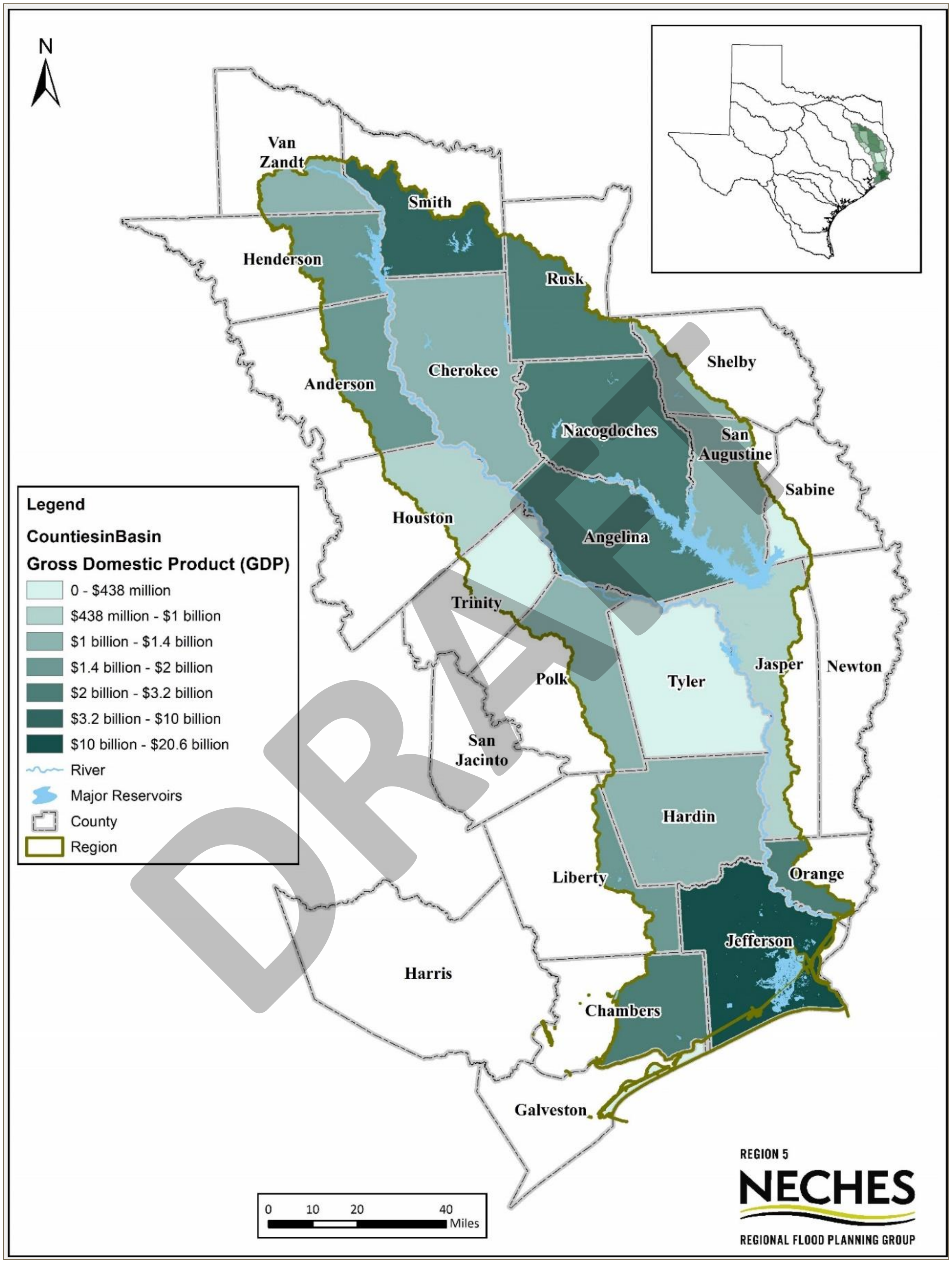


FIGURE 1-5: MAP OF GDP BY COUNTY

Agricultural/Ranching

The Neches River Basin generates nearly $1.7 billion in agricultural revenue each year. Although fewer individuals are exposed to flood hazards in rural areas, flooding can and does impact agriculture. Floods can kill livestock and crops, and may also damage equipment and structures, causing significant economic hardship to farmers and ranchers. Most of the agricultural revenue in the region is generated by livestock operations, primarily poultry in Shelby and Nacogdoches Counties. Crop revenue is led by production from Cherokee, Van Zandt, and Smith Counties. **Table 1-4** shows agriculture revenue according to the most recent available data from the United States Department of Agriculture (USDA) 2017 Census of Agriculture. The agriculture revenue displayed in the below table excludes values associated with timber farming.

TABLE 1-4: AGRICULTURE REVENUE DISTRIBUTION FOR NECHES RIVER BASIN COUNTIES

County	Crop Revenue	Livestock Revenue	Total Agricultural Revenue
Shelby	$2,837,000	$464,720,000	$467,557,000
Nacogdoches	$3,156,000	$367,586,000	$370,742,000
Cherokee	$66,491,000	$49,201,000	$115,692,000
Van Zandt	$42,428,000	$62,175,000	$104,603,000
Rusk	$5,956,000	$94,201,000	$100,157,000
Anderson	$15,551,000	$77,392,000	$92,943,000
Houston	$6,802,000	$57,716,000	$64,518,000
Angelina	$2,594,000	$58,815,000	$61,409,000
San Augustine	$1,296,000	$55,380,000	$56,676,000
Smith	$36,759,000	$16,846,000	$53,605,000
Henderson	$11,645,000	$28,538,000	$40,183,000
Jefferson	$17,688,000	$14,629,000	$32,317,000
Liberty	$12,075,000	$17,875,000	$29,950,000
Chambers	$11,077,000	$8,175,000	$19,252,000
Sabine	$450,000	$17,265,000	$17,715,000
Tyler	$9,643,000	$5,243,000	$14,886,000
Jasper	$4,007,000	$5,132,000	$9,139,000
Trinity	$2,108,000	$6,120,000	$8,228,000
Polk	$2,291,000	$4,540,000	$6,831,000
Orange	$1,489,000	$3,478,000	$4,967,000
Hardin	$2,366,000	$2,328,000	$4,694,000
TOTALS	**$258,709,000**	**$1,417,355,000**	**$1,676,064,000**

Source: U.S. Department of Agriculture, National Agricultural Statistics Service, 2017 Census of Agriculture, https://www.nass.usda.gov/Quick_Stats/CDQT/chapter/2/table/1/state/TX/county/199/year/2017; 4/21/2022

Energy

Oil and gas production is an integral component of Texas industry, and the Neches River Basin is no exception. The upper portions of the planning area known as the East Texas Oil Field possess the highest percentage of oil production for the Neches region, primarily in western Rusk, northeastern Cherokee, and southeastern Smith Counties. In the central portion of the basin, gas wells associated with the Texas-Louisiana Salt Basin are more common, primarily located in San Augustine, Nacogdoches, Rusk, and Shelby Counties.

In the southern portion of the region, some of the state's earliest examples of commercial petroleum production derive from the Sour Lake and Spindletop Oil Fields. Additionally, pipeline networks connecting national trunk systems to refineries on the Gulf Coast are concentrated in the southern Neches River Basin along with associated petrochemical manufacturing industries. The area of Jefferson and Orange County in particular is a critical player in the economy of both Texas and the United States. There are numerous chemical and petrochemical facilities located in the area, some of which rank among the largest of their kind in their United States. Southeast Texas itself, which includes Jefferson and Orange Counties, represents 5.9% of the national manufacturing GDP and 26.5% of Texas's refining capacity.

Adjacent to Jefferson and Orange Counties is the Sabine-Neches Waterway, which is comprised of the Ports of Beaumont, Port Arthur, Sabine Pass, and Orange. The Port of Orange, although part of the larger Waterway, is in the Sabine Flood Planning Region. The Sabine-Neches Waterway handles 22% of Texas's cargo and 4.7% of the national cargo total; it also ranks as the 3rd largest port/waterway complex in the nation in terms of tonnage with a 2018 export revenue of $30.2 billion. Currently, there is $54 billion in announced and proposed industrial projects along the Waterway.

Production data provided by the Texas Railroad Commission for December 2021 shows Region 5 oil and gas production compared to other Texas counties in **Table 1-5**.

TABLE 1-5: MONTHLY OIL AND GAS PRODUCTION, DECEMBER 2021, NECHES RIVER BASIN COUNTIES

County	Crude Oil Production (Barrels)	Oil Production Rank (Texas)	Natural Gas Production (MCF)	Gas Production Rank (Texas)
Rusk	98,456	55	5,957,244	26
Smith	95,765	56	708,158	78
Liberty	46,003	84	166,085	126
Van Zandt	42,127	85	21,478	166
Hardin	40,590	89	310,612	107
Anderson	30,298	92	125,438	134
Jefferson	23,381	100	108,822	138
Houston	22,362	103	167,538	124
Jasper	17,495	108	556,934	85
Henderson	17,290	109	307,705	108
Tyler	17,264	111	809,231	74
Polk	16,169	117	845,500	72
Cherokee	10,603	135	990,133	66

County	Crude Oil Production (Barrels)	Oil Production Rank (Texas)	Natural Gas Production (MCF)	Gas Production Rank (Texas)
Orange	8,095	140	160,992	127
Trinity	1,128	181	5,555	183
Shelby	918	185	4,944,223	31
Nacogdoches	907	186	8,844,814	19
San Augustine	737	187	16,916,381	15
Angelina	0	203	1,781,434	57
Sabine	0	210	38,989	155

Source: Texas Railroad Commission, Oil and Gas Production Data, https://www.rrc.texas.gov/oil-and-gas/research-and-statistics/production-data/; 4/21/2022

Economic Status of Population

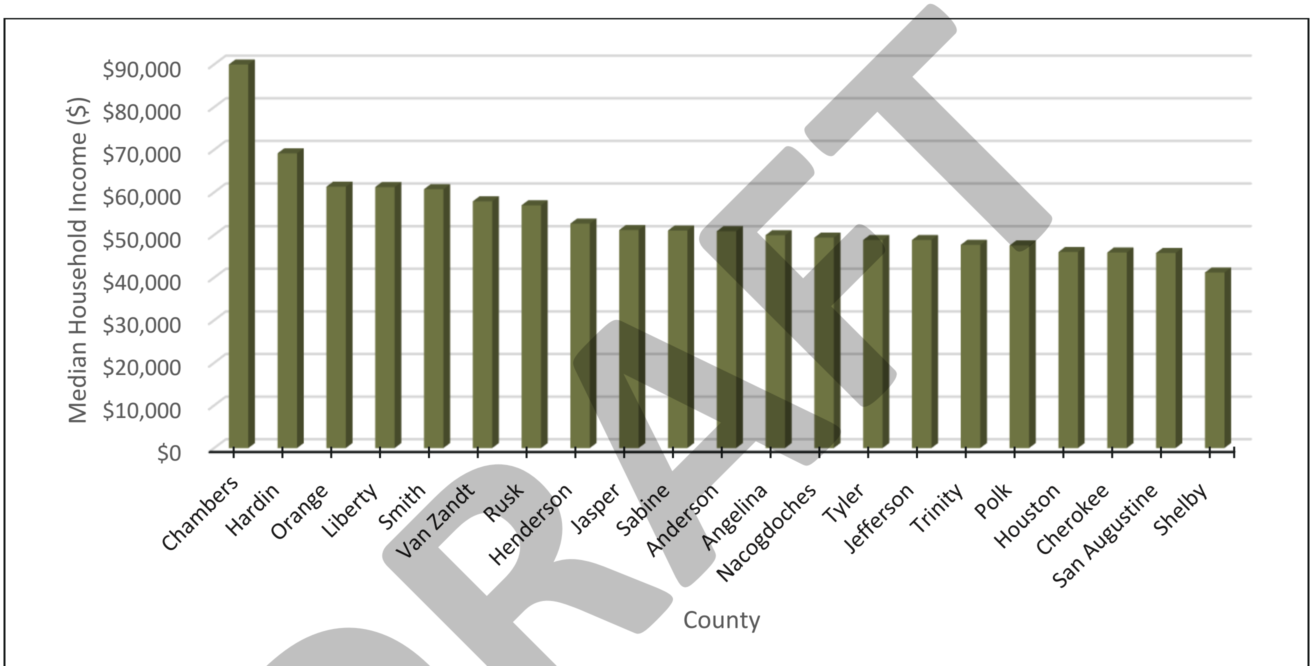
Median household incomes can be affected by many factors, including education levels, opportunity of employment, and location. The median household income provides a good comparison for income levels across the basin. Within the region, the median household income is $50,879 per year, which is 79.7% of the Texas median and 75.4% of the national median ($67,521, 2020). A correlated income measure is per capita income, which is $42,830 per year for the Neches region. **Table 1-6** and **Figure 1-6** compare the median household income of the counties in the Neches region.

TABLE 1-6: MEDIAN HOUSEHOLD INCOME, BY COUNTY

County	Median Household Income	Percentage of US Median	Percentage of Texas Median
Chambers	$89,991	133.3%	141.0%
Hardin	$69,151	102.4%	108.3%
Orange	$61,323	90.8%	96.1%
Liberty	$61,230	90.7%	95.9%
Smith	$60,735	89.9%	95.2%
Van Zandt	$57,891	85.7%	90.7%
Rusk	$56,954	84.4%	89.2%
Henderson	$52,660	78.0%	82.5%
Jasper	$51,153	75.8%	80.1%
Sabine	$51,046	75.6%	80.0%
Anderson	$50,879	75.4%	79.7%
Angelina	$49,943	74.0%	78.2%
Nacogdoches	$49,375	73.1%	77.4%
Tyler	$48,809	72.3%	76.5%
Jefferson	$48,808	72.3%	76.5%
Trinity	$47,685	70.6%	74.7%
Polk	$47,535	70.4%	74.5%

County	Median Household Income	Percentage of US Median	Percentage of Texas Median
Houston	$45,989	68.1%	72.1%
Cherokee	$45,894	68.0%	71.9%
San Augustine	$45,781	67.8%	71.7%
Shelby	$41,194	61.0%	64.5%
MEDIAN	**$50,879**	**75.4%**	**79.7%**

Source: U.S. Census Bureau (2020)



Source: U.S. Census Bureau (2020)

FIGURE 1-6: MEDIAN HOUSEHOLD INCOME BY COUNTY

1.A.1.c. Projected Growth Within the Region

The population projections completed for the 2022 State Water Plan show the highest anticipated population growth concentrated in Chambers (62.6% increase, 2020-2050), Nacogdoches (37.5% increase, 2020-2050), and Liberty Counties (37.8% increase, 2020-2050). There is high projected growth in portions of both Jefferson and Chambers Counties, with a smaller yet not insignificant projected growth in the northern area of the region from 2020 to 2050.

National trends in recent decades have shown larger percentages of population growth in urban centers and relatively slow growth in rural areas. These national trends are also represented in Neches River Basin population projections, with the most intense growth occurring in developed areas and low levels of growth occurring in rural land. Very small amounts of population growth are projected for the central portion of the region that includes land from San Augustine and Sabine Counties. **Figure 1-7** shows the percentage of population growth at the HUC10 watershed level throughout the region. For background, HUC stands for hydrologic unit code; the 10-digit HUC, otherwise known as HUC10, is used by the United States Geological Survey (USGS) to identify watersheds.

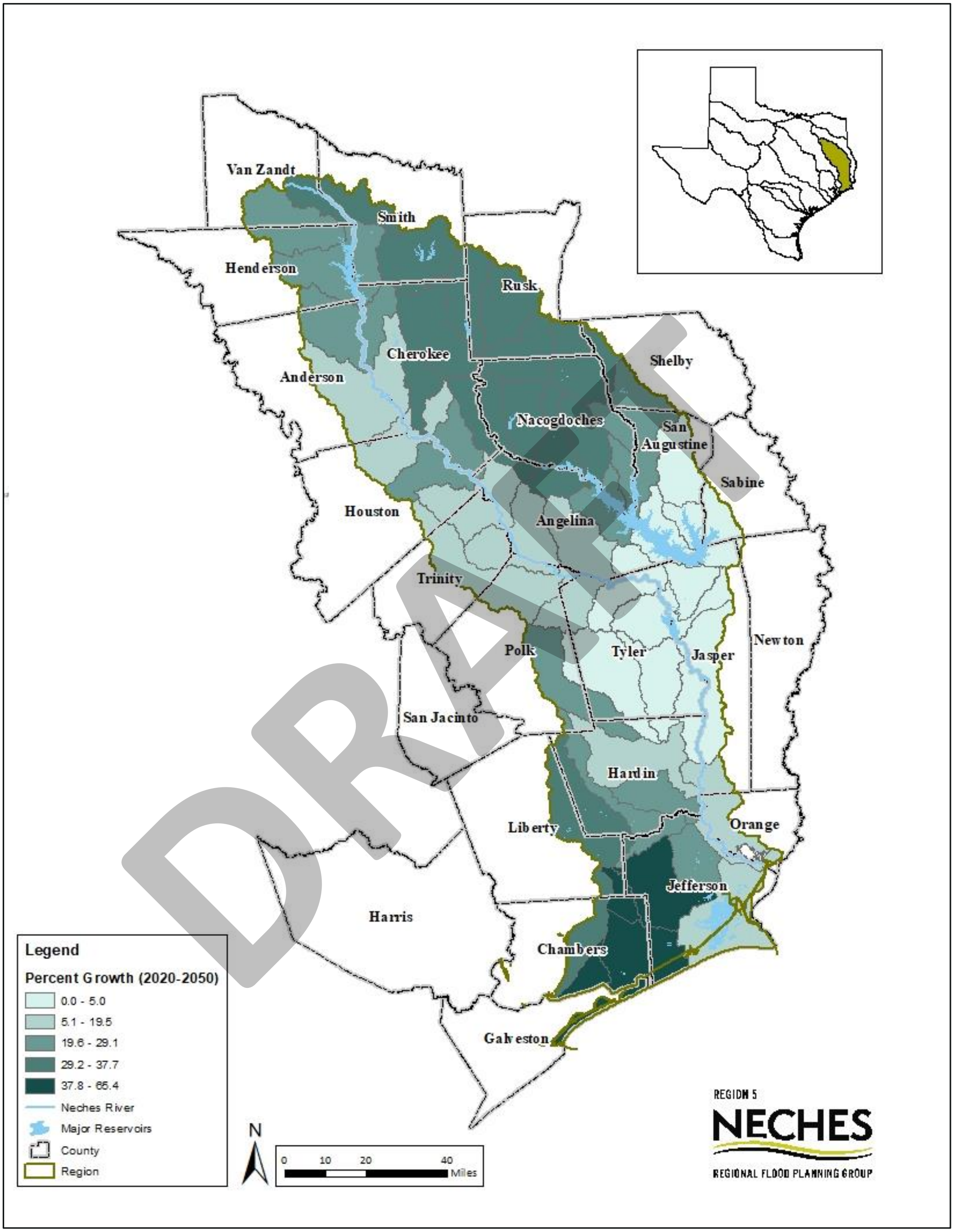


FIGURE 1-7: PROJECTED POPULATION GROWTH IN REGION 5 (HUC10)

1.A.1.d. Social Vulnerability Analysis

When anticipating the extent of damages to a community from catastrophic floods, an important dimension to consider is each community's relative "vulnerability" to floods as they occur. Disasters impact people or groups in diverse ways, which include but are not limited to their ability to evacuate an area in harm's way, the likelihood of damage to their homes and properties, and their capacity to marshal the financial resources needed to recover and rebuild after a storm. These factors are evaluated to determine an area's vulnerability, which measures a person's or group's "capacity to anticipate, cope with, resist and recover from the impacts of a natural hazard" per the Exhibit C Guidelines given by TWDB.

The Social Vulnerability Index (SVI) is a standard system for assigning a Social Vulnerability score on a census-tract basis. There exist different Social Vulnerability Indices used by various entities to examine a community's vulnerability; for this planning effort, the SVI used by the Centers for Disease Control and Prevention (CDC) was used to conduct the vulnerability analysis. A score of 0.75 or greater indicates that a community is highly vulnerable to impacts from a natural disaster. Within the Neches region, the counties of Chambers, Polk, and San Augustine have the highest average SVI scores within the planning region. Census tracts identified as highly vulnerable are listed below in **Table 1-7**. SVI can be seen by census tract in **Figure 1-8** and by county in **Figure 1-9.**

TABLE 1-7: HIGH VULNERABILITY CENSUS TRACTS

Census Tract	Nearest City	SVI
Census Tract 9504, Cherokee County, Texas	Jacksonville, TX	0.9637
Census Tract 9507, Cherokee County, Texas	Jacksonville, TX	0.9453
Census Tract 9508, Rusk County, Texas	Henderson, TX	0.799
Census Tract 9502, Shelby County, Texas	Timpson, TX	0.7798
Census Tract 2.01, Smith County, Texas	Tyler, TX	0.9606
Census Tract 2.02, Smith County, Texas	Tyler, TX	0.98
Census Tract 3, Smith County, Texas	Tyler, TX	0.8917
Census Tract 16.01, Smith County, Texas	Tyler, TX	0.9268
Census Tract 1, Smith County, Texas	Tyler, TX	0.9
Census Tract 4, Smith County, Texas	Tyler, TX	0.9293
Census Tract 5, Smith County, Texas	Tyler, TX	0.8161
Census Tract 7, Smith County, Texas	Tyler, TX	0.8836
Census Tract 9505, Cherokee County, Texas	Jacksonville, TX	0.9382
Census Tract 6, Smith County, Texas	Tyler, TX	0.7832
Census Tract 9, Smith County, Texas	Tyler, TX	0.7896
Census Tract 17, Smith County, Texas	Tyler, TX	0.7863
Census Tract 9501, Nacogdoches County, Texas	Garrison, TX	0.8074
Census Tract 9503.02, Nacogdoches County, Texas	Nacogdoches, TX	0.8368
Census Tract 9509, Nacogdoches County, Texas	Nacogdoches, TX	0.933
Census Tract 9502, San Augustine County, Texas	San Augustine, TX	0.8566
Census Tract 5, Angelina County, Texas	Lufkin, TX	0.88
Census Tract 6, Angelina County, Texas	Lufkin, TX	0.8399

Census Tract	Nearest City	SVI
Census Tract 9507, Nacogdoches County, Texas	Nacogdoches, TX	0.9627
Census Tract 9508, Nacogdoches County, Texas	Nacogdoches, TX	0.9697
Census Tract 7, Angelina County, Texas	Lufkin, TX	0.9743
Census Tract 10.01, Angelina County, Texas	Lufkin, TX	0.9691
Census Tract 9502, Jasper County, Texas	Jasper, TX	0.7721
Census Tract 2104, Polk County, Texas	Corrigan, TX	0.8107
Census Tract 9, Jefferson County, Texas	Beaumont, TX	0.8706
Census Tract 13.01, Jefferson County, Texas	Beaumont, TX	0.7752
Census Tract 20, Jefferson County, Texas	Beaumont, TX	0.8988
Census Tract 117, Jefferson County, Texas	Beaumont, TX	0.8625
Census Tract 9503, Jasper County, Texas	Jasper, TX	0.942
Census Tract 1.03, Jefferson County, Texas	Beaumont, TX	0.9228
Census Tract 5, Jefferson County, Texas	Beaumont, TX	0.7922
Census Tract 9503, Tyler County, Texas	Woodville, TX	0.7769
Census Tract 64, Jefferson County, Texas	Port Arthur, TX	0.8992
Census Tract 65, Jefferson County, Texas	Port Arthur, TX	0.8871
Census Tract 66, Jefferson County, Texas	Port Arthur, TX	0.8785
Census Tract 101, Jefferson County, Texas	Port Arthur, TX	0.8462
Census Tract 25, Jefferson County, Texas	Beaumont, TX	0.8583
Census Tract 59, Jefferson County, Texas	Port Arthur, TX	0.76
Census Tract 61, Jefferson County, Texas	Port Arthur, TX	0.7719
Census Tract 68, Jefferson County, Texas	Port Arthur, TX	0.794
Census Tract 7105, Chambers County, Texas	Anahuac, TX	0.8017
Census Tract 21, Jefferson County, Texas	Beaumont, TX	0.9076
Census Tract 22, Jefferson County, Texas	Beaumont, TX	0.822
Census Tract 9505, Anderson County, Texas	Palestine, TX	0.8433
Census Tract 9507, Anderson County, Texas	Palestine, TX	0.905
Census Tract 4, Angelina County, Texas	Lufkin, TX	0.8719
Census Tract 9503.01, Nacogdoches County, Texas	Nacogdoches, TX	0.7947

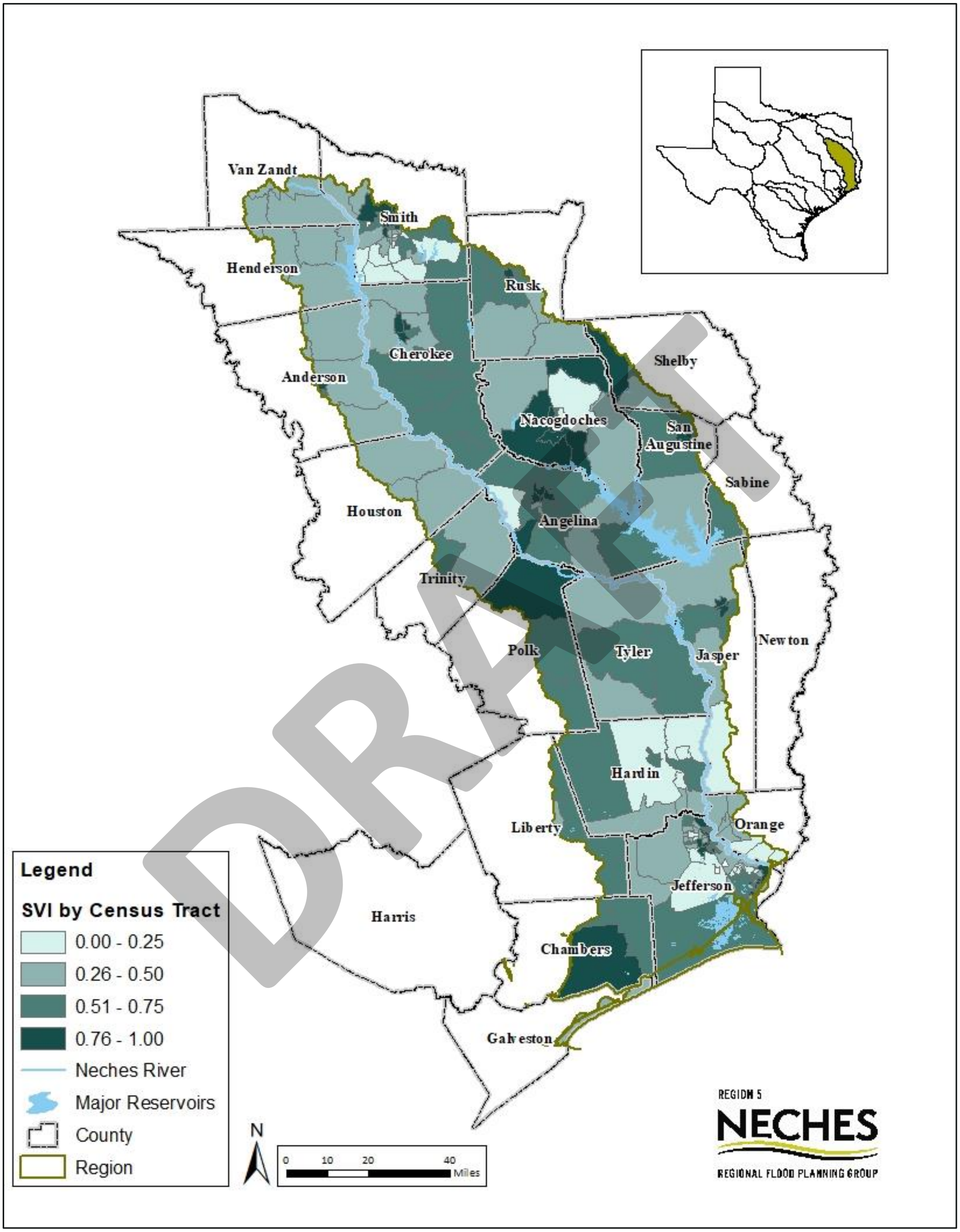


FIGURE 1-8: REGION 5 SVI (CENSUS TRACT)

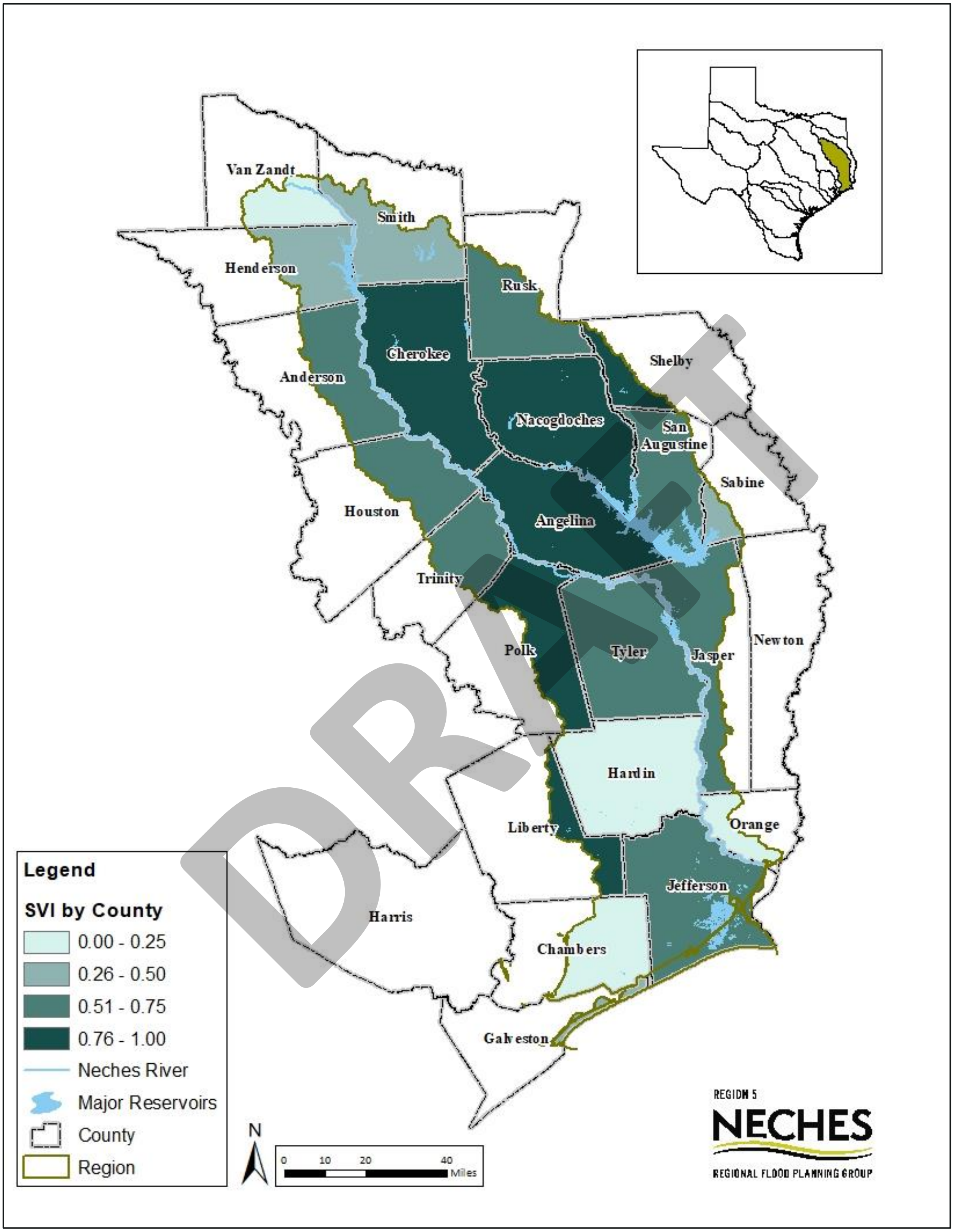


FIGURE 1-9: REGION 5 SVI (COUNTY)

Baseline of Where Growth Intersects with Vulnerability

Population growth within the Neches region was analyzed for high social vulnerability areas. For this analysis, the population growth compared to existing population (2020 – 2050) was determined for census tracts with an SVI of at least 0.50. Census tracts in both Chambers County and the southern portion of Jefferson County are expected to experience high population growth while also scoring above 0.50 on the SVI. Population growth for areas of high vulnerability can be seen in **Figure 1-10.**

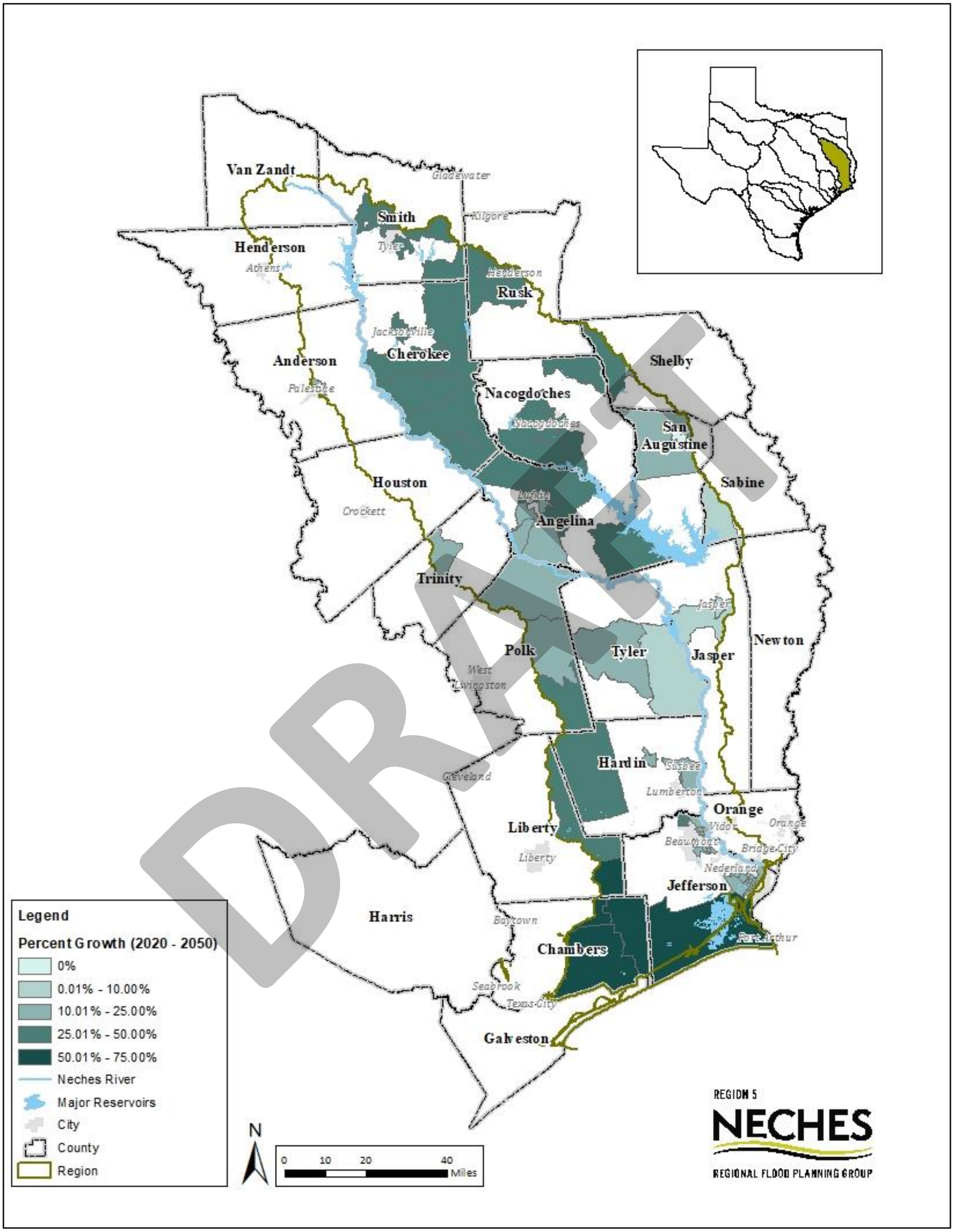


FIGURE 1-10: POPULATION GROWTH IN AREAS OF HIGH VULNERABILITY

1.A.2. Flood Prone Areas & Flood Risks to Life and Property

As Texas seeks to better manage flood risk in order to mitigate loss of life and property from flooding, it is important to establish a baseline of what is known with respect to the area's exposure to flood hazards, as well as the vulnerability of the communities within the Neches River Basin. A multitude of plans, regulations, and infrastructure are currently in place to address flood hazards in Texas. This planning largely takes place at a local level, with variable standards from community to community and lack of available floodplain mapping creating significant challenges in quantifying risk across the region. Flood risks and exposure of life and property to those risks are analyzed and documented further in **Chapter 2**.

1.A.2.a. Types of Major Flood Risks

The primary flood risk types in Region 5 are riverine and pluvial flooding which severely affect the southern portion of the region to include the counties of Chambers, Jefferson, Galveston, and Orange. A secondary flood risk type is tributary creek flash flooding. This flooding type can occur at various locations across the planning area.

1.A.2.b. Identification of Flood Prone Areas

The entirety of Region 5 is covered by Federal Emergency Management Agency (FEMA) Base Level Engineering (BLE) mapping data. Floodplain mapping within Region 5 is also taken from sources including Effective Data, Preliminary Data, and Effective Approximate Data taken from the National Flood Hazard Layer (NFHL). Almost all the mapping data sourced from NFHL is decades old, may not take into consideration recent changes in land use due to development, and often fails to identify flood risks associated with changes in the topography and the environment. Additionally, BLE data does not contain watershed-specific hydrology and hydraulic models. Lastly, it does not consider structures such as roadway crossings, limiting the data's application towards floodplain mapping.

As part of RFP development efforts, the TWDB has provided a "flood quilt," which is a flood dataset compiling various sources of existing statewide flood hazard information. The flood quilt contains flood data from FEMA flood maps, BLE, First American Flood Data Services (FAFDS), Cursory Floodplain Data, and the U.S. Army Corps of Engineers (USACE). In a related effort, the TWDB is actively working to expand the availability of floodplain mapping information in Texas through the development of the aforementioned FEMA BLE data. All watersheds in the Neches region benefit from the availability of BLE data, which was incorporated into the draft Regional Flood Plan.

Identification of possible flood prone areas for this initial plan was originally anticipated to be reliant on public comments accepted via online survey and public meetings hosted at various locations within the region. Due to publicly identified flood prone areas being within the extent of existing floodplain mapping data, the Neches RFPG approved supplementation of additional flood prone areas using flood risk data set prepared by FAFDS and furnished by the TWDB. Using these various data sources, it is estimated that approximately 262 square miles, or 2.3% of the watershed, are within potential flood prone areas.

While much of the flooding occurs outside of population centers, there are an estimated 34,728 properties within the 1% Annual Chance Event (ACE) floodplain across the region. The 1% ACE floodplain is defined as the area of land that is covered in water during a flood event that has a 1% chance of being equaled or exceeded each year. 15 communities have been identified as having 20% or more of their land area located in the 1% ACE floodplain. However, even in undeveloped areas, flooding represents an existing hazard, as well as a constraint to future development. **Chapter 2** of this report catalogues in more detail the people, places, and facilities most impacted by flooding.

1.A.2.c. Rates of NFIP Participation & Flood Related Planning Activities

Approximately 84% of municipalities in Region 5 participate in the National Flood Insurance Program (NFIP). Participation in the NFIP improves a community's prospects for economic recovery in the event of a major flood. However, many communities are using maps that are decades old and may not accurately capture existing flood risk. These maps may not reflect changing patterns of development and often fail to identify flood risks associated with changes in the topography and environment. **Figure 1-11** shows the participating municipalities within the Neches region. All of the counties within the region participate in the NFIP.

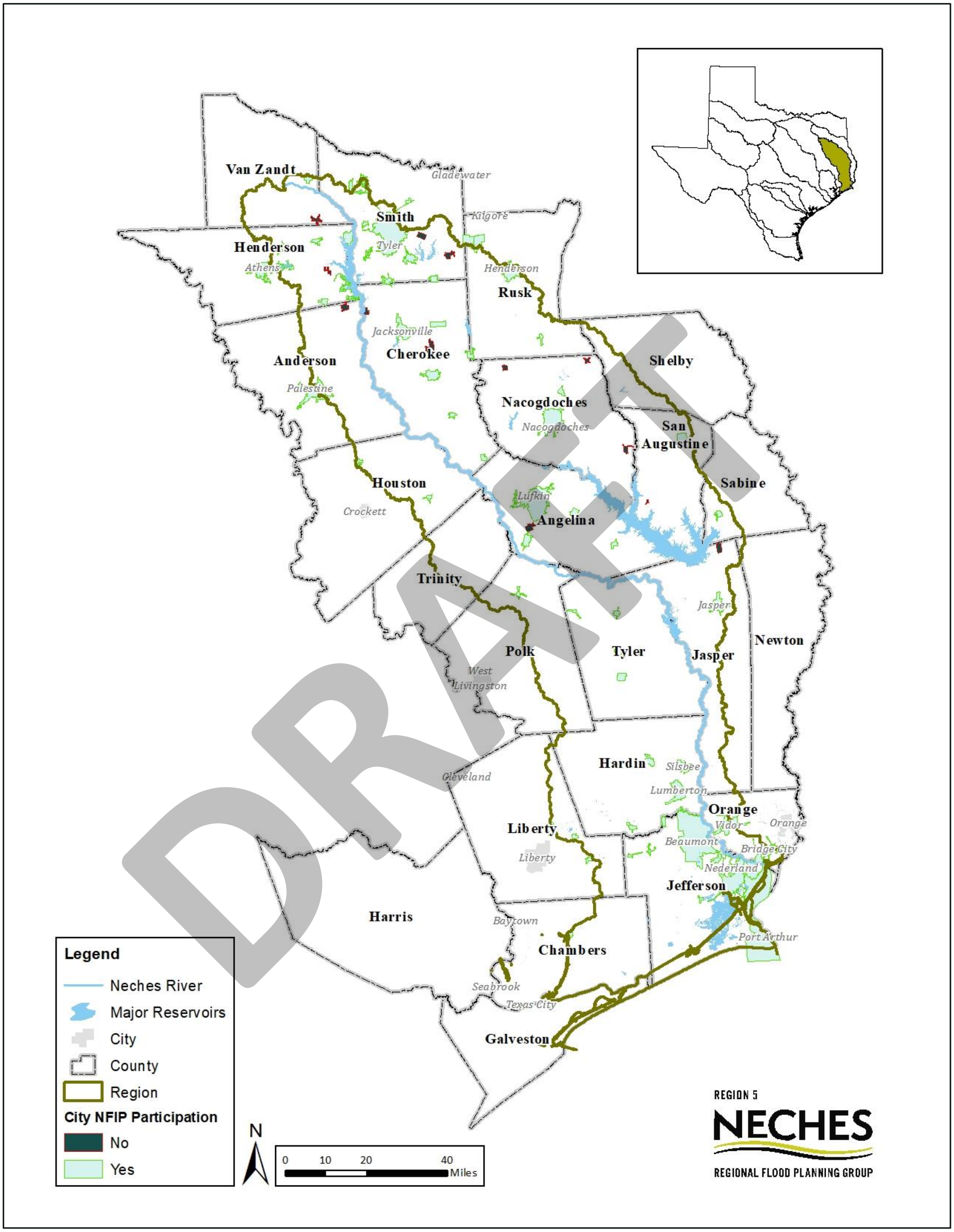


FIGURE 1-11: MUNICIPALITY NFIP PARTICIPATION

1.A.2.d. Critical Assets in Flood Prone Areas

Critical assets within the region include schools, hospitals, fire stations, shelters, nursing homes/assisted care facilities, water and wastewater treatment plants, and facilities associated with petroleum refinement and energy generation. These critical assets and facilities should be given special consideration when formulating regulatory alternatives and floodplain management plans. **Map 7** in **Appendix 2-A** shows a density map of the number of critical facilities across the region. **Table 1-8** provides the number of critical facilities by type within the Neches FPR.

TABLE 1-8: CRITICAL FACILITIES IN REGION 5 BY CATEGORY

Critical Facility	Quantity
Emergency (Fire Stations, Police Stations, Shelters)	111
Infrastructure (All Petroleum and Natural Gas Facilities, Petroleum Refineries, Ethylene Crackers, Airports, Power Plants, Water/Wastewater Treatment Plants)	1,880
Medical (Nursing Homes, Assisted Care Facilities, Hospitals)	47
Schools	333
Other (Strategic Petroleum Reserves)	2

Having these critical facilities affected by flood events compounds the impact flooding has on the community. For example, if emergency and medical facilities are inaccessible during a flood event additional lives are put at risk from lack of access to these services and people inside such facilities may be put at risk. Disruption of key infrastructure facilities such as power plants, airports, petrochemical plants and wastewater treatment plants due to flooding results in power outages, delays in relief efforts due to fuel shortages and closed airports, and potential increased exposure to pathogens due to flooded treaments plants. Additionaly, fuel shortages disrupt national supply chains, resulting in disruption across the nation, highlighting the critical nature of the energy facilities located in the region.

1.A.3. Key Historical Flood Events

1.A.3.a. Historic Events Prior to Current Level of Regulation

The Neches region has a lengthy history of prolific storms and flooding which have caused millions of dollars in damages and a significant number of fatalities. The following section summarizes the most significant storms in the region's history in addition to various losses incurred as a result of these flood events. Although this report does not describe in detail the full list of all major flood events within the region, the events presented in this section are intended to provide a concise overview of the regional character of flooding and its impacts within the Neches region.

May 1884 brought heavy rainfall to the central United States. Little information is available for specific impacts of this storm to the Neches River basin. However, on the Angelina River and its associated tributaries, the peak discharges for this flood were approximated to be 110,000 cubic feet per second (cfs) near Diboll, 125,000 cfs at Evadale, and 130,000 cfs near Lufkin.

The flood of August 1915 originated with heavy rainfall that was primarily centered in the city of San Augustine; around 19.8 inches of rainfall fell on the city within a four-day period. This flood would demonstrate significant impacts downstream, producing the second highest known stage of 34.00 ft at Village Creek near the city of Kountze. The flood also had an estimated peak discharge of 102,000 cfs that was recorded along the Neches River near Evadale. The associated flood stage was estimated to be 1.70 ft lower than the stage recorded during the aforementioned May 1884 flood. The August 1915 flood also set the highest stage of record at the Neches River near Beaumont with a peak stage of 14.0 ft; this would eventually be surpassed by the flooding brought by Hurricane Harvey in 2017.

May 1944 saw heavy precipitation over the Neches River Basin with 16.00 inches, 15.91 inches, and 12.00 inches of rain reported near the communities of Pollok, Jackson Hill, and Flint, respectively. The May 1944 flood is the third highest flood of record at Evadale - a peak discharge near the city was recorded to be 92,100 cfs.

1.A.3.b. Historic Tropical Flooding Events

Hurricane Rita made landfall near Sabine Pass as a Category 3 hurricane on September 26, 2005, severely impacting the Neches River Basin. Hurricane Rita's peak wind speed reached 180 miles per hour (mph) and achieved a minimum pressure of 895 millibars, making it the strongest storm of record in the Gulf of Mexico. (Source: National Weather Service). Storm surge values of 8 to 10 ft were recorded across eastern Jefferson and Orange counties.

Hurricane Ike made landfall on September 13, 2008 near Galveston as a Category 2 hurricane. While Hurricane Ike did not bring record setting rainfall to the basin, the storm's 400-mile-wide tropical storm force wind field produced severe storm surge values, which ranged from 9.3 to 12.5 ft along the coast of Orange County. (Source: National Weather Service). Maximum wind gust in Orange County averaged 96 mph and many communities experienced sustained wind speeds over 70 mph.

Hurricane Harvey made landfall near Port Aransas on August 25, 2017, as a Category 4 hurricane. Orange County received approximately 30-50 inches of rainfall between August 25 and September 1, 2017, flooding over 27,000 homes. Several locations throughout Jefferson County reported 50-60 inches of rain during the event, and almost 90% of the gages maintained by the National Weather Service in southeast Texas reached flood stage. Village Creek near Kountze experienced its highest stage of record of 35.96 ft during the event. The Neches River at Beaumont also reached its record flood stage of 19.59 ft on September 1, 2017. The extreme rainfall resulted in Harvey being the most damaging storm in the region since the NFIP launched in 1968; floods in Orange County resulted in at least ten direct fatalities with five additional fatalities occurring in Jefferson County.

Tropical Storm Imelda made landfall near Freeport on September 17, 2019. The National Ocean Service recorded sustained wind speed of 40 mph with gusts up to 48 mph near Sabine Pass. As the storm stalled over southeast Texas, widespread rainfall amounts exceeding 30 inches were reported across several counties. Tropical Storm Imelda also caused massive amounts of flooding along the I-10 corridor linking the city of Winnie to the Beaumont/Port Arthur area. The National Weather Service estimated that 5,100 homes were flooded in Jefferson County alone with an estimated $14 million in damages caused by the storm in the Neches River watershed.

1.A.3.c. Historic Flooding of Non-Tropical Origin

Severe thunderstorms in East Texas created flooding conditions in the Neches River basin during October and November 2002. Rainfall totals reported by various observers in the affected area totaled from 5 to 12 inches, with the cities of Lumberton and Silsbee each reporting approximately 10 inches of rainfall. The Neches River near Beaumont crested nearly 8 ft with crests of 22.80 ft and 30.59 ft reported at Village Creek near Kountze and Pine Island Bayou at Sour Lake, respectively. In addition, federal disaster declarations were issued for Jasper and Orange Counties.

A series of heavy rainfall events between October 15-22, 2006 initially provided relief during year of abnormally dry conditions in southeast Texas but would eventually lead to floods as rain continued to fall on saturated ground (Source: National Weather Service). Continuous heavy rain especially impacted Tyler, Hardin, and Orange counties – Orange County reported nearly 40 homes destroyed with another 100 damaged, and both Hardin County and Tyler County reported 100 homes damaged each. The Neches River near Beaumont reached a crest of 11.70 ft, and Village Creek near Kountze had a crest of 28.33 ft; this was the third highest crest recorded for the location. Strong coastal winds brought by the storms caused the tides to rise 3-5 ft above normal levels.

1.A.3.d. Damages and Flood Claims

It is worth noting that the majority of impacts from the historic events discussed in the preceding sections were primarily confined to the southern portion of the Neches River watershed. This area of the watershed is regularly impacted by tropical storms, hurricanes and is subject to tidal influence. Major storm events and associated flood claims and damages are reported in **Table 1-9**.

TABLE 1-9: REPORTED FLOOD DAMAGES AND CLAIMS FOR HISTORIC EVENTS IN THE NECHES RIVER BASIN

Name	Year	Total Flood Damages[1]	No. Flood Insurance Claims
Hurricane Harvey	2017	$ 349,487,175	2854
Tropical Storm Imelda	2019	$ 164,231,312	1621
Hurricane Ike	2008	$ 139,486,696	1498
March 16	2016	$ 11,887,622	151
Oct/Nov 2002	2002	$ 2,646,072	142
Oct 2006	2006	$ 2,051,917	70
Hurricane Rita	2005	$ 1,489,080	76

[1]*Dollar values reported in year of historic event occurrence*

Hurricane Harvey was the most destructive historic storm event, as reported by the flood damage value in United States Dollars. It should be noted that for all these events, the actual loss of property is likely much higher than the reported amount as properties without flood insurance at the time of the event are excluded and are not accounted for in the number of claims.

1.A.3.e. Past Casualties and Property Damage

Fatalities, personal injuries, emotional trauma, and loss of wages and revenue also contribute to the total damages experienced by a community during a flood event. The National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Information maintains the Storm Events Database, which documents weather events that result in loss of life, injuries, or significant property damage. In the Neches River Basin, there have been a total of 34 losses of life and 18 injuries reported as being direct results of a flood event. **Table 1-10** provides a summary of events, deaths, and injuries documented by NOAA from 1999-2020.

TABLE 1-10: FLOOD RELATED FATALITIES AND INJURIES

Event	Location	Event Type	No. Fatalities	No. Injuries
Hurricane Laura (2020)	Sabine County	Hurricane	1	0
Tropical Storm Imelda (2019)	Jefferson County	Flash Flood	3	0
Hurricane Harvey (2017)	Bridge City, TX	Flash Flood	10	0
	Chester, TX	Flash Flood	1	0
	Griffing, TX	Flash Flood	5	1
April 2016	Palestine, TX	Flash Flood	6	0
	Deanwright, TX	Flash Flood	1	0
December 2015	Thedford, TX	Flash Flood	0	1
March 2012	Bridge City, TX	Flood	1	0
June 2010	Swan, TX	Flash Flood	0	1
Hurricane Ike (2008)	Smith County	Tropical Storm	1	0
	Trinity County	Hurricane (Typhoon)	1	0
Hurricane Humberto (2007)	Jefferson County	Hurricane (Typhoon)	0	12
	Orange County	Hurricane (Typhoon)	1	0
May 2006	Fannett, TX	Flash Flood	1	0
Hurricane Katrina (2005)	Galveston County	Hurricane (Typhoon)	0	3
	Angelina County	Hurricane (Typhoon)	1	0
October 2002	Beaumont, TX	Flash Flood	1	0

Source: NOAA NCEI Storm Events Database

1.A.3.f. Past Losses for Farming & Ranching

There is a substantial presence of rice, sorghum, soybeans, and wheat cultivated within the Neches region. The cumulative reported losses to crops due to flooding in the region since 1990 amounted to over $18 million as reported by the USDA Risk Management Agency. The USDA Cause of Loss historical data files are summarized in **Table 1-11** which shows the crop damages by county within the Neches River basin region since 2000. These crop losses are additionally shown in a regionwide map in **Figure 1-12.**

TABLE 1-11: TOTAL CROP DAMAGE VALUE BY COUNTY (TABLE)

County	Years of Loss	Indemnity Amount
Anderson	2011, 2015	$28,873.03
Chambers	2003, 2005, 2007, 2008, 2017, 2018, 2019, 2020	$7,733,789.79
Galveston	2005, 2017, 2018	$162,921.00
Hardin	2020	$35,772.00
Harris	2000, 2008	$87,453.40
Houston	2008, 2017, 2018, 2020	$2,079,102.60
Jefferson	2001, 2005, 2006, 2007, 2008, 2017, 2018, 2019, 2020	$7,577,956.48
Liberty	2005, 2008, 2019	$1,071,156.00
	TOTAL	**$18,777,024.30**

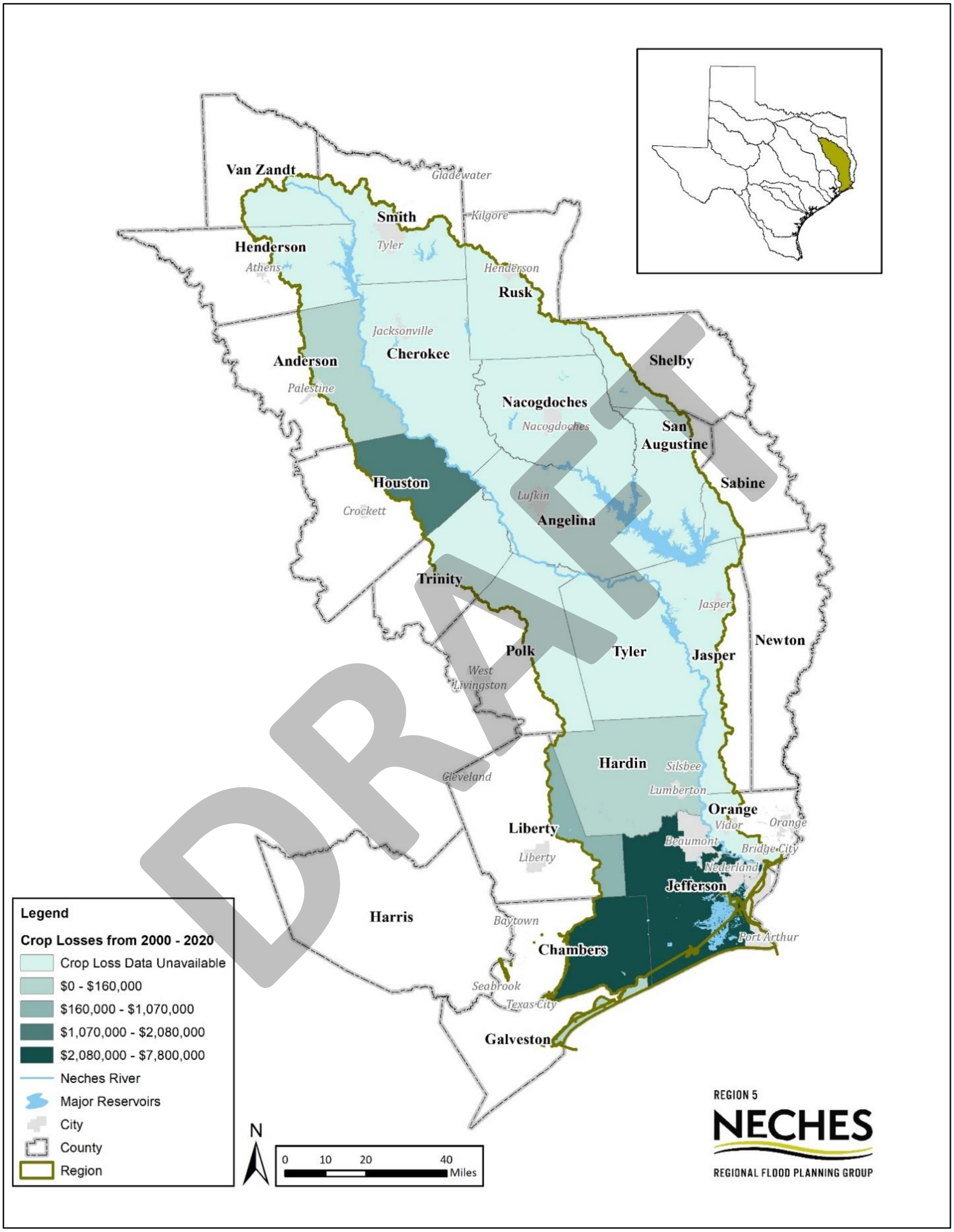


FIGURE 1-12: CROP LOSSES (2000 – 2020) WITHIN REGION 5

1.A.4. Political Subdivisions with Flood Related Authority

State guidelines for "Flood Protection Planning for Watersheds" define political subdivisions with flood related authority as cities, counties, districts, or authorities created under Article III, Section 52, or Article XVI, Section 59, of the Texas Constitution. In addition, any other political subdivision of the state, any interstate compact commission to which the state is a party, and any nonprofit water supply corporation created and operating under Chapter 67 can also be considered political subdivisions with flood related authority. State law also provides for limited purpose Water Supply & Utility Districts, known variously as Municipal Utility Districts, Municipal Water Districts, Fresh Water Supply Districts, Water Control and Improvement Districts, and Special Utility Districts. These districts may be located in or adjacent to cities or their respective counties and may be involved in the reclamation and drainage of its overflowed land.

Of the political subdivisions referred to above, the majority found within the Neches region are municipal or county governments. The data collection effort for the RFP identified 79 cities and 24 counties within the region. An additional 8 entities with varying degrees of potential authority were identified. Additional detail is provided in **Table 1-12**.

TABLE 1-12: POLITICAL SUBDIVISIONS WITH FLOOD-RELATED AUTHORITY

Type of Political Subdivision	Number of Jurisdictions	NFIP Participants
Municipality	79	66
County	24	24
River/Watershed Authorities & Drainage Districts	8	N/A

In the Neches FPR, the vast majority of eligible entities participate in the NFIP. For political entities that participate in the NFIP program, Texas Water Code §16.315 requires them to adopt a floodplain management ordinance and to designate a floodplain administrator who will be responsible for understanding and interpreting local floodplain management regulations and reviewing them for compliance with NFIP standards.

1.A.5. Extent of Local Regulations & Development Codes

Using policies and regulations to reduce the exposure of people and properties to flood risk are forms of non-structural flood control. Communities can reduce the likelihood and extent of damages to new development by avoiding developing in flood prone areas altogether. Alternatively, precautions can be taken including but not limited to increasing building elevation and preserving overflow areas through buffering and avoiding sensitive natural areas such as wetlands.

Along the coastal region of the Neches River Basin, a majority of cities and counties have additional regulations in place. Recent historical flooding events have also caused increased public awareness for these issues. In the upper portion of the basin in rural cities and counties, regulations are less stringent but in some cases do exceed the minimum requirements set forth to be an NFIP participant. The Neches River Basin has three major cities outside of the coastal region – Lufkin, Tyler, and Nacogdoches. Each entity has adopted their own version of advanced regulations to try and achieve the goals previously mentioned.

1.A.6. Agricultural and Natural Resources Most Impacted by Flooding

Flood events can have an adverse impact on both the agricultural and natural resources of the Neches region. The Neches region contains land that is utilized for crops, grazing lands, timber, and wildlife management areas. As this region lies primarily within the Piney Woods Region, over 60% of the total agricultural acreage is utilized for timber production. The other major function of these lands is for grazing pastures which covers over 1.8 million acres. **Table 1-13** details the area of the Neches region that is divided into use for farming, forestry, ranching, or otherwise utilized for urban development.

TABLE 1-13: REGIONAL LAND USE SUMMARY

Land Use	Total Area in Region (Sq. Mi.)	Total Area in Region at Risk of Flooding (Sq. Mi.)
Farming	1,161	629
Forestry	7,138	2,313
Ranching	2,280	572
Urban Development	823	197

Source: Task 2A Existing Flood Hazard & USDA Land Use Agriculture

Economic factors most at risk within the Neches region include but are not limited to timber, ecosystem health, petroleum resources (oil and gas production, petroleum refining, and ethylene crackers), and farming (sorghum, rice, soybeans, and corn).

1.A.6.a. Farming

Flooding or excess precipitation can impact cropland in several ways including rapid direct damage to crops or long-term impacts through soil erosion and soil nutrient losses. The severity of impact flooding has on farming depends on a broad range of factors including the crop type and timing of storm events relative to planting or crop growth stage. Additionally, the stage of growth of a crop influences the susceptibility to damage due to excess water. Different crops have different resiliency to excess precipitation and prolonged standing water. Permanent crops, such as fruit trees, tend to be more resilient to excess precipitation and standing water than row crops such as cotton. Heavy rain prior to planting could delay planting or prevent planting entirely. Damage can also occur after a crop has been harvested. Crops such as hay or cotton that have been harvested but not baled or processed can be degraded by heavy rainfall in the region.

1.A.6.b. Forestry and Timber

Flooding can impact forestry in a number of ways. Flash flooding can bring swiftly moving debris that can physically wound trees and create conditions for contaminated flood water to introduce diseases. Additionally, sustained flooded conditions can deplete the soil oxygen supply and cause root damage. (Source: Texas A&M Forest Service). Forestry within the Neches Flood Planning Region is primarily oriented towards pine plantations that include loblolly and long-leaf pine species. Flooding can suppress the productivity of these plantations and thus result in negative impacts to both the local economy and other natural resources. However, flooding can also have a positive effect on forestry within the region by clearing weaker trees, spreading seeds, and stimulating growth of surviving trees. (Source: University of Arkansas Agriculture Research & Extension). Certain hardwood trees in the Neches region benefit from floods, a couple of notable examples being black tupelo and cypress trees.

According to the Texas A&M Forest Service, there are over 4.4 million acres of forest land in the Neches region, which represents 61.2% of the total land area. Timber production and the manufacturing of forest resources generate $3.2 billion annually across the Neches region and supports 9,961 people in directly related employment. **Table 1-14** below shows a breakdown of the timber related industry output per county.

TABLE 1-14: TIMBER PRODUCTION AND MANUFACTURING: ECONOMIC IMPACT

County	Total Forestry Direct	Direct
Polk	$648,120,000	1,894
Jasper	$462,060,000	762
Orange	$358,650,000	557
Angelina	$260,860,000	862
Nacogdoches	$238,000,000	789
Hardin	$221,900,000	614
Cherokee	$186,710,000	793
Smith	$174,220,000	545
Rusk	$137,330,000	635
Sabine	$130,780,000	389
Anderson	$84,190,000	269
Tyler	$55,520,000	291
Jefferson	$65,170,000	409
Shelby	$57,220,000	344
San Augustine	$40,140,000	142
Van Zandt	$30,720,000	195
Liberty	$25,860,000	164
Trinity	$11,490,000	176
Houston	$10,370,000	76
Henderson	$7,630,000	55
TOTALS	**$3,206,940,000**	**9,961**

Source: Texas A&M Forest Service, *https://texasforestinfo.tamu.edu/;*

In addition to resource extraction and manufacturing, forest lands in the Neches region also generate measurable economic ecosystem services. Estimates developed by the Texas A&M Forest Service measure value for a range of ecosystem services including air quality, biodiversity, carbon sequestration, cultural value, and watershed benefits. Estimates for the combined total annual value of ecosystem services is nearly $10 billion per year, as shown in **Table 1-15.**

TABLE 1-15: ECONOMIC VALUE OF SELECTED FOREST ECOSYSTEM SERVICES

Ecosystem Service	Rural Value ($)	Urban Value ($)	Total Value ($)
Air Quality	$93,800	$15,248,000	$15,341,800
Biodiversity	$1,059,818,700	$11,243,700	$1,071,062,400
Carbon	$406,704,600	$2,735,500	$409,440,100
Cultural	$5,013,482,600	$69,760,500	$5,083,243,100
Watershed	$3,326,940,600	$83,755,200	$3,410,695,800
Totals	**$9,807,040,300**	**$182,742,900**	**$9,989,783,200**

Source: Texas A&M Forest Service, Texas Forest Information Portal, https://texasforestinfo.tamu.edu/forestecosystemvalues/, 4/21/2022

Distribution of total annualized forest ecosystem services value is most concentrated in the central basin and diminishes moving south in the basin, as shown in **Figure 1-13**.

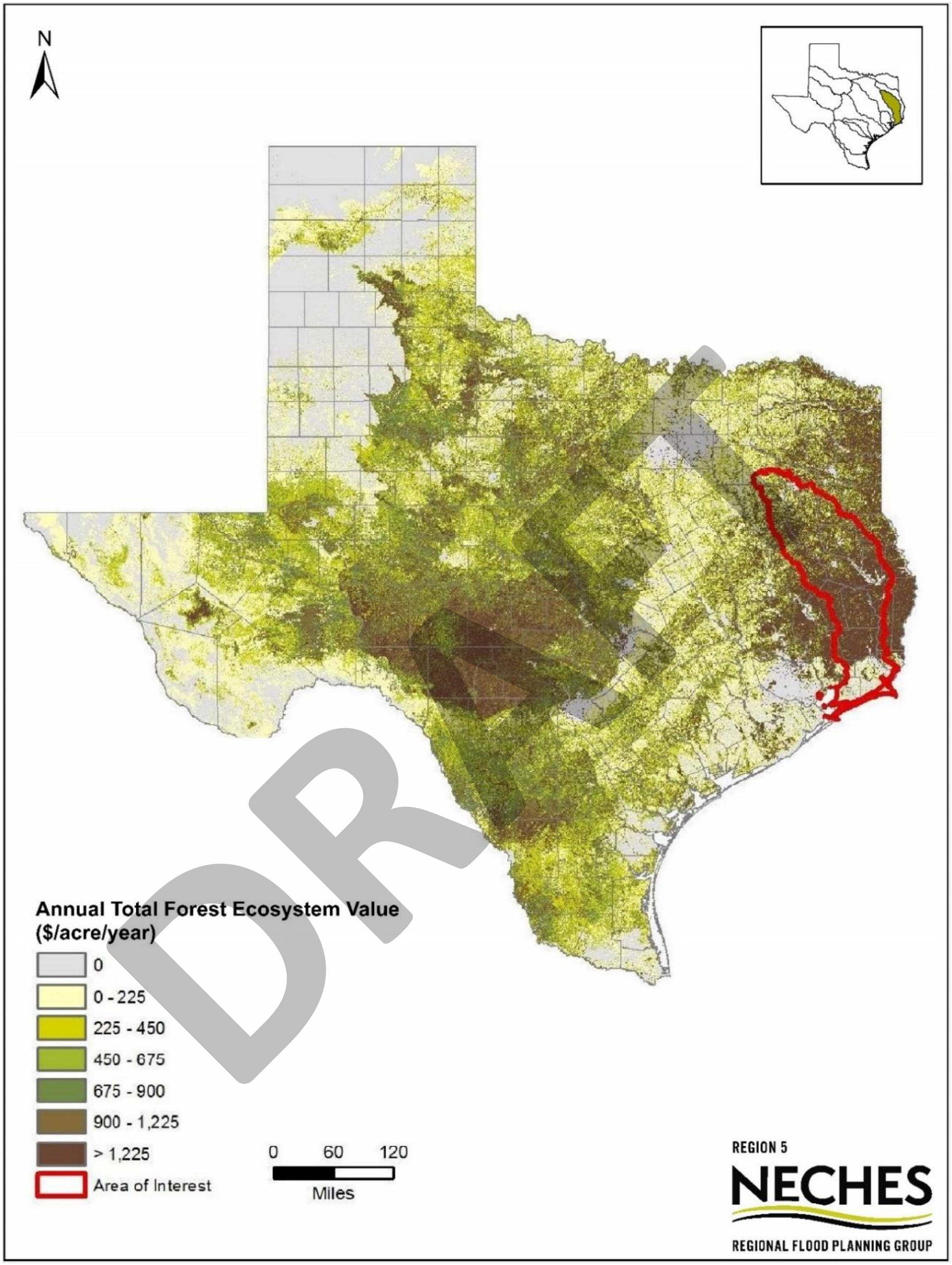


FIGURE 1-13: DISTRIBUTION OF FOREST ECOSYSTEM BENEFIT IN REGION 5

Source: Texas A&M Forest Service, Texas Forest Information Portal, https://texasforestinfo.tamu.edu/forestecosystemvalues/, 4/21/2022.

1.A.6.c. Ranching

Ranching activities in the region are also impacted by flooding. Livestock can be swept away, drowned, or injured by flash floods. Livestock exposed to contaminated flood waters can experience health issues such as pneumonia or foot rot and may additionally be exposed to disease carrying mosquitoes. Prolonged flood events and impacts can cause further challenges to the ranching sector by causing delays in building back livestock herds or limiting the availability of accessible and usable forage. (Source: Texas A&M AgriLife Extension)

Unknown numbers of cattle were reported to have drowned in the floods associated with Hurricanes Imelda, Harvey, and Ike. The areas that have experienced this impact the most include areas in Jefferson, Hardin, Jasper, and Tyler counties. Emergency management operations to aid cattle during severe flooding events have been conducted, one such example being a helicopter drop of cattle feed to herds that were stranded in pastures with limited high ground.

In the southernmost portion of the basin, hurricane storm surge related flooding can impact the soil chemistry of grassland pastures. Although this impact from flooding is temporary, the salinity of the flood waters can increase the alkalinity of the soil and suppress future vegetation growth during a seasonal cycle.

1.A.6.d. Natural Resources

The Neches FPR contains many natural resources that can be negatively impacted by flood events. As with livestock, wildlife can be injured or killed by flash floods. Severe flood conditions can degrade stream health and impact ecosystems in the region by potentially introducing contaminated runoff from nearby sites. Oil and gas extraction can also be interrupted by flood conditions – severe weather events can hamper and/or shut down operations and roadways becoming inundated can present major issues for transportation of materials to and from oil extraction sites. However, it is also possible for floods to carry nutrients that can replenish soil fertility and maintain biodiversity in select ecosystems in the region.

1.A.7. Existing Flood Planning Documents

This section will provide insight into the regulatory and policy environment governing floodplain management in the various jurisdictions of the Neches region. Flood risk across the region is managed through regulations and ordinances as a form of non-structural flood control. Current regulations and development codes include floodplain ordinances, building & design standards, and zoning & land use policies. The number of entities that use these practices is detailed in **Table 1-16** with **Table 1-17** showing the number of entities that have adopted regulations that exceed minimum standards set by the NFIP.

1.A.7.a. Floodplain Ordinances

Floodplain Ordinances regulate development and the impact it has on a community's floodplain. Community regulations are based on FEMA-provided flood hazard information. Participation in the NFIP ensures regulations properly consider flood hazards. Some entities also consider Base Flood Elevations (BFEs) as a regulation criterion. In Region 5, 66 municipalities and 24 counties have been determined to utilize adopted ordinances to regulate floodplain development by virtue of their participation in the NFIP.

The most common regulation format is the Flood Damage Prevention Order (for counties) and Flood Damage Prevention Ordinance (for cities). These documents are based on a standard NFIP-provided template which establish who is affected, why the program is necessary, and what constitutes the 100-year flood. Additionally, the NFIP template also addresses statutory authorization, general provisions, administration, and provisions for flood hazard reduction. By definition or unless otherwise specified, these floodplain regulations only apply to development in Special Flood Hazard Areas as defined on FEMA Flood Insurance Rate Maps.

1.A.7.b. Building and Design Standards

Most incorporated cities in the Neches region have adopted various forms of building code, with the most common examples being the International Building Code (IBC). County jurisdictions in the Neches region do not have set building codes for residential and commercial structures, but most have adopted subdivision regulations and septic-site approval mechanisms.

Adopted drainage criteria set the minimum standards development must follow prior to the approval of new construction plans. Drainage criteria in the region are typically adopted by municipalities but are also used by counties and levee improvement districts. Requirements that are common in the region include mitigating downstream impacts and changes to existing floodway boundaries and requiring elevation certificates prior to forming/pouring slabs. Some entities require stormwater detention to mitigate development impacts; other entities can require no rise certification for development within the floodway. Additionally, entities in the region may require developers to conduct studies to determine BFE prior to design approval. For Region 5, Jefferson County Drainage Districts 6 and 7 provide design criteria or drainage design manuals to mitigate flood risk.

1.A.7.c. Zoning and Land Use Policies

Planning and zoning ordinances regulate acceptable types of land uses within a community. Zoning policies promote appropriate development, safety, and general welfare. Communities establish conservation easements and minimum setbacks from wetlands within land use codes to promote sustainable and resilient development.

Currently 9 municipalities in the Neches region utilize zoning as a land use policy to guide future development.

1.A.7.d. Local and Regional Flood Plans

Local and regional flood plans analyze a community’s flood risk and present how that entity will improve its resiliency. Drainage master plans describe a community’s physical and institutional planning environment and establish interjurisdictional roles and responsibilities when many drainage entities are present. Exploratory committees comprised of regional counties can also use capital improvement plans (CIPs) to identify capital project alternatives to potentially establish drainage districts covering a broader geographic area.

In the Neches region, 69 entities have adopted local flood plans, master drainage plans, or hazard mitigation plans.

TABLE 1-16: ENTITIES WITH FLOODPLAIN REGULATIONS

Type of Regulation	Number of Institutional Entities
Drainage Districts/Criteria/Design Manual	4
Land use regulations / Subdivision Development Requirements	101
Ordinances (Floodplain, Drainage, Stormwater, etc.)	101
Unified Development Code (UDC) and/or Zoning Ordinance with map	9

Source: Neches RFP Survey Responses and TWDB NFIP Resources

TABLE 1-17: ENTITIES WITH STANDARDS HIGHER THAN NFIP MINIMUM

NFIP Higher Standard Required	Number of Institutional Entities
Above current base flood elevation (BFE)	60
BFE + 1 foot (current 100-year conditions)	9
BFE + 2 ft (current 100-year conditions)	5
BFE + 2 ft (future 100-year conditions)	1
BFE + 2 ft (current 500-year conditions)	1

1.A.7.e. Previous and Ongoing Flood Studies

Local and regional flood plans analyze a community's flood risk and present how that entity will improve its resiliency. Flood studies are critical in defining flood risk, ascertaining the extent of existing risk, and recommending options and measures to manage and mitigate risk. These studies can be executed at various levels ranging from localized drainage studies to regional flood studies. Drainage master plans describe a community's physical and institutional planning environment and establish interjurisdictional roles and responsibilities when many drainage entities are present. **Table 1-18** lists previous flood studies considered to be relevant to development of the Neches RFP. **Table 1-19** lists ongoing flood studies also considered to be of value to the development of the RFP.

TABLE 1-18: PREVIOUS FLOOD STUDIES

Flood Study	Sponsor	Location	Date
Anderson County FIS	FEMA	Anderson County	2010
Anderson County Hazard Mitigation Plan	Anderson County	Anderson County	2018
Angelina County FIS	FEMA	Angelina County	2010
Angelina County Hazard Mitigation Plan	Angelina County	Angelina County	2018
City of Beaumont Master Drainage Plan	City of Beaumont	City of Beaumont	2019
Chambers County FIS	FEMA	Chambers County	2018
Chambers County Hazard Mitigation Plan	Chambers County	Chambers County	2017
Chambers County Master Drainage Plan (Volume I)	Chambers County	Chambers County	2014
Chambers County Master Drainage Plan (Volume II)	Chambers County	Chambers County	2014
Cherokee County FIS	FEMA	Cherokee County	2011
Cherokee County Hazard Mitigation Plan	Cherokee County	Cherokee County	2020
City of Nacogdoches Flood Control Study	City of Nacogdoches	City of Nacogdoches	2010
City of Tyler Master Drainage Study	TWDB	City of Tyler	2008
Hardin County – Lumberton Drainage Study	Lumberton/Hardin County	Lumberton/Hardin County	2016
Hardin County FIS	FEMA	Hardin County	2010
Henderson County FIS	FEMA	Henderson County	2010
Henderson County Hazard Mitigation Plan	Henderson County	Henderson County	2020
Houston County FIS	FEMA	Houston County	2011
Jasper County FIS	FEMA	Jasper County	2010
Hazard Mitigation Plan Update	Jefferson County Drainage District 6	Jefferson County	2016
Hazard Mitigation Plan Update	Jefferson County Drainage District 7	Jefferson County	2018
JCDD7 Master Drainage Plan	Jefferson County Drainage District 7	Jefferson County	2019
Jefferson County FIS	FEMA	Jefferson County	2002
Liberty County FIS	FEMA	Liberty County	2018
Liberty County Hazard Mitigation Plan	Liberty County	Liberty County	2017
Nacogdoches County FIS	FEMA	Nacogdoches County	2010
Orange County FIS	FEMA	Orange County	2014
OCDD Hazard Mitigation Plan	Orange County Drainage District	Orange County	2017
Flood Protection Planning Study – Cow Bayou and Adams Bayou	TWDB, Orange County Drainage District	Orange County	2015

Flood Study	Sponsor	Location	Date
Flood Protection Planning Study – Hurricane Flood Protection System	TWDB, Orange County, Orange County EDC	Orange County	2012
OCDD Drainage Criteria Manual and Regulations	Orange County Drainage District	Orange County	2020
OCDD Master Drainage Plan	Orange County Drainage District	Orange County	2020
City of Port Arthur Disaster Recovery Plan	City of Port Arthur	City of Port Arthur	2018
Polk County FIS	FEMA	Polk County	2010
Polk County Hazard Mitigation Plan	Polk County	Polk County	2018
Polk County Multi-Jurisdiction Hazard Mitigation Plan	Polk County	Polk County	2018
Rusk County FIS	FEMA	Rusk County	2010
Multi-Jurisdiction Hazard Mitigation Plan	San Augustine County	San Augustine County	2018
San Augustine Hazard Mitigation Plan	San Augustine County	San Augustine County	2018
Smith County Hazard Mitigation Plan	Smith County	Smith County	2018
Trinity County Hazard Mitigation Plan	Trinity County	Trinity County	2019
Tyler County FIS	FEMA	Tyler County	2011
Van Zandt County FIS	FEMA	Van Zandt County	2010
Van Zandt County Hazard Mitigation Plan	Van Zandt County	Van Zandt County	2019
Lower Angelina Watershed Hydraulic Analysis (BLE)	FEMA	Angelina County, Jasper County, Nacogdoches County, Newton County, Rusk County, Sabine County, San Augustine County, Shelby County	2019
Lower Neches Watershed Hydraulic Analysis (BLE)	FEMA	Angelina County, Hardin County, Jasper County, Jefferson County, Orange County, Tyler County,	2019
Middle Neches Watershed Hydraulic Analysis (BLE)	FEMA	Angelina County, Cherokee County, Houston County, Jasper County, Polk County, Trinity County, Tyler County	2019

Flood Study	Sponsor	Location	Date
Pine Island Bayou Watershed Hydraulic Analysis (BLE)	FEMA	Hardin County, Jefferson County, Liberty County, Polk County	2019
Upper Angelina Watershed Hydraulic Analysis (BLE)	FEMA	Angelina County, Cherokee County, Nacogdoches County, Rusk County, Smith County	2019
Upper Neches Watershed Hydraulic Analysis (BLE)	FEMA	Anderson County, Cherokee County, Henderson County, Houston County, Smith County, Van Zandt County	2019
Sabine Pass to Galveston Bay, Texas Pre-Construction, Engineering and Design – Hurricane Coastal Storm Surge and Wave Hazard Assessment	USACE/ERDC	Brazoria County, Jefferson County, Orange County	2020
Coastal Texas Protection and Restoration Feasibility Study	USACE, GLO	Gulf Coast (to include Orange County)	2020
Sabine Pass to Galveston Bay, Texas Coastal Storm Risk Management and Ecosystem Restoration	USACE, GLO	Gulf Coast (to include Orange County)	2020
Village Watershed Hydraulic Analysis (BLE)	FEMA	Hardin County, Polk County, Tyler County	2019
IH-10 Hydraulic Analysis and Resilience Assessment	Texas Department of Transportation (TxDoT)	Jefferson County, Chambers County, Orange County	2020
State Flood Assessment	TWDB	Neches Flood Planning Region	2019
Texas Integrated Flooding Framework Planning Project	TWDB, USACE, USGS	San Augustine County, Sabine County, Newton County, Polk County, Tyler County, Jasper County, Hardin County, Liberty County, Orange County, Jefferson County, Chambers County, Galveston County	2020

TABLE 1-19: ONGOING FLOOD STUDIES

Flood Study	Sponsor	Location	Date
Chambers County FIF Study	TWDB	Chambers County	2024
City of Silsbee Flood Protection Planning	TWDB	Hardin County	TBD
Jefferson County Drainage District No. 6 Regional Watershed Study	Jefferson County Drainage District 6	Jefferson County	2024
Orange County Watershed Study (Anderson Gully, Tiger Creek, Caney Creek, Tenmile Creek)	Orange County Drainage District	Orange County	TBD
Combined River Basin Flood Study	Texas General Land Office (GLO)	San Augustine County, Sabine County, Newton County, Polk County, Tyler County, Jasper County, Hardin County, Liberty County, Orange County, Jefferson County, Chambers County, Galveston County	2024
Southeast Texas Flood Coordination Study	Lamar University		TBD
Interagency Flood Risk Management (InFRM) Study	FEMA, USACE, USGS, NWS	Texas	TBD

Chapter 1.B. Assessment of Flood Infrastructure

The following RFP subsections provide an overview of natural and constructed flood infrastructure in the Neches Flood Planning Region (Neches FPR) that contribute to lowering the flood risk. Flood infrastructure in the region includes both natural areas and built features which are owned and managed by stakeholders ranging from the Texas Parks and Wildlife Department to individual farmers and ranchers. This plan considers both the natural and constructed features that contribute to risk reduction, which may include:

- rivers and tributaries, and functioning floodplains
- wetlands
- playa lakes
- sinkholes
- alluvial fans
- vegetated dunes
- levees
- sea barriers, walls, and revetments
- tidal barriers and gates
- stormwater tunnels
- stormwater canals
- dams that provide flood protection
- detention and retention ponds
- weirs
- storm drain systems
- stormwater pumps

TWDB provided several data sources to assist with the identification of flood management infrastructure in the Flood Data Hub. There were also questions posed in the data collection survey that were used to complement the information provided by existing data sources to create a more complete pictures of how communities in the region protect themselves from flood risk.

A comprehensive inventory of existing flood infrastructure is provided in **Appendix 1-B**. This inventory serves as the basis for several tables, charts, and summary figures provided in this section. Due to the scale of this assessment, the RFP includes only major flood infrastructure such as regional detention facilities, but not minor elements such as small stock ponds servicing individual properties. A series of maps have been provided showing the location of different types of flood infrastructure within the region. **Map 1**, which details existing flood infrastructure in the region, is presented in **Appendix 1-A**.

1.B.1. Natural Features

1.B.1.a. Rivers, Tributaries and Functioning Floodplains

The Neches region covers an area of approximately 11,452 square miles containing approximately 9,673 stream miles. Within the region are three major river basins that include the Neches River, the Angelina River, and the Pine Island Bayou basins. Rivers were compiled using the National Hydrologic Dataset (NHD) layer. Functioning floodplain is a broad term used to describe a natural area susceptible to flooding that provides a broad range of ecological and hydrological functions, including the flood storage, water quality maintenance, and groundwater recharge. Functioning floodplain areas were compiled using the NHD dataset. Watersheds that have substantial areas within the Neches region are shown in **Figure 1-14.**

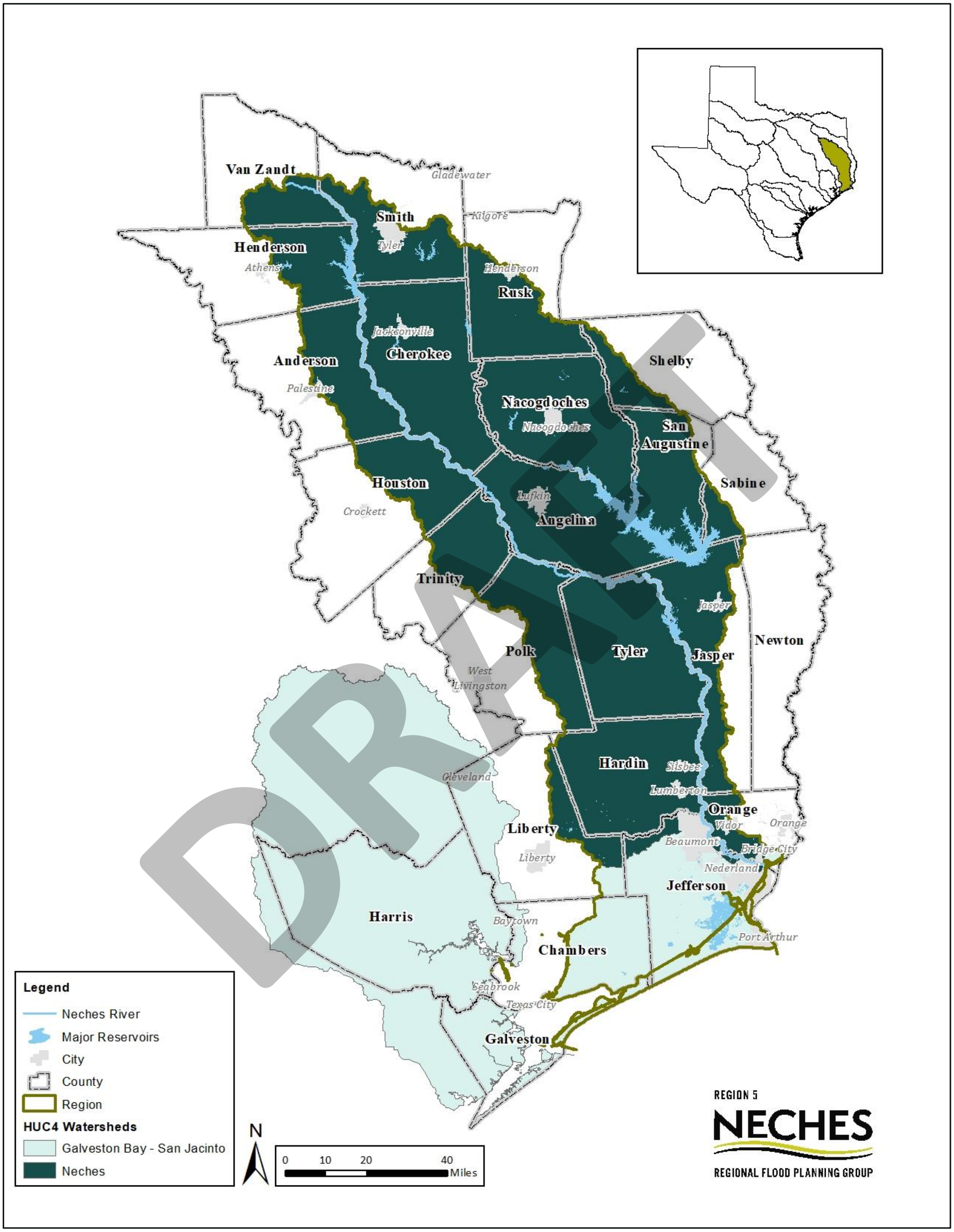


FIGURE 1-14: MAJOR WATERSHEDS WITHIN REGION 5

1.B.1.b. Wetlands and Marshes

A wetland is an ecosystem that is flooded by water, either permanently, seasonally, or after discrete rainfall events. Wetlands provide an important ecosystem for aquatic plants and animals, as well as significant flood storage. The Neches region contains over 236,000 acres of freshwater wetlands. Wetland features were compiled from the US Fish and Wildlife Service's Nation Wetlands Inventory Mapper.

1.B.1.c. Parks, Preserves, and Other Natural Areas

Parks and preserves are included in the flood infrastructure assessment as they include essential components for the infiltration and retention of stormwater during and after a rainfall event. These types of natural flood infrastructure are generally located within or adjacent to floodplain areas throughout the basin with higher concentrations of them being located along or close to major rivers.

Information on parks, preserves, and other natural areas were compiled from various sources. Parks within the Neches region include four state parks, eleven wildlife management areas, one USACE reservoir, three national forests and one Wildlife Preserve. State parks within the Neches region make up around 8,000 acres of land. The one wildlife preserve present within the region is the Big Thicket National Preserve, which accounts for nearly 110,000 acres of land.

1.B.1.d. Coastal Areas

Estuaries denote places of transition between riverine and maritime environments. The Sabine-Neches Estuary, commonly referred to as Sabine Lake, covers approximately 45,320 acres and receives close to 14 million acre-feet of freshwater inflow from both the Sabine and Neches Rivers. Although the Sabine-Neches Estuary is the smallest of Texas' seven major estuaries, it still supports extensive coastal wetland ecosystems and is connected to the Gulf of Mexico via Sabine Pass, which acts as a tidal inlet.

1.B.2. Constructed Flood Infrastructure and Structural Protections

A vast number of stormwater features have been constructed across Texas, ranging from major flood control infrastructure such as reservoirs, dams, and levees, to municipal drainage systems comprised of constructed channels and ditches, closed storm drain systems, and detention and retention ponds. Each of these elements plays an important role in protecting Texas communities from flooding.

1.B.2.a. Dams, Reservoirs, Levees, and Weirs

Reservoirs and their associated dams and weirs in Texas may serve one or more purposes, including recreation, flood risk mitigation, irrigation, water supply, and fire protection. Information on major reservoirs for the RFP analysis was compiled from the TWDB dataset. Twelve major reservoirs (**Table 1-20**) were identified in the Neches FPR, one of which had a known flood protection function. Each major reservoir is shown and labeled in **Figure 1-15.**

Several other dams were identified on smaller impoundments across the region, compiled from multiple datasets. While many of the dams across the region were constructed by the National Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service, the origin and purpose of most of the other dams are not well documented. As a result, all identified dams have been included as part of the RFP analysis inventory since they potentially serve a flood protection function. Overall, there were 338 dams identified. There were no individual weir structures identified from any open-source datasets, but it is understood that dam spillways operate as weirs during overtopping events.

Levees are man-made embankments that artificially contain flood flows to a restricted floodplain. More than one million Texans and $127 billion dollars' worth of property are protected by levees. There were various levees found throughout the region, but the largest one identified is the Port Arthur Hurricane Flood Protection System located in the vicinity of Port Arthur, TX.

TABLE 1-20: LIST OF MAJOR RESERVOIRS IN REGION 5

Lake/Reservoir	Location	Surface Acres	Normal Impoundment Capacity (Acre-Feet)
Lake Athens	Henderson County	1,799	29,475
Lake B.A. Steinhagen	Town Bluff, TX	10,235	69,259
Lake Jacksonville	Jacksonville, TX	1,164	26,732
Lake Kurth	Lufkin, TX	726	14,769
Lake Nacogdoches	Nacogdoches, TX	2,212	39,523
Lake Palestine	Frankston, TX	23,112	367,312
Pinkston Lake	Center, TX	523	7,380
Sam Rayburn Reservoir	Jasper, TX	112,590	2,876,033
Lake Striker	Rusk, TX	1,920	22,865
Lake Tyler	Whitehouse, TX	4,714	77,284
Lake Nanconiche	Nacogdoches, TX	692	Not Available
J.D. Murphy Wildlife Impoundment	Jefferson County	24,250	32,000

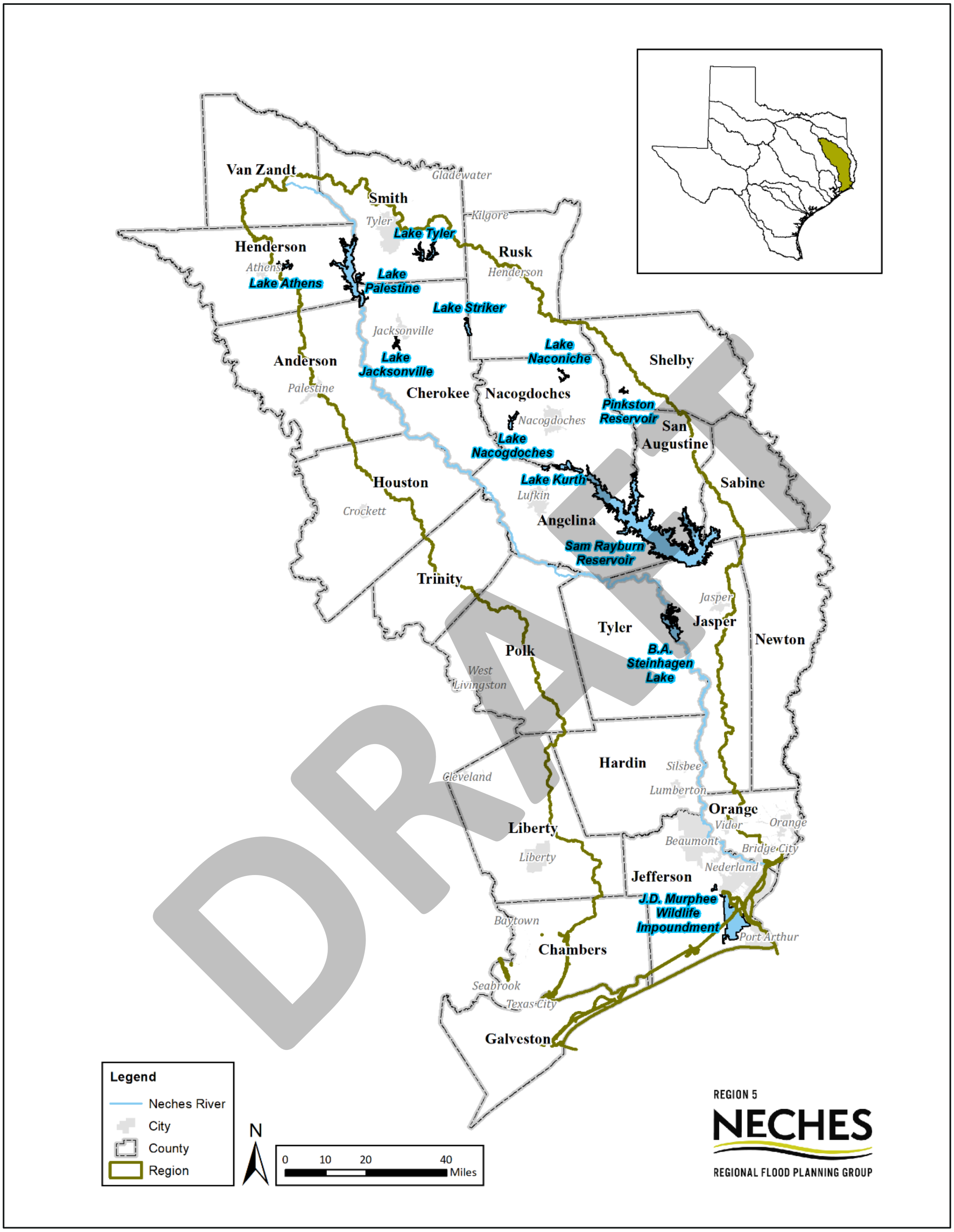


FIGURE 1-15: MAJOR RESERVOIRS IN REGION 5

1.B.2.b. Stormwater Management Systems

Stormwater management systems serve to manage both the quantity and quality of the water that drains into natural waterways. The TCEQ regulates the discharge of municipal separate storm sewer systems (MS4s) through the two sets of permits administered under the Texas Pollutant Discharge Elimination System (TPDES), known as Phase I (large) or Phase II (small) MS4 permits. To be subject to MS4 permit requirements, a community must own and operate storm drainage infrastructure.

Phase I MS4s are cities that had populations exceeding 100,000 as of the 1990 census. The city of Beaumont, Texas is the only community within the Neches region that is subject to Phase I MS4 requirements due to its high population. Some cities in the region are subject to the Phase II MS4 permit, which applies to communities of any size located at least partially within a census-designated urbanized area. The cities of Tyler, Port Neches, Port Arthur, and Lumberton, as well as Bullard, Groves, Whitehouse, Rose Hill Acres, Pine Forest, Vidor, and Rose City are all subject to Phase II MS4 requirements, and thus own and operate storm drainage infrastructure. The cities of Henderson and Bridge City also fall under the Phase II MS4 permit but are only partially located within Region 5.

1.B.2.c. Tunnels and Canals

Region 5 features a large concentration of stormwater canals in the southern portion of the region, specifically within the counties of Chambers, Jefferson, Orange, and Liberty. For the current version of the plan, no information was found regarding stormwater tunnels within Region 5.

1.B.2.d. Storm Drain Systems

An issue encountered during the attempt to compile a dataset of storm drain systems within the region is that there are few publicly available datasets of municipal storm drain systems when it is highly probable that most communities maintain at the very minimum a limited amount of storm drainage infrastructure. As of writing, storm drain infrastructure has only been determined for the cities of Port Neches, Tyler, and Nacogdoches. To address this limitation, collection of spatial data of storm drain systems for this plan relied on survey responses. While survey respondents provided information indicating that the entities they represent maintain public drainage systems, most respondents did not have ready access to geospatial data to include in the geographic information system (GIS) inventory prepared as part of this planning effort.

1.B.2.e. Detention and Retention Areas

Several ponds have been identified within city extents and residential areas throughout Region 5. However, further refinement of the available spatial data is required to ascertain if these ponds identified are intended for retention and/or detention purposes or if they were designed for another function such as recreation. Identifying detention and retention areas will be an area of focus in subsequent updates to the Regional Flood Plan.

1.B.2.f. Stormwater Pumps

The area around Port Arthur is host to an extensive system of stormwater pumps maintained by Jefferson County Drainage District 7. During periods of extreme flooding, stormwater pumps pump away large amounts of stormwater which would otherwise threaten to inundate nearby structures. Identifying the existing status and assessment of the various stormwater pumps in the region will be a focus of future planning cycles.

1.B.2.g. Coastal Areas

Region 5 contains the counties of Galveston, Jefferson, Orange, and Chambers, all which either border or are within close proximity to the Texas coastline. Various coastal infrastructure designed to mitigate flooding damage is present in these counties, covered below in the following sub-sections.

1.B.2.h. Sea Barriers, Walls, and Revetments

The city of Port Arthur is protected by a flood wall that is part of the Port Arthur Hurricane Flood Protection System. Improvement and extension are scheduled to be made to the flood wall as part of the USACE Sabine Pass to Galveston Bay Coastal Storm Risk Management Program. As of 2022, construction is expected to be completed by 2026. At the time of development of the RFP, no sea barriers or revetments were identified within Region 5.

1.B.2.i. Tidal Barriers and Gates

Tidal gates were located in Region 5 as part of the Port Arthur Hurricane Flood Protection System. Similar to the flood wall part of the aforementioned system, the tidal gates are also in the future subject to improvements from the Port Arthur project of the Sabine Pass to Galveston Bay Coastal Storm Risk Management Program.

1.B.3. Assessment of Condition and Functionality of Existing Infrastructure

Detailed information on the condition of the Neches region's flood mitigation features is currently limited. However, throughout Texas, flood infrastructure is rapidly aging and in need of repair. Assessment of condition for the RFP was based primarily on information provided by the TWDB through the State Flood Data Hub, supplemented by data provided by Region 5 stakeholders. **Table 1-21** details the survey responses from various entities in the region that detailed the amount of non-functional and/or deficient flood infrastructure within their respective jurisdictions. For the purposes of this exercise, "non-functional" is defined as infrastructure not providing its intended or design level of service while "deficient" is delineated as meaning the infrastructure or natural feature is in poor structural or non-structural condition and needs replacement, restoration, or rehabilitation. The most common reasons given for non-functional and deficient constructed infrastructure included inadequate operation and maintenance budgets, impacts from recent development, and lack of adequate standards during original construction. For natural features, inadequate budget to maintain natural features was cited as causing non-functional or deficient infrastructure. **Map 3** in **Appendix 1-A** includes a graphical representation of assessment of flood infrastructure in Region 5.

TABLE 1-21: NON-FUNCTIONAL AND DEFICIENT INFRASTRUCTURE SURVEY SUMMARY

Entity	Infrastructure	Non-Functional	Deficient
Bevil Oaks	Stormwater Canals	50%	75%
Bevil Oaks	Regional Detention Facility	25%	75%
Bevil Oaks	Stormwater Tunnels	50%	75%
Bevil Oaks	Storm Drain Systems	25%	75%
Bevil Oaks	Pump Stations	50%	50%
Bevil Oaks	Rivers, Creeks, Tributaries, and Functioning Floodplains	N/A	50%
Bevil Oaks	Wetlands	N/A	75%
Bevil Oaks	Levees	N/A	75%
Jefferson County Drainage District 6	Stormwater Tunnels	75%	50%
Jefferson County Drainage District 6	Stormwater Canals	50%	50%
Jefferson County Drainage District 6	Regional Detention Facility	50%	50%
Jefferson County Drainage District 6	Storm Drain System	50%	50%
Jefferson County Drainage District 6	Rivers, Creeks, Tributaries, and Functioning Floodplains	50%	50%
Henderson County	Levees	50%	N/A
Henderson County	Rivers, Creeks, Tributaries, and Functioning Floodplains	100%	N/A
Henderson County	Flood Protection Dams	50%	N/A
Henderson County	Wetlands	50%	N/A
Henderson County	Pump Stations	25%	N/A
Big Thicket National Preserve	Rivers, Creeks, Tributaries, and Functioning Floodplains	25%	50%
Big Thicket National Preserve	Wetlands	25%	50%
Big Thicket National Preserve	Alluvial Fans	25%	50%
Big Thicket National Preserve	Vegetated Dunes	25%	50%
City of Ivanhoe	Flood Protection Dams	50%	50%
City of Ivanhoe	Storm Drain Systems	50%	75%
City of Ivanhoe	Regional Detention Facility	N/A	N/A
City of Ivanhoe	Storm Drain System	75%	25%
City of Ivanhoe	Rivers, Creeks, Tributaries, and Functioning Floodplains	25%	25%
City of Ivanhoe	Wetlands	25%	25%

Entity	Infrastructure	Non-Functional	Deficient
Hardin County	Rivers, Creeks, Tributaries, and Functioning Floodplains	50%	50%
	Wetlands	50%	50%
	Alluvial Fans	50%	50%
City of Vidor	Storm Drain System	25%	50%
	Stormwater Tunnels	25%	25%
	Rivers, Creeks, Tributaries, and Functioning Floodplains	25%	50%
	Wetlands	25%	25%
City of San Augustine	Stormwater Canals	25%	50%
	Stormwater Tunnels	25%	50%
	Flood Protection Dams	25%	100%
	Regional Detention Facility	25%	25%
	Storm Drain System	25%	50%
	Rivers, Creeks, Tributaries, and Functioning Floodplains	25%	100%
	Pump Stations	50%	75%

1.B.3.a. Dam Safety Assessment

In 2019, the Association of State Dam Safety Officials (ASDSO) estimated the cost to rehabilitate all non-federal dams in Texas at around $5 billion. The TSSWCB estimates about $2.1 billion is needed to repair or rehabilitate dams included in the Small Watershed Programs.

Even though the minority of the dams in the region were built for flood control, the consequences downstream can still be severe, with losses of life, agricultural resources, and property. Of the 7,200 non-federal dams in the state, approximately 25% could result in loss of life should they fail. More than 3,200 Texas dams are exempt from dam safety requirements by State legislation, which represents almost half of these dams.

338 dams have been determined to be within the Neches region. Of this number of dams, 31 have been identified as being functional while 26 have been deemed non-functional. While there are 88 dams in the region that are non-deficient, 16 dams have been recognized as being deficient. Information on the condition of dams was sourced from datasets obtained from TCEQ.

Deficient dams are located in the northern areas of the Neches region to include Anderson, Henderson, Smith, Cherokee, Nacogdoches, Tyler, and Polk Counties. Non-functional dams follow the same trend in their location, being located in Anderson, Henderson, Smith, Cherokee, Tyler, Shelby, Nacogdoches, and Van Zandt Counties.

At least two cases of structural damages to dams within the Neches Flood Planning Region have been documented during the last decade. On May 27, 2016, the Colmesneil area received a reported 14 inches of rainfall in one afternoon that resulted in the structural failure of the Lake Amanda Dam. According to local media reports, a 100-foot section of the dam washed downstream, emptying the lake in less than two hours. Repairs were coordinated through Tyler County, TCEQ, and local water control and improvement districts. Repairs were completed in August 2018 at an estimated cost of $1.5 million.

On April 24, 2022, the Wildwood Lake Dam in norther Hardin County sustained a structural breach to one of its sections. While the downstream impacts of the breach were determined to be minimal, evacuation recommendations and warnings were still issued to local residents.

1.B.3.b. Levee Safety Assessment

Condition-related data for the region's levees is largely unknown due to the fact that most of the levees in the state are built, inspected and/or maintained by local governing agencies who may not have the resources for routine assessment and performance tracking. Recent increases in frequency and intensity of storms continue to test the capacity of the state's levees. More than 75% of Texas levee systems are without screened risk classification. Without a clearer picture of the state's levee infrastructure and concerted funding to assist private owners, the vast majority of the state's levees will remain in the presumed deficient status. Limited information on the condition of specific levees in the Neches region was available for development of the RFP. For future cycles, coordination with communities, special districts, and the public will likely lead to the acquisition of more detailed information that can be incorporated in future flood plans.

1.B.4. Proposed or Ongoing Flood Mitigation Projects

1.B.4.a. Structural Projects Under Construction

There are several projects under construction that are concentrated largely in the southern counties of the region. Hardin County features a number of projects tied to the improvement of road infrastructure to include resurfacing and road elevation to mitigate future flood impacts. The projects under construction in Jefferson County include the excavation of detention basins and various ditch and channel improvements throughout the area. Finally, the structural projects in Orange County are targeted toward the improvement of flood infrastructure to include culverts, ditches, and various other drainage structures.

1.B.4.b. Non-Structural Flood Mitigation Projects Being Implemented

The main type of non-structural flood mitigation project currently being implemented in the region is property acquisition. The action of property acquisition involves government entities acquiring structures, often via a buyout program, which are flood prone to prevent monetary damage and loss of life to future flood events and to allow former residents to relocate to areas less susceptible to flood risk. Property acquisition programs have been identified in the counties of Hardin, Orange, and Jefferson.

1.B.4.c. Existing Structural and Non-Structural Flood Mitigation Projects

Table 1-22 details the existing structural and non-structural flood mitigation projects identified in the current planning cycle for the Neches region. Additional information on each project, such as the anticipated year of completion, can be found in **Table 2** in **Appendix 1-C**. These same projects are also shown spatially throughout the Neches region in **Map 2** in **Appendix 1-A.**

TABLE 1-22: EXISTING FLOOD MITIGATION PROJECTS IN REGION 5

Project Name	Structural/Non-Structural	Description	County	Source of Funding	Anticipated Benefit
Byrd Gully Relief Project	Structural	The project consists of both channel and crossing improvements on the upstream end of Byrd Gully. This channel side slopes will be laid back from 2:1 slopes to 3:1 slopes and slightly deepened. Crossings will be upsized.	Jefferson	FMA, Texas State Grant, JCDD6 Budget	This project will address shallow home flooding by tripling the size of the LNVA BI Canal; the receiving stream for the runoff from the benefits area will be Byrd Gully.
Elinor Street Drainage Project	Structural	This project will involve the installation of 670 linear feet (LF) of 48-in and 720 LF of 60-in reinforced concrete pipe under 8th street from Elinor Street north, three blocks to Ditch No. 110.	Jefferson	FMA, Texas State Grant, JCDD6 Budget	This project will address drainage issues in the project vicinity by routing runoff from the curb and gutter street or the open road ditches into the new storm sewers.
Brentwood/Amelia Cutoff Slope Failures	Structural	Repair earthen ditch slope failures by adding geogrid material and compacting the slope in lifts for a stable 4:1 slope	Jefferson	JCDD6 Budget	This project will increase ditch capacity, reduce erosion, and protect adjoining lands.
Ditch 110 Railroad Bridge	Structural	Design and construct a repair for a damaged concrete-lined ditch section under the BNSF Railroad near 11th Street	Jefferson	JCDD6 Budget	This project will increase capacity through the crossing and prevent further erosion.
Willow Slough Flap Gates - Sabine Ranch	Structural	Install one-way flow flap gates to the Willow Slough crossing at the Sabine Ranch Road.	Jefferson	JCDD6 Budget	This project will address concerns raised by the U.S. Fish and Wildlife Service of unacceptable low water levels in the refuge caused by drainage into the Needmore Diversion Channel.
Fleetwood Detention Basin	Structural	Excavate a 4-acre basin south of Washington and east of IH-10 adjacent to Ditch 100	Jefferson	JCDD6 Budget	This project will provide additional detention and flood relief for the Blossom Subdivision and surrounding area.
Green Pond Detention Enhancements	Structural	Raise and rock the eastern 24,000-ft detention levee. Construct a hardened emergency spillway between the existing spillway at Green Pond Gully and the pipeline corridor (approximately 3,300 L.F.)	Jefferson	JCDD6 Budget	This project will protect the east end of the levee from failure, while providing all-weather access and a controlled overflow without failure.
Wellington Detention Basin	Structural	Excavate 4-acre basin adjacent to Ditch 100/121 confluence on property donated to DD6 in the past for drainage improvements	Jefferson	JCDD6 Budget	This project will provide additional detention and flood relief.
White's Ranch Outfall	Structural	Construct four saltwater barrier outfall structures at White's Ranch (near the GIWW and downstream from the existing structures), and demolish the existing, non-functioning structures. Rock existing mud roads for access to the structures.	Jefferson	JCDD6 Budget	This project will provide critical all-weather access to the structures, better drainage, and reduce maintenance dredging of the outfalls, as well as protect freshwater marshes from saltwater intrusion.
Saratoga Roads Elevation and Culverts	Structural	Elevation of approximately 26000 LF of roads, installation of 74 culverts to improve stormwater conveyance and reduce flood street impacts across area of western Hardin County serving roughly 750 predominantly LMI residences.	Hardin	CDBG-DR	This project will reduce flooding risk on roads within Saratoga and additionally improve flood water conveyance with improved culverts.
Road Resurfacing and Drainage	Structural	Road elevation, culvert upsizing, and repair of roadway flood damage to 5 mile street network for City of Rose Hill Acres.	Hardin	CDBG-DR	This project will resolve drainage issues currently experienced on roads within the city's jurisdiction.
Gore Store Road Elevation and Culverts	Structural	Road elevation, culvert upsizing, and repair of roadway flood damage to 4.2 mile stretch of county road in northern Hardin County.	Hardin	CDBG-DR	This project will improve stormwater conveyance and reduce roadway flood impacts for important travel corridor serving LMI area.
Property Structure Elevation	Structural	Elevate 34 properties in Hardin County for flood mitigation purposes.	Hardin	HMGP	This project will elevate properties such that they will be more resilient to major flood events.

Project Name	Structural/Non-Structural	Description	County	Source of Funding	Anticipated Benefit
Green Branch Ditch	Structural	Drainage improvements to be conducted for a segment of Green's Branch ditch to include but not limited to cleaning, debris removal, and excavation/embankment.	Hardin	HMGP	This project will reduce the WSE for approximately 500 structures in the residential areas of central Lumberton.
Property & Open Space Acquisition	Non-Structural	Eliminate flood impacts for 12 properties in Hardin County comprising approximately 20 acres. Parcels will be preserved as open space for beneficial floodplain functions.	Hardin	FMA	This project will aid residents by acquiring existing properties and land to encourage people to relocated from or not build in flood-prone areas.
Property & Open Space Acquisition	Non-Structural	Eliminate flood impacts for 19 properties in Hardin County comprising approximately 20 acres. Parcels will be preserved as open space for beneficial floodplain functions.	Hardin	HMGP	This project will aid residents by acquiring existing properties and land to encourage people to relocated from or not build in flood-prone areas.
Property & Open Space Acquisition	Non-Structural	Eliminate flood impacts for 4 properties in Hardin County comprising approximately 44 acres. Parcels will be preserved as open space for beneficial floodplain functions.	Hardin	CDBG-DR	This project will aid residents by acquiring existing properties and land to encourage people to relocated from or not build in flood-prone areas.
Rose Hill Acres Property Acquisition	Non-Structural	Eliminate flood impacts for 6 properties in Rose Hill Acres comprising approximately 6 acres. Parcels will be preserved as open space for beneficial floodplain functions.	Hardin	CDBG-DR	This project will aid residents by acquiring existing properties and land to encourage people to relocated from or not build in flood-prone areas.
Drainage Improvements	Structural	Repair and improve drainage structure damaged during Hurricane Harvey at various locations within the County.	Orange	CDBG-DR	This project will repair and upgrade existing drainage infrastructure previously damaged by Harvey to future extreme flood events.
Property Acquisition	Non-Structural	Acquire properties damaged during Hurricane Harvey to assist residents who wish to relocate from flood-prone areas.	Orange	CDBG-DR	This project will aid residents by acquiring existing properties to encourage people to relocate from flood-prone areas.
Property Buyout	Non-Structural	Acquire 16 repetitive loss properties throughout the County.	Orange	HMGP	This project will aid residents by acquiring existing properties to encourage people to relocate from flood-prone areas.
Property Structure Elevation	Structural	Raise flood-prone structures to flood of record or BFE using FEMA's preliminary flood map data.	Orange	HMGP	This project will elevate properties such that they will be more resilient to major flood events.
Four Oaks Riverbed Stabilization	Structural	Upgrade culverts and elevate Four Oaks Ranch Rd. to mitigate flooding during future storm events.	Orange	HMGP	This project will increase the drainage capabilities of Four Oaks Ranch Road to mitigate future flood risk.
Bridge City Drainage Improvements	Structural	Provide flood and drainage improvements throughout the city	Orange	HMGP	This project will mitigate future flood risk to residents of Bridge City by improving the existing drainage infrastructure.
Bridge City Property Acquisition	Non-Structural	Acquire properties damaged during Hurricane Harvey to assist residents who wish to relocate from flood-prone areas.	Orange	CDBG-DR	This project will aid residents by acquiring existing properties to encourage people to relocate from flood-prone areas.

CHAPTER 2
FLOOD RISK ANALYSES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

CHAPTER 2. FLOOD RISK ANALYSIS

The goal of Task 2 was to perform a comprehensive and cohesive flood risk analysis for the planning region. Flood risks for the 1% annual chance exceedance (1% ACE) event and the 0.2% annual chance exceedance (0.2% ACE) event were assessed. The analysis was performed for existing conditions of the basin, as well as a future condition scenario that considers changes in flood hazards over the 30-year planning horizon. As shown in **Figure 2-1**, the overall flood risk analysis is comprised of three separate but related evaluations, including:

1. **Flood Hazard Analyses**, which characterize location, magnitude, and frequency of flooding;
2. **Flood Exposure Analyses**, which identify who and what might be harmed within the region; and
3. **Vulnerability Analyses**, which identify vulnerabilities of communities and critical facilities.

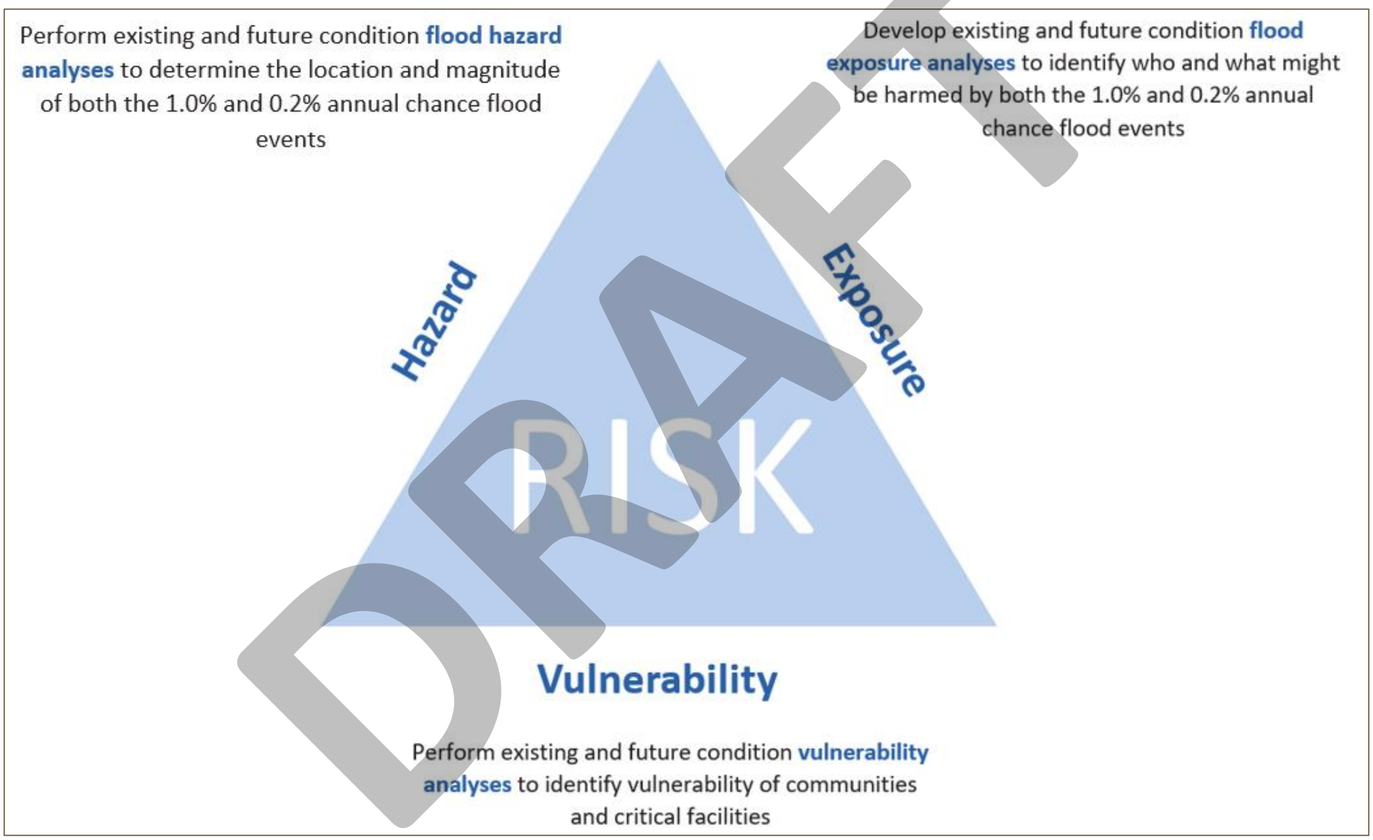


FIGURE 2-1: FLOOD RISK ANALYSES COMPONENTS

The following sections describe the process that was undertaken to determine and quantify flood hazards in the region. The results of the evaluation are presented in the section and include a summary of the types and magnitude of flooding and the communities most susceptible to its harmful effects.

Chapter 2.A. Existing Condition Flood Hazard Analysis

This step of the process is primarily a data gathering exercise in which the RFPG compiled a comprehensive outlook of existing condition flood hazards in the region, including riverine, urban, and coastal flooding in addition to flood prone areas. This effort is not regulatory in nature, instead intended to gather a single, comprehensive set of best available information on actual flood risk in the region.

The types of flooding hazard data considered and included in this plan are summarized below:

Riverine Flooding: Riverine flooding is caused by bank overtopping when the flow capacity or rivers and streams is exceeded. This increase in flow capacity can be attributed to high-intensity rainfall causing soil saturation and large volumes of runoff either locally or in upstream watershed areas.

Urban Flooding: Urban flooding occurs when the inflow of stormwater in urban areas exceeds the capacity of drainage systems to either reroute it elsewhere or direct the incoming flow into the soil to infiltrate. This can occur due to heavy rainfall, storm surges, or high tides. Land development and the presence of undersized storm systems can also have an acute effect on this phenomenon.

Coastal Flooding: Coastal flooding occurs when normally dry, low-lying land is inundated by seawater. This type of flooding is most prevalent in the southern portion of the region to include the portions of Galveston, Chambers, Jefferson, Harris, and Orange Counties.

Additional Flood Prone Areas: Additional flood prone areas are areas outside of previously mapped flood hazard areas identified by the RFPG. These areas are determined through the location of hydrologic features, historic flooding, and/or local knowledge.

2.A.1. Characterization of Existing Condition Floodplains

Floodplain information was initially provided by the TWDB in the floodplain quilt. The floodplain quilt dataset includes flood data from the National Flood Hazard Layer (NFHL), Base Level Engineering (BLE) studies, and from First American Flood Data Services (FAFDS). This dataset was subsequently supplemented with Cursory Floodplain Ddata provided by TWDB in October 2021.

Per the TWDB guidelines, the initial ranking order of the floodplain quilt data is as follows with NFHL Pending Data being the most accurate data available and Cursory Floodplain Data being the most approximate data available.

1. NFHL Pending Data
2. NFHL Preliminary Flood Hazard Data
3. NFHL Effective Detailed Data
4. Base Level Engineering (BLE) Data
5. NFHL Effective Approximate Data
6. First American Flood Data Services (FAFDS)
7. Cursory Floodplain Data

The Neches region was fortunate enough to have total coverage of its area come from both NFHL data and BLE studies, data sources which have been deemed as the most accurate for determining flood inundation extent. Cursory Floodplain Data, the most approximate floodplain data available, was used to identify flood prone areas that are outside the existing 1% and 0.2% ACE flood hazard boundaries. Flood prone areas were delineated for areas that intersected low water crossings, major roads, or were within boundaries of cities located within the region that did not have defined floodplains. Given the placement of the NFHL and BLE data on the data accuracy hierarchy provided by TWDB, the floodplain quilt has been deemed sufficient for planning level exercises. However, further refinement to existing floodplain data is recommended for future planning cycles.

Some of the prominent issues encountered when evaluating the NFHL data collected for the region include the NFHL Effective Approximate data not including information on 500-year floodplains and the NFHL Effective Detailed data being outdated in several areas within the region. It should also be noted that the BLE data prevalent in the region functions best as an approximate study; studies behind BLE data often lack information on watershed-specific hydrology and do not include any structures such as roadway crossings which could influence floodplain delineation.

2.A.1.a. Best Available Data

Floodplain information was initially provided by the TWDB in the floodplain quilt. The floodplain quilt dataset includes flood data from the National Flood Hazard Layer (NFHL) and Base Level Engineering (BLE) studies. This dataset was subsequently supplemented with Cursory Floodplain Data provided by TWDB in October 2021. **Figure 2-2** shows the source and location of best available floodplain information for the Neches River Basin.

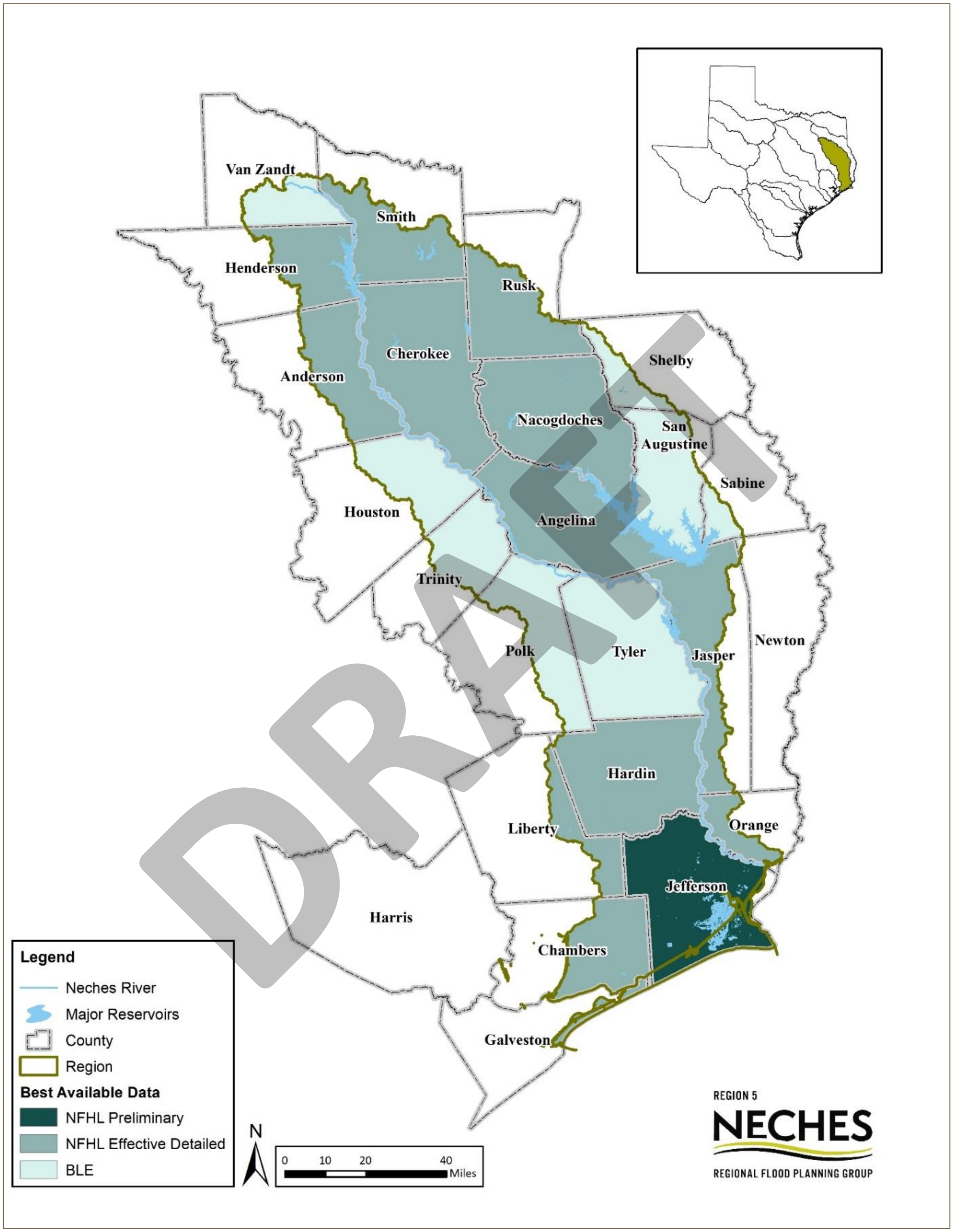


FIGURE 2-2: BEST AVAILABLE FLOOD DATA BY SOURCE

The Technical Consultant (TC) performed a closer evaluation of the FEMA data to determine the adequacy of existing data for inclusion in the flood hazard datasets and to identify mapping knowledge gaps within the region. NFHL Effective Approximate floodplains, denoted as Zone A in FEMA mapping, were deemed to not be adequate for inclusion in the final floodplain in areas where more accurate data was available. NFHL Effective Approximate floodplains represent approximate or estimated inundation limits and are not based on detailed studies or detailed floodplain mapping, hence their exclusion. Additionally, NFHL Effective Approximate floodplains did not provide a 0.2% ACE flood hazard boundary, which is required as part of this Regional Flood Plan (RFP). However, NFHL Effective Approximate floodplains located within Chambers and Liberty Counties were included in the final flood hazard layer under the grounds that the data was in areas of known inundation.

For the Neches region, mapping backed by a detailed study (FEMA Zone AE, FEMA Zone X shaded) was evaluated by reviewing the Flood Insurance Study (FIS) reports for each county. While all NFHL data was included in the floodplain quilt for the region, special attention was called to mapping that possessed outdated hydrologic and hydraulic studies. There were many instances of detailed studies in the region using outdated software such as the HEC-1 and HEC-2 modeling programs; upon investigating the FIS reports for the counties in the Neches region, 2012 was selected as the cutoff for modeling and floodplain mapping being reasonable with current practices. **Table 2-1** lists the dates of the NFHL hydrologic and hydraulic models found within the extents of Region 5.

While floodplain studies preceding 2012 were kept in the floodplain quilt under the pretense of being the best available data for the areas in which they are in, such studies were highlighted to be included as a mapping knowledge gap within the region, discussed later in the section.

TABLE 2-1: NFHL DATA FOR NECHES RIVER BASIN

County	Community	Date
Anderson County	City of Palestine	1984
Angelina County	Angelina County	2008
Chambers County	Chambers County	1981 - 2014
Cherokee County	Cherokee County	1993, 1995
Hardin County	Hardin County	2008
Henderson County	Henderson County	N/A, no FIS report available for Region 5
Houston County	Houston County	1978
Jasper County	Jasper County	1984
Jefferson County	City of Beaumont	1980
Jefferson County	Jefferson County	1980
Liberty County	Liberty County	1985 - 2014
Nacogdoches County	City of Nacogdoches	1978
Newton County	Newton County	1998 - 2015
Orange County	Orange County	1980 - 2014
Polk County	Polk County	N/A, no detailed study
Rusk County	City of Henderson	1989
Rusk County	Rusk County	1989
Sabine County	Sabine County	N/A, no FIS report available

County	Community	Date
San Augustine County	City of San Augustine	N/A, no FIS report available
Shelby County	Shelby County	N/A, no FIS report available for Region 5
Smith County	Smith County	2014
Smith County	Tyler	2008
Trinity County	City of Groveton	N/A, no FIS report available
Tyler County	Tyler County	N/A, no detailed study
Van Zandt County	Van Zandt County	1984

2.A.1.b. Existing Model Coverage

Existing model coverage not tied to those used to generate NFHL data are summarized in **Table 2-2.** These models were created using a variety of different software and are detailed in the table. It is important to note that not all the models included were utilized in development of the existing conditions flood hazard layer.

TABLE 2-2: AVAILABLE FLOOD-RELATED MODELS FOR NECHES RIVER BASIN

Model	Description	Location	Source of Data
Alligator Bayou Models	HEC-HMS (v3.5) and HEC-RAS (v4.1.0) Models of Alligator Bayou within Port Arthur, Port Neches, Nederland, and Groves	Port Arthur, Port Neches, Nederland, and Groves	Jefferson County Drainage District 7
Bayou Din Detention Models	HEC-RAS (6.1) Models of Bayou Din Detention Project located near Beaumont	Jefferson County	Jefferson County Drainage District 6
Channel 100-A Models	HEC-RAS (5.0.7) Models of Channel 100-A Concrete Repair Project located within Beaumont	Beaumont/Jefferson County	Jefferson County Drainage District 6
City of Beaumont Master Drainage Plan Model	InfoWorks ICM Model in the Master Drainage Plan - Project was led by LAN	Beaumont/Jefferson County	Director of Public Works
Bessie Heights Drainage Ditch Extension Models	HEC-RAS (6.0) Models of the Bessie Heights Drainage Ditch Extension Project near Bridge City	Orange County	Orange County Drainage District
Sabine Pass to Galveston Bay CSRM Models	Models created to support the Sabine Pass to Galveston Bay Coastal Storm Risk Management Program projects in both Port Arthur and Orange County	Port Arthur, Orange County	USACE

Model	Description	Location	Source of Data
Lower Angelina Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Angelina County, Jasper County, Nacogdoches County, Newton County, Rusk County, Sabine County, San Augustine County, Shelby County	FEMA
Lower Neches Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Angelina County, Hardin County, Jasper County, Jefferson County, Orange County, Tyler County,	FEMA
Middle Neches Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Angelina County, Cherokee County, Houston County, Jasper County, Polk County, Trinity County, Tyler County	FEMA
Pine Island Bayou Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v 5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Hardin County, Jefferson County, Liberty County, Polk County	FEMA
Upper Angelina Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v 5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Angelina County, Cherokee County, Nacogdoches County, Rusk County, Smith County	FEMA
Upper Neches Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v 5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Anderson County, Cherokee County, Henderson County, Houston County, Smith County, Van Zandt County	FEMA
Village Watershed Hydraulic Analysis (BLE)	Steady flow HEC-RAS (v 5.0.7) models developed for the 10-year, 25-year, 50-year, 100-year, and 500-year flood events	Hardin County, Polk County, Tyler County	FEMA

2.A.1.c. Gaps in Inundation Boundaries

A gap analysis was completed to identify remaining gaps in flood risk mapping. This was completed at a Hydrologic Unit Code (HUC) 12 watershed level. Inadequate mapping within the Neches region has been defined as:

- **Outdated Rainfall Data** – Several of the southern counties in the Neches region require updated rainfall data from TP-40 to Atlas 14 upon recent findings from studies conducted in the region. **Figure 2-3** shows the difference between TP-40 and Atlas 14 rainfall throughout the state. **Table 2-3** shows the differences in TP40 and Atlas 14 rainfall in the Neches region by HUC8 watershed.
- **Inundation maps produced based on analysis performed before 2012** - These older analyses may not reflect current development conditions and may be based on coarse terrain datasets and/or utilize outdated modeling software for hydraulic and hydrologic computations. **Table 2-1** contains the dates of the hydrologic and hydraulic models used to delineate NFHL boundaries within the extents of Region 5.
- **BLE Mapping** – Base Level Engineering data is approximate mapping that covers over 80% of the Neches region. BLE data does not contain watershed-specific hydrology and hydraulic models incorporated in the data do not account for any structures such as roadway crossings.

It should be noted that although much of the flood planning region is considered to have a gap, areas that need to incorporate Atlas 14 rainfall represent the highest gap priority. Many of the areas with gaps are being considered as potential flood mitigation evaluations (FMEs). There are ongoing studies in the Neches River Basin that will provide detailed information but will not be completed in time to be included in this planning cycle. Existing condition map gaps are summarized on a HUC12 areal extent in **Map 5** in **Appendix 2-A**.

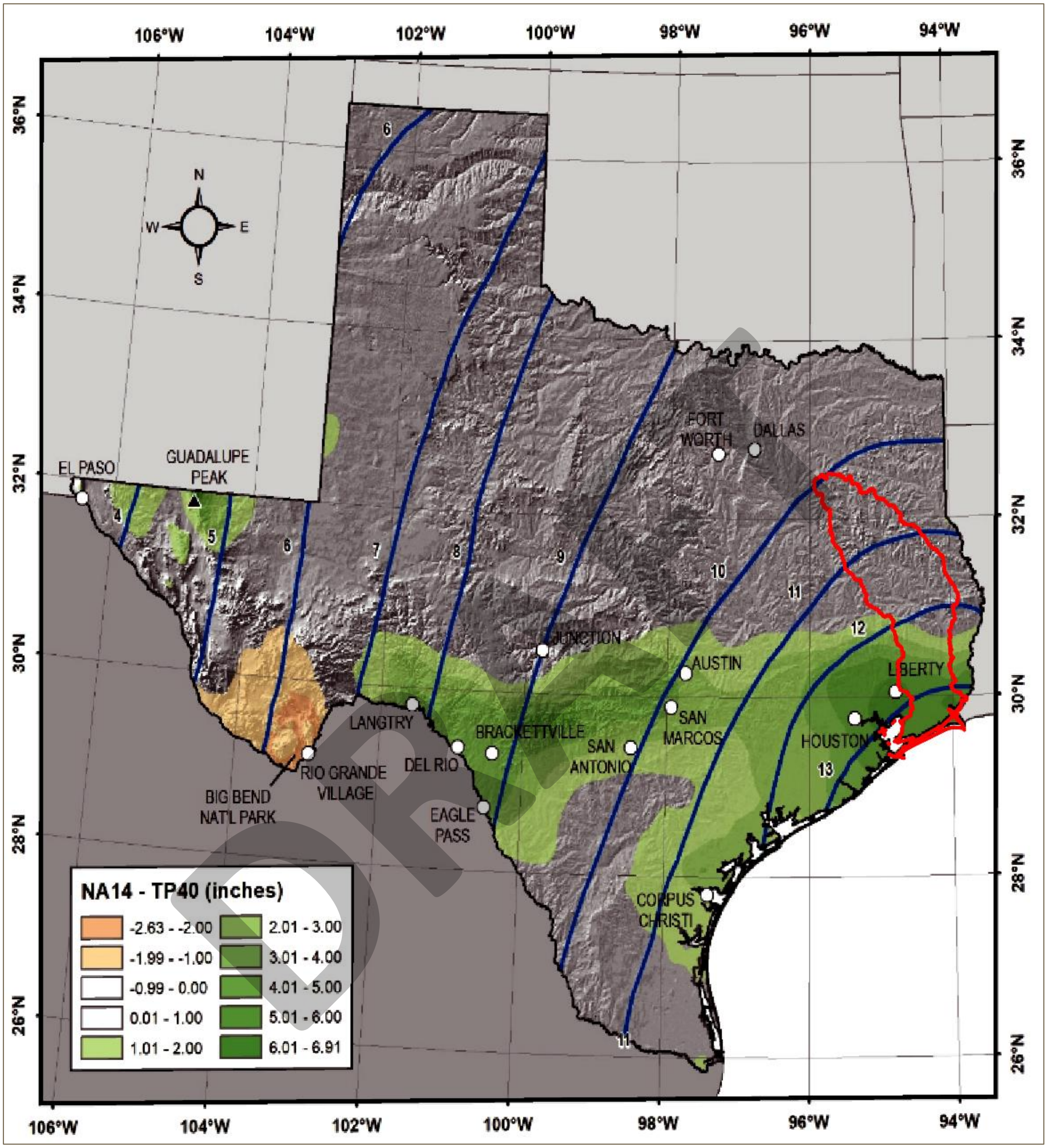


FIGURE 2-3: CHANGE IN 24-HOUR 100-YEAR RAINFALL BETWEEN NA14 AND TP40

TABLE 2-3: NECHES REGION 100-YR, 24-HR PRECIPITATION

<table>
<tr><th>HUC8 Watershed</th><th>TP40 Rainfall (in)</th><th>Atlas 14 Rainfall (in)</th></tr>
<tr><td>Upper Neches</td><td colspan="2">10.0 - 11.2</td></tr>
<tr><td>Upper Angelina</td><td colspan="2">10.4 – 11.3</td></tr>
<tr><td>Lower Angelina</td><td colspan="2">10.8 – 12.1</td></tr>
<tr><td>Middle Neches</td><td colspan="2">11.2 – 12.0</td></tr>
<tr><td>Lower Neches</td><td>12.0 – 13.5</td><td>13.0 – 19.5</td></tr>
<tr><td>Village</td><td>12.3 – 13.3</td><td>16.3 – 18.3</td></tr>
<tr><td>Pine Island Bayou</td><td>13.0 – 13.3</td><td>18.0 – 19.3</td></tr>
</table>

2.A.1.d. Possible Flood Prone Areas

Possible flood prone areas are areas that the RFPG identified that are outside of previously mapped flood hazard areas. They were identified through the location of hydrologic features, historic flooding, and/or local knowledge. Initially, the Neches RFPG opted to utilize public comments collected through the online survey as flood prone areas.

An ArcGIS Online web map was used to collect the location of additional flood prone areas. This map was shared on the RFPG website, emailed to community officials, and made available to the public at existing flood risk public meetings held in Beaumont and Port Arthur on January 11, 2022, and February 15, 2022, respectively. Locations that were outside of the 1% and 0.2% ACE flood hazard areas were delineated as possible flood prone areas. 1% ACE Cursory Floodplain Data was used to define the extent of these flood prone areas. All public comments received reference flooding concerns already within the 1% ACE flood hazard area. The comments received are shown on **Map 5** in **Appendix 2-A.**

Based on historic flooding and local knowledge, the RFPG decided to supplement the publicly identified flood prone areas by incorporating Cursory Floodplain Data in select locations. These areas include identified low water crossings and water courses that crossed major roads or were within the boundary of a city. Information on low water crossings in the region was taken from data collected by the Texas Natural Resources Information System (TNRIS). A survey was sent to stakeholders in the region that requested information on additional low water crossings that may not have been accounted for in TNRIS's data, but no additional crossings were acquired from the survey.

2.A.2. 1% and 0.2% Annual Chance Exceedance Floodplains

A series of flood hazard area maps displaying existing conditions flood risk throughout the Neches region is included in **Map 4** in **Appendix 2-A.** These floodplains cover approximately 3,715 square miles and 32% of the land area in the Neches River Basin. Of the mapped flood hazard area, approximately 3,079 square miles are inundated during the 1% ACE event and an additional 374 square miles are inundated during the 0.2% ACE event. **Figure 2-4** shows the area in the region in square miles that are within either the 1% or 0.2% ACE flood hazard areas or in additional flood prone areas. **Table 3** in **Appendix 2-B** summarizes existing flood risk area on a county and frequency basis in the Neches Flood Planning Region. Additionally, **Table 2-4, Table 2-5**, and **Table 2-6** summarize the existing area of each flood risk type for the counties included in the region. The flood risk types in the region include Riverine, Coastal, Local/Urban, and Other.

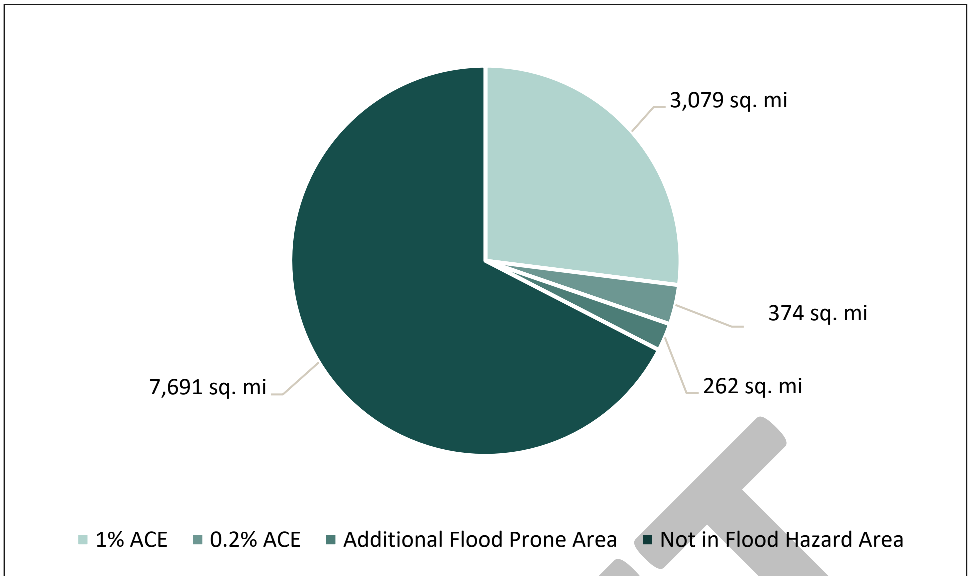


FIGURE 2-4: REGION 5 AREA (SQ. MI) BY FLOOD FREQUENCY

TABLE 2-4: TOTAL LAND AREA OF EXISTING 1% ACE FLOOD RISK TYPE BY COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	70.71	0	0	0
Angelina	228.11	0	0	0
Chambers	203.33	61.30	0	0
Cherokee	171.37	0	0	0
Galveston	6.41	47.42	0	0
Hardin	306.36	0	0	0
Harris	0	0.17	0	0
Henderson	74.62	0	0	0
Houston	61.41	0	0	0
Jasper	197.00	0	0	0
Jefferson	533.32	71.47	0	0
Liberty	73.97	0	0	0
Nacogdoches	170.57	0	0	0
Newton	0.74	0	0	0
Orange	87.23	15.36	0	0
Polk	100.67	0	0	0
Rusk	72.39	0	0	0
Sabine	21.31	0	0	0
San Augustine	122.72	0	0	0
Shelby	21.61	0	0	0
Smith	69.13	0	0	0

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Trinity	73.89	0	0	0
Tyler	186.00	0	0	0
Van Zandt	29.91	0	0	0

TABLE 2-5: TOTAL LAND AREA OF EXISTING 0.2% ACE FLOOD RISK TYPE BY COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	74.66	0	0	0
Angelina	238.56	0	0	0
Chambers	310.09	61.30	0	0
Cherokee	180.89	0	0	0
Galveston	7.38	47.42	0	0
Hardin	355.49	0	0	0
Harris	0	0.17	0	0
Henderson	78.57	0	0	0
Houston	66.16	0	0	0
Jasper	212.37	0	0	0
Jefferson	623.46	71.47	0	0
Liberty	85.66	0	0	0
Nacogdoches	178.39	0	0	0
Newton	0.83	0	0	0
Orange	106.22	15.36	0	0
Polk	106.02	0	0	0
Rusk	76.87	0	0	0
Sabine	22.49	0	0	0
San Augustine	127.07	0	0	0
Shelby	22.67	0	0	0
Smith	73.54	0	0	0
Trinity	78.99	0	0	0
Tyler	198.72	0	0	0
Van Zandt	32.01	0	0	0

TABLE 2-6: TOTAL LAND AREA OF EXISTING FLOOD PRONE AREAS BY FLOOD RISK TYPE AND COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	0.53	0	3.43	0

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Angelina	1.39	0	7.31	0.02
Chambers	0	0	0	12.27
Cherokee	2.49	0	8.64	0
Galveston	0	0	0	0.44
Hardin	0	0	0	22.51
Harris	0	0	0	0
Henderson	0.25	0	2.39	0.02
Houston	1.68	0	2.18	0.10
Jasper	0	0	0	1.96
Jefferson	0	0	0	122.93
Liberty	0	0	0	31.77
Nacogdoches	1.96	0	5.96	0
Newton	0	0	0	0
Orange	0	0	0	1.41
Polk	0	0	0	1.48
Rusk	2.64	0	5.13	0
Sabine	0.06	0	0.67	0.37
San Augustine	1.29	0	3.25	0
Shelby	0.21	0	1.01	0
Smith	0.79	0	6.05	0.14
Trinity	0.28	0	2.06	0
Tyler	0	0	0	2.10
Van Zandt	0.18	0	2.42	0.13

2.A.3. Existing Condition Flood Exposure Analysis

Following the identification of the existing flood hazard areas, the existing condition flood exposure analysis was performed to identify the people and property at risk of flooding. This analysis determined the features that spatially intersected with the flood hazard area boundaries. Features utilized include but are not limited to:

- Residential properties
- Critical facilities
- Public infrastructure
- Agricultural areas
- Roadways
- Low water crossings

The results of the exposure analysis for existing condition are summarized in **Table 3** in **Appendix 2-B**. Values presented for each county only represent the portion of the counties within the Neches FPR, and excludes all features located within other planning regions.

Table 2-7 details the area of each county that is contained in the region's extent. **Map 6** in **Appendix 2-A** identifies areas of concentrated exposure features across the region. As expected, the coastal communities in Jefferson, Galveston, Chambers, and Orange counties have the highest density of development within the floodplain, followed by the urban centers of Lufkin, Nacogdoches, and Tyler. However, inundated roadways and agricultural areas are found throughout the region, and the impacts due to the loss of function in these areas should not be understated.

TABLE 2-7: REGION 5 COUNTY AREA BREAKDOWN

County	Total County Area (sqmi)	County Area in Region 5 (sqmi)	% of Total County Area in Region 5
Anderson	1073.75	495.35	46.13
Angelina	860.98	860.98	100.00
Chambers	865.55	434.46	50.19
Cherokee	1057.77	1057.77	100.00
Galveston	664.95	56.94	8.56
Hardin	893.96	887.60	99.29
Harris	1770.82	0.17	0.01
Henderson	944.99	373.91	39.57
Houston	1232.09	418.21	33.94
Jasper	965.90	615.49	63.72
Jefferson	954.14	954.14	100.00
Liberty	1169.76	235.49	20.13
Nacogdoches	977.21	977.21	100.00
Newton	936.10	6.39	0.68
Orange	371.04	155.72	41.97
Polk	1105.87	535.17	48.39
Rusk	935.45	524.87	56.11
Sabine	573.99	95.27	16.60
San Augustine	590.07	533.50	90.41
Shelby	831.01	159.87	19.24
Smith	946.09	509.57	53.86
Trinity	710.01	341.74	48.13
Tyler	931.72	931.72	100.00
Van Zandt	856.37	244.01	28.49

2.A.3.a. Structures within Flood Hazard Areas

The building footprints used in the exposure analysis, taken from the TWDB Flood Planning Data Hub, were produced by TNRIS utilizing Microsoft Buildings and Stratmap LiDAR. Each building footprint was assigned an individual Social Vulnerability Index (SVI) value as developed by the Centers for Disease

Control and Prevention (CDC). Daytime and nighttime population figures in the buildings layer provided by TWDB were sourced from LandScan population estimates (Oak Ridge National Laboratory, 2019). Of the near 473,000 buildings TWDB included in the buildings dataset for the Neches region, 77,717, or 16%, has been determined to be within either the 1% or the 0.2% ACE flood hazard areas. 26,543 structures have been identified as being in possible flood prone areas. As expected, Jefferson County has the highest number of structures within flood hazard areas. Structures found partially within the 1% and 0.2% ACE flood hazard areas were included with the 1% ACE flood hazard area. Non-critical structures that had a building footprint less than 500 square feet were not considered in the exposure analysis due to the small area most likely being associated with storage and not population. **Figure 2-5** shows the distribution of structures exposed to flood hazard by building category.

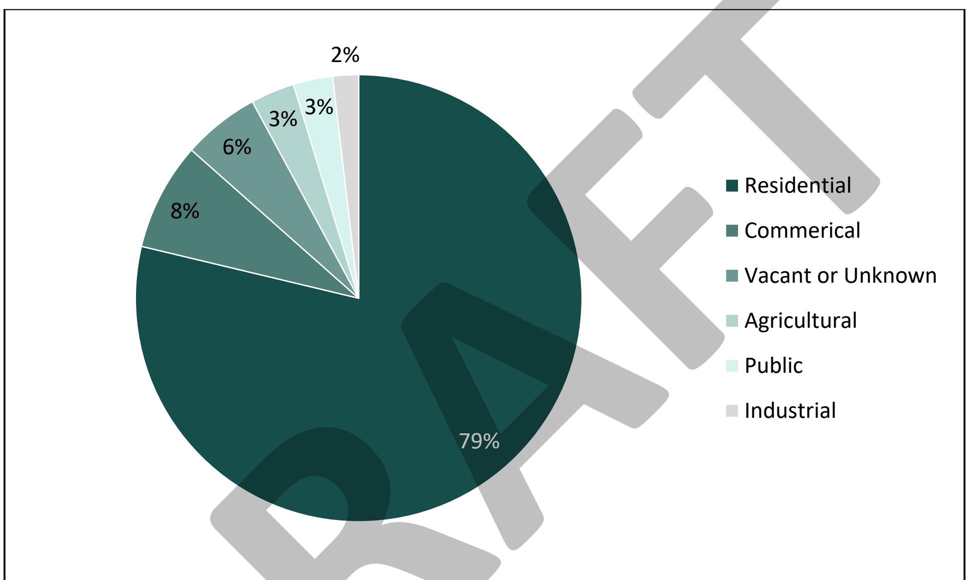


FIGURE 2-5: EXISTING FLOOD RISK STRUCTURE EXPOSURE BY BUILDING CATEGORY

The user type for each structure was also considered in the exposure analysis. The type categories associated with each structure was assigned by TWDB and include agricultural, commercial, industrial, public, residential, and vacant or unknown. Within the Neches region, around 25,000 residential structures are exposed to the 1% ACE event with around 35,000 additional structures exposed to the 0.2% ACE event. Nearly 40% of the residential structures in the region exposed to the 1% ACE are located in Jefferson County.

2.A.3.b. Population within Flood Hazard Areas

Population values used in the exposure analysis were included with building footprints used to identify structural exposure. Separate sums of the daytime and nighttime populations were taken for all buildings in the region to be compared against the 2019 population estimate for the region. The population sums from the buildings layer were determined to be extremely close (within 1.5%) of the 2019 population estimate; thus, no modifications were made to the population data contained in the building footprint dataset provided by TWDB. The daytime and nighttime populations exposed to flood hazard for each ACE event were summed in each county within the region; the higher of the the two values was taken as the population reported in **Table 3** in **Appendix 2-B**. Within the Neches region, there are an estimated 65,717 people in the 1% ACE flood hazard area and a total of 158,275 people in the 0.2% ACE flood hazard area. Jefferson County alone has almost 26,027 people exposed to the 1% ACE with a total of 98,396 people exposed to the 0.2% ACE. 89,118 people in the region were identified as being in additional flood prone areas; of that number, 65,461 people have been identified to be within Jefferson County.

2.A.3.c. Critical Facilities and Public Infrastructure within Flood Hazard Areas

Critical facilities and public infrastructure perform essential functions that require enhanced consideration in flood planning. Examples of critical facilities and public infrastructure considered in the exposure analysis include the following:

- Hospitals
- Police Stations
- Fire Stations
- Schools
- Shelters
- Industrial Areas (Petroleum Refineries, Power Plants, etc.)
- Airports
- Assisted Care Facilities/Nursing Homes
- Water/Wastewater Treatment Plants

Table 2-8 summarized the critical facilities in flood hazard areas identified in the existing condition exposure analysis. The coastal counties of Jefferson and Orange, along with the northern county of Smith, experience some of the highest exposure of critical facilities and public infrastructure within the region.

In the exposure analysis, critical facilities categorized under "Emergency" include facilities that are directly involved in the wake and in the immediate aftermath of various kinds of disasters including but not limited to fire stations, police stations, and shelters. A myriad of structures are considered under the "Infrastructure" category – any airports and water/wastewater treatment plants were included as part of this classification in addition to a variety of structures tied to industrial use. A few of the industrial structures identified as critical facilities include the following:

- Petroleum Refineries
- Ethylene Crackers
- Power Plants
- Petroleum Product Terminals
- Biodiesel Plants
- Natural Gas Processing Plants

While industrial infrastructure can be found throughout the region, there is a dense concentration of industrial facilities in the vicinity of the cities of Beaumont, Port Arthur, Nederland, Port Neches, and Groves. The oil and gas industry is a significant part of the economy in Southeast Texas and is tied to international markets; any damages to these industrial facilities from severe flooding events can have far-reaching adverse impacts.

Structures under the "Medical" category include hospitals in addition to assisted care facilities and nursing homes. The "School" category includes all educational facilities to include institutions of higher learning such as Lamar University.

TABLE 2-8: SUMMARY OF CRITICAL FACILITY EXPOSURE IN REGION 5

County	Emergency	Infrastructure	Medical	School	Total
Anderson	0	0	1	0	**1**
Angelina	2	0	3	17	**22**
Chambers	1	0	2	0	**3**
Cherokee	1	2	0	1	**4**
Galveston	8	0	0	0	**8**
Hardin	8	0	0	26	**34**
Henderson	1	0	0	3	**4**
Houston	0	0	0	2	**2**
Jasper	2	7	0	6	**15**
Jefferson	67	1,715	30	204	**2,016**
Liberty	0	2	0	0	**2**
Nacogdoches	4	0	1	2	**7**
Orange	12	44	1	65	**122**
Rusk	1	0	1	0	**2**
Sabine	0	3	0	0	**3**
Smith	4	107	8	7	**126**
TOTAL	**111**	**1,880**	**47**	**333**	**2,371**

2.A.3.d. Roadway Crossings and Roadway Segments

Roadways were the next element of existing development considered in the existing condition flood risk exposure analysis. The TxDOT roadway data was provided by TWDB and included information on various roads, including but not limited to interstates, farm to market (FM) roads, and state highways. For the exposure analysis, the number of stream crossings was analyzed along with the total length of roadway in miles inundated during a flood event. Bridge deck elevation was not included in the analysis; as a result, all points of intersection between streams and roads exposed to the 1% and 0.2% ACE events were considered as exposure points.

There are 3,558 stream crossings in the 1% ACE flood hazard area with an added 717 crossings exposed to the 0.2% ACE flood hazard area for a total of 4,275 crossings in known flood hazard areas. 705 roadway crossings were found to be in additional flood prone areas. Additionally, 186 roadway crossings were identified as low water crossings using a statewide inventory provided by TNRIS.

1,505 miles of roadways were exposed to the 1% ACE event with an added 949 miles inundated by the 0.2% ACE event for a total of 2,454 miles of roadways within known flood hazard areas. An additional 615 miles of roadway were found to be in supplemental flood prone areas. The complete roadway crossing and roadway segment exposure analysis by county can be found in **Table 3** in **Appendix 2-B.**

2.A.3.e. Agricultural Area within Flood Hazard Area

Agricultural area in the region was identified using the 2020 CropScape – Cropland Data Layer produced by USDA National Agricultural Statistics Service. Land use categories associated with farming and ranching were included in the exposure analysis as agricultural areas. Fallow or idle cropland and forestry were excluded from the analysis out of a concern of overrepresenting agricultural area subject to flood risk. While the CropScape layer included information where deciduous, evergreen, and mixed forests are located within the Neches region, the layer did not include information on lands dedicated to harvesting timber. A total of 119 square miles of agricultural land is exposed to the 1% ACE event with 48 additional square miles exposed to the 0.2% ACE event. 42 square miles of agricultural land have been found to be in additional flood prone areas. The agricultural exposure analysis by county can also be found in **Table 3** in **Appendix 2-B.**

2.A.3.f. Flood Exposure Due to Existing Levees or Dams

The analysis also required the consideration of population and property located in areas where existing levees or dams do not meet FEMA accreditation. From the infrastructure analysis in **Chapter 1,** 338 dams and a major levee system have been identified within the region. All 338 dams have been included as part of the RFP analysis due to limited information on dam function. The major levee system identified is the Port Arthur Hurricane Flood Protection System. Dam/levee accreditation is defined as FEMA's recognition that a levee or dam is reasonably certain to contain the base regulatory flood, often represented by the extents of the 1% ACE floodplain. No dams or levees in the region were specifically identified as not meeting FEMA accreditations based on stakeholder outreach survey responses. The survey was sent to the agencies in charge of operating these systems. Therefore, it was assumed that the current floodplain limits properly reflect the flood protection benefits of these structures.

2.A.4. Expected Loss of Function

The impact of flooding on people and property are felt long after high water recedes. To properly assess the damage to communities that experience flooding, many types of impacts related to disruptions to life, businesses, and public services were identified. Infrastructure inundated during a major flooding event often become non-functional during the event and often for a short, but significant time afterward. A full description of impacts due to historical floods in the Neches River Basin is included in **Chapter 1.**

2.A.4.a. Inundated Structures

When flood water inundates a structure, damage is caused to the building and the contents within it. The severity of damage to the structure directly increases with the depth of water in the structure. Impact is also felt from monetary costs associated with people being either displaced from their homes or replacing possessions that were damaged by floods. Businesses can have their normal operations disrupted due to flooding events; in times where surrounding areas are heavily inundated from flooding, businesses can experience a loss in activity, inadequate staffing, delays in shipments, or other complications.

2.A.4.b. Transportation

Some of the most immediate and significant impacts of flooding are related to transportation and emergency services. Inundated roadways block the flow of people seeking to evacuate a flooded area; depending on flood severity, high water levels can render traditional methods of transportation such as automobiles and buses infeasible due to risk of drowning. Flooding can also delay or entirely prevent emergency services from reaching people in need of help. Depending on severity of conditions, this can lead to further loss of life.

Loss of function is also dependent on the severity of the flooding event. Bridges affected during major flooding events may need costly repair; in addition, erosion could be exacerbated due to wet conditions and force long-term road closures which can further hamper emergency operations and general public transportation.

2.A.4.c. Health and Human Services

The health-related impacts of flooding can be both direct and indirect. The most common direct impact of flooding on health is indeed the risk of drowning, cited by a 2014 report from the World Health Organization as causing two-thirds of flood-related deaths worldwide. It should also be noted that floodwaters often contain a high concentration of harmful bacteria and viruses which can cause illness and in severe cases, death. From the same 2014 WHO report, water contamination was listed as an indirect health-related impacts in addition to disruption of food supply, water shortage, and population displacement. Flood preparedness for hospital and other medical facilities is imperative to decrease the health-related impacts of floods.

2.A.4.d. Water and Wastewater Treatment

Water and wastewater treatment plants can be impacted by flood events as these facilities are often located along water courses for discharging treated water. If these facilities are not protected from flood events, the impact on nearby communities' water supply and water quality can be devastating. Lives of nearby residents can be disrupted as they receive notices to limit water usage, and the potential of people being exposed to raw sewage overflows can cause illnesses and a significant amount of time and resources to eliminate the contamination.

2.A.4.e. Utilities and Energy Generation

Flood events or associated strong winds can damage power lines and other electricity distribution infrastructure. Roadway inundation often hinders the swift repair of damaged equipment, and a prolonged lack of electricity in a community will significantly magnify all the impacts previously discussed.

Energy generation in the Neches River Basin is an important part of both the local, state, and national economy. Historical flood events in the basin and along the Gulf Coast have been shown to have significant impacts to oil and gas production and distribution. Potential failure of power generation plants due to flooding can cause direct losses including having to replace damaged equipment in addition to surrounding facilities losing power. For example, cities and counties may depend on local refineries to provide fuel necessary to operate emergency vehicles and stormwater pumps.

2.A.5. Existing Conditions Vulnerability Analysis

The goal of the vulnerability analysis was to identify vulnerabilities of communities and critical facilities within the region. The Social Vulnerability Index (SVI) was utilized for this analysis. The SVI, obtained from the Centers for Disease Control and Prevention (CDC), is a metric which draws upon 15 different U.S. Census variables to assist in identifying communities that may require support before, during, and after disasters. These variables are displayed in **Figure 2-6**. Some Census variables used in the metric include but are not limited to poverty level, transportation access, and housing density. For this analysis, the SVI metric was calculated on a building-by-building basis and has a score range of 0 to 1 with higher SVI scores indicating a higher need.

The exposure analysis identified the structures and population within the Neches region that were at risk of exposure to either the existing 1% or 0.2% ACE events. The SVI scores of these exposed structures were recorded with special focus being paid to exposed structures which are marked as critical facilities. The SVI scores of all exposed structures were averaged on a county basis. In addition, critical facilities at risk of flooding that possess an SVI score above 0.75 were recorded for future investigation.

All exposure and vulnerability spatial features and required tables were completed in accordance with 31 Texas Administrative Code (TAC) §361.33. **Map 7** in **Appendix 2-A** details the existing condition vulnerability analysis in the Neches region.

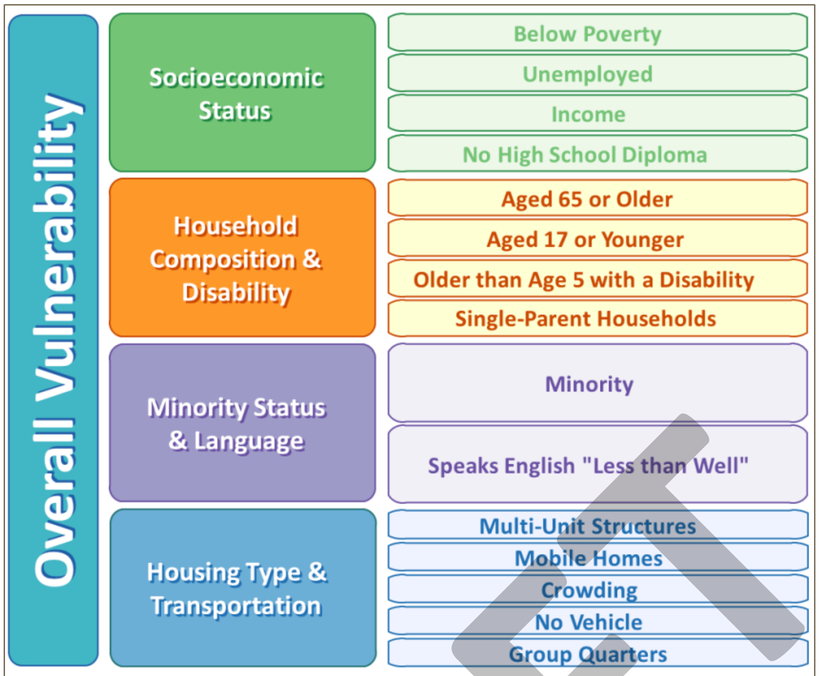


FIGURE 2-6: U.S. CENSUS VARIABLES USED FOR SOCIAL VULNERABILITY INDEX (SVI)

Source: https://svi.cdc.gov/Documents/Data/2018_SVI_Data/SVI2018Documentation.pdf

Chapter 2.B. Future Condition Flood Hazard Analysis

The RFPG was tasked with considering the change in flood risk over the next 30 years, thus developing floodplain extents for 2053. Future condition flood risk hazard analyses accounted for projected increases in flood hazard areas, and the additional population and property at risk of exposure.

The purpose of the future condition flood hazard analysis was to identify the future condition flood hazard area based on a projected increase in impervious cover, forecasted changes in rainfall patterns, anticipated variations in relative sea level and/or land subsidence, expected sedimentation in flood control structures, and other factors that may result in increased or altered flood hazards in the future. Flood exposure and vulnerability analyses were performed based on the future condition flood hazard layer generated for this analysis. Future Condition Flood Hazard areas for the region are shown in **Map 8** in **Appendix 2-A.**

2.B.1. Characterization of Future Conditions Based on “No Action” Scenario

The future conditions flood risk analysis performed for this plan is based on a 30-year “no action” scenario. This scenario accounts for continued population growth, current regulations, current land use/development trends, potential increases to flood risk from sea level rise, and changes in rainfall patterns. Flood mitigation projects recommended in this plan are not incorporated into the future conditions analysis. The analysis is to be used for planning purposes only and is not intended for regulatory purposes.

2.B.1.a. Sea Level Change and Subsidence

Relative sea level change (RSLC) refers to the change in sea level compared to land elevation at a particular location. Sea level change is understood to be affected by global and local phenomena including changes in:

- Ocean mass changes associated with land ice melt results in changes to Earth's gravity field and slightly shifts the direction of Earth's rotation
- Density from total salinity
- Heat content of the world's ocean
- Estuarine and shelf hydrodynamics
- Regional oceanographic circulation patterns (often caused by changes in regional atmospheric patterns)
- Hydrologic cycles (river flow)
- Local and/or regional vertical land motion (subsidence or uplift)

RSLC can increase flood hazards in low lying coastal communities. The Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (USACE) have developed methodology for tracking sea level change by quantifying the average number of coastal flood events per year and estimating anticipated future sea level changes. **Figure 2-7** shows the average number of coastal flood events per year for various Gulf Coast communities in the United States. The EPA found that each station has experienced a significant increase in quantity of annual coastal flooding compared to previous decades. Since 1960, the National Oceanic and Atmospheric Administration (NOAA) tide gauges along the Texas and Louisiana coasts recorded a RSLC increase of 10 to 20 inches, as displayed in **Figure 2-8**. During this time frame, the community of Sabine Pass, TX has witnessed 14.55 total inches of sea level rise (SLR).

USACE has developed a methodology to estimate future sea level change by calculating "low," "intermediate," and "high" scenarios. The "low" scenario projects a continuation of the currently observed linear sea level trend. The "intermediate" scenario uses the National Research Council (NRC) Curve I model with low values assumed for global and local phenomena. Finally, the "high" scenario uses the NRC Curve III model with higher assumed values for global and local phenomena in addition to low assumptions for glacier melt. At Sabine Pass, in the next 30 years, the approximate "high" SLR is approximated to be 2.30 feet with the "intermediate" SLR projected to be 1.36 feet and the "low" SLR estimated to be 1.06 feet. A graph showing the SLR projections for Sabine Pass is shown in **Figure 2-9.**

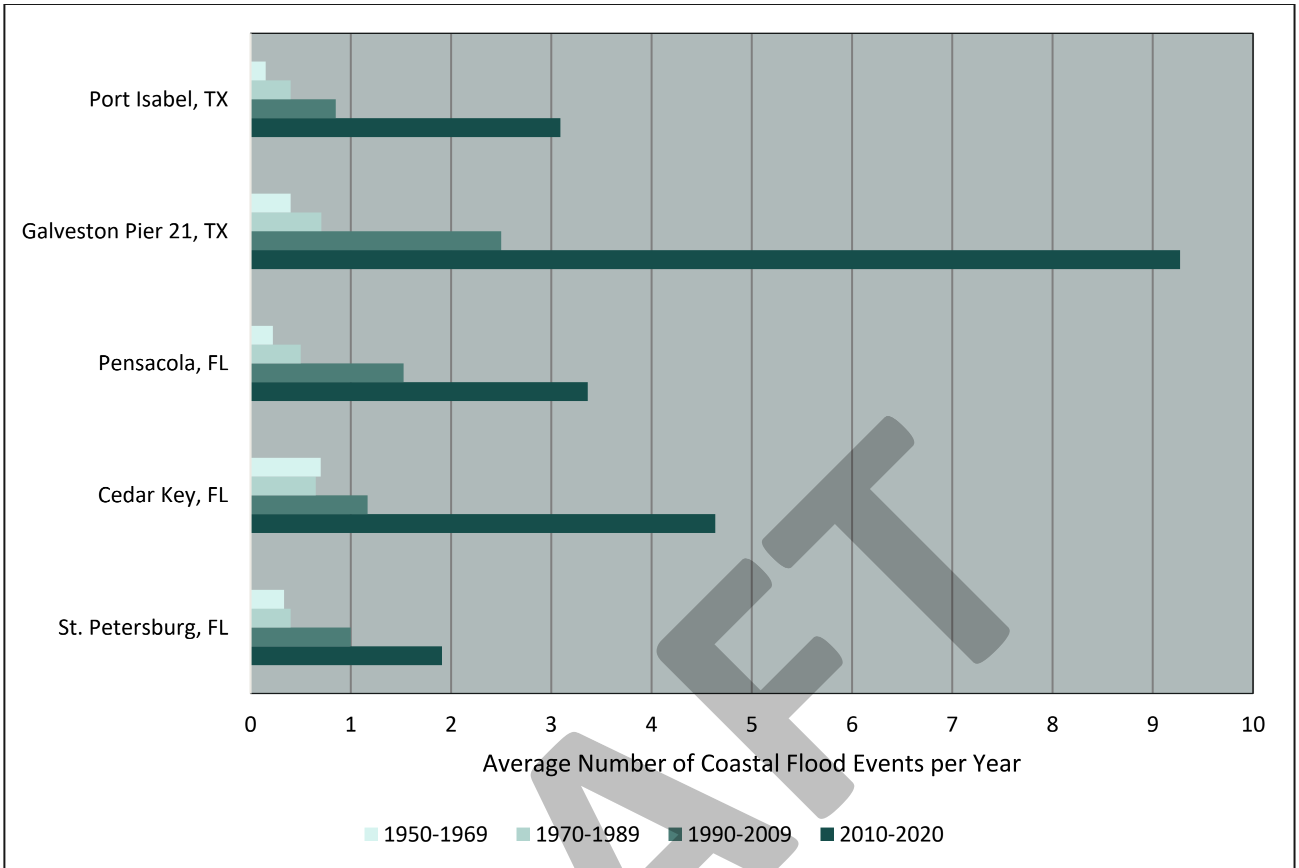


FIGURE 2-7: AVERAGE NUMBER OF RECORDED COASTAL FLOOD EVENTS PER YEAR

(Adopted from EPA's Climate Change Indicators in the United States: www.epa.gov/climate-indicators)

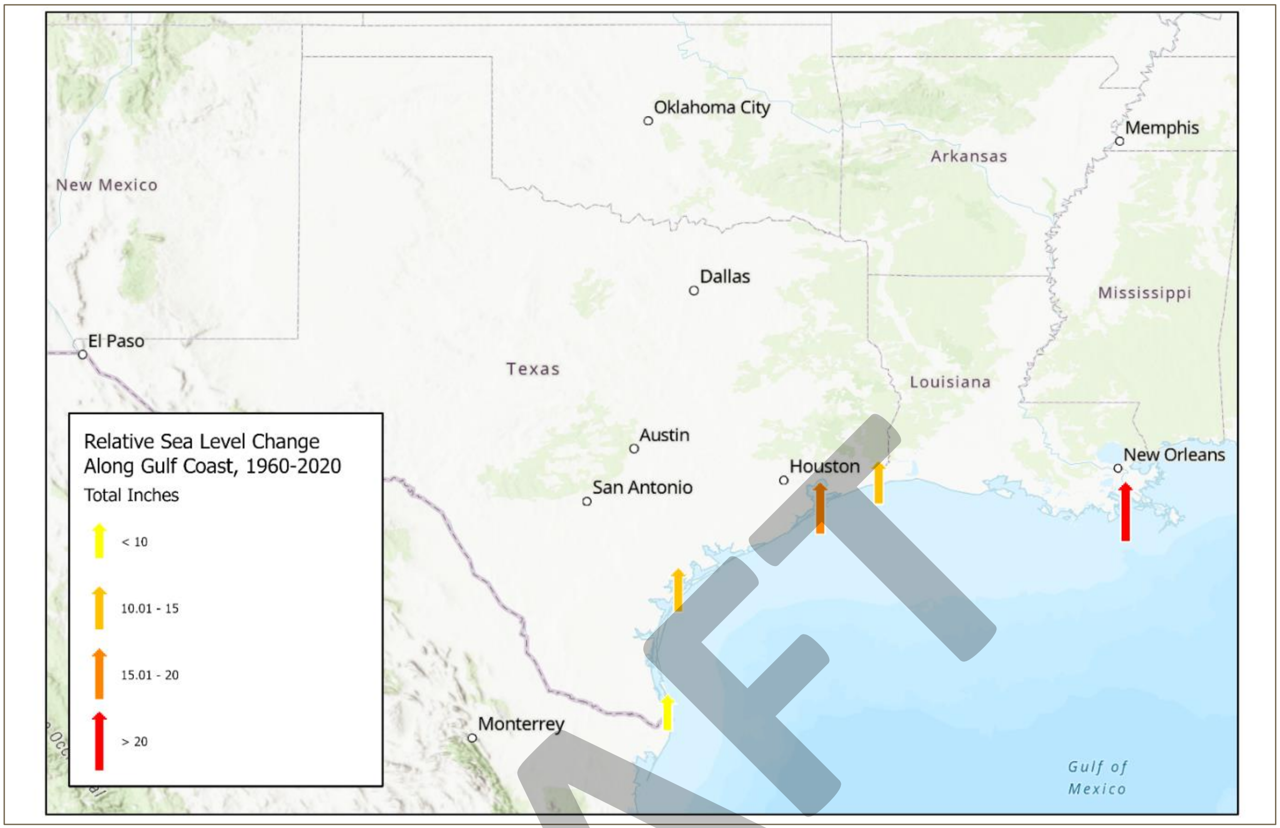


FIGURE 2-8: RELATIVE SEA LEVEL CHANGE ALONG GULF COAST

(Adapted from: EPA's Climate Change Indicators in the United States: www.epa.gov/climate-indicators)

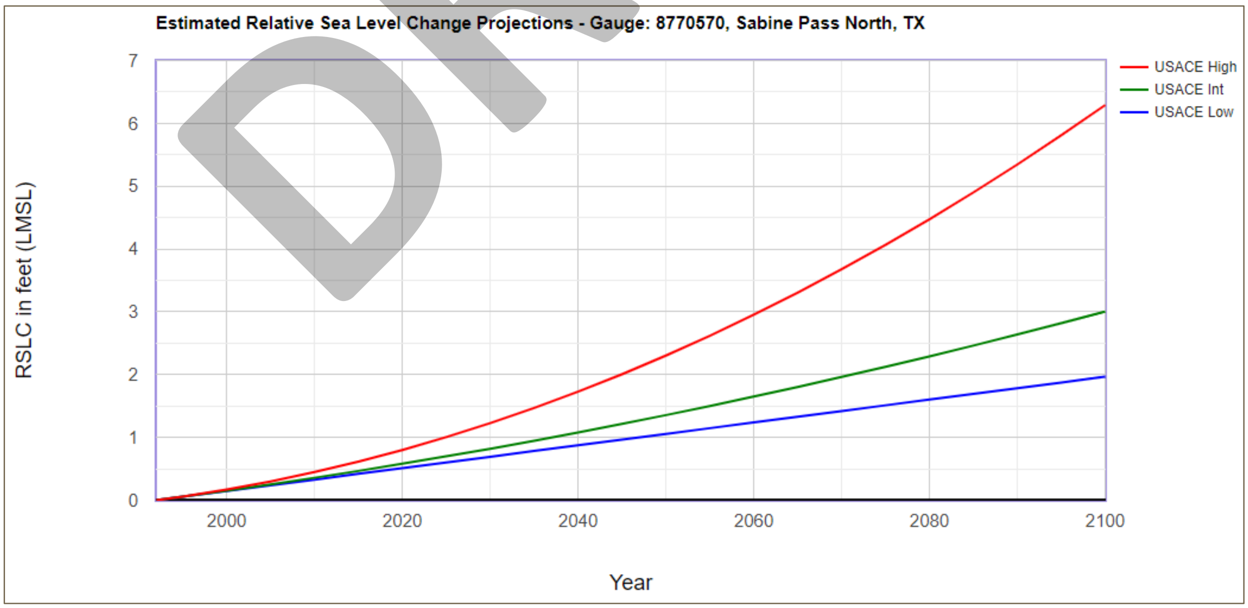


FIGURE 2-9: RELATIVE SEA LEVEL CHANGE PROJECTION FOR SABINE PASS

(Adapted from USACE https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html)

2.B.1.b. Sedimentation and Major Geomorphic Changes

Sedimentation is a significant issue within the Neches basin. Sediment transport on a river system is a complex phenomenon with substantial geographic and temporal variability. The assessment and information provided in this section is based on a series of simplifying assumptions and is only intended to serve as a general indicator of the potential impacts of sedimentation in future flood risk at a regional scale within a 30-year planning horizon. The following sections speak to these sedimentation and geomorphic changes in the basin and their impact of flood control structures and flood risk.

The Neches River has many flood control structures including reservoirs, dams, and levees that protect people and property from flood risk. Of these structures, reservoirs are the most susceptible to sedimentation in terms of their effectiveness of flood control. Sediment deposits in a reservoir directly reduce the volume available in the conservation pool, as shown in **Figure 2-10**. This available volume, in most cases provides water supply, hydropower generation, or is utilized for other purposes such as recreation.

The Regional Water Plans evaluate the impacts sedimentation may have on reservoirs' ability to maintain a steady supply of water. **Figure 2-11** and **Figure 2-12** show the sediment thickness and water depths respectively in B.A. Steinhagen Lake. More acute levels of sediment buildup are found in areas of the lake where the water depth is greater. Sediment buildup can occur in the upper reaches of a reservoir, which can impact both the flood control pool and the conservation pool. Additionally, backwater from the reservoir can lower the velocity of the water entering the reservoir; the channels feeding into a reservoir, if their flow rates are reduced, will be subject to greater flood potential. Sedimentation rates for each of the major reservoirs located within the Neches region are shown in **Table 2-9.**

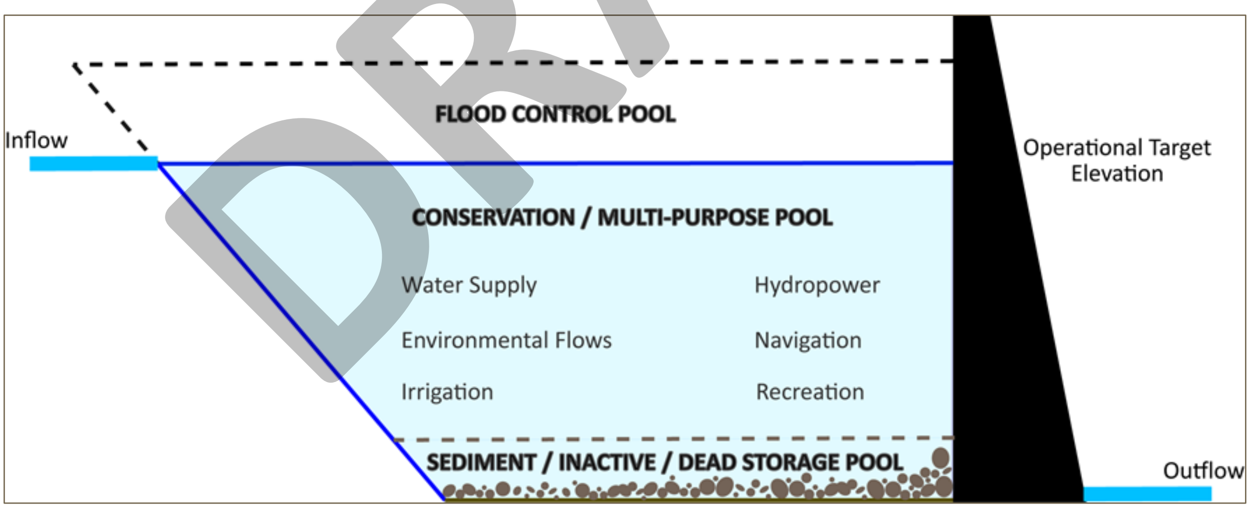


FIGURE 2-10: EFFECTS OF SEDIMENTATION ON MULTIPURPOSE RESERVOIRS

(Source: https://nicholasinstitute.duke.edu/reservoir-reallocation/)

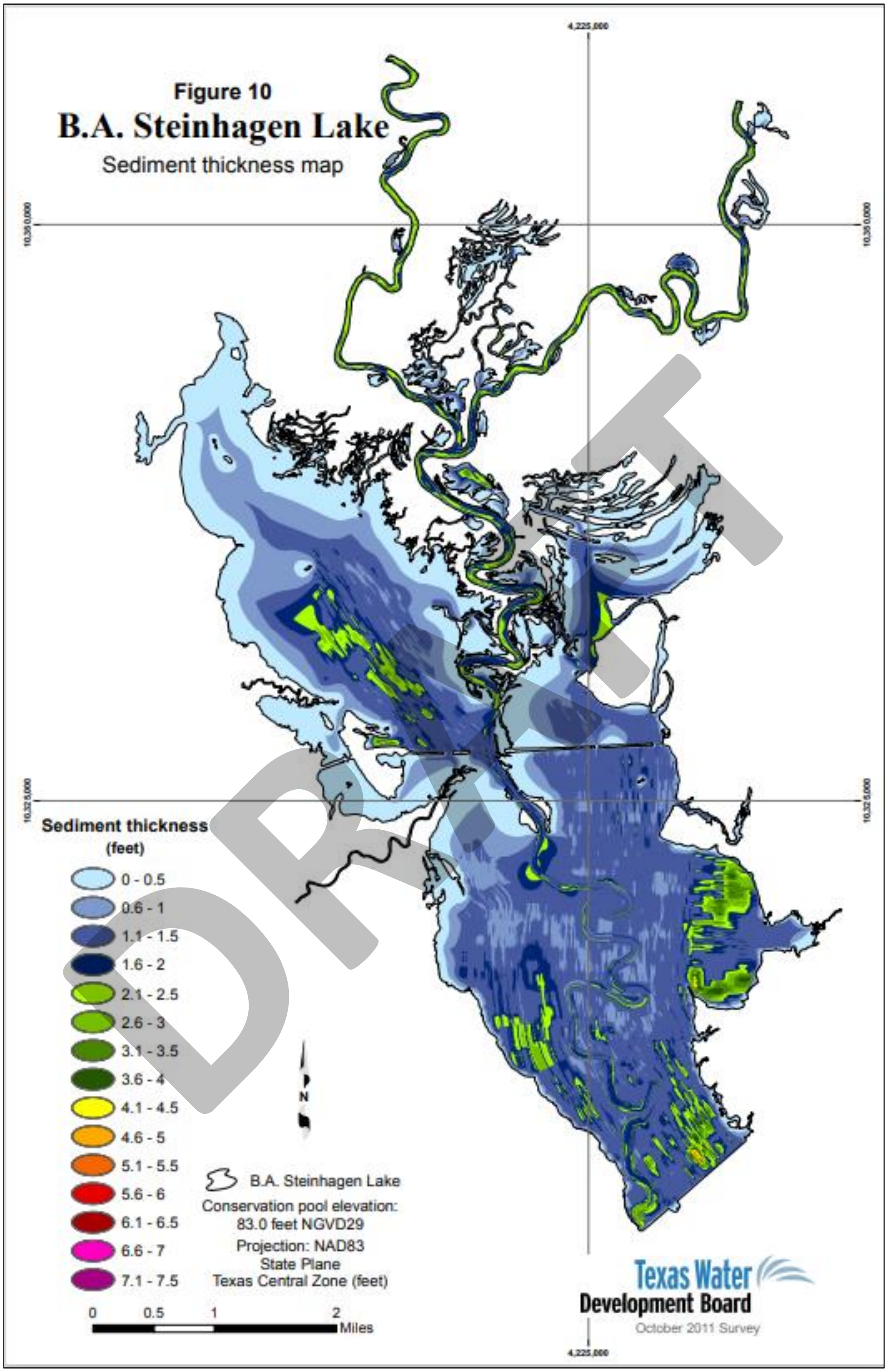


FIGURE 2-11: SEDIMENT THICKNESS MAP FOR B.A. STEINHAGEN LAKE

(Source: Volumetric and Sedimentation Survey of B.A. Steinhagen Lake, TWDB, 2011)

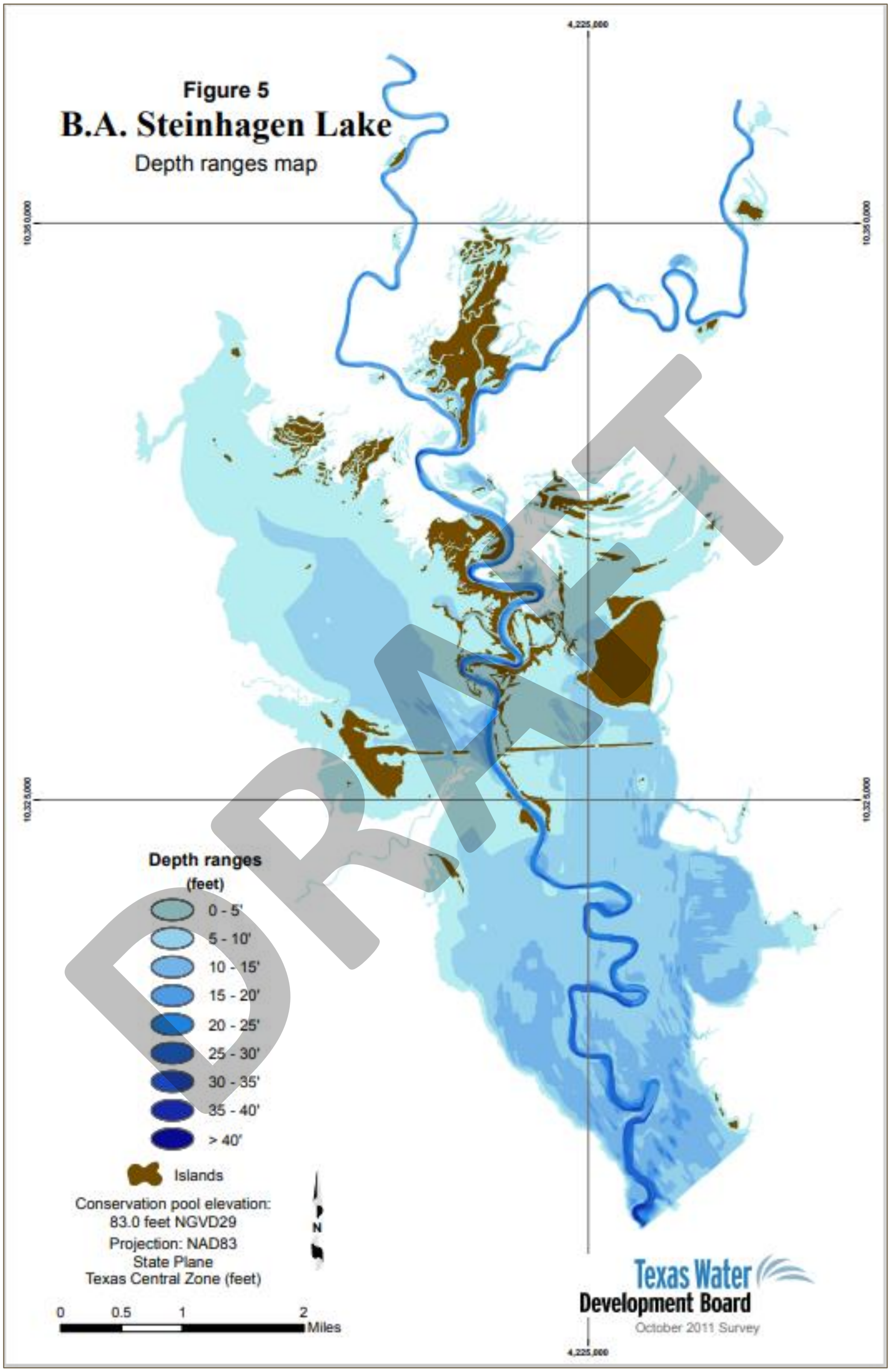


FIGURE 2-12: DEPTH RANGES MAP FOR B.A. STEINHAGEN LAKE

(Source: Volumetric and Sedimentation Survey of B.A. Steinhagen Lake, TWDB, 2011)

TABLE 2-9: SEDIMENTATION RATES IN MAJOR RESERVOIRS IN REGION 5

Lake/Reservoir	Location	Year of Most Recent Survey	Sediment-Contributing Drainage Area (mi²)	Sedimentation Rate (ac-ft/yr/mi²)
Lake Athens	Henderson County	1998	22	4.35
Lake B.A. Steinhagen	Town Bluff, TX	2011	3,251	0.06
Lake Jacksonville	Jacksonville, TX	2006	34	2.88
Lake Kurth	Lufkin, TX	1996	4	8.57
Lake Nacogdoches	Nacogdoches, TX	1994	89	1.75
Lake Palestine	Frankston, TX	2012	817	0.76
Pinkston Lake	Center, TX	*	14	0.19
Sam Rayburn Reservoir	Jasper, TX	2004	3,010	0.18
Lake Striker	Rusk, TX	1996	182	0.85
Lake Tyler	Whitehouse, TX	2013	107	1.00
Lake Nanconiche	Nacogdoches, TX	*	27	0.19

*No survey available.

(Source: 2021 Region I Regional Water Plan, Appendix 3-B)

Significant geomorphic change has been identified at the outlet of the Neches River to Sabine Lake. Geomorphic changes in this area, which includes the cities of Beaumont, Port Arthur, and Port Neches, is heavily linked to the area being developed for commercial and industrial use. There have been numerous land changes in the area due to the construction of new piers, docks, and industrial/commercial facilities. In addition, the configuration of the Neches River has also been altered from previous conditions, largely in part because of industrial channelization.

Smaller geomorphic changes can also occur in the region in the aftermath of major flooding events. Trees found in the more heavily forested areas in the region can be felled by major flooding events and the debris from them can cause log jams in downstream channels and water bodies. If these jams persist over an extended period of time, sand bars can accumulate behind these log jams, resulting in noticeable geomorphic change. It should be noted that this phenomenon is not strictly tied to debris from trees; any kind of flood debris, whether it be discarded equipment, vehicles, or unsecured household furniture, can lead to sediment buildup over time if they block a waterway.

2.B.2. Development of Future Condition Floodplains

The TWDB defined multiple methods for conducting future condition flood hazard analyses where data was not available. Per the Technical Guidelines for Regional Flood Planning, these methods are described below:

- Method 1: Increase water surface elevation based on projected percent population increase
- Method 2: Utilize the existing condition 0.2% ACE floodplain as a proxy for the future 1% ACE floodplain
- Method 3: Combination of Methods 1 and 2 or an RFPG-proposed method
- Method 4: Request TWDB for a Desktop Analysis

In the Neches FPR, method 3 was selected for implementation.

2.B.2.a. Future Conditions for Large Rivers

Due to the large size of its watershed, the Neches River is anticipated to be less susceptible to localized increases in storms. In part, this is due to reservoirs that regulate releases, such as flood control reservoirs or in some instances water supply reservoirs. Another factor is that larger floodplains result in greater attenuation of flood flow when compared to the floodplains for smaller streams.

Hence, the approach taken for determining the future flood hazard area for the Neches River downstream of Sam Rayburn Reservoir was to maintain the existing flood hazard extent, as displayed in **Figure 2-13**. It should be noted that this approach was also utilized for the portion of the Angelina River that flowed downstream from Sam Rayburn Reservoir into B.A. Steinhagen Lake. The segment of the Neches River where Existing Conditions were maintained for the Future Condition analysis is shown in **Figure 2-14**.

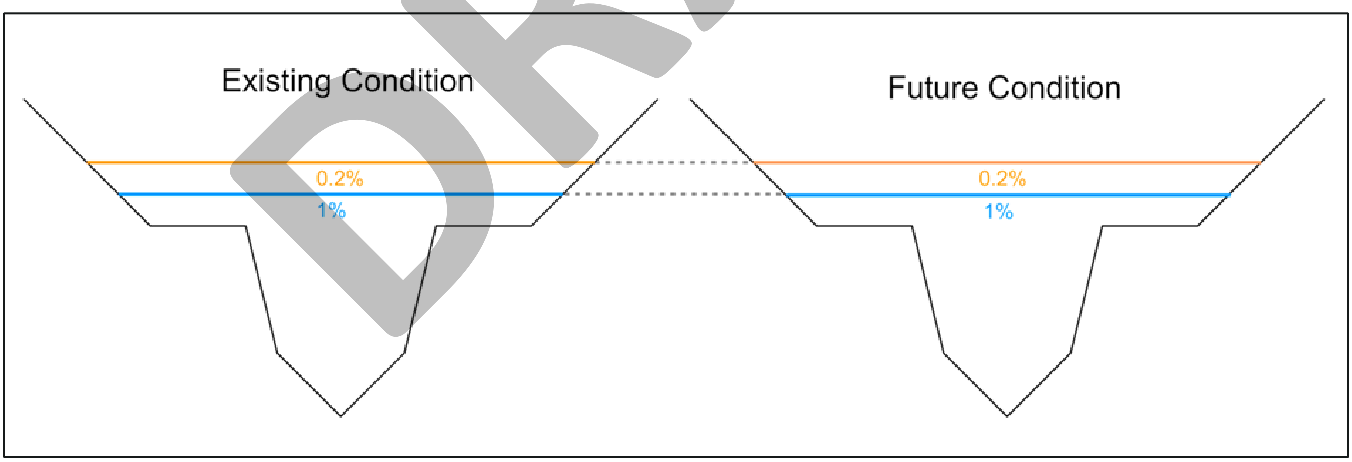


FIGURE 2-13: FUTURE CONDITION FLOOD HAZARD FOR NECHES RIVER DOWNSTREAM OF SAM RAYBURN RESERVOIR

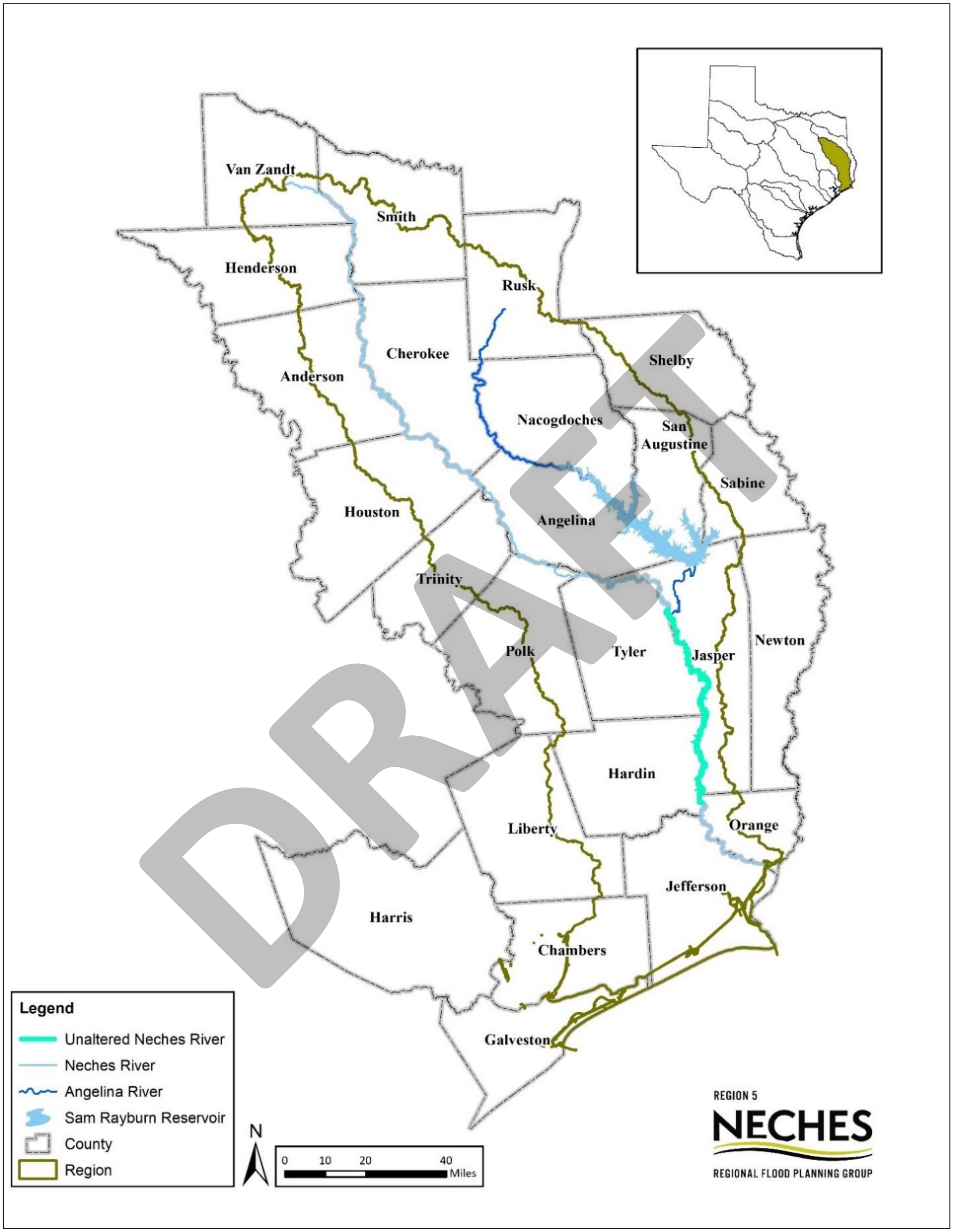


FIGURE 2-14: NECHES RIVER SEGMENT WITH MAINTAINED EXISTING CONDITIONS

2.B.2.b. Future Conditions for Tributaries Feeding into Larger Rivers

For tributaries feeding into larger rivers within the Neches basin, the existing 0.2% ACE flood hazard area from the existing condition flood hazard analysis is assumed to be the approximate future 1% ACE flood hazard area as depicted in **Figure 2-15**. This approach was used for all streams and tributaries present in the region, barring the segment of the Neches River downstream of Sam Rayburn Reservoir, for determining the future 1% ACE area.

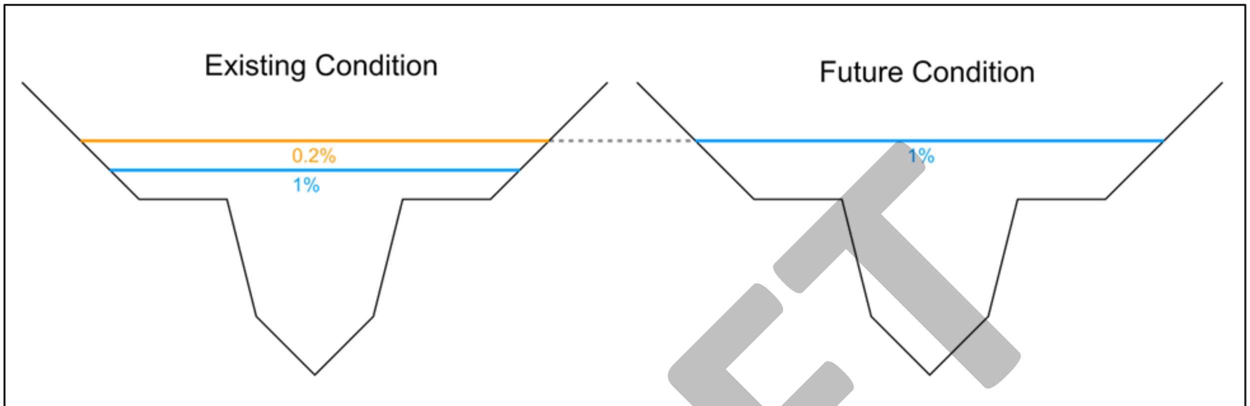


FIGURE 2-15: FUTURE CONDITION FLOOD HAZARD 1% (100-YR) TRIBUTARY METHOD

2.B.2.c. Future Conditions for Areas with BLE as Best Available Data

In areas where Base Level Engineering (BLE) data is determined to be the best available, the relationship between the 1% and the 0.2% ACE flood hazard areas was determined by comparing water surface elevations (WSEL). The elevation difference between the existing 1% ACE WSEL and 0.2% ACE WSELs will be maintained in future conditions as depicted in **Figure 2-16**. The future 0.2% ACE WSEL was compared to the existing topography to determine the extents of the future 0.2% ACE flood hazard boundary. This method was utilized in all areas of the region that contained BLE data, which consist of nearly the region's entire area barring the counties of Chambers, Jefferson, and part of Liberty, as shown in **Figure 2-17.**

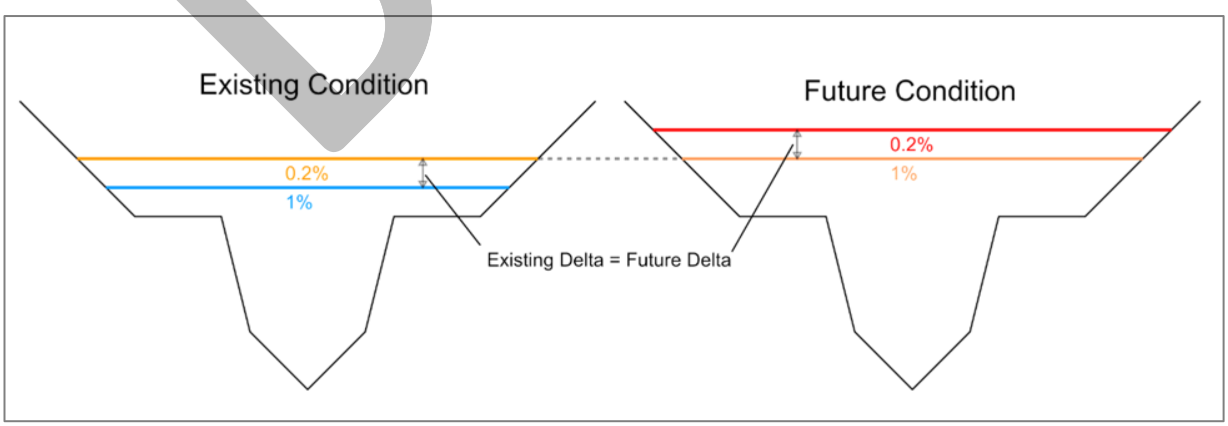


FIGURE 2-16: FUTURE CONDITION FLOOD HAZARD 1% ACE AND 0.2% ACE VERTICAL BUFFER METHOD (BLE)

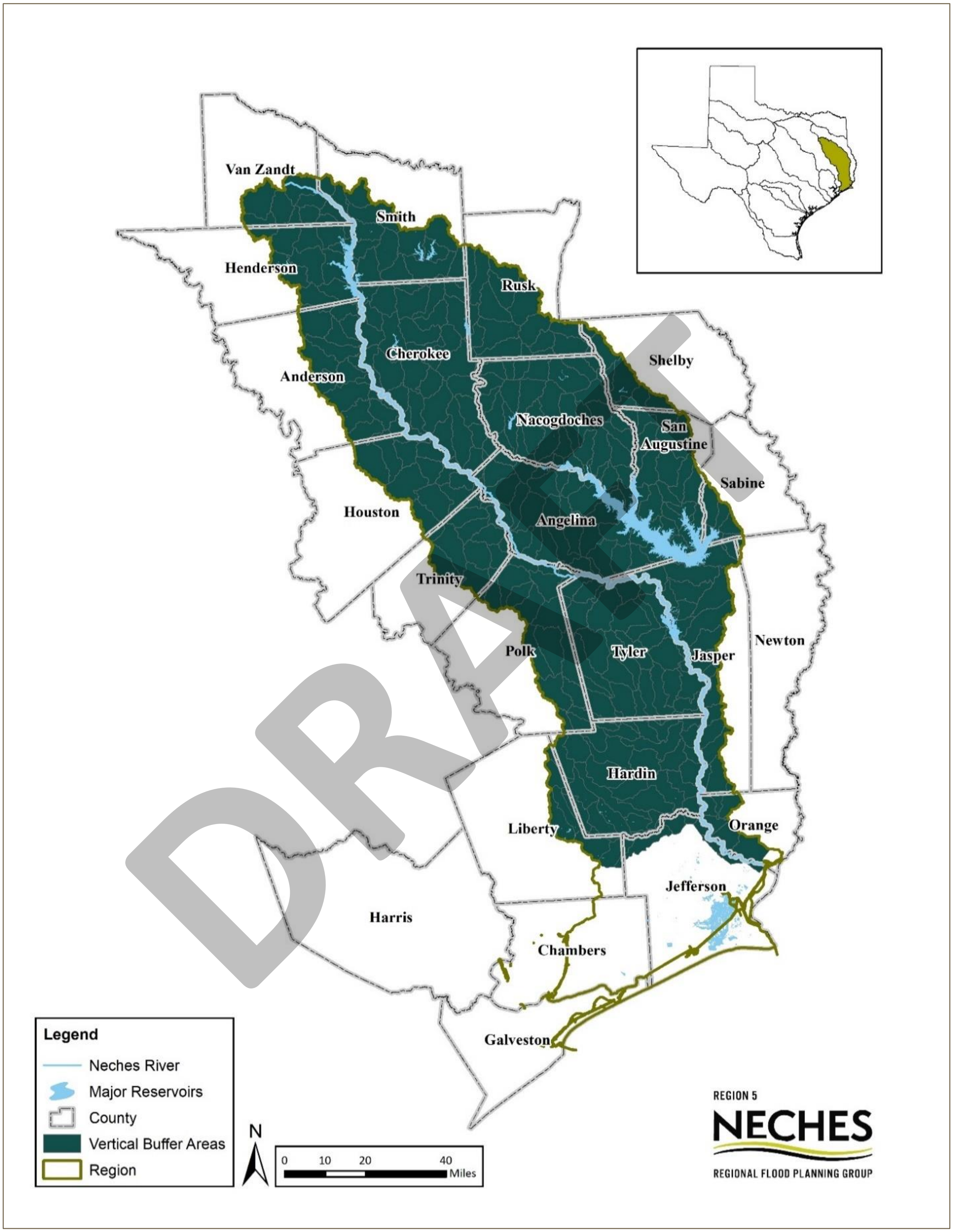


FIGURE 2-17: VERTICAL BUFFER AREAS

2.B.2.d. Future Conditions for Areas with NFHL as Best Available Data

In areas where NFHL Effective data is considered the best available data or is beyond the extents of BLE mapping, the future 0.2% ACE flood hazard area boundary is represented as a horizontal buffer outward from the future 1% ACE flood hazard area boundary. This method was utilized in areas where data provided by NFHL eclipsed BLE, as shown in **Figure 2-18**. There were segments identified in the floodplain quilt within the northern HUC12 watersheds where the NFHL data indicated a larger inundation area than BLE data did; for these segments, the horizontal buffer method was used and later merged with the results of the vertical buffer method to generate the final future floodplain quilt.

The extent of the buffer is determined based on the existing condition flood hazard layer. The horizontal buffer method first measures the distance between the extent of the existing 0.2% ACE floodplain and the extent of the existing 1% ACE floodplain. Once the difference in extents between the two floodplains is calculated, this value is applied to the outmost extents of the existing 0.2% ACE floodplain to spatially determine the extents of the future 0.2% ACE floodplain. It should be noted that this horizontal buffer significantly varies throughout the region; whereas one area may have a sizeable gap between the existing 0.2% and 1% ACE floodplains, another area in the region may have a much smaller space between the existing 0.2% and 1% ACE floodplains. **Table 2-10** shows the values of the horizontal buffers used in the region for tributaries and local streams, averaged within the area of a HUC8 watershed. The vicinity of Beaumont and Port Arthur features a concentration of developed area in addition to flat terrain which results in larger and wider floodplains. Due to this, a **buffer of 1,970 feet** was used to capture the extents of the future 0.2% ACE floodplain. A graphical depiction of this method is illustrated in **Figure 2-19.**

TABLE 2-10: HORIZONTAL BUFFERS BY HUC8 WATERSHED

HUC8 Watershed	Tributary Buffer (ft)	Local Stream Buffer (ft)
Upper Neches	50	15
Middle Neches	58	25
Lower Neches	82	-
Upper Angelina	73	23
Lower Angelina	53	-

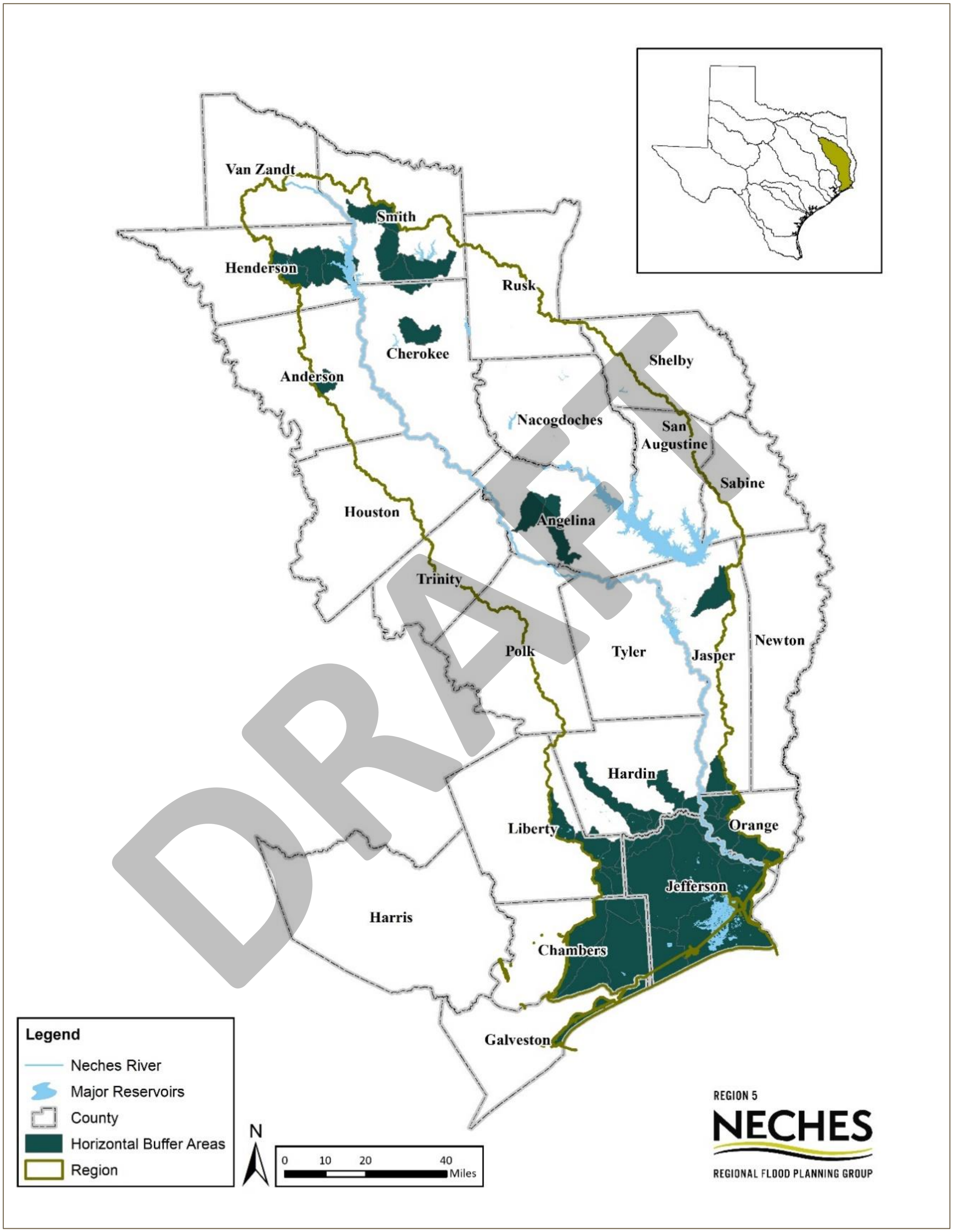


FIGURE 2-18: HORIZONTAL BUFFER AREAS

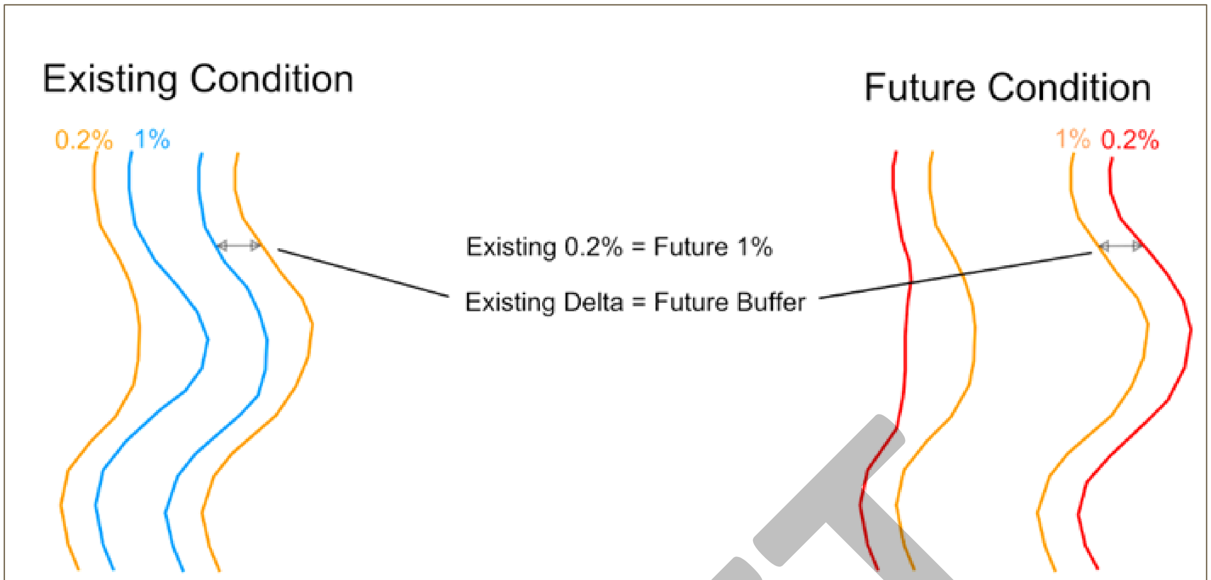


FIGURE 2-19: FUTURE CONDITION FLOOD HAZARD 1% ACE AND 0.2% ACE HORIZONTAL BUFFER METHOD (NFHL)

2.B.2.e. Coastal Areas

For areas with coastal flooding, future conditions should also include expected sea level rise as data becomes available. More detailed data from the Sabine Pass to Galveston Bay Coastal Storm Risk Management Program is expected to inform the development of future condition coastal inundation and be incorporated in future RFPs. The study quantifies future (years 2050, 2080 and 2130) sea level rise and benefits from a multitude of projects including flood walls, pump stations and levees proposed in Orange and Jefferson Counties and the local vicinities.

2.B.2.f. Data Gaps and Future Flood Prone Areas

No future condition hydrologic and hydraulic models or floodplain mapping were available in the planning region for use in Task 2B. As a result, the entire region is reflected as a gap in inundation boundary mapping, as detailed in **Map 9** in **Appendix 2-A**.

2.B.3. Future Condition 1% and 0.2% Annual Chance Exceedance Floodplains

Map 8 in **Appendix 2-A** shows the future condition flood hazard areas across the Neches River Basin. **Map 10**, also found in **Appendix 2-A**, shows the changes in flood hazard data from existing to future conditions as a result of the buffering techniques described above. **Table 2-11** contains a summarized comparison between existing and future flood hazard areas. **Table 5** in **Appendix 2-B** summarizes future flood risk area on a county and frequency basis in the Neches Flood Planning Region. Additionally, **Table 2-12**, **Table 2-13**, and **Table 2-14**- summarize the future area of each flood risk type for the counties included in Region 5 by 1% ACE, 0.2% ACE, and flood prone areas, respectively. The flood risk types in the region include Riverine, Coastal, Local/Urban, and Other.

TABLE 2-11: INCREASE IN FLOOD HAZARD AREA FOR FUTURE CONDITION COMPARED TO EXISTING CONDITION

Flood Frequency	Existing Conditions Area (Sq. Mi)	Future Conditions Area (Sq. Mi)	Increase (Sq. Mi)	% Increase
1% ACE	3,079	3,433	354	11.5%
0.2% ACE	3,453	3,862	409	11.8%

TABLE 2-12: TOTAL LAND AREA OF FUTURE 1% ACE FLOOD RISK TYPE BY COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	74.66	0	0	0
Angelina	238.56	0	0	0
Chambers	310.09	61.16	0	0
Cherokee	180.89	0	0	0
Galveston	7.37	47.04	0	0
Hardin	350.56	0	0	0
Harris	0	0	0	0
Henderson	78.57	0	0	0
Houston	66.16	0	0	0
Jasper	204.39	0	0	0
Jefferson	623.43	71.47	0	0
Liberty	85.66	0	0	0
Nacogdoches	178.39	0	0	0
Newton	0.83	0	0	0
Orange	104.32	15.36	0	0
Polk	106.02	0	0	0
Rusk	76.87	0	0	0
Sabine	22.49	0	0	0
San Augustine	127.07	0	0	0
Shelby	22.67	0	0	0
Smith	73.54	0	0	0
Trinity	78.99	0	0	0
Tyler	194.33	0	0	0
Van Zandt	32.01	0	0	0

TABLE 2-13: TOTAL LAND AREA OF FUTURE 0.2% ACE FLOOD RISK TYPE BY COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	78.10	0	0	0
Angelina	247.06	0	0	0
Chambers	339.97	61.16	0	0
Cherokee	188.90	0	0	0
Galveston	9.51	47.04	0	0
Hardin	393.94	0	0	0
Harris	0	0	0	0
Henderson	81.89	0	0	0
Houston	69.79	0	0	0
Jasper	222.39	0	0	0
Jefferson	816.92	71.47	0	0
Liberty	128.89	0	0	0
Nacogdoches	185.37	0	0	0
Newton	0.90	0	0	0
Orange	132.11	15.36	0	0
Polk	111.14	0	0	0
Rusk	80.67	0	0	0
Sabine	23.35	0	0	0
San Augustine	130.84	0	0	0
Shelby	23.57	0	0	0
Smith	77.56	0	0	0
Trinity	83.13	0	0	0
Tyler	207.35	0	0	0
Van Zandt	33.87	0	0	0

TABLE 2-14: TOTAL LAND AREA OF FUTURE FLOOD PRONE AREAS BY FLOOD RISK TYPE AND COUNTY

County	Total Riverine Flood Risk Area (sqmi)	Total Coastal Flood Risk Area (sqmi)	Total Local/Urban Flood Risk Area (sqmi)	Total Other Flood Risk Area (sqmi)
Anderson	0.66	0	4.17	0
Angelina	1.40	0	8.74	0.01
Chambers	0	0	0	4.53
Cherokee	2.46	0	11.17	0
Galveston	0	0	0	0
Hardin	0	0	0	31.81
Harris	0	0	0	0
Henderson	0.43	0	3.44	0
Houston	1.86	0	3.27	0
Jasper	0	0	0	2.37
Jefferson	0	0	0	22.01
Liberty	0	0	0	22.54
Nacogdoches	2.33	0	7.54	0
Newton	0	0	0	0
Orange	0	0	0	0.18
Polk	0	0	0	2.02
Rusk	3.16	0	6.45	0
Sabine	0.47	0	1.01	0
San Augustine	1.18	0	4.20	0
Shelby	0.23	0	1.15	0
Smith	0.99	0	7.58	0
Trinity	0.21	0	2.49	0
Tyler	0	0	0	2.58
Van Zandt	0.22	0	3.13	0

2.B.3.a. Future Development within the Floodplain Population Growth

Population projections were developed at the watershed (HUC10) and sub-basin (HUC8) levels using county and Water User Group (WUG) population projections developed for the 2022 State Water Plan (SWP). The projections from the SWP span from 2020 to 2070, but for the purposes of projecting future population growth for the flood planning effort, only the projections from 2020-2050 were used. Although some Water User Groups cross watersheds and sub-basins, the population projections used in this analysis fall within the Neches River Basin. The population within the planning region is projected to grow by 24%, or 234,175 people, from 2020 to 2050. Population projections for each WUG in the planning region can be found in **Appendix 2-C**. A summary of regionwide growth is shown in **Table 2-15** below. **Table 2-16** details the future population projections for the major cities in the Neches region.

TABLE 2-15: FUTURE POPULATION PROJECTIONS FOR REGION 5

Region	2020	2030	2040	2050

	Population	% Increase	Population	% Increase from 2020	Population	% Increase from 2030	Population	% Increase from 2040
Neches	962,876	N/A	1,041,511	8.17	1,116,737	7.22	1,197,051	7.19

TABLE 2-16: FUTURE POPULATION PROJECTIONS FOR MAJOR CITIES IN REGION 5

City	2020		2030		2040		2050	
	Population	% Increase	Population	% Increase from 2020	Population	% Increase from 2030	Population	% Increase from 2040
Tyler	104,881	N/A	114,209	8.89	125,583	9.96	133,688	6.45
Nacogdoches	37,580	N/A	42,218	12.34	46,791	10.83	51,656	10.40
Port Arthur	55,398	N/A	56,095	1.26	56,095	0	56,095	0
Beaumont	99,600	N/A	138,409	38.96	147,221	6.37	157,461	6.96
Lufkin	43,626	N/A	46,679	7.00	49,241	5.49	51,580	4.75

2.B.3.b. Anticipated Future Development

The future conditions analysis included distributing projected population growth spatially within the planning region. The process to decide where anticipated development would occur took into consideration regional infrastructure, undeveloped land, natural features, existing flood risk, jurisdictions, and current development trends. The input factors were combined using local knowledge to represent how likely new development could occur throughout the region. Future development was distributed within each WUG based on the following factors in descending priority order:

1. Proximity to Recent Development
2. Proximity to Existing Development
3. Proximity to Interstates and Highways
4. Proximity to Major Local Thoroughfares
5. Proximity to Planned Highway Local Thoroughfares
6. Wetlands
7. Identified Flood Hazard Areas
8. Areas within City Limits or Extraterritorial Jurisdictions (ETJs)

Future development was restricted in the following areas:

- Existing Floodways
- Existing Parks, Cemeteries, Airports, Golf Courses
- Government Owned/Protected Land
- Existing Railroad Right of Ways
- Existing Road Right of Ways
- Existing Developments
- Areas with Heavy Concentration of Industrial Facilities

Anticipated population densities shown in **Table 2-17** were informed by the 2020 Census. High population density was assigned to existing urban centers. Medium density was used for suburban areas within 3 miles of existing urban centers, and low density was used for the remaining area in the planning region. The remaining area in the Neches region outside of suburban and urban areas mostly consisted of rural area.

TABLE 2-17: APPROXIMATE FUTURE POPULATION DENSITY

Population Density	People per Acre
High	18
Medium	9
Low	5

Future development was distributed within each WUG beginning with the most desirable areas as determined by the factors listed above. This process continued until all anticipated population was assigned. A trend noticed in heavily developed WUGs was that the projected population growth exceeded the land available to develop. In these scenarios, population in excess of the WUG capacity was transferred to the closest "County-Other" WUG. Areas anticipated to be developed were divided into individual parcels based on population densities from the areas determined in the 2020 Census. A single residential structure was created at the center of each parcel for inclusion in the future conditions flood risk exposure analysis.

Figure 2-20 illustrates the outcome of the process; the zones identified as potential future development, as well as the predicted layout of residential structures, can be seen in the figure. The shaded area follows typical development patterns as undeveloped land near the major thoroughfares and pockets of vacant land within the city become developed. Additional land on the edge of the existing urban area also became developed. The shaded areas identified as future development were then divided into potential future structures based on population associated with the development.

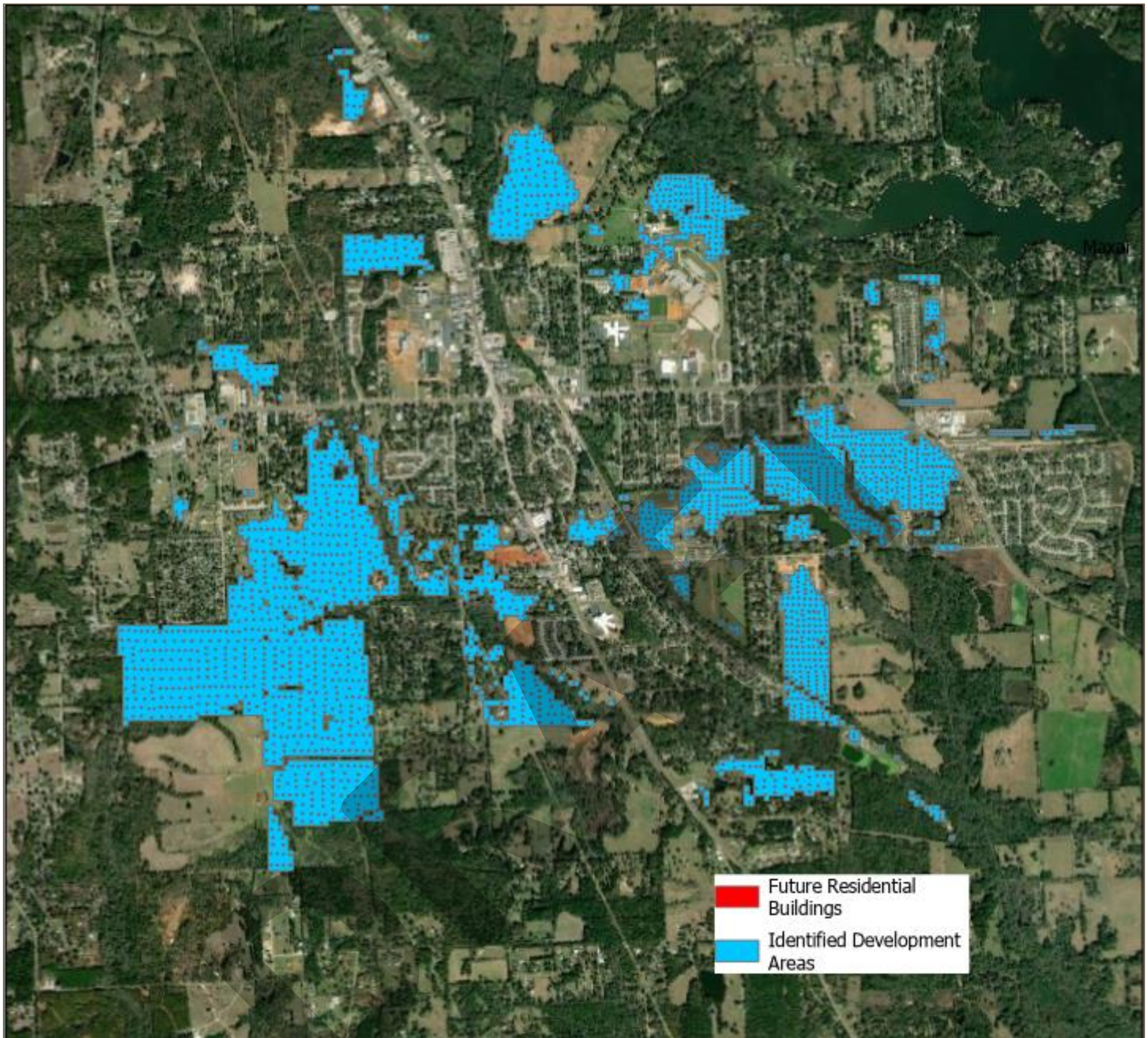


FIGURE 2-20: SAMPLE AREA OF ANTICIPATED FUTURE DEVELOPMENT

2.B.4. Future Condition Flood Exposure Analysis

Flood exposure for future conditions followed the same methodology as existing conditions using future flood hazard areas. However, residential structures that were created based on projected future development and population projections were incorporated into the exposure analysis. Existing buildings, roadway crossings, and agricultural areas were maintained in the future conditions analysis. The summary of future flood exposure by county can be found in **Table 5** in **Appendix 2-B** and **Map 11** located in **Appendix 2-A**. The increase in future conditions exposure compared with the existing conditions exposure is summarized in **Table 2-18** below. Exposure to the 1% and 0.2% ACE flood hazard areas is accounted for in addition to exposure to additional flood prone areas.

TABLE 2-18: SUMMARY OF INCREASE IN EXPOSURE IN FLOOD HAZARD AREAS

Features	Existing Conditions	Future Conditions	Increase	% Increase
Population	247,393	364,265	116,872	47%
Total Structures	104,260	141,290	37,030	36%
Residential Structures	81,884	110,769	28,885	35%
Non-Residential Structures	22,376	30,521	8,145	36%
Critical Facilities	2,373	3,541	1,168	49%
Roadway Crossing	4,980	5,749	769	15%
Roadway Segments (miles)	3,069	3,988	919	30%
Agricultural Area (sq. mi)	209	231	22	11%

Population data for the future conditions flood risk exposure analysis accounted for projected population growth from new development in addition to existing population data. The population associated with existing structures was not altered for the future exposure analysis. The population of the new structures was identified using population projections and population density as discussed previously.

2.B.4.a. Population within Flood Hazard Areas

The Neches FPR is expected to grow by 234,175 people by year 2050 to a total population of 1,197,051. Approximately 158,000 people are anticipated to be located within the future 1% ACE flood hazard area with an estimated total of nearly 290,000 people estimated to be within the future 0.2% ACE flood hazard area. About 75,000 people are estimated to be in possible future flood prone areas. **Table 2-19** itemizes the population for both existing and future conditions.

TABLE 2-19: COMPARISON OF POPULATION IN FLOOD HAZARD AREAS

Condition	Estimated Population	People in 1% ACE Flood Hazard Area	People in 0.2% ACE Flood Hazard Area	People in Possible Flood Prone Areas
Existing	962,876	65,717	158,275	89,118
Future	1,197,051	157,903	288,931	75,334

2.B.4.b. Structures within Flood Hazard Areas

Almost all the total regional increase in structural risk is contained in four counties, detailed in **Table 2-20**.

TABLE 2-20: COUNTIES WITH SUBSTANTIAL INCREASE IN TOTAL STRUCTURE EXPOSURE IN FLOOD HAZARD AREAS

Counties	Existing Conditions Structures	Future Conditions Structures	Increase
Jefferson	66,174	91,684	25,510
Orange	11,334	15,825	4,491
Hardin	6,456	8,857	2,401
Smith	4,549	5,677	1,128

Jefferson County has extreme flood risk from its expansive future floodplains which cover 95% of the county area in the basin. Addressing the potential flood risk exposure in Jefferson County requires major flood infrastructure projects, information on which can be found both in **Chapter 4** and **Chapter 5**. The southern portion of the Neches River Basin, although at much higher risk of coastal and riverine flooding, is projected to experience significant growth by 2050. If no action is taken to mitigate flood risk, the exposure will increase substantially and an increase in both property damage and loss of life can be expected.

Residential structures make up most of the exposed structures in the Neches basin. 60,167 residential structures are at risk of being impacted by the future 1% ACE flood and a total of 100,524 residential structures have been found to be within the future 0.2% ACE flood hazard area. Over 69,000 residential structures in Jefferson County alone are exposed to the future 0.2% ACE flood. **Table 2-21** details counties in the Neches region that experience acute increases in residential structures impacted between future and existing conditions.

TABLE 2-21: COUNTIES WITH SUBSTANTIAL INCREASE IN RESIDENTIAL STRUCTURE EXPOSURE IN FLOOD HAZARD AREAS

Counties	Existing Conditions Residential Structures	Future Conditions Residential Structures	Increase
Jefferson	54,636	75,055	20,419
Orange	9,872	13,658	3,786
Hardin	4,486	6,142	1,656
Smith	2,715	3,621	906

Non-residential structure inventory data included agricultural, commercial, industrial, and public buildings. No additional non-residential structures were included in the analysis due to the uncertainty of where or how many of these structures could be expected in the future. While the exposure of existing non-residential structures is anticipated to increase by 36% in future conditions, the exposure of future non-residential structures is unknown. **Table 2-18** summarizes the change in structural flood exposure in future conditions compared to existing conditions. **Figure 2-21** compares the categories of building exposed in the 0.2% ACE flood hazard area in addition to future possible flood prone areas.

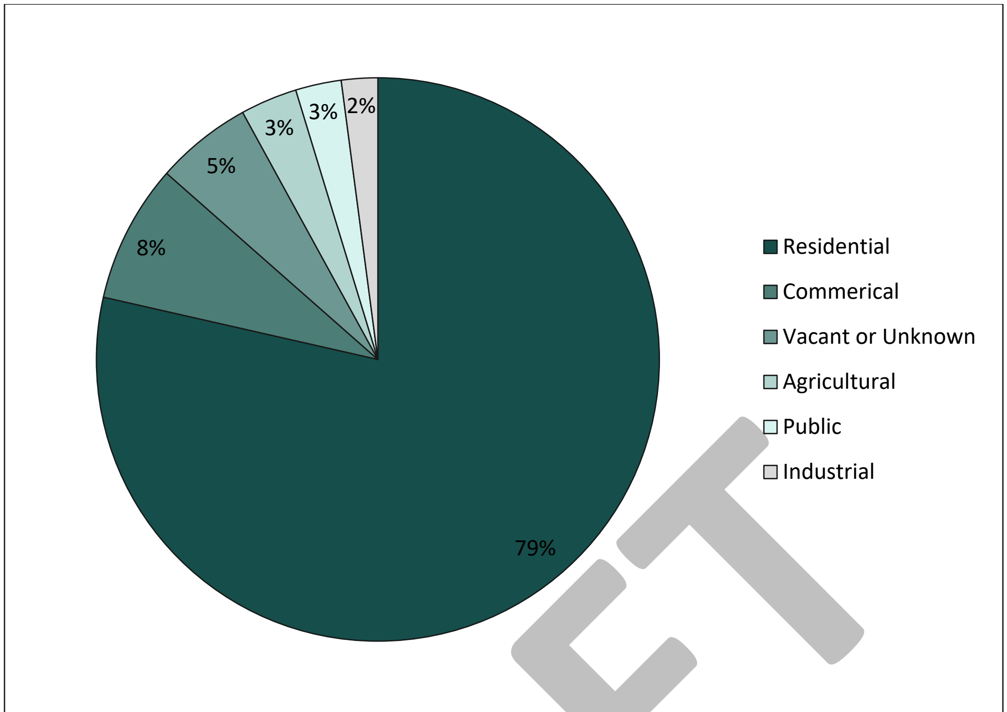


FIGURE 2-21: FUTURE FLOOD RISK STRUCTURE EXPOSURE BY BUILDING CATEGORY

2.B.4.c. Critical Facilities and Public Infrastructure within Flood Hazard Area

Critical facilities and public infrastructure were analyzed with the future flood hazard areas to determine future flood risk exposure of these features. No additional features were added to the dataset compiled in the existing conditions flood exposure analysis. The future condition scenario assumes that all new critical facilities are constructed outside of the future flood hazard areas and that no exiting critical facilities are retrofitted to decrease the flood risk exposure. A total of 3,541 critical facilities were identified in the future condition flood exposure analysis including an additional 1,168 critical facilities that were not previously identified in existing conditions. Jefferson County alone contains nearly 87% of the exposed critical facilities in the region; a significant portion of these identified critical facilities are structures associated with industrial use located in the Port Arthur, Port Neches, and Nederland areas.

2.B.4.d. Roadway Crossings and Roadway Segments within Flood Hazard Area

The future flood risk exposure analysis for roadways used only the existing roadway data available from TxDOT. Without considering additional future roads, the future flood risk exposure resulted in an 15% increase in roadway crossings and 30% increase in miles of inundated roadways. While larger flood hazard areas resulted in a sizeable increase in inundated roadway miles, increases to the flood hazard area has less of an impact to roadway stream crossings; most crossings in the region were already identified in the existing conditions analysis. Bridge deck height was not considered in the future condition exposure analysis.

2.B.4.e. Agricultural Area within Flood Hazard Area

Agricultural area in the planning region was also evaluated to determine future flood exposure. The same area determined in the existing exposure analysis as agricultural area was used in the future flood risk exposure analysis. Without altering the agricultural land dataset, the future flood risk exposure resulted in a 11% increase in agricultural land in flood hazard areas.

2.B.5. Future Condition Vulnerability Analysis

Vulnerability was assessed used the same methodology as the existing flood risk exposure analysis. All new residential structures developed to account for the projected population were assigned the existing SVI of the census tract. The results of the vulnerability analysis are summarized by county in **Table 5** in **Appendix 2-B**. This information is also shown in **Map 12** in **Appendix 2-A**. **Map 12** also includes the location of critical facilities in the basin identified in the existing conditions flood risk exposure analysis color-coded by their SVI. Within the Neches region, Polk, San Augustine, and Chambers Counties experience the highest three SVI scores on the county level.

CHAPTER 3

FLOODPLAIN MANAGEMENT PRACTICES AND FLOOD PROTECTION GOALS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix 3-A: Supplementary Maps for Chapter 3

Appendix 3-B: Existing Floodplain Management Practices

Appendix 3-C: Floodplain Management Goals

Appendix 3-D: Additional Information

Appendix 3-E: Bibliography

CHAPTER 3. FLOODPLAIN MANAGEMENT PRACTICES AND FLOOD PROTECTION GOALS

The Regional Flood Planning Group (RFPG) has been tasked with the following:

1. Identify and reduce the risk and impact to life and property that already exists and,
2. Avoid increasing or creating new flood risk by addressing future development within the areas known to have existing or future flood risk.

To meet these goals, the RPFG evaluated existing floodplain management practices throughout the region and defined flood mitigation and floodplain management goals.

Chapter 3.A. Evaluation and Recommendations on Floodplain Management Practices

The following section provides a qualitative assessment of existing regional trends in floodplain management practices across the Neches River basin.

3.A.1. Existing Floodplain Management Practices and Impacts on Flood Risk

An assessment of current floodplain management practices for entities with flood-related authority (cities, counties, and flood districts) within the region was performed. The assessment was limited to cities, counties, and various special-districts as these entities are the only ones with authority to enact flood control regulations. A total of 111 entities were assessed and are listed in **Table 3-1**:

TABLE 3-1: ENTITIES WITH FLOOD RELATED AUTHORITY

Count	Municipality
1	City of Frankston
2	City of Palestine
3	City of Burke
4	City of Diboll
5	City of Hudson
6	City of Huntington
7	City of Lufkin
8	City of Zavalla
9	City of Anahuac
10	City of Alto
11	City of Cuney
12	City of Gallatin
13	City of Jacksonville
14	City of New Summerfield
15	City of Coffee City
16	City of Moore Station
17	City of Murchison
18	City of Poynor
19	City of Grapeland
20	City of Kennard
21	City of Browndell
22	City of Jasper
23	City of Beaumont
24	City of Bevil Oaks
25	City of China
26	City of Groves
27	City of Nederland
28	City of Port Arthur

Count	Municipality
29	City of Rusk
30	City of Wells
31	City of Reklaw
32	City of Bullard
33	City of Troup
34	City of Kountze
35	City of Lumberton
36	City of Rose Hill Acres
37	City of Silsbee
38	City of Sour Lake
39	City of Athens
40	City of Berryville
41	City of Brownsboro
42	City of Chandler
43	City of Vidor
44	City of Corrigan
45	City of Henderson
46	City of Mount Enterprise
47	City of New London
48	City of Overton
49	City of Pineland
50	City of Broaddus
51	City of San Augustine
52	City of Arp
53	City of Hideaway
54	City of Lindale

Count	Municipality
55	City of Port Neches
56	City of Rose City
57	City of Taylor Landing
58	City of Nome
59	City of Daisetta
60	City of Devers
61	City of Hardin
62	City of Appleby
63	City of Chireno
64	City of Cushing
65	City of Garrison
66	City of Nacogdoches
67	City of Bridge City
68	City of Pine Forest
69	City of New Chapel Hill
70	City of Noonday
71	City of Tyler
72	City of Whitehouse
73	City of Groveton
74	City of Chester
75	City of Colmesneil
76	City of Ivanhoe
77	City of Woodville
78	City of Edom
79	City of Van

Count	County
80	Anderson
81	Angelina
82	Chambers
83	Cherokee
84	Galveston
85	Hardin
86	Harris[1]
87	Henderson
88	Houston

Count	County
89	Nacogdoches
90	Newton
91	Orange
92	Polk
93	Rusk
94	Sabine
95	San Augustine
96	Shelby
97	Smith

Count	County
98	Jasper
99	Jefferson
100	Liberty

Count	County
101	Trinity
102	Tyler
103	Van Zandt

Count	Special Districts/River Authorities
104	Angelina and Neches River Authority
105	Jefferson County Drainage District #3
106	Jefferson County Drainage District #6
107	Jefferson County Drainage District #7
108	Liberty County Drainage District[2]
109	Lower Neches Valley Authority
110	Orange County Drainage District
111	Trinity River Authority of Texas

[1] *Harris County is included in the table despite having 0.17 square miles of area within the region.*

[2] *Liberty County Drainage District was recently created in 2019.*

Floodplain management documents such as city floodplain protection ordinances and drainage criteria manuals were collected via an open-source search. Alongside this effort, a web-based survey was sent to entities with flood-related authority within the region to collect more detailed information regarding current floodplain management practices. Detailed data collected from these two efforts is included in a general summary of existing floodplain management regulations and practices in **Table 6** in **Appendix 3-B.** This table includes all entities within the region that have been identified as having flood-related authority, regardless of their current participation status in the NFIP.

3.A.1.a. National Flood Insurance Program (NFIP)

Although the majority of entitites in the region has adopted minimum floodplain regulations, the RFPG considers that there is still a significant gap with respect to key floodplain management practices and that communities could enhance their policies to prevent the creation of additional flooding risks in the future. The RFPG categorized existing floodplain management practices as,

- "Low" (regulations meet the minimum NFIP standards),
- "Moderate" (some higher standards, such as freeboard, or fill restrictions),
- "Strong" (significant regulations that exceed NFIP standard with enforcement, and community belongs to the Community Rating System).

These categories were used to assess existing floodplain management practices within the Neches Flood Planning Region (FPR). The assessment is depicted in **Figure 3-1** and **Figure 3-2**.

Low Floodplain Management Practices

Entities (cities, counties, and special districts) were considered to have "Low" floodplain management practices if current regulations meet the minimum requirements per NFIP standards. "Unknown" classification was assigned to entities from which no data was obtained through the methods previously discussed. It is important to note that this classification does not confirm nor imply that floodplain regulations are non-existing; in many instances, the copy of the regulations consulted did not explicitly address flooding, preventing its assessment.

Floodplain management criteria for flood-prone areas with minimum requirements per Title 44 of the Code of Federal Regulations (44 CFR) §60.3 are listed at the end of this section and summarized below.

- Require permits for all proposed construction in the community to determine whether construction is proposed within flood-prone areas.
- Review proposed development to assure that all necessary permits have been received.
- Review all permit applications to determine whether proposed building sites will be reasonably safe from flooding:
    - If a proposed building site is in a flood-prone area, all new construction and substantial improvements shall be designed to adequately prevent flotation or collapse and be constructed with materials resistant to flood damage.
- Review subdivision proposals to determine whether such proposals will be reasonably safe from flooding:
    - If a subdivision proposal is in a flood-prone area, any such proposals shall be reviewed to assure that all such proposals are consistent with the need to minimize flood damage within the flood-prone area and
        - All public utilities and facilities, such as sewer, gas, electrical, and water systems are located and constructed to minimize or eliminate flood damage.
        - Adequate drainage is provided to reduce exposure to flood hazards
- Require within flood-prone areas new and replacement water supply systems to be designed to minimize or eliminate infiltration of flood waters into the system.
- Require within flood-prone areas new and replacement sanitary sewage systems to be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters and onsite waste disposal systems to be located to avoid impairment to them or contamination from them during flooding.

46 out of the 111 entities surveyed within the region were classified as having "Low" floodplain management practices, while 31 out of the 111 entities were classified as "Unknown". **Figure 3-1** shows the approximate geographical location of entities with practices classified as "Low" or "Unknown" across the region. A detailed summary of existing floodplain management practices is included in **Table 6** in **Appendix 3-B.**

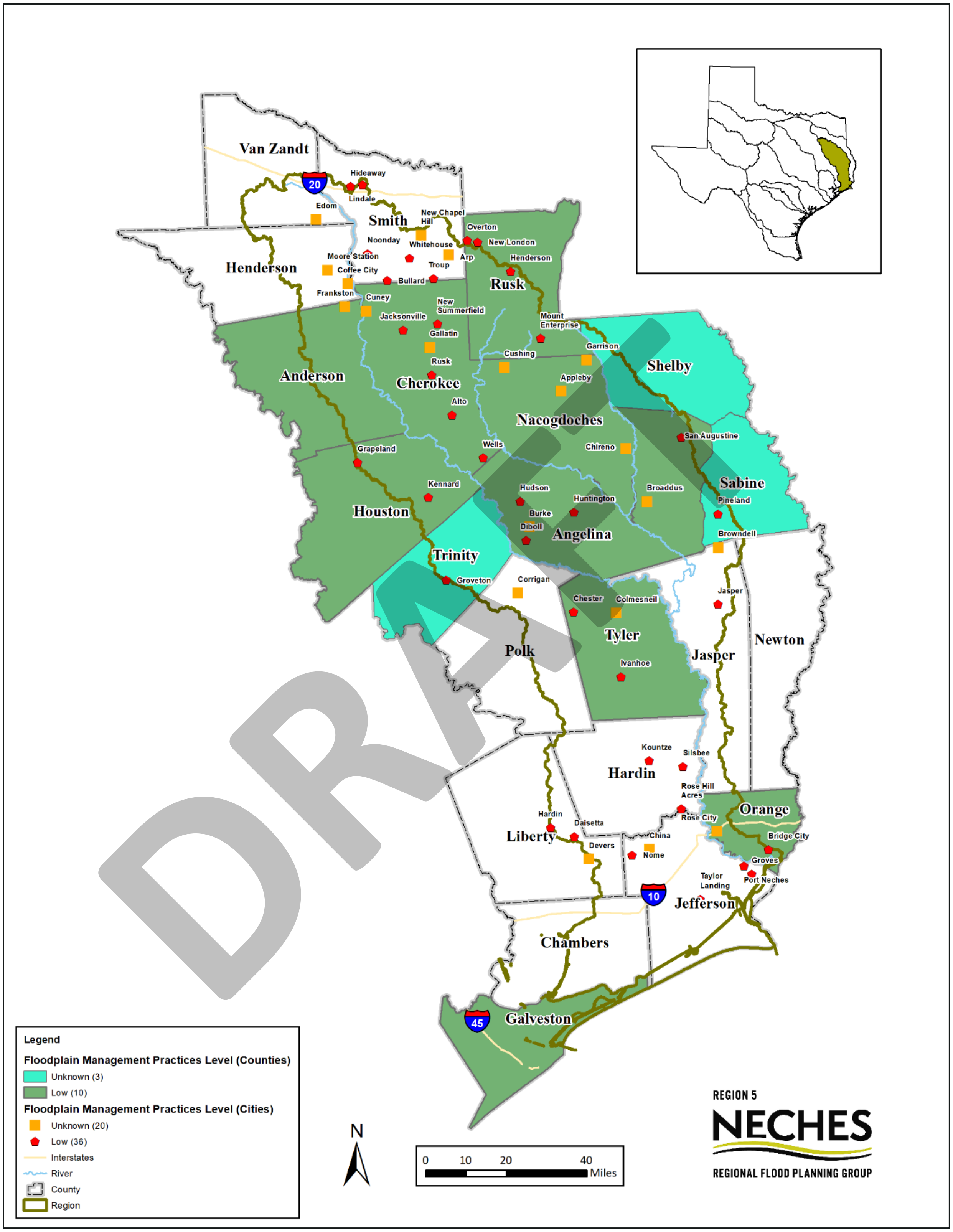


FIGURE 3-1: LEVEL OF FLOODPLAIN MANAGEMENT PRACTICES BY ENTITY: LOW OR UNKNOWN

Moderate Floodplain Management Practices

Entities were considered to have "Moderate" floodplain management practices if in addition to NFIP-compliant regulations they also enforce the supplementary higher standard of elevating structures above identified BFEs (freeboard). 30 out of the 111 entities within the region were classified as having "moderate" floodplain management practices, under the aforementioned definition. **Figure 3-2**: shows the approximate geographical location of entities with practices classified as "moderate" across the region.

Strong Floodplain Management Practices

Entities were considered to have "Strong" floodplain management practices if the entity is part of the Community Rating System (CRS) and enforce regulations that surpass NFIP standards. Only 4 entities within the region participate in the NFIP and maintain participation in the CRS as of October 1, 2021 – **Appendix 3-D** contains the list of CRS participating communities consulted. The practices classified as "Strong" were confined to the cities of Beaumont, Bevil Oaks, and Port Arthur in addition to Harris County. These three cities are in the lower portion of the watershed, located closer to the low-lying coast and are frequently affected by severe tropical storms thus providing momentum for the strongest floodplain management practices in the Neches Region, as defined above.

Figure 3-2: shows the approximate geographical location of entities with practices classified "Strong" across the region. Harris County was excluded from the figure due to having an extremely small area within the region. A detailed summary of existing floodplain management practices is included in **Table 6** in **Appendix 3-B**.

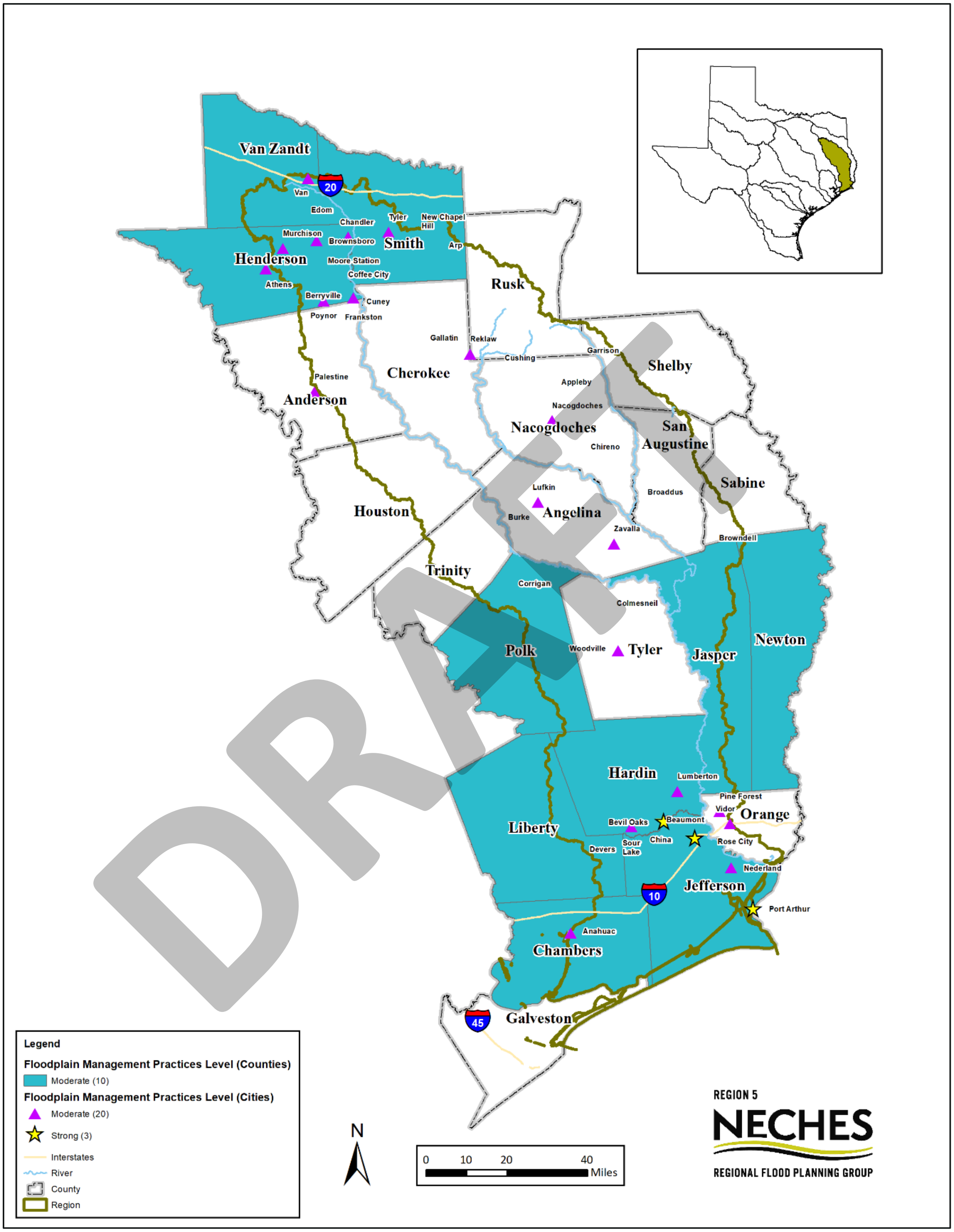


FIGURE 3-2: LEVEL OF FLOODPLAIN MANAGEMENT PRACTICES BY ENTITY: MODERATE OR STRONG

3.A.2. Variation of Key Floodplain Management Practices across the Region

Although FEMA manages the NFIP and defines minimum standards for participation, floodplain management and practices are defined by local communities and vary widely from one entity to another. The following section discusses variations in key floodplain management such as freeboard, floodplain fill, and stormwater utilities fees across the region.

3.A.2.a. National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) was established by Congress in 1968 to provide federally subsidized flood insurance protection. Title 44 of the Code of Federal Regulations (44 CFR) includes the rules and regulations of the program, while Part 60 establishes minimum criteria that the Federal Emergency Management Agency (FEMA) requires for participation.

Cities and counties that participate in the NFIP work with FEMA to establish Base Flood Elevations (BFEs) and Special Flood Hazard Areas (SFHAs) along rivers, creeks, and large tributaries that are shown on Flood Insurance Rate Maps (FIRMs). FIRMs define the geographic area for which local floodplain regulations are applicable. These products are developed by FEMA via hydrologic and hydraulic analyses. Communities use the FIRM, BFE, and SFHA data in their floodplain permitting processes as a requirement for participating in the NFIP.

By participating in the NFIP, a community must adopt minimum standards that are outlined in 44 CFR. FEMA maintains records of community eligibility in the form of a publicly available Community Status Book Report and suspends communities that fail to meet the requirements.

Cities and counties have the authority to establish their own policies, standards, and practices to manage land use in and around areas of flood risk. NFIP Participating communities have the responsibility and authority to permit development that is reasonably safe from flooding; additionally, they can adopt and enforce higher standards than the FEMA NFIP minimum to better protect people and property from flooding. FEMA encourages entities to enact higher standards that exceed minimum requirements by offering discounts for all flood insurance policies in communities that adopt higher standards, as assessed through the Community Rating System (CRS).

Enforcement capabilities come in the form of specific penalties for non-compliance written into local Flood Damage Prevention Ordinances (FDPO). When penalties are codified in adopted regulations, they also require understanding, preparation, and support from local administrative boards and others tasked with enforcement and application of penalties.

The assessment of existing floodplain practices verified that *all* counties within the Neches region are NFIP participants based on FEMA records and additionally verified the existence of an FDPO for all counties, except Shelby and Sabine. The RFPG was unable to obtain a copy of the FDPO using the methods outline earlier in this chapter. **Map 13 in Appendix 3-A**, summarizes the counties for which existence of floodplain regulations was verified.

3.A.2.b. Freeboard Requirements

Freeboard is used as a factor of safety and is defined as an additional amount of height above the Base Flood Elevation (BFE) in determining the level at which a structure's lowest floor must be elevated or floodproofed in accordance with community floodplain management regulations. Freeboard by itself is not required by NFIP standards; however, 34 entities out of 111 within the region were identified as having freeboard requirements ranging from 1 to 3 feet above the BFE as shown in **Table 3-2**.

TABLE 3-2: ENTITIES WITH FREEBOARD AS HIGHER STANDARD

Entity	Higher Standard (Freeboard Requirements)	Feet Above BFE
Chambers County	Yes	1.0
City of Anahuac	Yes	1.0
City of Athens	Yes	3.0
City of Beaumont	Yes	1.5
City of Berryville	Yes	2.0
City of Bevil Oaks	Yes	2.0
City of Brownsboro	Yes	2.0
City of Chandler	Yes	2.0
City of Lufkin	Yes	1.0
City of Lumberton	Yes	1.0
City of Murchison	Yes	2.0
City of Nacogdoches	Yes	1.0
City of Nederland	Yes	1.5
City of Palestine	Yes	1.0
City of Pine Forest	Yes	2.0
City of Port Arthur	Yes	1.0
City of Poynor	Yes	2.0
City of Reklaw	Yes	2.0
City of Sour Lake	Yes	1.0
City of Tyler	Yes	1.0
City of Van	Yes	2.0
City of Vidor	Yes	1.0
City of Woodville	Yes	1.0
City of Zavalla	Yes	1.0
Hardin County	Yes	1.0
Harris County	Yes	1.5
Henderson County	Yes	2.0
Jasper County	Yes	2.0
Jefferson County	Yes	1.0
Liberty County	Yes	2.0
Newton County	Yes	1.0

Entity	Higher Standard (Freeboard Requirements)	Feet Above BFE
Polk County	Yes	2.0
Smith County	Yes	2.0
Van Zandt County	Yes	2.0

3.A.2.c. Fill Requirements

Fill placement restrictions are used as floodplain management practices to prevent the addition of fill drastically altering the hydraulic characteristics of a floodplain. The addition of fill can change nearby floodplains by rerouting floodwaters to threaten properties previously determined to not be at flood risk. All NFIP-participating communities, at minimum, must regulate fill placed in the floodway. In the region, the generalized interpretation of this NFIP requirement is to restrict fill in the floodway unless no adverse impact can be demonstrated.

To supplement this regulation, the cities of Lufkin and Tyler also require compensatory storage for all fill in the 100-year floodplain. Compensatory floodplain storage is considered a "Higher Standard" by the NFIP and while encouraged for the additional protection it provides, it is not required.

3.A.2.d. Stormwater or Drainage Fees

Stormwater or drainage fees assessed through a stormwater utility as a floodplain management practice generate revenue which allow entities to implement or initiate the construction of flood mitigation and floodplain management projects within their jurisdiction. Within the Neches region, information on drainage fees has been difficult to identify. The City of Tyler is known to charge stormwater fees based on responses to the *2018 Texas Floodplain Management Association (TFMA) Higher Standards Survey*. Stormwater fees are also levied by the City of Port Neches, Jefferson County Drainage District #6, and Jefferson County Drainage District #7 based on input from the RFPG.

3.A.3. Impacts of Floodplain Management on Populations and Property

3.A.3.a. Risks to Existing Population and Property

The general assessment of floodplain management practices indicates that all counties and most cities within the region participate in the NFIP, and many have adopted floodplain protection ordinances that meet or exceed NFIP standards. Non-NFIP participants are confined to smaller cities in the northern portion of the watershed with potentially minimal access to staff, resources, and funding necessary to participate. However, some of these municipalities have adopted basic floodplain management regulations, while in other instances the existence of regulations is unknown. **Figure 3-3** shows the NFIP status of cities and counties across the region; note that all counties participate in the NFIP.

Participation in the NFIP grants a basic level of protection by enabling members of the participating community to access a subsidized form of property flood insurance. However, it should be noted that minimum standards are based on maps that represent "current" conditions. A vast majority of the Neches FPR regulatory floodplains are defined based on outdated modeling and mapping, which represents a significant risk to the protection of population and property. A summary of the modeling data used to define the SFHA regulated to is provided in **Table 3-3**. Further discussion regarding inadequate inundation maps is provided in **Chapter 4**.

TABLE 3-3: DATES OF H&H MODELING USED FOR SFHA DELINEATION

County	Community	Date
Anderson County	City of Palestine	1984
Angelina County	Angelina County	2008
Chambers County	Chambers County	1981 - 2014
Cherokee County	Cherokee County	1993, 1995
Hardin County	Hardin County	2008
Henderson County	Henderson County	N/A, no FIS report available for Region 5 extent
Houston County	Houston County	1978
Jasper County	Jasper County	1984
Jefferson County	City of Beaumont	1980
Jefferson County	Jefferson County	1980
Liberty County	Liberty County	1985 - 2014
Nacogdoches County	City of Nacogdoches	1978
Newton County	Newton County	1998 - 2015
Orange County	Orange County	1980 - 2014
Polk County	Polk County	N/A, no detailed study
Rusk County	City of Henderson	1989
Rusk County	Rusk County	1989
Sabine County	Sabine County	N/A, no FIS report available
San Augustine County	City of San Augustine	N/A, no FIS report available
Shelby County	Shelby County	N/A, no FIS report available for Region 5 extent
Smith County	Smith County	2014
Smith County	Tyler	2008
Trinity County	City of Groveton	N/A, no FIS report available
Tyler County	Tyler County	N/A, no detailed study
Van Zandt County	Van Zandt County	1984

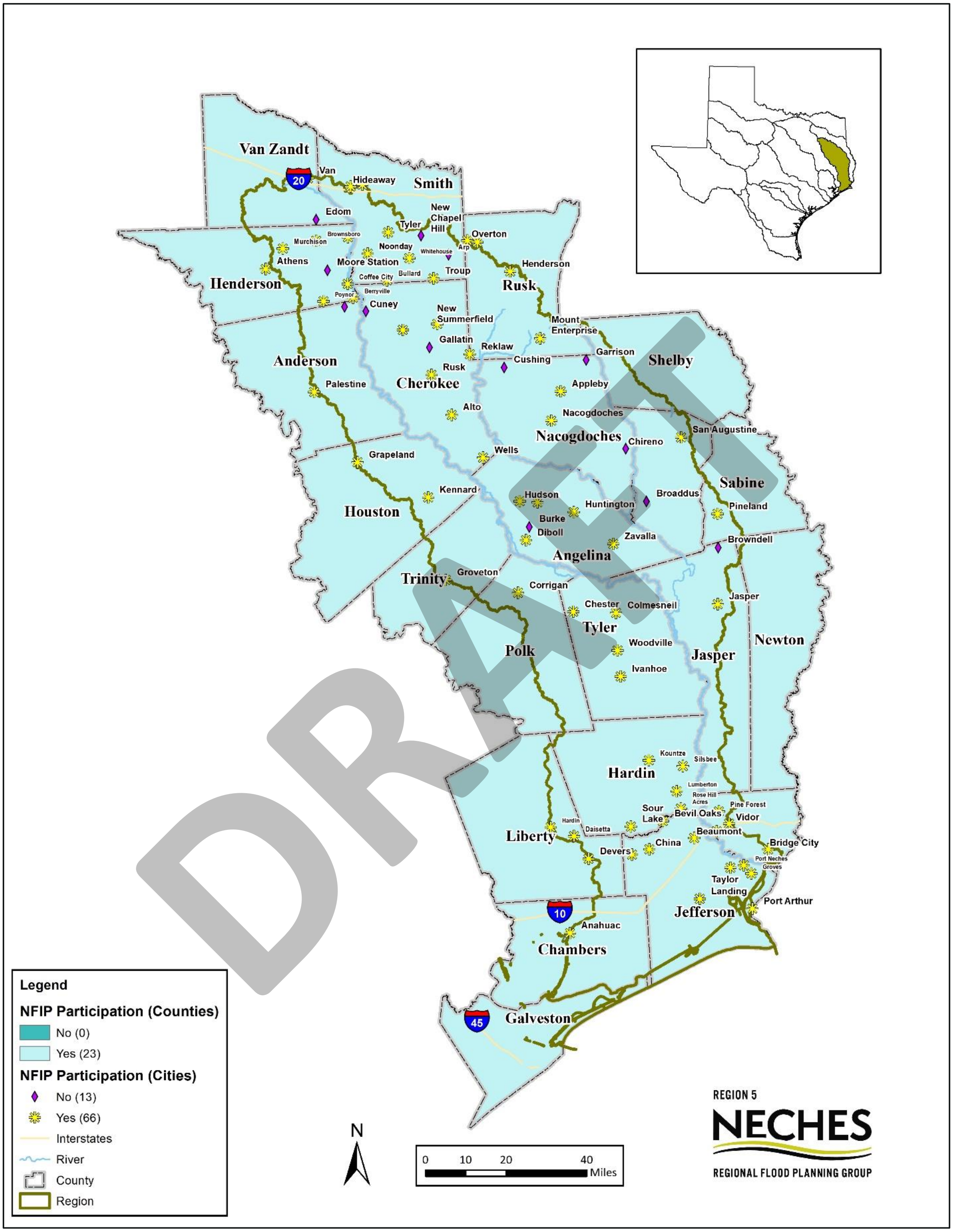


FIGURE 3-3: NFIP PARTICIPATION ACROSS THE NECHES REGION

3.A.3.b. Risks to Future Population and Property

As the future conditions flood risk analysis detailed in **Chapter 2** shows, the 1% ACE floodplain is estimated to increase by 11.5% (354 sq mi) and the 0.2% ACE floodplain is estimated to increase by 11.8% (409 sq mi). This could result in an additional 136,455 people and 37,030 structures in the floodplain. Some of the higher standards in the existing floodplain ordinances may continue to protect future population and property if they are enforced. However, the gap in current inundation mapping and inconsistent floodplain management practices across the region poses an increasing level of flood risk as population continues to grow. Where appropriate, entities should consider adopting higher standards to provide greater levels of protection against loss of life and property due to flooding.

Similarly, areas without maps and models or with outdated maps and models are at greater risk of future population and property development within the floodplain. Entities should prioritize comprehensive map updates to better direct development from flood-prone areas.

3.A.4. Recommendation of Minimum Floodplain Management and Land Use Standards

The Neches RFPG considered the possibility of recommending or adopting consistent minimum floodplain management standards and land use practices for the entire Region. This topic was last discussed in the meeting held on March 24, 2022. Emphasis was placed on the understanding that recommended practices encourage entities with flood-related authority to establish minimum floodplain management standards over the next several years and allow for all potentially feasible FMEs, FMSs and FMPs to be considered for inclusion in the RFP.

The RFPG was reluctant to require minimum floodplain management standards citing that, in Texas, authority for enforcing floodplain management regulations lies with local governments at the municipal and county levels. Regional Flood Planning Groups themselves do not have the authority to enact or enforce floodplain management, land use regulations, and other infrastructure design standards. The Neches RFPG concluded that recommendation of standards would allow for an improved first cycle of regional flood planning by allowing a higher number of potential FMEs, FMSs and FMPs be considered for inclusion in the flood plan. Any standards recommended by the RFPG in this task are encouraged to be implemented by all entities in the region that regulate development within the floodplain .

The qualitative assessment of current floodplain management regulations previously described served as a guide to compile a preliminary set of minimum standards, which were continuously presented and discussed until the March 24, 2022 RFPG meeting. One of the main outcomes from this meeting was that **the Neches RFPG recommends, not adopts, minimum standards for the Region**.

The Neches RFPG considered the information presented within and proceeded to recommend region-wide floodplain management standards aimed at implementing *basic* floodplain management practices across the region. The recommended standards are included in **Table 3-4.**

TABLE 3-4: RECOMMENDED FLOODPLAIN MANAGEMENT STANDARDS

Category	Type	Recommended Standard
Floodplain Management Practices	Minimum Regulations	All municipalities should adopt minimum requirements outlined by FEMA for NFIP participation. Where appropriate, consider adopting higher standards to provide higher levels of protection against loss of life and property due to flooding.
		All communities should enforce floodplain regulations.
	Property Acquisition	All communities should adopt a property acquisition program for repetitive loss structures which can be used as beneficial use area (i.e. pocket park) for the local community.
	Operations & Maintenance	Entities should create a maintenance plan for drainage infrastructure in order to prevent more expensive replacement costs.
		Communities should create a drainage infrastructure maintenance strategy following complaints or damages after a storm.
Emergency Preparedness	Flood Awareness	All communities should create and maintain a website or webinars on public flood risk awareness.
	Flood Risk Information	All communities should use the best available precipitation data for regulatory and design criteria/standards.
	Flood Response	All communities should have a Hazard Mitigation Plan for significant storm events.
		All communities should have a warning system to contact citizens before and during storm events.

Category	Type	Recommended Standard
New Development	Roadways	Roadways designated as major thoroughfares should be designed such that the 100-year inundation extent is contained within the right-of-way and at least one navigable lane is maintained in each direction.
		Roadways should be designed to cause no adverse impacts up to and including the 100-year storm event.
	Culverts and Bridge Crossings	Culverts should demonstrate no adverse impact for 100-year storm event.

Category	Type	Recommended Standard
	Detention	Communities should require compensatory storage for all fill in the 100-year floodplain.
		Communities should require all new development in Zone A or unmapped areas provide a hydrologic and hydraulic study and demonstrate no adverse impacts downstream.
	Habitable Structures	All habitable structures in coastal communities should be designed such that finished floor elevations are 3 feet above the BFE including the combined riverine and coastal effects.
		All habitable structures in non-coastal communities are designed such that finished floor elevations are 2 feet above the riverine 100-year WSE, EXCEPT where stricter local standards apply.
	Critical Facilities	All critical facilities in coastal communities should be designed such that finished floor elevations are 2 feet above the highest elevation of either the riverine 500-year or coastal 100-year WSE including the combined riverine and coastal effects.
		All critical facilities in non-coastal communities should be designed such that finished floor elevations are 2 feet above the riverine 100-year WSE.
	Nature-Based Solution	All new construction should consider nature-based solutions, low impact development, or green stormwater infrastructure.

Chapter 3.B. Flood Mitigation and Floodplain Management Goals

One of the critical components of the initial State Flood Plan is the development of flood mitigation and floodplain management goals. The objective of Task 3B is to define specific and achievable flood mitigation and floodplain management goals along with target years by which to meet those goals.

The RFPG must identify goals that are specific and achievable, and when implemented, will demonstrate progress towards the overarching goal set by the State, protect against the loss of life and property. Per Texas Water Development Board (TWDB) requirements and guidelines, the goals selected by the RFPG must include the information listed below:

- Description of the goal
- Term of the goal set at 10 years (short-term) and 30 years (long-term)
- Extent or geographic area to which the goal applies
- Residual risk that remains after the goal is met
- Measurement method that will be used to measure goal attainment
- Association with overarching goal categories

3.B.1. Flood Mitigation and Floodplain Management Goals

The Neches RFPG explored community values and discussed the development of the best goals for the Region over several months. The goals, outlined on the following pages, were developed during regular RFPG meetings, as well as input from regional stakeholders provided through the data collection survey. The discussion and development of goals occurred over the course of the following meetings:

- **September 9, 2021** – Introduction to floodplain management strategies and goals
- **September 22, 2021** – Interactive goal development session and identification of draft goal categories
- **October 14, 2021** – Discussion and action to adopt final floodplain management goals
- **December 15, 2021** – Discussion on amending language on existing goals
- **March 24, 2021** – Action to approve amendments to existing goals

The RFPG members participated in a polling exercise during the September 22, 2021 RFPG meeting to identify which goal categories were of highest importance. Results of the polling exercise are summarized in **Figure 3-4.** In addition, within each goal category, sub goals were presented and RFPG members were asked to rank them in order of priority and relevance. Results from the polling exercise were evaluated to determine the RFPG's priorities and to establish the highest ranked sub-goals for the Neches RFPG.

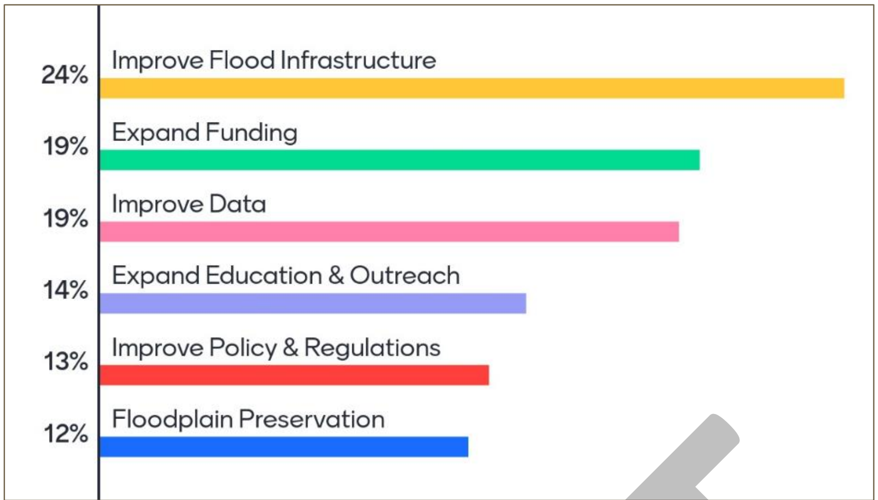


FIGURE 3-4: RFPG PRIORITIZATION OF FLOOD MITIGATION AND FLOODPLAIN MANAGEMENT GOAL CATEGORIES

The poll also allowed the planning group to rank specific subgoal topics within each of the broader categories based on relevance. The subgoals are more specific and provide direction to achieve the larger goals of the RFP. For example, under the "Improve Flood Infrastructure" goal category, the presented subgoals include "design future regional infrastructure for larger storm events" and "increase sustainability and resiliency". A weighting and scoring exercise was performed with input from the RFPG to determine the highest ranking sub-goals to narrow the focus of flood mitigation and floodplain management goals. Draft goals recommendations were provided to the RFPG in advance of the October 2021 RFPG meeting; goals were discussed in subsequent RFPG meetings and finalized and adopted in the March 24, 2022 meeting. **Table 11** in **Appendix 3-C** details the flood mitigation and floodplain management goals adopted by the RFPG per 31 Texas Administrative Code (TAC) §361.36.

3.B.2. Adoption of Flood Mitigation and Floodplain Management Goals

The RFPG utilized the assessment of current floodplain management and land use practices from Task 3A and the flood mitigation needs of the region as guides for developing and defining the goals. After careful consideration of these factors, the Neches RFPG adopted the flood mitigation and floodplain management goals summarized in **Table 3-5**. These specific goals were reviewed and approved by the Neches RFPG during the RFPG meeting held on October 14, 2021. The RFPG revisited the discussion on December 15, 2021 to clarify the language of the adopted goals and discuss possible amendments to existing goals and additional goals to be included. The amendments to the existing goals were approved on March 24, 2022. The adopted goals apply to the entire flood planning region; no sub-regional goals were identified.

TABLE 3-5: SUMMARY OF ADOPTED FLOOD MITIGATION AND FLOODPLAIN MANAGEMENT GOALS

Short Term (10 year)	Long Term (30 year)
An average of 10% of the new regional infrastructure projects between 2023 – 2033 will utilize larger storm events (>100-year) as the basis of their design.	An average of 25% of the new regional infrastructure projects between 2033 – 2053 will utilize larger storm events (>100-year) as the basis of their design.
RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 10% of their new flood risk reduction projects between 2023 - 2033.	RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 25% of their new flood risk reduction projects between 2033 - 2053.
Reduce the number of critical facilities in the 100-year flood risk inundation extents by 15%.	Reduce the number of critical facilities in the 100-year flood risk inundation extents by 25%.
Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 10% of structures.	Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 30% of structures.
Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 25%.	Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 75%.
Increase percentage of areas with dedicated funding sources for operations & maintenance for storm drainage system to 50% of communities.	Increase percentage of areas with dedicated funding sources for operations and maintenance for storm drainage system to 75% of communities.
50% of the region's population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.	75% of the region's population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.
Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 75% of areas identified as having current gaps in flood mapping.	Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 100% of areas identified as having current gaps in flood mapping.
Increase the number of gauges across the Neches basin to cover 50% of the region's HUC10s.	Increase the number of gauges across the Neches basin to cover 100% of the region's HUC10s.
Develop and maintain critical infrastructure database	N/A

Short Term (10 year)	Long Term (30 year)
Give notice to 100% of affected units of local government and improve 50% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.	Give notice to 100% of affected units of local government and improve 100% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.
Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 25% of Low Water Crossings identified in the latest Regional Flood Plan.	Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 80% of Low Water Crossings identified in the latest Regional Flood Plan.
100% of counties to perform public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.	Maintain 100% participation of counties performing public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.

3.B.3. Transformed and Residual Risk

Flood risk will be reduced by the implementation of the actions and construction of projects necessary to achieve the identified goals. However, the Neches RFPG acknowledges that it is not possible to protect against all potential flood risk. The RFPG has determined the residual and transformed flood risk to the region remaining after each goal is achieved. Transformed risk is defined by the US Army Corps of Engineers (USACE) as the change in the nature of flood risk for an area associated with the presence of flood hazard reduction infrastructure. The adopted goal combined with the residual and transformed risk represents the totality of flood risk faced by the Neches River Basin. Residual/Transformed Risk for each identified goal in the region, in addition to the measurement method used to determine the success of each goal, are listed in **Table 11** in **Appendix 3-C**.

3.B.4. Goals as a Guide for the Regional Flood Plan

The selected specific goals guided the development of the Flood Management Strategies (FMSs), Flood Management Evaluations (FMEs), and Flood Mitigation Projects (FMPs) recommendations for the Neches FPR. The goals approved as part of this planning effort build upon TWDB regional flood planning guidance and provide a comprehensive framework for future strategy development focused on reducing flood risk to people and property, while not negatively affecting neighboring areas.

CHAPTER 4
ASSESSMENT AND IDENTIFICATION OF FLOOD MITIGATION NEEDS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

CHAPTER 4. ASSESSMENT AND IDENTIFICATION OF FLOOD MITIGATION NEEDS

The Neches Regional Flood Planning Group (RFPG) assessed and identified flood mitigation needs within the basin. The analysis conducted to complete this task used information and data discussed in the earlier chapters of the RFP. The results of this analysis were used to determine areas within the flood planning region that have the most acute flood mitigation need. The RFPG then compiled various flood mitigation evaluations (FMEs), flood mitigation strategies (FMSs), and flood mitigation projects (FMPs) that had been identified by local stakeholders in the region. A more detailed analysis of these FMEs, FMSs, and FMPs is included as part of **Chapter 5**.

Chapter 4.A. Flood Mitigation Needs Analysis

The following sections describe the methodology adopted by the RFPG to conduct the flood mitigation needs analysis. The focus of this analysis is to identify areas in the region with the greatest gaps in flood risk knowledge, and areas with the greatest known flood risk and mitigation needs. It should be emphasized that this is a high-level assessment based on multiple factors. The results of this assessment helped identify potential FMEs, FMSs, and FMPs within the region.

4.A.1. Process and Scoring Criteria

The flood mitigation needs scoring process was performed using a geospatial assessment which evaluated a variety of different categories and factors. This geospatial assessment was performed at a HUC12 watershed level of detail, which is the smallest watershed unit available at a statewide level. A Hydrologic Unit Code (HUC) is a unique code assigned to watersheds in the United States; as the size of the watershed decreases, the number of units used to identify them increases. There are 262 HUC12 watersheds within the Neches region with an average size of 44 square miles.

Consideration was made to conduct the analysis at a county level to be consistent with the exposure and vulnerability analysis detailed in **Chapter 2**. However, it was determined that this would not provide a sufficient level of detail for this task. One of the main reasons this analysis was conducted at a HUC12 watershed level is that utilizing hydrologic boundaries to address flood risk and knowledge gaps is better aligned with the overarching plan goal of proposing regional solutions. Factors used in the flood mitigation needs analysis are shown in **Table 4-1**. These factors were selected because their data had been compiled in previous components of the Neches RFP and provide good measures of flood exposure and vulnerability within the region. The following sections provide a brief description of the data categories included and how each HUC12 watershed was scored.

TABLE 4-1: FLOOD MITIGATION NEEDS FACTORS CONSIDERED

Categories	Factors Considered
Flood-prone Areas Threatening Life and Property	• Buildings • Low Water Crossings • Agricultural Areas • Critical Facilities
Current Floodplain Management and Land Use Policies	• Communities Participating in NFIP • Communities Not Participating in NFIP
Areas Identified as Flood Map Gaps	• Approximate NFHL Data • Detailed NFHL Data based on Study Older than 10 Years • Atlas 14 Update Required
Historical Flood Events	• Disaster Declarations • FEMA Claims
Other Factors	• Social Vulnerability Index (SVI)

4.A.1.a. Flood-prone Areas Threatening Life and Property

Datasets developed as part of the existing condition flood exposure analysis outlined in **Chapter 2** were used to score the flood mitigation need in each HUC12 as related to the threat to life and property. The results from the future condition flood exposure analysis are approximate in nature and were not utilized in the flood mitigation need analysis. The following sections details the different flood exposure datasets compiled and used to complete the flood mitigation need analysis.

Buildings

The structures exposed to the 1% ACE event in each HUC12 watershed in the region was determined. The count significantly varies throughout the region; rural counties in the northern area of the Neches region have significantly less buildings exposed than the more developed counties do in the south towards the coast. This was the second highest ranking category by weight as determined by the RFPG Technical Committee, the organization and membership of which are detailed in **Chapter 10.**

Low Water Crossings

Low water crossings (LWCs) were first discussed in **Chapter 1** and used sites identified by TNRIS. As with structural exposure, the count had significant variation throughout the region; many HUC12 watersheds were found to have no identified LWCs while HUC12 watersheds that intersected denser urban areas throughout the region or regions closer to the coast were found to contain multiple LWCs.

Agricultural Areas

Agricultural areas were identified in the existing condition flood exposure analysis in **Chapter 2** and is defined as land use related to farming or ranching. As expected, many rural HUC12s scored higher in this category as agricultural areas due to flooding being much more prominent in those watersheds.

Critical Facilities

Critical facilities determined in the existing conditions flood exposure analysis in **Chapter 2** include hospitals, schools, police/fire stations, industrial facilities, and shelters. Many HUC12 watersheds, especially within the counties of Jefferson, Hardin, Orange, and Chambers, feature a significant number of critical facilities exposed. This was the highest-ranking category by weight as determined by the RFPG expert panel.

4.A.1.b. Current Floodplain Management and Land Use Policies

Communities Not Participating in the NFIP

The rate of participation in the National Flood Insurance Program (NFIP) among counties and municipalities in the planning region was identified in **Chapter 3**. It is assumed that communities participating in the NFIP that are in good standing would enforce floodplain management regulations to a greater degree compared to communities that do not participate. Non-participants may potentially be in need of mechanisms to enforce or generate minimum floodplain regulations standards, thus reflected in the higher score.

4.A.1.c. Areas Identified as having Flood Mapping Gaps

Flood Mapping Gaps

Accurate and effective flood mapping information is necessary for regulatory purposes and can also be used as a tool by members of the public to better understand flood risk and how it impacts their communities. Much of the Neches FPR does not have adequate mapping and needs to be updated to incorporate recent changes in design rainfall data. **Map 14** in **Appendix 4-A** shows the existing greatest gaps in flood risk information; the southern portion of the region is in need of Atlas 14 Data Updates due to its proximity to the coast; much of the northern portion of the region is either covered by approximate data or has detailed data that is older than 10 years. To address the existing gaps in flood risk information, several county-wide flood hazard mapping updates have been proposed as flood management evaluations. Master drainage plans have also been identified as potential flood management evaluations for counties and cities alike throughout the region; it is intended that a more detailed study of flood hazard throughout the region can lead to a greater comprehension of flood risk and the potential genesis of additional flood management strategies or flood mitigation projects designed to reduce adverse flood impact throughout the region.

4.A.1.d. Historic Flooding Events

Flood-Related Disaster Declarations

Federal disaster declarations occur when a community experiences substantial impact and requires federal aid to fully recover. Declarations are made county wide and for this analysis were assigned to HUC12 watersheds without duplicating declarations that were related to a single event. Watersheds with the highest incidence of disaster declarations are generally located in the lower portion of the watershed, specifically near low lying land frequently affected by tropical storms.

FEMA Claims

FEMA NFIP flood claims within the Neches River Basin from 1950 to 2021 were reviewed as part of the effort for **Chapter 1**. The geospatial data available for individual claims was redacted; to counter this, locations were summarized by local area codes and city information. Therefore, the cities to which the flood claims were assigned was used to divide claims into the HUC12s that intersected the city limits.

4.A.1.e. Other Factors

Social Vulnerability Index

Social Vulnerability Index (SVI) refers to the potential negative effects from hazardous events on communities caused by external stresses on human health. Such stresses include but are not limited to natural or human-caused disasters and disease outbreaks. Communities with higher SVI values associated with them experience heightened vulnerability to disasters and experience a greater amount of difficulty recovering from them in the immediate aftermath. Conversely, communities with lower SVI values associated with them exhibit greater resilience to withstand various hazardous events. SVI values are assigned per census tract by the Center for Disease Control (CDC), which were converted to the HUC12 extent for this analysis. SVI values were assigned to each HUC12 based on an area-weighted average.

4.A.2. Needs Analysis Criteria Weighting

The RFPG recognized that some of the categories used in this analysis capture the flood mitigation needs of the region better than others. As a result, the RFPG members assigned numerical weights to each of the categories via a polling exercise during the April 2022 RFPG meeting. The panel assigned a numerical value to each category on a scale from 1 to 10 to reflect its relevance in defining flood mitigation needs in the FPR. A score of 1 represents a low importance and 10 represents a high importance. The results of the poll are shown in **Figure 4-1** and summarized in **Table 4-2**.

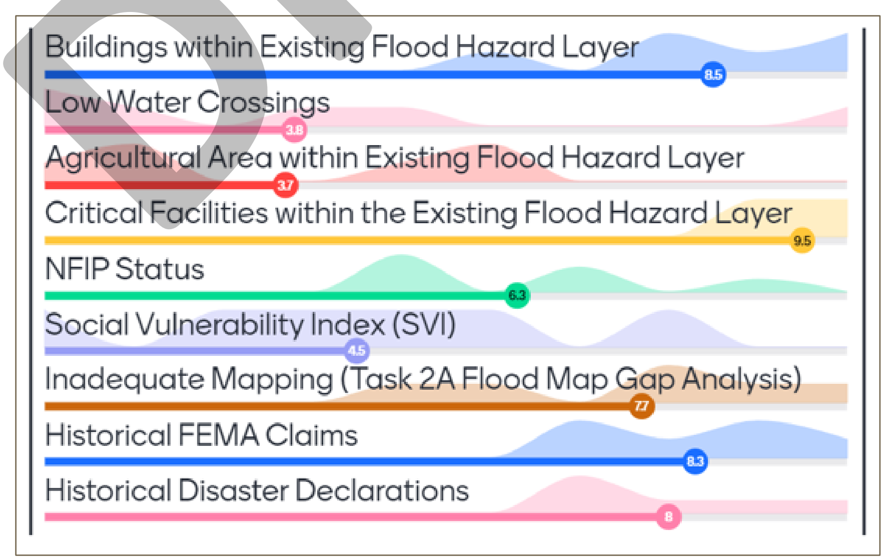


FIGURE 4-1: RESULTS OF FLOOD NEED CATEGORY WEIGHTING POLL

TABLE 4-2: WEIGHT SCORES FOR FLOOD NEEDS ANALYSIS CRITERIA

Flood Needs Analysis Criteria	Score (out of 10)	Percent Weight Assigned for Analysis
Buildings within Existing Flood Hazard Layer	8.5	80%
Low Water Crossings	3.8	40%
Agricultural Area within Existing Flood Hazard Layer	3.7	39%
Critical Facilities within the Existing Flood Hazard Layer	9.5	89%
NFIP Status	6.3	61%
Social Vulnerability Index (SVI)	4.5	45%
Inadequate Mapping (Task 2A Flood Map Gap Analysis)	7.7	77%
Historical FEMA Claims	8.3	79%
Historical Disaster Declarations	8	76%

4.A.3. Analysis and Results

There are 262 HUC12 watersheds within the Neches region. The HUC12 range in size from 15.7 to 323.6 square miles. Due to the flat and low-lying topography, the HUC12 boundaries in the southern (coastal) zone are much larger than those in the northern part of the region. To assure an equitable comparison of need, all data points were normalized by area to avoid overrepresenting HUC12s with a larger geographical footprint. The numerical datasets (buildings, low water crossings, agricultural area, SVI, historical FEMA claims, and historical disaster declarations) were assigned a needs score of 0 to 5 for each category. The top 20% of values (80th percentile) within the region were given the highest needs score (5), while the bottom 20% of all values were given the lowest score (1). **Table 4-3** illustrates the score breakdown for all numerical categories.

Categories with zero features within a HUC12 were given a score of 0. Non-numerical datasets (NFIP status and inadequate mapping) were assigned scoring ranges based on how each factor impacts flood mitigation need for a community on a scale from 1 to 5. If a community was found to not be a participant in the NFIP, all HUC12 watersheds that spatially intersected that community were assigned a score of 5 points as shown in **Table 4-4.**

Scoring for flood mapping data gaps were assigned based on the quality of the available flood data and the urgency of which a new flood mapping study is needed; for example, areas found to be in need of an Atlas 14 data update were assigned the maximum score of 5 to communicate that a new study for these areas is needed as soon as possible to ensure the flood mapping data reflects the most recent rainfall data. The varying levels of flood mapping information in the region is reflected in the scoring criteria in **Table 4-5.**

It should be noted that 41 of the 262 HUC12 contain critical facilities. Due to the importance of these facilities a score of 5 was assigned to any HUC12 that contained a critical facility while a score of 0 was assigned to HUC12s with no critical facilities. The presence of critical facilities in a HUC12 is reflected in the scoring criteria in **Table 4-6**.

TABLE 4-3: SCORING RANGES FOR NUMERICAL CATEGORIES

0 points	1 point	2 points	3 points	4 points	5 points
Null/Zero value	Lower than 20% of values	Lower than 40% of values	Lower than 60% of values	Lower than 80% of values	Higher than 80% of values

TABLE 4-4: SCORING RANGES FOR COMMUNITIES NOT PARTICIPATING IN THE NFIP

0 points	1 point	2 points	3 points	4 points	5 points
Participant	N/A	N/A	N/A	N/A	Non-Participant

TABLE 4-5: SCORING RANGES FOR AVAILABLE FLOODPLAIN MAPPING

0 points	1 point	2 points	3 points	4 points	5 points
N/A	Approximate Data	N/A	Detailed Study Older Than 10 Years	N/A	Atlas 14 Data Update Required

TABLE 4-6: SCORING RANGES FOR HUC12 WITH CRITICAL FACILITIES

0 points	1 point	2 points	3 points	4 points	5 points
No	N/A	N/A	N/A	N/A	Yes

Scores for each category were summed together. Additionally, each of the category scores was assigned a percent weight based on the results of the RFPG poll, detailed in **Table 4-2**. The total scores for each category were determined and then summed together on a HUC12 basis to determine the areas of greatest flood mitigation need in the region. The top 20% of total HUC12 scores were identified as the areas with the highest flood mitigation need.

The final flood mitigation needs analysis scores calculated for the HUC12s in the region ranged from 4.62 to around 28.5. There was a significant number of HUC12s intersecting Jefferson, Hardin, Chambers, Liberty, and Orange Counties that were found to have high flood mitigation need scores. Additionally, HUC12s that were near or intersected major cities in the region such as Lufkin and Tyler were found to have high flood mitigation need scores.

Results of the analysis are shown in **Map 15** in **Appendix 4-A**. This map served as a guide to the RFPG's subsequent efforts to identify potential FMEs and potentially feasible FMPs and FMSs.

Chapter 4.B. Identification and Evaluation of Potential Flood Management Evaluations and Potentially Feasible Flood Management Strategies and Flood Mitigation Projects

4.B.1. Identification of Potentially Feasible FMEs, FMSs, and FMPs

One of the tasks of the RFP is to define and evaluate a variety of potential actions to identify and mitigate flood risks across the Neches FPR. Actions to identify and mitigate flood risk consist of Flood Management Evaluations (FMEs), Flood Mitigation Projects (FMPs), and Flood Management Strategies (FMSs). They are defined as the following:

- A **Flood Management Evaluation (FME)** is a proposed flood study of a specific, flood-prone area that is needed in order to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs.
- A **Flood Mitigation Project (FMP)** is a proposed project, either structural or non-structural, that has non-zero capital costs or other non-recurring cost and when implemented will reduce flood risk or mitigate flood hazards to life or property.
- A **Flood Management Strategy (FMS)** is a proposed plan to reduce flood risk or mitigate flood hazards to life or property. At a minimum, RFPGs should include as FMSs any proposed action that the group would like to identify, evaluate, and recommend that does not qualify as either a FME or FMP.

The identification of potential FMEs, FMSs, and FMPs began with the development of the Flood Mitigation Needs Analysis covered in **Chapter 4.A**. After the areas of greatest flood mitigation need were identified, the RFPG developed a list of potential flood risk reduction actions for addressing flood needs in these areas.

Flood mitigation and floodplain management actions were acquired from a variety of sources including, but not limited to federal funding applications, hazard mitigation plans, and contributions from the RFPG and other regional stakeholders. These contributions were comprised of past flood studies, drainage master plans, and capital improvement programs. Nearly 300 different actions were considered prior to starting the evaluation process. It should be noted that new FMPs will likely not be developed as part of the first planning cycle.

4.B.1.a. Classification of FMEs, FMSs, and FMPs

Once the comprehensive list of potential flood risk reduction actions was collected a screening process was performed to sort actions into proper categories in accordance with TWDB guidance. The screening process implemented by the RFPG is displayed below in **Figure 4-2**. In addition to falling into the general categories of action types outlined in the figure, potential FMPs and FMSs were screened further to determine if enough detail was available to be included in the plan. A summary of general action types by each category is summarized in **Appendix 4-B** and in **Table 4-7**, **Table 4-8**, and **Table 4-9.**

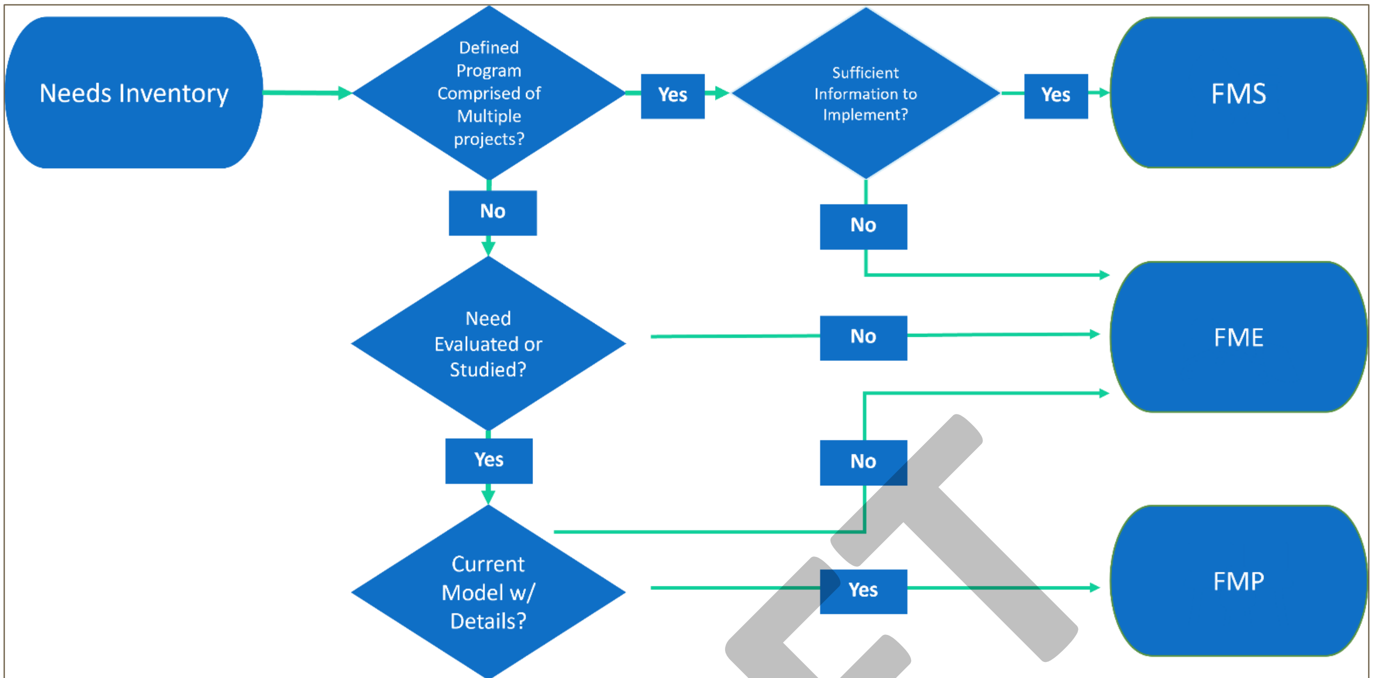


FIGURE 4-2: FLOOD RISK REDUCTION ACTION SCREENING PROCESS

Across the region there were 330 flood mitigation actions that were identified. **Table 4-7** summarizes the 157 FMEs determined to be potentially feasible. The extent of potential FMEs and existing mapping needs are summarized in **Map 16** in **Appendix 4-A**.

It is important to note that some of the FMEs identified as part of this effort are intended to expand upon previous studies conducted for BLE, the GLO Combined Rivers Basin Study, and FIF grants. For FMEs identified in areas that have FIF or GLO studies, there is potential for the FME itself to identify alternatives that had initially not been examined in the studies. Additionally, the studies associated with FIF, BLE, and GLO focus on riverine flooding whereas some identified FMEs in the region pertain to urban flooding – the difference in flooding type will necessitate a change in modeling approach. It is intended that the FMEs identified in the Regional Flood Plan will utilize existing information from pervious study efforts to better identify alternatives for reducing flood risk within the region.

Table 4-8 summarized the 147 potentially feasible FMSs found in the region; the extent of these FMSs are included in **Map 18** in **Appendix 4-A**. Finally, **Table 4-9** summarizes the 26 potentially feasible FMPs; **Map 17** in **Appendix 4-A** details the extents of these FMPs within the region.

Potentially feasible FMEs came from flood risk action items that have not been studied or developed to the extent to be classified as an FMP. In addition to the FMEs that were acquired from documentation and stakeholder input, the RFPG was also responsible for creating additional FMEs directed at addressing needs related to flood risk information within the region. These additional FMEs take the form of actions to update county-wide flood hazard mapping in addition to conducting master drainage plans for select counties and cities within the region. These actions are aimed to address the existence of outdated flood mapping in the region in addition to incorporating updated Atlas 14 rainfall data that was discussed in **Chapter 2**. A full list of potential FMEs and potentially feasible FMSs and FMPs are included in **Table 4-10,**

Table 4-11**,** and **Table 4-12,** respectively.

TABLE 4-7: POTENTIALLY FEASIBLE FME TYPE DISTRIBUTION

FME Type	Description	Count
Flood Mapping Updates	Updates to floodplain mapping to include new hydrologic and hydraulic modeling for defining flood hazard areas.	22
Master Drainage Plan	An assessment of a watershed or community to estimate flood risk and recommend flood management and flood mitigation projects.	37
Feasibility Assessments	Develop flood mitigation project alternatives for a discrete high flood risk area, estimate construction costs for alternatives, and determine flood reduction benefit for alternatives. Evaluation may require creation of H&H modeling.	7
Project Design Development	Evaluate identified potential flood mitigation projects to define costs, quantify flood reduction benefits, demonstrate no adverse impacts, and evaluate design alternatives. Evaluation may require the creation or updating of hydrologic and hydraulic models.	91
	TOTAL	**157**

TABLE 4-8: POTENTIALLY FEASIBLE FMS TYPE DISTRIBUTION

FMS Type	Description	Count
Education and Outreach	Programs or initiatives that aim to educate the public on the hazards and risks of flooding.	25
Flood Measurement and Warning	Installation and operation of stream gauges, monitoring stations, alert systems to provide flood hazard information.	17
Property Acquisition and Structural Elevation	Administration of program to acquire and demolish structures and convert the land to open space to mitigate flooding.	18
Regulatory and Guidance	Development of ordinances, development criteria, building codes, design standard to prevent new flood risk.	31
Infrastructure	Establish program, plan, or standards to facilitate future infrastructure improvements.	54
Other	Maintenance and inspection of flood infrastructure to ensure its design level of service is maintained.	2
	TOTAL	**147**

TABLE 4-9: POTENTIALLY FEASIBLE FMP TYPE DISTRIBUTION

FMP Type	Description	Count
Channel	Channel extensions and upgrades to increase capacity of water conveyance.	6
Comprehensive	Improve existing levees, build new pump stations, construct/reconstruct floodwalls to higher elevations.	16
Detention Pond	New detention pond construction	4
	TOTAL	**26**

TABLE 4-10: LIST OF POTENTIAL FMES

FME ID	FME Name	Description	Sponsor	Cost
051000001	Anderson County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Anderson County	$2,236,919
051000002	Angelina County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Angelina County	$3,900,000
051000003	Chambers County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Chambers County	$652,546
051000004	Cherokee County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Cherokee County	$4,800,000
051000005	Galveston County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Galveston County	$68,502
051000006	Hardin County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Hardin County	$1,800,000
051000007	Henderson County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Henderson County	$1,681,614
051000008	Houston County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Houston County	$1,697,174
051000009	Jasper County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Jasper County	$1,210,721
051000010	Jefferson County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Jefferson County	$1,900,000
051000011	Liberty County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Liberty County	$402,626
051000012	Nacogdoches County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Nacogdoches County	$4,400,000
051000013	Orange County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Orange County	$760,000
051000014	Polk County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Polk County	$375,054
051000015	Rusk County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Rusk County	$1,318,550
051000016	Sabine County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Sabine County	$182,571
051000017	San Augustine County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	San Augustine County	$904,125
051000018	Shelby County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Shelby County	$711,827
051000019	Smith County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Smith County	$1,225,342
051000020	Trinity County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Trinity County	$1,540,238
051000021	Tyler County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Tyler County	$1,800,000

FME ID	FME Name	Description	Sponsor	Cost
051000022	Van Zandt County Update Flood Hazard Mapping	Complete a detailed study within the county extent to delineate an updated flood hazard area, which can be used for regulatory purposes.	Van Zandt County	$1,111,237
051000023	Anderson County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Anderson County	$737,953
051000024	Angelina County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Angelina County	$1,700,000
051000025	Chambers County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Chambers County	$1,600,000
051000026	Cherokee County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Cherokee County	$1,600,000
051000027	Hardin County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Hardin County	$1,000,000
051000028	Henderson County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Henderson County	$1,900,000
051000029	Houston County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Houston County	$610,983
051000030	Jasper County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Jasper County	$1,200,000
051000031	Jefferson County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Jefferson County	$1,100,000
051000032	Liberty County Master Drainage Plan	Complete a county wide drainage plan, which can be used for regulatory purposes.	Liberty County Drainage District	$201,313
051000033	Nacogdoches County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Nacogdoches County	$1,900,000
051000034	Orange County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Orange County	$450,000
051000035	Polk County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Polk County	$150,021
051000036	Rusk County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Rusk County	$1,400,000

FME ID	FME Name	Description	Sponsor	Cost
051000037	Sabine County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Sabine County	$76,348
051000038	San Augustine County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	San Augustine County	$379,732
051000039	Shelby County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Shelby County	$1,250,000
051000040	Smith County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Smith County	$538,612
051000041	Trinity County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Trinity County	$481,324
051000042	Tyler County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Tyler County	$700,000
051000043	Van Zandt County Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Van Zandt County	$484,386
051000044	City of Palestine Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Palestine	$700,000
051000045	City of Lufkin Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Lufkin	$1,000,000
051000046	City of Jacksonville Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Jacksonville	$560,000
051000047	City of Rusk Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Rusk	$280,000
051000048	City of Lumberton Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Lumberton	$380,000
051000049	City of Rose Hill Acres Master Drainage Plan	Develop drainage study to identify flood mitigation measures and drainage improvements including purchase of easements in the ETJ or a possible MOU to implement improvements.	Rose Hill Acres	$200,000
051000050	City of Silsbee Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Silsbee	$320,000
051000051	City of Athens Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Athens	$31,056

FME ID	FME Name	Description	Sponsor	Cost
051000052	City of Jasper Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Jasper	$440,000
051000053	City of Beaumont Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Beaumont	$600,000
051000054	City of Nederland Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Nederland	$240,000
051000055	City of Nacogdoches Update Flood Control Study	Conduct Flood Control Study and implement actions such as channelization, detention, retention, etc. to stop repetitive flood losses.	Nacogdoches	$1,080,000
051000056	City of Henderson Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Henderson	$480,000
051000057	City of Arp Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Arp	$1,300,000
051000058	City of Tyler Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Tyler	$2,200,000
051000059	City of Whitehouse Master Drainage Plan	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Whitehouse	$150,000
051000060	Willie Nerron Road and Gillan Creek Bridge Replacement	Evaluate bridge improvements (upgrade bridge and increase channel flow) to current crossing to develop costs, quantify benefits, evaluate impacts, and begin design.	Angelina County	$325,000
051000061	Hall Street over White Oak Creek Bridge Improvements	Evaluate alternatives to elevate bridge over White Oak Creek on Hall St going into the park	Diboll	$103,000
051000062	Preliminary Engineering of Gibsonville Street and Porterville Road Bridges Improvements	Evaluate alternatives to raise bridges on Gibsonville St. and Porterville Road to increase flow of creek under.	Huntington	$650,000
051000063	Shawnee Creek Concrete Canal	Evaluate project to quantify benefits, evaluate impacts, and begin design for a concrete canal for Shawnee Creek from Louisiana Street to 6th Street.	Huntington	$390,000
051000064	City of Lufkin Detention Pond Construction and Improvements	Evaluate project to quantify benefits, evaluate impacts, and begin design for a retention pond behind Inez Timms property. Increase holding capacity of existing retention ponds throughout the city.	Lufkin	$82,500
051000065	Anahuac, North of Canal Drainage	Study to identify possible drainage improvements in the city limits of Anahuac. Study will focus on the area north of the Chambers-Liberty Counties Navigation District canal generally along N. Main Street, Texas Avenue, and Work Street.	Chambers County	$100,000
051000066	Dredging West Fork- Double Bayou	Evaluate project to quantify benefits, evaluate impacts, and begin design. Improvements include dredging West Fork- Double Bayou from mouth to FM 562 bridge.	Chambers County	$1,400,000
051000067	Spindletop Bayou Ditch Improvement	Evaluate project to quantify benefits, evaluate impacts, and begin design. Improvements include increasing IH10 crossings, enlarge ditches and create retention along the Spindletop Bayou in east Chambers County.	Chambers County	$1,500,000
051000068	North Anahuac Drainage	Evaluate project to quantify benefits, evaluate impacts, and begin design. Improvements include expanding/repairing road ditches and culverts and channelizing the drainage outfall for the area north of Lonestar Canal.	Anahuac	$800,000
051000069	Southeast Drainage Ditch	Evaluate project to quantify benefits, evaluate impacts, and begin design. Improvements include channelization and crossing upgrades from Benton Lane to FM 563.	Anahuac	$125,000

FME ID	FME Name	Description	Sponsor	Cost
051000070	Southwest Anahuac Ditch	Evaluate project to quantify benefits, evaluate impacts, and begin design. Improvements include channelization and crossing upgrades from Main Street to Bay.	Anahuac	$125,000
051000071	City of Lumberton Adler Ditch Drainage Improvements	H&H Study to identify alternatives for improving existing drainage of Adler Ditch	Lumberton	$100,000
051000072	City of Lumberton East Village Creek Parkway Drainage Improvements	H&H Study to identify alternatives for improving existing drainage of East Village Creek Parkway	Lumberton	$125,000
051000073	City of Lumberton Greens Branch Ditch Western Extension	H&H Study to identify alternatives for improving existing drainage of Greens Branch Ditch	Lumberton	$100,000
051000074	City of Lumberton Drainage Chance Cut Off Concrete Lining	H&H Study to identify alternatives for improving existing drainage of Chance Cut Off	Lumberton	$50,000
051000075	City of Lumberton Detention Pond at FM 421	H&H Study to develop alternatives for detention at FM 421	Lumberton	$50,000
051000076	City of Lumberton Elevate Taft Road and Brushy Creek Subdivision	H&H Study to identify alternatives for elevating Taft Road and Brushy Creek Subdivision	Lumberton	$75,000
051000077	City of Rose Hill Acres Flood Mitigation Improvements	Develop drainage study to identify flood mitigation measures in and around Rose Hill Acres ETJ.	Rose Hill Acres	$500,000
051000078	City of Nacogdoches Flood Mitigation Project	H&H study to mitigate the wide-spread flooding that occurs along LaNana and Banita Creeks in the City of Nacogdoches	Nacogdoches	$100,000
051000079	City of Rose Hill Acres Ditch Improvements	H&H Study to identify alternatives for ditch improvements within Rose Hill Acres	Rose Hill Acres	$50,000
051000080	City of Rose Hill Acres Road and Bridge Elevation	H&H study to locate roadways prone to flooding and identify alternatives to improve drainage.	Rose Hill Acres	$50,000
051000081	City of Silsbee Easy Street Drainage Improvements	H&H study to locate roadways prone to flooding and identify alternatives to improve drainage.	Silsbee	$50,000
051000082	City of Vidor Schoolhouse Ditch Alternative B	H&H study to identify alternatives for Schoolhouse Ditch	Orange County	$100,000
051000083	City of Vidor Schoolhouse Ditch Alternative C	H&H study to identify alternatives for Schoolhouse Ditch	Orange County	$100,000
051000084	City of Vidor Drainage Improvements	Perform H&H modeling to identify and define flood risk, develop conceptual alternatives to reduce flood risk, develop OPCC for conceptual alternatives, and rank projects. Conceptual alternatives should evaluate feasibility of nature based solutions.	Orange County	$100,000
051000085	Hardin County Black Creek Detention Pond	H&H Study to develop alternatives for detention at Black Creek.	Hardin County	$150,000
051000086	Hardin County Boggy Creek Detention Pond	H&H Study to develop alternatives for detention on Boggy Creek.	Hardin County	$150,000
051000087	Hardin County Cooks Lake Road Bridge Elevation	H&H study to improve drainage along Cooks Lake Bridge.	Hardin County	$20,000
051000088	Hardin County Reservoir	H&H study of large reservoir for flood control / drought assistance.	Hardin County	$500,000
051000089	Hardin County South Area Drainage System	H&H study to identify alternatives for developing a drainage system to drain / retain flood waters around the communities of Pinewood, Countrywood, Bevil Oaks, and Rose Hill	Hardin County	$1,000,000
051000090	Hardin County SE Area Drainage System	H&H study to identify alternatives for developing a large drainage system to drain Lumberton directly into the Neches River, instead of Pine Island Bayou.	Hardin County	$1,250,000
051000091	Hardin County Pinewood Drainage Improvements	H&H Study to identify alternatives for improving existing drainage within Pinewood.	Hardin County	$350,000
051000092	Hardin County Coon Marsh Gully Drainage Improvements	H&H Study to identify alternatives for improving existing drainage within Marsh Gully	Hardin County	$300,000
051000093	Hardin County Municipal Storm Drain Project	Evaluate project to quantify benefits, evaluate impacts, and begin design.	Hardin County	$2,000,000
051000094	City of Coffee City Flood-prone Roadway and Infrastructure Evaluation	Locate roadways and properties prone to flooding due to heavy rainfall	Coffee City	$25,000
051000095	City of Moore Station Flood-prone Roadway and Infrastructure Evaluation	Locate roadways and properties prone to flooding due to heavy rainfall	Moore Station	$25,000
051000096	Houston County Earthen Dike Construction	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of an earthen dike to elevate emergency vehicle access road to critical facilities to provide protection to the 500-year flood level.	Houston County	$16,972

FME ID	FME Name	Description	Sponsor	Cost
051000097	Ditch 100 A (East Caldwood) Improvements	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of 2,200 ft of channel to be retrofitted with an underground culvert to allow for shaping and resizing the ditch to allow for continued maintenance.	Jefferson County Drainage District 6	$75,000
051000098	Ditch 119 Crossings at Yount and Edson	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of crossing improvements that will protect about 50 homes and mitigate flood risk on a historically flood prone road.	Jefferson County Drainage District 6	$50,000
051000099	Lateral B4A and B4A Ext. Improvements	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossings to reduce out of bank flooding.	Jefferson County Drainage District 7	$225,000
051000100	Rodair Pump Station	Evaluate project to quantify benefits, evaluate impacts, and begin design.	Jefferson County Drainage District 7	$2,000,000
051000101	Upgrade to Lateral B4B	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossings to reduce out of bank flooding.	Jefferson County Drainage District 7	$50,000
051000102	Beauxart Gardens Central Ditch Improvements	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossings to reduce out of bank flooding.	Jefferson County Drainage District 7	$50,000
051000103	Houston Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$250,000
051000104	Grannis Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000105	Foley Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000106	Lakeside Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000107	Rodair Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000108	9th Avenue - Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000109	Halbouty Add two pumps (open spots in structure)	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000110	Rodair Upper Build new station with associated levee	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000111	Main C Diversion - Build New Pump Station and Channel	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000113	Central Gardens Ditch - Upgrade Drainage Channel	H&H study to identify alternatives for Central Gardens Ditch	Jefferson County Drainage District 7	$100,000
051000114	Pure Oil Ditch Improvements	H&H study to identify alternatives for Pure Oil Ditch	Jefferson County Drainage District 7	$100,000
051000115	Rodair Gulley Ditch Improvements	H&H study to identify alternatives for Rodair Gulley	Jefferson County Drainage District 7	$100,000
051000116	Main C Diversion Channel Improvements	H&H study to identify alternatives for Main C Diversion Channel	Jefferson County Drainage District 7	$100,000

FME ID	FME Name	Description	Sponsor	Cost
051000117	Main B Channel Improvements	H&H study to identify alternatives for Main B Channel	Jefferson County Drainage District 7	$100,000
051000118	Main A Channel Improvements	H&H study to identify alternatives for Main A Channel	Jefferson County Drainage District 7	$100,000
051000119	Rodair Lateral 5 Detention Pond Excavation	H&H study to identify additional detention required to expand existing level of service	Jefferson County Drainage District 7	$100,000
051000120	Halbouty Detention Pond Excavation	H&H study to identify additional detention required to expand existing level of service	Jefferson County Drainage District 7	$100,000
051000121	9th Avenue Additional Detention Excavation	H&H study to identify additional detention required to improve existing level of service	Jefferson County Drainage District 7	$100,000
051000123	JCDD7 Hurricane Flood Protection Levee Study	Study to identify possible upgrades to levees to help reduce the risk of flooding and to help the District review and update levees in jurisdictional area.	Jefferson County Drainage District 7	$777,000
051000124	Crane Bayou Channel Improvements	H&H study to identify alternatives for Crane Bayou Channel	Jefferson County Drainage District 7	$100,000
051000125	Rodair Upper Additional Pump Station	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000128	Rodair Gully System Detention	H&H study to identify additional detention required to expand existing level of service	Jefferson County Drainage District 7	$100,000
051000129	El Vista Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000130	W. Port Arthur Road Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000131	Central - Upgrade Pumping Equipment and Structure	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000132	Star Lake Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000133	Crane Bayou Additional Pumping	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000134	Lakeview Additional Pumping	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000135	City of Daisetta Drainage Projects	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of drainage improvements throughout the city to include widening culverts and ditches.	Daisetta	$150,000
051000136	Liberty County Culvert Replacement Project	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of increasing culvert size in identified flood hazard problem areas within Liberty County.	Liberty County	$100,657
051000137	Liberty County Recanalization Feasibility Study	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of dechannelizing existing feeder creeks that flow from north to south and improve drainage for storm water runoff.	Liberty County	$26,171
051000138	Stadium Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000139	Delmar Upgrade Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000
051000140	DeQueen Additional Pumping Equipment	H&H study to size pump upgrades and improve existing level of service.	Jefferson County Drainage District 7	$100,000

FME ID	FME Name	Description	Sponsor	Cost
051000143	Tyrrell Park Detention	Install a detention pond in the vicinity of Tyrrell Park Rd. within the city of Beaumont.	Jefferson County Drainage District 6	$500,000
051000144	Mayhaw Lateral Improvements	Rectify negative impacts to properties downstream of IH-10 caused by additional drainage crossings	Jefferson County Drainage District 6	$2,200,000
051000145	Feasibility Assessment for Increase in Size of Culverts and Railroad Trestles on Major Drainage Structures Throughout Orange County	H&H Study to analyze most efficient alternatives for dredging, widening, or otherwise improving culverts and railroad trestles within Orange County.	Orange County Drainage District	$150,000
051000146	Feasibility Assessment of the Capacity of Drainage Ditches and Channels that Convey Stormwater from Neighborhoods Located Within Orange County	H&H Study to analyze most efficient alternatives for improving existing drainage ditches and channels linked to neighborhoods within Orange County.	Orange County Drainage District	$100,000
051000147	Orange County DD Harvey Repairs	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of repairing damage to drainage ditches, crossings, culverts, levees, and right-of-ways caused by Hurricane Harvey to restore pre-flood capacity.	Orange County Drainage District	$130,000
051000148	Orange County DD SW Detention/Retention Facilities	Evaluate project to quantify benefits, evaluate impacts, and begin design. Project consists of stormwater detention/retention facilities throughout OCDD.	Orange County Drainage District	$130,000
051000149	Feasibility Assessment of Widening and Deepening Segments of Tiger Creek	H&H Study to analyze most efficient alternatives for constructing improvements to segments of Tiger Creek.	Orange County Drainage District	$150,000
051000150	Feasibility Assessment of Construction of a Stormwater Detention Pond Adjacent to Tiger Creek	H&H Study to analyze most efficient alternatives for constructing a stormwater detention pond in the vicinity of Tiger Creek.	Orange County Drainage District	$100,000
051000151	Feasibility Assessment of Widening and Deepening Segments of Ten-Mile Creek	H&H Study to analyze most efficient alternatives for constructing improvements to segments of Ten-Mile Creek.	Orange County Drainage District	$175,000
051000152	Feasibility Assessment of Widening and Deepening Segments of Anderson Gully	H&H Study to analyze most efficient alternatives for constructing improvements to segments of Anderson Gully.	Orange County Drainage District	$325,000
051000153	City of Bullard Culvert Upgrades	Study to evaluate existing culverts for current condition and identify culverts that need to be upgraded.	Bullard	$50,000
051000154	Smith County Drainage Capacity Upgrades	Study to evaluate existing culverts within Smith County and identify culverts that need to be upgraded.	Smith County	$225,000
051000155	Bridge City Drainage Outfall Improvement Project	Improve and extend three major drainage ditches and extend a neighborhood outfall to reduce structural flooding in residences within the area.	Orange County Drainage District	$200,000
051000156	Colonial Outfall Ditch Culvert Improvements	Installation of New Culverts along FM 1442 (Bridge City) at Colonial Outfall Ditch	Orange County Drainage District	$200,000
051000157	City of Beaumont Drainage Projects	Drainage study to evaluate new storm water and sanitary sewer lines associated with reconstruction of key areas in the city to reduce localized flooding issues.	City of Beaumont	$118,750
051000158	Mayhaw Bayou Regional Detention Basin	Evaluate a regional detention facility north and west of IH10 in the upper portion of the Mayhaw Bayou watershed.	Jefferson County Drainage District 6	$75,000
051000159	North Taylor Regional Detention Basin	Evaluate a regional detention facility north of FM365 and west of South China Road in the upper portion of the North Fork of Taylors Bayou watershed.	Jefferson County Drainage District 6	$75,000
051000160	South Taylor Regional Detention Basin	Evaluate a regional detention facility west of Heizig Road in the watersheds of both the North and South Forks of Taylors Bayou.	Jefferson County Drainage District 6	$75,000
051000161	Calder Diversions Connections	Evaluate sub-surface diversion primarily located along Calder Avenue that discharges into the Neches River.	Jefferson County Drainage District 6	$75,000
051000162	Needmore Diversion	Evaluate a diversion channel from downstream of Lower Mayhaw Bayou to Needmore.	Jefferson County Drainage District 6	$75,000

FME ID	FME Name	Description	Sponsor	Cost
051000163	Channel 100A Concrete Repair	Evaluate repairs and improvements to Channel 100-A located within the City of Beaumont.	Jefferson County Drainage District 6	$75,000

TABLE 4-11: LIST OF POTENTIALLY FEASIBLE FMSS

FMS ID	FMS Name	Description	Sponsor	Cost
052000001	Anderson County Flood Education Program	Educate homeowners to increase awareness about the hazard of flooding and to inform residents of mitigation actions to reduce risk.	Anderson County	$50,000
052000002	Anderson County Natural Hazards Education Program Development	Develop, enhance and implement education programs to increase awareness of natural hazards and to inform residents of mitigation actions to reduce risk to citizens, public infrastructure, private property owners, businesses and schools.	Anderson County	$50,000
052000003	City of Frankston Flood Education Program	The City will provide public education on the dangers of flash flooding, and to inform residents of mitigation actions to reduce risk to citizens, public infrastructure, private property owners, businesses and schools.	Frankston	$50,000
052000004	Angelina County Public Education on Mitigation Techniques	Publish educational materials to inform the public in methods of mitigating private property against natural hazard damage.	Angelina County	$10,000
052000005	Chambers County Public Education on Mitigation Techniques	Implement an outreach and education campaign to educate the public on mitigation techniques for all hazards to reduce loss of life and property.	Chambers County	$50,000
052000006	City of Gallatin "Turn Around Don't Drown" Campaign	Promote the "Turn Around Don't Drown" campaign in partnership with DPS.	Gallatin	$10,000
052000007	City of Jacksonville Public Education on Mitigation Actions	Develop and implement public education program to educate the public on mitigation actions to reduce their risk, along with posting updated pertinent weather information on City social media during weather events.	Jacksonville	$20,000
052000008	City of Rusk "Turn Around Don't Drown" Campaign	Promote the "Turn Around Don't Drown" campaign in partnership with DPS.	Rusk	$10,000
052000009	Henderson County Emergency Training Program	Increase training opportunities for citizens to encourage their involvement in mitigation efforts.	Henderson County	$50,000
052000010	City of Berryville Public Education on Mitigation Techniques	Provide materials and data sources to educate citizens of all potential hazards in the planning area and methods to mitigate hazards and increase awareness.	Berryville	$3,000
052000011	City of Brownsboro Flood Mitigation Education for City Officials and Citizens	Seek FEMA and State training in flood mitigation to assist with NFIP and encourage awareness of flood hazard and National Flood Insurance Program assistance to citizens	Brownsboro	$5,000
052000012	City of Brownsboro Public Education on Mitigation Techniques	Provide materials and data sources to educate citizens of all potential hazards in the planning area and methods to mitigate hazards and increase awareness.	Brownsboro	$5,000
052000013	City of Chandler Citizen/Business/City Mitigation Strategy Planning	Encourage the development of public and private partnership with businesses, service organizations and other community groups to work together on mitigation	Chandler	$10,000
052000014	City of Chandler Public Education on Code Red System	Provide public training and education materials about the Code Red system and how to register for the warning system notifications	Chandler	$10,000
052000015	Houston County Property Elevation and Public Education on NFIP	Conduct program to educate residents on NFIP/availability of flood insurance and elevating new construction in and outside of mapped floodplain areas.	Houston County	$10,000
052000016	Houston County Public Education Program on Emergency Evacuation	Conduct public education program and advertise Houston County Emergency Evacuation Plan, such as escape routes in coordination with TxDOT.	Houston County	$22,200
052000017	City of Kennard Public Awareness Program	Conduct public awareness program and distribute NFIP education information to citizens including availability of flood insurance.	Houston County	$10,000
052000018	JCDD6 Public Education Material Distribution	Develop distribution centers in local libraries, DD6 facilities, DD6 website and other public buildings where information and safety guidance on natural and manmade hazards as well as ways to mitigate hazards can be provided to citizens	Jefferson County Drainage District 6	$50,000

FMS ID	FMS Name	Description	Sponsor	Cost
052000019	City of Daisetta Education of City Council on Mitigation Benefits	Educate City Council on benefits of mitigation and encourage council members to become more involved.	Daisetta	$10,000
052000020	City of Nacogdoches Public Education Program	Develop and promote a public education program regarding flood hazards, NFIP, and flood plain regulations.	Nacogdoches	$20,000
052000021	Polk County Public Education Campaign	Initiate public education campaign to improve the community's understanding and access to information on natural hazards and how to improve level of protection for their homes.	Polk County	$50,000
052000022	San Augustine County Public Education on Mitigation Techniques	Includes programs in schools and senior citizen centers, pamphlets, and community meetings.	San Augustine County	$10,600
052000023	Shelby County Public Education on Hazards	Educate the residents of Shelby County and participating jurisdictions on safety and planning for the hazards identified in this plan	Shelby County	$50,000
052000024	City of Groveton Public Education on Mitigation Actions	Create a program to educate the public about specific mitigation actions for multiple hazards	Groveton	$5,100
052000025	Trinity County Public Education on Mitigation Actions	Create a program to educate the public about specific mitigation actions for multiple hazards	Trinity County	$10,200
052000026	Anderson County Code Red System	Plan and implement a new publicity campaign to expand enrollment in CODE RED notification system; use CODE RED to warn of impending hazard events.	Anderson County	$100,000
052000027	Angelina County Siren Warning System Installation	Install warning siren system.	Angelina County	$209,000
052000028	Houston County Alert/Notification System Installation	Purchase and install I-info alert/notification system including one user license per jurisdiction or participating entity.	Houston County	$602,000
052000029	Houston County Gage Installation and Monitoring	Install stream and rain gauges in flood prone areas and waterways as part of overall rainfall tracking, recording program, and new alert notification system.	Houston County	$121,000
052000030	Houston County Rainfall Observer Program	Implement rainfall observer program utilizing volunteers.	Houston County	$5,000
052000031	City of Brownsboro Code Red System Implementation	Obtain access and/or incorporate the use of the automated emergency calling system, Code Red, into local emergency management plan	Brownsboro	$100,000
052000032	City of Chandler Warning Siren Maintenance	Check the location and condition of warning sirens; determine if repairs are needed	Chandler	$100,000
052000033	City of Murchison Warning Siren System Installation	Obtain early warning siren system installment inside jurisdiction to assist in public notification of hazard prior to hazard occurrence	Murchison	$100,000
052000034	JCDD6 Increase Flood Predictive Capability for Streams and Creeks	Utilize ALERT stations and work with National Weather Service to help citizens of the Bevil Oaks community better understand the flood warnings and predictions.	Jefferson County Drainage District 6	$100,000
052000035	JCDD7 Update Data Operation System-Control Center	Will allow officials to see what pump stations are operating in real time, monitor pumps/generator conditions and status	Jefferson County Drainage District 7	$104,000
052000036	OCDD Hazard Notification System Development	Develop employee emergency notification system to warn staff of imminent hazards/risks.	Orange County Drainage District	$11,000
052000037	OCDD Installing Additional Stream Gages	Add stream gauges to the major watersheds to increase flood predictive capability for streams and creeks that affect OCDD (stream gages)	Orange County Drainage District	$534,000
052000038	Polk County Improved Hazard Communication	Upgrade and expand implementation of natural hazard warning systems and methods.	Polk County	$3,110,000
052000039	Shelby County Electronic Hazard Warning Message Board Acquisition	Acquire electronic message board for use during disaster response and recovery operations	Shelby County	$111,000
052000040	Shelby County Warning Siren Installation	Install warning sirens at strategic locations for use during disaster events	Shelby County	$3,319,000
052000041	City of Groveton Warning System Upgrades	Implement, upgrade, expand, and integrate digital methods for storm notification to include all methods of communication including: cell phones, text messages, land-lines, internet networking sites, television, and radio.	Groveton	$11,000
052000042	Van Zandt County Warning System Acquisition	Acquire and Install Warning Systems throughout the County, including Incorporated Jurisdictions. Reduce risk to citizens through improved communications and early warning.	Van Zandt County	$82,000
052000043	Angelina County Property Acquisition	Acquire repetitive loss properties.	Angelina County	$2,100,000
052000044	Angelina County Property Elevation	Elevate properties in the floodplain.	Angelina County	$630,000

FMS ID	FMS Name	Description	Sponsor	Cost
052000045	Hardin County Voluntary Flood Buyout	Voluntary flood buyouts.	Hardin County	$4,000,000
052000046	Hardin County Voluntary Residential Structure Elevation	Voluntary elevations of flood prone properties in Hardin County.	Hardin County	$7,500,000
052000047	City of Kountze Flood Buyout	Voluntary flood buyouts.	Kountze	$6,000,000
052000048	City of Lumberton Voluntary Flood Buyout	Voluntary flood buyouts.	Lumberton	$6,000,000
052000049	City of Rose Hill Acres Voluntary Flood Buyout	Voluntary flood buyouts.	Rose Hill Acres	$5,000,000
052000050	City of Rose Hill Acres Voluntary Residential Structure Elevation	Voluntary elevations of flood prone properties in Rose Hill Acres.	Rose Hill Acres	$6,000,000
052000051	City of Silsbee Voluntary Flood Buyout	Voluntary flood buyouts.	Silsbee	$6,000,000
052000052	City of Sour Lake Voluntary Flood Buyout	Voluntary flood buyouts.	Sour Lake	$6,000,000
052000053	Jefferson County Property Elevation	FIF Application; aimed to elevate houses within county subject to inundation from flooding.	Jefferson County	$1,110,000
052000054	Liberty County Property Acquisition	Acquire property located in the floodplain including properties located in subdivisions along the Trinity River.	Liberty County	$2,140,000
052000055	City of Nacogdoches Study and Ranking of Repetitive Loss Structures	Analyze flood-prone properties in the City of Nacogdoches and identify appropriate mitigation options for each repetitive loss structure.	Nacogdoches	$327,000
052000056	San Augustine County Acquisition and Conversion of Flood Prone Properties	Acquire flood prone/repetitive loss properties and convert to open space, parks, boating access, trails, agricultural projects, and/or as a general community asset.	San Augustine County	$530,000
052000057	San Augustine County Structure Elevation	Elevate existing flood prone structures above the base flood elevation to reduce flood losses. Flood proof historical structures at risk from flooding.	San Augustine County	$318,000
052000058	Shelby County Property Acquisition	Acquire flood prone/repetitive loss properties and convert to open space, parks, boating access, trails, agricultural projects, and/or as a general community asset	Shelby County	$100,000
052000059	Trinity County Buyout Program Implementation	Develop and implement a program to buyout repetitive loss properties and convert to open space, parks, boating access, trails, and/or as a general community asset.	Trinity County	$100,000
052000060	City of Groveton Buyout Program Implementation	Develop and implement a program to buyout repetitive loss properties and convert to open space, parks, boating access, trails, and/or as a general community asset.	Groveton	$100,000
052000061	City of Diboll Ordinance and Regulation Update	Update building code and subdivision ordinance to include restrictions on the distance a structure can be built from active streams and creeks.	Diboll	$10,000
052000062	City of Cuney Bridge and Culvert Inspection Program	Plan and implement a program to regularly inspect low-lying bridges and highway culverts, clear debris, and create safe pathways for excess water runoff, to avoid flooding.	Cuney	$25,000
052000063	City of Cuney Seek NFIP Participation	Pass appropriate Resolutions and Ordinances for participation in the National Flood Insurance Program.	Cuney	$5,000
052000064	City of Gallatin Multi-Jurisdiction Coordination	Work with County or TXDOT to increase drainage capacity in sites that are prone to flooding.	Gallatin	$5,000
052000065	City of Jacksonville Multi-Jurisdiction Coordination	Work with County or TXDOT to increase drainage capacity in sites that are prone to flooding.	Jacksonville	$10,000
052000066	City of Reklaw Improved Enforcement of Ordinances	Improve the long-range management and use of flood-prone areas by the adoption and enforcement of local ordinances to regulate new development within the floodplain. Review and revise ordinances, when needed.	Reklaw	$10,000
052000067	City of Rusk Flood Maps Maintenance and Update	Work with state and federal agencies to maintain current flood maps.	Rusk	$10,000
052000068	Hardin County Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Hardin County	$80,000
052000069	Hardin County Drainage District	Form Drainage District: Purpose would be to oversee/ maintain, and construct required drainage projects for the County. Regulate stormwater mitigation for new and future developments.	Hardin County	$900,000
052000070	City of Kountze Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Kountze	$60,000

FMS ID	FMS Name	Description	Sponsor	Cost
052000071	City of Lumberton Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Lumberton	$80,000
052000072	City of Rose Hill Acres Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Rose Hill Acres	$80,000
052000073	City of Silsbee Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Silsbee	$50,000
052000074	City of Sour Lake Continued NFIP Participation	Continue participation in the NFIP and initiate participation in CRS. Includes improvement of flood mapping and elevation data, mitigation for repetitive loss properties, and instituting higher regulatory standards for future floodplain development.	Sour Lake	$60,000
052000075	Houston County Mobile Home Inspection	Conduct routine inspection of manufactured home/mobile homes in flood-prone area to ensure proper tie-downs per Flood Damage Ordinance.	Houston County	$61,000
052000076	JCDD6 Multi-Jurisdiction Coordination	Increase coordination with the City and County regarding flood predictions and post event recovery.	Jefferson County Drainage District 6	$20,000
052000077	JCDD6 Severe Weather Action Plan	Create severe weather action plan, conduct drills, identify and promulgate evacuation and sheltering options.	Jefferson County Drainage District 6	$60,000
052000078	JCDD7 Storm Water Management Plan	Help to establish and allow District to enforce development regulations within existing flood zones.	Jefferson County Drainage District 7	$50,000
052000079	City of Daisetta Property Construction Ordinance	The city shall adopt a land-use ordinance which prohibits building residential or commercial structures in the 100-year floodplain.	Daisetta	$10,000
052000080	City of Daisetta Property Elevation Ordinance	The city shall adopt a land use ordinance which requires any structure within the 100-year floodplain to be elevated 2 feet above base flood elevation.	Daisetta	$5,000
052000081	City of Hardin Subdivision Ordinance Implementation	Implement subdivision ordinance regulations concerning building in flood-prone areas.	Hardin	$10,000
052000082	City of Nacogdoches Stormwater Drainage Fee Implementation	Implement stormwater drainage fee to assist funding of flood mitigation infrastructure projects	Nacogdoches	$40,000
052000083	City of Nacogdoches Codes and Ordinances Update	Review and update, if necessary, all City codes and ordinances pertaining to floodplain management to ensure their compliance with state and federal laws and to achieve cohesion with the mitigation strategies contained herein.	Nacogdoches	$30,000
052000084	OCDD Drainage Criteria Manual and Regulations Enforcement	Implement and enforce the Drainage Criteria Manual and Regulations for regulation of the effects of new developments and stormwater runoff.	Orange County Drainage District	$20,000
052000085	OCDD Support/Create Stricter Floodplain Ordinances	Work with Communities to support ordinances or create ordinances that help to protect new structures from being built in the floodplain or floodway	Orange County Drainage District	$40,000
052000086	San Augustine County Continue NFIP Participation	Continue participation in the National Flood Insurance Program (NFIP) and expand administration and monitoring capabilities	San Augustine County	$53,000
052000087	City of Linsdale Natural Runoff Policies Implementation	Incorporate “natural run-off” policies. Calculate cumulative effect of development, increase capacity of storm water drainage systems, institute regular drain system maintenance.	Lindale	$30,000
052000088	City of Linsdale No Adverse Impact Implementation	Incorporate "no adverse impact“ design requirements in community development. Provide awareness to stakeholders and design engineers; building code adoption and plan approval process.	Lindale	$60,000
052000089	City of Troup Floodplain Ordinance Update	Adopt and enforce a stricter floodplain ordinance that no new structures are allowed in the 100-year floodway. Adopted by City Council action.	Troup	$40,000
052000090	Trinity County Dam/Levee Failure Data Collection	Develop and implement standard operating procedures for collecting and sharing data to provide extent of dam/levee failure	Trinity County	$30,600

FMS ID	FMS Name	Description	Sponsor	Cost
052000091	Van Zandt County Higher Standards Incorporation	Incorporate Higher Standards for Hazard Resistance in Local Application of the Building Code.	Van Zandt County	$30,000
052000092	Anderson County Culvert Improvements	Widen culverts to mitigate against future drainage issues that lead to flooding.	Anderson County	$3,000,000
052000093	Anderson County Dam Inspection and Maintenance Program	Work with dam owners to keep dams in excellent condition by visiting dam locations and doing inspections with owners to ensure that dams are properly maintained and failure possibilities are greatly reduced.	Anderson County	$2,000,000
052000094	City of Frankston Culvert Improvements	Develop plan to increase drainage capacity in sites that are prone to flooding.	Frankston	$1,000,000
052000095	City of Palestine Drainage System Expansion and Maintenance	Establish plan and necessary standards to increase the capacity of drainage ditches along all city streets and roads	Palestine	$2,000,000
052000096	Angelina County Culvert Improvements	Develop plan to upgrade major culvert areas which are prone to flooding.	Angelina County	$2,000,000
052000097	City of Burke Drainage Ditch Capacity Upgrades	Establish a plan and necessary standards to increase the capacity of drainage ditches along all city streets and roads	Burke	$500,000
052000098	Chambers County Property Protection	Project will clear obstacles, widen and reshape ditches, and upgrade culverts to restore adequate drainage to mitigate flooding throughout all participating jurisdictions	Chambers County	$1,000,000
052000099	Cherokee County Culvert Upgrades	Develop plan to upgrade major culvert areas which are prone to flooding.	Cherokee County	$2,000,000
052000100	City of Alto Culvert Improvements	Develop plan to increase drainage capacity in sites that are prone to flooding.	Alto	$1,000,000
052000101	City of Reklaw Drainage System Upgrades	Establish plan to increase drainage capacity in sites that are prone to flooding.	Reklaw	$1,000,000
052000102	City of Rusk Culvert Improvements	Establish plan to increase drainage capacity in sites that are prone to flooding.	Rusk	$1,000,000
052000103	City of Wells Culvert Improvements	Establish plan to increase drainage capacity in sites that are prone to flooding.	Wells	$1,000,000
052000104	Hardin County Culverts, Ditches, and Channel	Establish plan to upgrade storm water capacity by installing/upgrading culverts and enlarging storm water channels.	Hardin County	$3,000,000
052000105	Hardin County Detention Ponds	Develop a program to construct water retention ponds to collect stormwater run-off, reduce flooding, and use as an alternate water source throughout Hardin County.	Hardin County	$1,000,000
052000106	Hardin County Elevate Roads and Bridges	Develop a program to elevate roads and bridges including installing, upsizing culverts and headwalls, and bridge upgrades.	Hardin County	$10,000,000
052000107	City of Kountze Culverts and Ditches	Develop plan to increase drainage capacity in sites that are prone to flooding.	Kountze	$3,000,000
052000108	City of Kountze Elevate Roads and Bridges	Develop a program to elevate roads and bridges including installing, upsizing culverts and headwalls, and bridge upgrades.	Kountze	$2,000,000
052000109	City of Kountze General Drainage Improvements	Increase drainage capacity; add stormwater detention basins and stormwater pumping stations where gravity flow is not feasible.	Kountze	$1,500,000
052000110	City of Lumberton Culverts, Ditches, and Channels	Develop plan to increase drainage capacity in sites that are prone to flooding.	Lumberton	$3,000,000
052000111	City of Rose Hill Acres Flood Control Improvements	Develop a program to upgrade flood control structures (barriers, berms) for the purpose of protecting critical facilities, potable water sources, and agricultural resources from water contamination and saltwater intrusion.	Rose Hill Acres	$3,000,000
052000112	City of Rose Hill Acres General Drainage Improvements	Establish criteria to increase drainage capacity; add stormwater detention basins, box culverts and/or pipes to increase drainage capacity.	Rose Hill Acres	$400,000
052000113	City of Silsbee Detention, Culverts, Ditches and Channels	Develop plan to increase drainage capacity in sites that are prone to flooding.	Silsbee	$1,500,000
052000114	City of Silsbee Drainage Ditches	Develop a program to upgrade drainage ditches and explore converting necessary ditches into curb / sewer construction.	Silsbee	$1,000,000
052000115	City of Silsbee Flood Mitigation for Hendrix Development	Explore, plan, and implement flood mitigation strategies within the Hendrix Development.	Silsbee	$5,000,000
052000116	City of Sour Lake Channel Improvements	Establish criteria and standards for installing large concrete channels, box culvert, concrete pipe, and/or mechanisms as needed to mitigate drainage ditch erosion and improve water capacity and conveyance.	Sour Lake	$500,000
052000117	City of Sour Lake Drainage Outfalls	Advance a plan to rectify, enlarge, and maintain outfall channels for the City of Sour Lake, including excavating interior roadside ditches.	Sour Lake	$1,000,000

FMS ID	FMS Name	Description	Sponsor	Cost
052000118	City of Sour Lake Stormwater Detention	Establish criteria and standards to construct water retention ponds to collect stormwater run-off and reduce flooding.	Sour Lake	$7,000,000
052000119	Houston County Drainage Culvert Upgrades	Develop a plan to expand/upgrade drainage culverts to prevent flooded roadways and add signage in low-water crossings.	Houston County	$3,000,000
052000120	Houston County Flood Infrastructure Maintenance	Clear debris from bridges, box culverts, and drainage systems throughout unincorporated county.	Houston County	$2,000,000
052000121	City of Grapeland Critical Facilities Flood-Proofing	Flood proof critical facilities to the 500-year flood that are located in flood-prone areas of the city.	Houston County	$1,000,000
052000122	City of Kennard Ditch Maintenance Program	Implement program to routinely remove debris from drainage ways and roadside ditches to prevent back up of flood velocity and improve conveyance of stream during flood events.	Kennard	$1,000,000
052000123	Liberty County Drainage Projects	The county will work with partnering jurisdictions and engineers in order to implement drainage projects throughout the county- including adding ditches, detention ponds and detention basins in identified locations throughout the county.	Liberty County	$2,000,000
052000124	City of Daisetta Culvert Maintenance and Upgrades	Removal of debris, silt and vegetation obstacles in drainage ways. Project will clear obstacles, mow and reshape ditches, and upgrade culverts to restore adequate drainage to mitigate flooding.	Daisetta	$1,000,000
052000125	OCDD Flood Infrastructure Improvements	Support regional efforts to plan, design, and construct large scale flood control / storm surge protection improvements	Orange County Drainage District	$3,000,000
052000126	Polk County Facilities Hazard Hardening Retrofit	Activities may include but are not limited to: flood proofing, impact resistant windows, storm shutters, roof straps, structural bracing, low-flow plumbing fixtures, roll-up door reinforcement, grounding systems, and surge-protection.	Polk County	$1,500,000
052000127	Polk County Flood Infrastructure Improvements	Implement program to elevate and reinforce roadways and bridges prone to inundation from flooding. Projects may include general road elevation; upgrading culverts and installing headwalls; upgrades and reinforcement of bridges and bridge footings.	Polk County	$2,000,000
052000128	City of Henderson Flood Infrastructure Maintenance	Establish a plan to conduct various flood control maintenance improvements throughout the City	Henderson	$1,000,000
052000129	San Augustine County Bridge Improvements	Develop a program to elevate roads and bridges including installing, upsizing culverts and headwalls, and bridge upgrades.	San Augustine County	$2,000,000
052000130	San Augustine County Culvert Upgrades	Establish a plan to upgrade culverts in county extent. Actions can include but are not limited to: installing/upgrading culverts and headwalls; and enlarging storm water ditches and canals.	San Augustine County	$2,000,000
052000131	San Augustine County Facilities Hazard Hardening Retrofit	Actions can include but are not limited to: installing window screens, storm shutters, window film reinforcements, roof straps, and flood proofing.	San Augustine County	$1,500,000
052000132	San Augustine County Detention and Retention Pond Construction	Construct storm water detention/retention ponds at strategic locations for improved stormwater storage to hold storm water run-off and as a mitigation measure for drought and wildfire.	San Augustine County	$3,000,000
052000133	City of San Augustine and City of Broaddus County Facilities Hazard Hardening Retrofit	Construct flood protection, winter storm-hardening, and expansive soils mitigation projects for water distribution networks and wastewater facilities for Cities of Broaddus and San Augustine.	San Augustine	$1,000,000
052000134	Shelby County Detention and Retention Pond Construction	Establish a plan and necessary standards to construct storm water detention/retention ponds at strategic locations for improved stormwater storage to hold storm water run-off and as a mitigation measure for drought and wildfire	Shelby County	$3,000,000
052000135	Shelby County Drainage Upgrades	Establish a plan to upgrade stormwater conveyance capacity via drainage improvement projects	Shelby County	$2,000,000
052000136	Shelby County Facilities Hazard Hardening Retrofit	Establish a plan to storm-harden and/or retrofit existing and newly constructed critical facilities	Shelby County	$2,000,000
052000137	Shelby County Roadway/Bridge Elevation	Develop a program to elevate roads and bridges including installing, upsizing culverts and headwalls, and bridge upgrades.	Shelby County	$2,000,000
052000138	City of Tyler Open Channel Improvements	Implement a program to enclose open channels that are contributing to flooding. Priority locations are: 1) Ashmore subdivision between Ashmore and Salisbury and 2) Fleishel Ave. between 6th and 8th Streets.	Tyler	$1,500,000
052000139	City of Whitehouse Drainage Capacity Upgrades	Establish a plan to increase stormwater drainage capacity by completing a hydraulic study, evaluating historical water drainage, then constructing needed improvements.	Whitehouse	$1,000,000

FMS ID	FMS Name	Description	Sponsor	Cost
052000140	Trinity County Flood Infrastructure Upgrades	Within the county, develop a plan to install/improve culverts and headwalls in addition to expanding stormwater ditches and canals	Trinity County	$2,000,000
052000141	Trinity County Flood-prone Infrastructure Upgrades	Develop a program to upgrade flood infrastructure in the county. May include general roadway elevation upgrading culverts and installing headwalls; upgrades and reinforcement of bridges and bridge footings; etc.	Trinity County	$2,000,000
052000142	City of Groveton Flood Infrastructure Upgrades	Within the city, develop a plan to install/improve culverts and headwalls in addition to expanding stormwater ditches and canals	Groveton	$750,000
052000143	Van Zandt County Drainage Capacity Upgrades	Establish a plan to increase Drainage Capacity; possible actions include installing French Drains, Building Elevation, and Upgrading Undersized Pipe under State Hwy for Water to Run into Creek.	Van Zandt County	$2,000,000
052000144	Van Zandt County Flood Infrastructure Maintenance	Adopt and Implement a Program for Clearing Debris from Bridges, Drains and Culverts. Reduce damages caused by flooding by maintaining or restoring drainage capacity.	Van Zandt County	$2,000,000
052000145	Van Zandt County Road Elevation	Develop a program to elevate roads and bridges including installing, upsizing culverts and headwalls, and bridge upgrades.	Van Zandt County	$2,000,000
052000146	Liberty County Topographical Mapping Update	Purchase updated topographical maps/complete LiDAR aerial survey for drainage plan.	Liberty County	$107,000
052000147	Liberty County Drainage District Multi-County Coordination	Work with adjoining counties regarding flood and drainage issues.	Liberty County Drainage District	$50,000

TABLE 4-12: LIST OF POTENTIALLY FEASIBLE FMPS

FMP ID	FMP Name	Description	Sponsor	Cost
053000001	Bayou Din Detention Basin	Construct a new detention basin with nearby channel and crossing improvements in the vicinity of Bayou Din.	Jefferson County Drainage District 6	$85,000,000
053000002	Bessie Heights Drainage Ditch Extension Project	Expand the Bessie Heights Drainage Ditch to address flooding risk to residential properties in the area.	Orange County Drainage District	$4,250,000
053000004	Port Arthur and Vicinity Coastal Storm Risk Management Project	Construct levees, floodwalls, pump stations, drainage structures, and other flood mitigation infrastructure to reduce adverse flood impact in the vicinity of the city of Port Arthur.	Jefferson County Drainage District 7	$863,000,000
053000005	Orange County Coastal Storm Risk Management Project	Construct levees, floodwalls, pump stations, drainage structures, and other flood mitigation infrastructure to reduce adverse flood impact in Orange County.	Orange County Drainage District	$119,900,000
053000006	Black Fork Creek Improvement Project	Construct a detention pond and install a diversion to be placed near the decommissioned Hogg Middle School within the city of Tyler.	City of Tyler	$22,234,300
053000007	Sandy Creek Improvement Project	The project includes two new detention basins located along Sandy Creek to mitigate flooding historically experienced by the City of Jasper.	City of Jasper	$224,924,330
053000008	Sour Lake Channel Improvements	The project proposes a new diversion channel through Sour Lake, providing a path for runoff from the West to the East.	Jefferson County Drainage District 6	$63,303,926
053000009	Rosedale Improvement System	The project proposes widening and deepening of existing channels upstream of the LNVA canal, a diversion channel to the Neches River, and detention basins, near the Rosedale Acres community.	Jefferson County Drainage District 6	$308,620,428
053000010	Nome Conveyance Improvements	The project proposes an improvement system consisting of channelization along Cotton Creek and an off-line detention basin to mitigate impacts.	Jefferson County Drainage District 6	$163,293,623
053000011	Pevitot Gully Improvement System	The project proposes an improvement system consisting of offline detention basins and channelization along Pevitot Gully.	Jefferson County Drainage District 6	$319,970,815
053000012	Willow Marsh Bayou Phelan Blvd Detention	The project proposes an improvement system consisting of in-line detention basins and channelization along Willow Marsh from Phelan Blvd to Highway 90.	Jefferson County Drainage District 6	$203,869,200
053000013	Willow Marsh Main Improvement System	The project proposes an improvement system consisting of off-line detention basins and channelization along Willow Marsh from Highway 90 to South Major Dr.	Jefferson County Drainage District 6	$1,136,334,277
053000014	Willow Marsh Downstream	The project proposes an improvement system consisting of off-line detention basins and channelization along Willow Marsh from South Major Dr to Hillebrandt Bayou.	Jefferson County Drainage District 6	$118,142,723
053000015	Tyrrell Park Improvements	The project proposes a new channel alignment across Tyrrell Park to an existing channel that outfalls into Hillebrandt Bayou; to gain the full benefits the project should be accompanied by improvements of roadside ditches in adjacent neighborhoods.	Jefferson County Drainage District 6	$25,095,036
053000016	Green Pond Flow Diversion	The project proposes a diversion of storm runoff into the Green Pond detention facility via construction of a berm and spillway across Channel 505-B east of the Green Pond facility. Channel improvements are also included.	Jefferson County Drainage District 6	$7,779,088
053000017	Lucas/Delaware Diversion	The project includes storm sewer improvements that divert flow away from DD6 channels 100 and 122 to be redirected to instead flow to channel 010 near Charles Street before ultimately discharging into the Neches River.	Jefferson County Drainage District 6	$130,286,230
053000018	South Park Diversion	The project includes storm sewer improvements that divert flow away from DD6 channels 104 and 104-B to be redirected to the Neches River.	Jefferson County Drainage District 6	$99,908,750
053000019	Tevis Diversion	This project includes storm sewer improvements that divert flow away from DD6 channel 115 to be redirected to the Neches River.	Jefferson County Drainage District 6	$97,327,200
053000020	Blanchette Diversion	The project proposes storm sewer improvements that divert flow away from existing channels to be redirected to the Neches River at a proposed outfall location near Blanchette Street.	Jefferson County Drainage District 6	$99,173,000
053000021	Tyrrell Park Detention	The project consists of installing eight new detention basins to increase capacity to existing storm sewer and provide storage during extreme rainfall events.	Jefferson County Drainage District 6	$187,974,220

FMP ID	FMP Name	Description	Sponsor	Cost
053000022	Virginia Street Detention	The project consists of storm sewer improvements and the construction of new detention ponds to provide increased capacity to the existing storm sewer system. Improvements primarily located at the southern edge of Beaumont near US-287 N.	Jefferson County Drainage District 6	$9,751,456
053000023	Delaware Hilcorp Detention Diversion	Construct two detention ponds near Delaware Street that outfall to DD6 Ditch 121 and Hillebrandt Bayou. Ponds to be accompanied by storm sewer improvements to aid in redirecting flow.	Jefferson County Drainage District 6	$13,181,257
053000024	Borley Heights Relief Project	The project consists of constructing three new crossings under the LNVA Canal, a diversion ditch on the west side of the canal, concrete-lined receiving ditches along the canal, and improvements to the existing Ditch 1002-B.	Jefferson County Drainage District 6	$4,577,210
053000025	East China Relief Project	The project consists of constructing new linear detention upstream of the LNVA Canal, a concrete block-lined channel downstream of the canal crossing, and an adequate structure at Turner Road.	Jefferson County Drainage District 6	$2,853,160
053000026	South Nome Relief Ditch	The project consists of constructing storm sewer improvements and a detention basin to prevent stormwater runoff from backing up into Nome.	Jefferson County Drainage District 6	$2,286,770
053000027	Ditch 505 Detention	The project consists of constructing a detention pond near the intersection of IH-10 and Hwy 365 to the southwest of Beaumont.	Jefferson County Drainage District 6	$13,803,086

4.B.1.b. Infeasible FMSs and FMPs

Table 4-13 details the infeasible FMSs and FMPs found for the planning region. Some potential reasons a project may not be recommended as feasible include but are not limited to the following:

- Action is a single localized project with a small service area
- Action does not achieve flood risk reduction
- Action does not align with the flood mitigation goal(s) adopted by the region and/or the guidance principles set forth by the state
- Action does not demonstrate benefits at a scale appropriate for inclusion in a regional plan
- Action duplicates the benefits of other action(s) included in the plan
- Action cannot obtain a form of concurrence from impacted entities
- Action does not demonstrate a sensible benefit-cost ratio or other metric
- Public input regarding the action demonstrates a need for further evaluation or consensus building with regional stakeholders
- Action does not receive a simple majority vote from a quorum of the RFPG members for inclusion in the RFP.

As FMEs are conducted, more action items could be considered infeasible based on the corresponding scope of work or the cost associated with executing the project or strategy.

TABLE 4-13: INFEASIBLE ACTIONS

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMS	Angelina County Generator Installation	Install generators for all City/County critical facilities	Angelina County	$500,000	Action does not directly address flood mitigation.
FMS	City of Brownsboro Mitigation Planning Organization	Train local EMC and officials on chosen Mitigation action items including record keeping or reports and data. Provide information during Hazard Mitigation Planning Committee Meeting update	City of Brownsboro	$10,000	Action does not directly address flood mitigation.

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMS	City of Chandler Emergency Response Grant Funding	Assist local fire department in applying for grant funding to purchase needed equipment and PPE; assist in qualification and grant writing	City of Chandler	$100,000	Action does not directly address flood mitigation.
FMP	Drainage Canal Improvements	Increase capacity of drainage canal behind high school baseball field to prevent flooding school property.	Corrigan-Camden ISD	$600,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMP	City of Corrigan Culvert Installation	Install culvert on MLK south of Hulett Street to prevent repeat of road washout.	City of Corrigan Public Works	$400,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMP	City of Corrigan Culvert Improvements	Enlarge culvert on MLK at Buckshot Ave.	City of Corrigan Public Works	$60,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMP	City of Diboll Stream Bed Restoration Project	Stream bed restoration project along Sewer Street	City of Diboll	$500,000	Action does not directly address flood mitigation.

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMS	City of Grapeland Ditch Maintenance	Remove dead trees and limbs from roadside ditches, natural drainage areas and waterways.	City of Grapeland	$15,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan
FMS	Purchase Back Up Power Generators	Installing generators at critical facilities will help ensure physical safety for facility occupants and maintain electronic systems functionality during power outages.	City of Groveton	$100,000	Action does not directly address flood mitigation.
FMS	Houston County Generator Acquisition	Install backup generators at critical facilities and shelters throughout county.	Houston County	$100,000	Action does not directly address flood mitigation.
FMS	Houston County Emergency Operations Center Update	Retrofit Emergency Operations Center to improve technological capabilities for monitoring, recording, and responding to disasters.	Houston County	$500,000	Action does not directly address flood mitigation.
FMS	Houston County Spillway Fencing	Fence emergency spillway to prevent 4-wheeler, trucks, and ATV traffic from destroying natural vegetation, causing erosion during severe rainfall event.	Houston County WCID #1	$5,000	Action does not directly address flood mitigation.

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMS	Houston County Erosion Prevention Improvements	Plant erosion prevention vegetation on lands and levees adjacent to and along river banks to mitigate excessive runoff during flood events.	Houston County	$50,000	Action does not directly address flood mitigation.
FMP	Jack Creek and Hwy 94 Streambed Restoration Project	Streambed restoration project for Jack Creek along HWY 94 where it has eroded away causing sewer line to be moved.	City of Hudson	$500,000	Action does not directly address flood mitigation.
FMS	City of Hudson Public Education on Streambed Erosion	Educate the public on techniques to mitigate streambed erosion on privately owned property.	City of Hudson	$5,000	Action does not directly address flood mitigation.
FMP	Shawnee Creek Bank Stabilization	Stabilize Shawnee creek bank to prevent under cutting Louisiana Street	City of Huntington	$60,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMS	City of Kennard Generator Acquisition	Install backup generators to support critical facilities in the event of outage.	City of Kennard	$20,000	Action does not directly address flood mitigation.

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMP	Winter Valley Subdivision Infrastructure Improvements	Harden bridge, dam and spillway in Winter Valley Subdivision under TCEQ permit NO. 366	Liberty County Engineering Department	$350,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMS	City of Murchison Roadway and Infrastructure Maintenance	Perform maintenance of culverts and ditches throughout the city and sewer plant location	City of Murchison	$100,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan
FMS	City of Murchison VFD Grant Application Aid	Assist local VFD with grant opportunities for needed resources	City of Murchison	$100,000	Action does not directly address flood mitigation.
FMS	OCDD Public Education on Flood Hazard	Educate the public about securing debris, propane tanks, yard items, or stored objects that may otherwise be swept away during a flood event	Orange County Drainage District	Unknown	Action does not directly address flood mitigation.
FMP	Route 66 Culvert Improvements	Enlarge culvert under Route 66 past Taylor Lake Estates.	Polk County Precinct 1	$60,000	Action does not demonstrate benefits at a scale appropriate for inclusion in the regional flood plan.
FMS	City of Poynor Roadway and Infrastructure Improvements	2 Step process of surveying and repaving city roadways through contracting company	City of Poynor	$350,000	Action does not directly address flood mitigation.

FMS/FMP	Action Name	Description	Entity	Estimated Project Cost ($)	Reason Action Infeasible
FMS	Trinity County Generator Acquisition	Installing generators at critical facilities will help ensure physical safety for facility occupants and maintain electronic systems functionality during power outages.	Trinity County	$100,000	Action does not directly address flood mitigation.

4.B.2. Evaluation of Potentially Feasible FMEs, FMSs, and FMPs

Each of the identified FMEs, FMSs, and FMPs, were evaluated against a variety of different criteria. This includes alignment with RFPG adopted goals, demonstration of no negative impact, estimate of benefited structures, population, roadways, and agricultural land, approximate costs, benefit—cost ratio, emergency need, available funding sources, and residual risk. The following sections provide a summary of the various evaluations completed for each of the identified FMEs, FMSs, and FMPs

4.B.2.a. Flood Mitigation and Floodplain Management Goals

The potential FMPs, FMSs, and FMEs were reviewed to determine connections to the short-term and long-term flood mitigation or floodplain management goals detailed in **Chapter 3** and adopted by the RFPG. All short-term goals adopted by the RFPG are connected to potential FMEs, FMSs, or FMPs that will in part help to achieve the goal. **Table 4-14** summarizes the short and long-term goals and the number of potential FMP, FMS, and FME connected to each individual goal.

TABLE 4-14: FLOOD MITIGATION AND FLOOD MANAGEMENT GOALS ADDRESSED BY POTENTIAL FMPS, FMSS, AND FMES

Goal ID	Goal	Short/Long Term?	FME	FMS	FMP
05000001	An average of 10% of the new region infrastructure projects between 2023 – 2033 will utilize larger storm events (>100-year) as the basis of their design.	Short Term (10-year)	103	38	26
05000002	An average of 25% of the new region infrastructure projects between 2033 – 2053 will utilize larger storm events (>100-year) as the basis of their design.	Long Term (30-year)	103	38	26
05000003	RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 10% of their new flood risk reduction projects between 2023 - 2033.	Short Term (10-year)	93	22	1
05000004	RFPG must consider in all projects and should incorporate nature-based practices and floodplain preservation in an average of 25% of their new flood risk reduction projects between 2033 - 2053.	Long Term (30-year)	93	22	1
05000005	Reduce the number of critical facilities in the 100-year flood risk inundation extents by 15%.	Short Term (10-year)	82	15	5
05000006	Reduce the number of critical facilities in the 100-year flood risk inundation extents by 25%.	Long Term (30-year)	82	15	5

Goal ID	Goal	Short/Long Term?	FME	FMS	FMP
05000007	Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 10% of structures.	Short Term (10-year)	121	81	0
05000008	Reduce exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating, or otherwise providing flood protection to 30% of structures.	Long Term (30-year)	121	81	0
05000009	Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 25%.	Short Term (10-year)	16	7	0
05000010	Increase the amount of State/Federal funding for flood mitigation projects and strategies awarded within the Neches Region by 75%.	Long Term (30-year)	16	7	0
05000011	Increase percentage of areas with dedicated funding sources for operations and maintenance for storm drainage system to 50% of communities.	Short Term (10-year)	0	9	0
05000012	Increase percentage of areas with dedicated funding sources for operations and maintenance for storm drainage system to 75% of communities.	Long Term (30-year)	0	9	0
05000013	50% of the region’s population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.	Short Term (10-year)	0	8	0
05000014	75% of the region’s population is part of an entity that has a dedicated drainage charge, fee, or other continuous funding mechanism for the maintenance and/or restoration of flood infrastructure.	Long Term (30-year)	0	8	0
05000015	Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 75% of areas identified as having current gaps in flood mapping.	Short Term (10-year)	59	2	0

Goal ID	Goal	Short/Long Term?	FME	FMS	FMP
05000016	Increase the coverage of flood hazard data across the region by completing detailed studies that utilize consistent methodology in 100% of areas identified as having current gaps in flood mapping.	Long Term (30-year)	59	2	0
05000017	Increase the number of gages across the Neches basin to cover 50% of the region's HUC10s.	Short Term (10-year)	0	4	0
05000018	Increase the number of gages across the Neches basin to cover 100% of the region's HUC10s.	Long Term (30-year)	0	4	0
05000019	Develop and maintain critical infrastructure database	Short Term (10-year)	0	0	0
05000020	Give notice to 100% of affected units of local government and improve 50% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.	Short Term (10-year)	0	0	0
05000021	Give notice to 100% of affected units of local government and improve 100% of Low Water Crossings, identified in the latest Regional Flood Plan, by installing warning devices.	Long Term (30-year)	0	0	0
05000022	Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 25% of Low Water Crossings identified in the latest Regional Flood Plan.	Short Term (10-year)	0	1	0
05000023	Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 80% of Low Water Crossings identified in the latest Regional Flood Plan.	Long Term (30-year)	0	1	0
05000024	100% of counties to perform public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.	Short Term (10-year)	0	40	0
05000025	Maintain 100% participation of counties performing public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.	Long Term (30-year)	0	40	0

4.B.2.b. No Negative Impact

All FMSs and FMPs are required to demonstrate that implementation will not negatively affect a neighboring area based on best available data. Demonstrations of no negative impact must reference water surface elevations (WSELs) associated with the 1% ACE event and peak discharges in both pre-project and post-project conditions. The criteria listed below does not possess any regulatory implications at the local, state, or federal levels due to the approximate nature of flood planning. For this flood planning effort, a determination of no negative impact is established if a project does not increase flood risk of existing infrastructure including but not limited to residential and commercial structures.

All the following requirements, per TWDB Technical Guidelines, have been met to establish no negative impact as applicable:

1. Stormwater does not increase inundation in areas beyond the public right-of-way, project property, or easement
2. Stormwater does not increase inundation of storm drainage networks, channels, and roadways beyond design capacity.
3. Maximum increase of 1D Water Surface Elevation must round to 0.0 feet (< 0.05ft) measured along the hydraulic cross-section.
4. Maximum increase of 2D Water Surface Elevations must round to 0.3 feet (< 0.35ft) measured at each computational cell.
5. Maximum increase in hydrologic peak discharge must be < 0.5 percent measured at computational nodes (sub-basins, junctions, reaches, reservoirs, etc.). This discharge restriction does not apply to a 2D overland analysis.

In contrast to the above statements, non-structural FMPs can be determined to have no negative impact on neighborhood impact by default. These projects do not propose physical changes to the floodplain and resulting flood hazard areas, which eliminates the potential for the action to result in increases to the 1% ACE WSEL and peak discharge. Non-structural projects reduce flood exposure often by virtue of removing individuals, property, or both from flood hazard areas.

Several of the FMSs are non-structural in nature and can be determined to have no negative impact on neighboring areas withouth a detailed analysis. These types of FMSs are listed below:

- Education and Outreach
- Flood Measurement and Warning
- Property Acquisition Flood Proofing, and Elevation in Place
- Regulatory and Guidance
- Other; includes maintenance, restoration, land use policies, sign installation, etc.

For the purposes of demonstrating no negative impact at a planning level, restoration, preservation, and maintenance activities encompassed by the “Other” strategy type will be assumed to retain the present function of natural or built flood infrastructure. Therefore, these strategies demonstrate no adverse impact as they do not significantly alter the physical environment.

For structural FMPs and FMSs, signed and sealed reports were checked for certified statements that the associated project or strategy would not cause negative impacts upstream, downstream, or within the project area in events up to and including the 1% ACE flood event. For FMPs and FMSs that certified statements could not be located for, existing H&H models were reviewed to confirm the absence of negative impacts as defined above. Specific information on model availability for the identified FMPs included in this Regional Flood Plan is included in **Chapter 5.**

4.B.2.c. Estimated Benefits of FMEs, FMSs, and FMPs

Identified FMPs in the region were examined using a benefit analysis that focused on existing flood risk in the project service area and reduction in flood risk due to the project. A comparison of existing and proposed conditions was used to determine the overall flood risk reduction benefits associated with each FMP. Other benefits that were analyzed for the FMPs include the overall change in service capacity from existing to proposed and estimated reduction in fatalities or injuries if the project or strategy was implemented. However, these metrics were difficult to determine with the modeling results. Unless stated directly in the source documentation, these items were left unidentified for many of the FMPs. To ensure consistency throughout the analysis process, each component of the assessment was approached the same way for each of the identified FMPs. This consistency allows for the estimated benefits associated with the individual FMEs, FMSs, and FMPs to be comparable. Some of the FMSs or FMEs may be refined further in future cycles to become future FMPs. **Table 4-15** lists the benefits examined from the each of the identified FMPs in the region.

Flood management strategies such as regulation updates and public education efforts do not have flood risk reduction benefits as the strategies do not directly affect flood hazard areas. Due to this, most of the identified FMSs in the region lacked information on flood risk reduction; thus, evaluations of flood risk reduction benefits were limited to only the FMPs.

Despite the lack of data on quantifiable benefits for FMEs and FMSs, it is important to note that benefits for FMEs, FMSs, and FMPs can also be ascertained with how they achieve the flood mitigation and floodplain management goals delineated as part of the effort for **Chapter 3**. All FMEs, FMSs, and FMPs identified in the region had been determined to at least meet one of the goals voted on by the RFPG; it was often the case that the FMEs, FMSs, and FMPs would satisfy two goals at the bare minimum as most goal actions were divided into short-term and long-term components.

Table 4-14 lists the number of FMPs and FMSs that comply with the flood mitigation and floodplain management goals. With the FMPs, the most often goals achieved were goals relating to new infrastructure projects utilizing larger storm events as the basis of their design (Goals 05000001 and 05000002 in **Table 4-14**). With the FMSs, the most often goals achieved were goals relating to reducing and removing structures in the floodplain by either acquisition, elevation, relocation, or providing flood protection (Goals 05000007 and 05000008). While the FMSs and FMPs achieving the flood mitigation and floodplain management goals can be seen as more of a qualitative benefit than a quantitative one, it should still be recognized as a benefit as it achieves the overarching goal of protecting against the loss of life and property.

TABLE 4-15: BENEFIT ANALYSIS FOR FMES, FMSS, AND FMPS

Category	Existing Flood Risk	Reduction in Flood Risk
Structures	Estimated number of structures in 1% ACE Flood Hazard Area	Number of structures with reduced exposure to 1% ACE Flood Hazard Area
		Number of structures removed from 1% ACE Flood Hazard Area
	Residential structures in 1% ACE Flood Hazard Area	Residential structures removed from 1% ACE Flood Hazard Area

Category	Existing Flood Risk	Reduction in Flood Risk
	Critical facilities in 1% ACE Flood Hazard Area	Critical facilities removed from 1% ACE Flood Hazard Area
Population	Estimated population in 1% ACE Flood Hazard Area	Estimated population removed from 1% ACE Flood Hazard Area
Roads	Number of low water crossings at flood risk	Number of low water crossings removed from 1% ACE Flood Hazard Area
	Estimated number of road closures	Estimated reduction in road closure occurrences
	Estimated length of roads 1% ACE Flood Hazard Area (miles)	Estimated length of roads removed from 1% ACE Flood Hazard Area (miles)
Agricultural Land	Estimated farm & ranch land 1% ACE Flood Hazard Area (acres)	Estimated farm & ranch land removed 1% ACE Flood Hazard Area (acres)

4.B.2.d. Estimated Cost of FMEs, FMSs, and FMPs

The FMPs found within the region used cost estimates that were provided by the engineering reports and documentation associated with each action. Cost estimates were adjusted to account for inflation and other changes in price of labor and commodities that had taken place since the publication date of the original reports and documentation. The cost estimates listed in **Appendix 4-B** are expressed in September 2020 dollars.

FMSs and FMEs were obtained from Hazard Mitigation Plans, FIF applications, and regional stakeholder input. Some FMSs and FMEs did not have cost estimates provided in the original documents they were acquired from; cost estimates were made for these FMEs and FMSs using assumptions based on engineering experience and comparisons with similar projects.

A number of counties within the Neches Flood Planning Region also have area within the neighboring Sabine, Trinity, and San Jacinto regions. Flood mapping updates and master drainage plans recommended for these counties are applicable to the entire county extent. It should be noted that the costs for FMEs that have been identified in multiple regions are only inclusive of area that falls within the Neches Flood Planning Region.

For the FMEs, costs were estimated for actions related to hydrologic and hydraulic modeling, flood hazard mapping, identification of potential flood risk reduction solutions for future implementation, project design, and construction engineering. For the FMSs, costs were estimated for actions related to public education programs, improvements to flood warning and measurement, updates to existing regulation, property acquisition, and infrastructure planning. Total FMS costs are meant to include costs associated with land acquisition, direct construction costs, buyouts, or contingencies. **Table 4-16** summarizes the ranges of costs utilized for FMEs in the Neches region and **Table 4-17** summarizes the ranges of costs used for the FMSs.

TABLE 4-16: FME ESTIMATED COST RANGES

FME Type	FME Description	Cost Estimate Range
Flood Mapping Updates	Updates to existing floodplain mapping to include hydrologic and hydraulic modeling for determining additional flood hazard areas and utilizing Atlas 14 rainfall data.	$760,000 - $5,000,000
Master Drainage Plans	Drainage master plans include hydrologic and hydraulic modeling to determine potential flood mitigation alternatives for a county or a city.	$150,000 - $2,200,000
Feasibility Assessments	Feasibility assessments can include impact analyses to determine potential benefit and/or adverse impact of flood mitigation projects.	$100,000 - $325,000
Project Design Development	Project design development can include analyzing best possible project alternatives and can also include analyzing benefit and scope of improvements.	$16,972 - $2,200,000

TABLE 4-17: FMS ESTIMATED COST RANGES

FMS Type	FMS Description	Cost Estimate Range
Education and Outreach	Implementation of program to educate the public on the hazards and risks of flooding.	$3,000 - $50,000
Flood Measurement and Warning	Installation and operation of stream gauges, monitoring stations, and alert systems to provide flood hazard information.	$5,000 - $3,319,000
Property Acquisition	Administration of program to acquire and demolish structures and convert the land to open space to mitigate flooding.	$100,000 - $7,500,000
Regulatory and Guidance	Development of ordinances, development criteria, building codes, design standard to prevent new flood risk.	$5,000 - $900,000
Infrastructure	Establish program, plan, or standards to facilitate future infrastructure improvements.	$400,000 - $10,000,000
Other	Maintenance and inspection of flood infrastructure to ensure its design level of service is maintained.	$50,000 - $107,000

4.B.2.e. Benefit-Cost Ratio for FMPs

The Benefit-Cost Ratio (BCR) is a concise way to compare and prioritize proposed projects and strategies by measuring the benefits a project or strategy achieves against the implementation cost required. BCRs greater than 1 indicate that there are more associated benefits than costs over the life of the proposed project. Despite this, many communities invest in projects that have BCRs less than 1 as the projects themselves can potentially display more qualitative than quantitative benefits. The TWDB provided a benefit-cost analysis (BCA) tool to be used for consistent and equitable comparison of projects across flood planning regions. The benefits provided to commercial and residential structures, critical facilities, streets, utilities, agriculture, water supply, and recreation are balanced by costs associated with construction, right-of-way acquisition, utility relocation, operation and maintenance, and the lifespan of the proposed project to determine if the benefits outweigh the costs. Environmental benefits provided by FMPs were also considered in their associated BCRs.

FMPs found within the Neches region generally had already been assigned BCRs from past project reports and from past FEMA Building Resilient Infrastructure and Communities (BRIC) applications which eliminated much of the need for a manual BCR analysis. However, one FMP found in the Neches region, Bessie Heights Drainage Improvements, lacked an existing BCR and thus required a manual benefit cost analysis.

For input into the TWDB BCA tool, structural flood risk reduction was determined using the results of hydraulic modeling associated with each FMP. The pre-project flood depth rasters provided by the modeling results were intersected with the structures dataset provided by TWDB to determine the existing level of flooding structures within the project area. This process would be repeated for post-project flood inundation extents provided by modeling results; the flood depths of structures at existing and proposed flood risk conditions were compared against one another to determine the number of structures removed and reduced.

Residential structures were grouped into small, medium, and large sized structures to match the BCA tool classifications. Each structure was categorized based on the measured square footage of each structure shape as provided in the structure database. Non-residential structures were generalized into broad categories of type of industry the building serves (commercial, industrial, public, etc.).

A similar process was performed for agricultural land; however, duration or depth of flooding was not considered. Agricultural land classification was also provided by the TWDB as a raster dataset. This dataset included two agricultural regions: farmland and ranch land. Approximate dollar per acre estimates were associated with each type of land. Farmland was considered a low-value crop based on the average crop type for the region (corn, rice, sorghum, etc.) and ranchland was considered a hay-type value crop. Values for each are based on the average crop yield values for each category taken from the Texas Almanac. Ranchland was assumed to be a hay-type value crop based on the primary assumption that, during a flooding event, livestock can be transported away from flood risk.

The calculated benefits depend on broad assumptions as stated above regarding value of structures, value of agricultural land, and other factors. BCRs developed as part of this plan are for high-level planning purposes only; further evaluation and modeling will be required to develop a more extensive and detailed BCR for the FMPs.

4.B.2.f. Emergency Need

The definition of emergency flood need in the Neches region was adopted by the RFPG. Areas with emergency flood need were defined by any areas included in at least one of the following points:

- Areas without Outdated Mapping
- Areas with History of Severe and/or Repetitive Flooding
- Areas with Critical Infrastructure within the 1% ACE Flood Hazard Area
- Areas with Structures within the 1% ACE Flood Hazard Area with SVI Greater Than 0.75
- Areas with Identified Deficient Infrastructure
- Areas with Evacuation Routes within the 1% ACE Flood Hazard Area

Table 4-18 references the number of FMEs, FMSs, and FMPs determined to be in areas of Emergency Need within the Neches region.

TABLE 4-18: FMES, FMSS, AND FMPS IN AREAS WITH EMERGENCY NEED

Type	Actions in Areas with Emergency Need	Total Actions
FME	147	157
FMS	110	147
FMP	26	26

4.B.2.g. Funding Sources

Potential funding sources were gathered for FMSs and FMPs. Funding related to each individual flood mitigation action will be assessed in **Chapter 9**. The Neches RFPG considered the funding mechanisms listed in **Table 4-19** to encompass the widest variety of needs.

TABLE 4-19: FUNDING SOURCES AVAILABLE FOR FMPS, FMSS, AND FMES

Level	Agency	Funding Source
Local	Local Sponsor (City, County, Drainage District)	Stormwater Utility, Local Taxes
State	Texas Water Development Board (TWDB)	Flood Infrastructure Fund (FIF)
		Clean Water State Revolving Fund (CWSRF)
Federal	Federal Emergency Management Agency (FEMA)	Building Resilient Infrastructure and Communities (BRIC)
		Flood Mitigation Assistance Grant Program (FMA)
	Department of Housing and Urban Development (HUD)	Community Development Block Grant – Mitigation (CDBG-MIT)

4.B.2.h. Residual Risk

Residual and future risks for the potential FMPs could be characterized as follows:

1. Flood events may exceed the level of service for which infrastructure is designed
2. Potential failure or overtopping of dams and levees
3. Maintenance of flood infrastructure being overlooked due to budget, staff, and/or time constraints
4. Policy changes that adversely impact budgets, prior plans, assets, and standards
5. Public lack of knowledge of flood warning systems

The engineering studies that provide the supporting data for the potential FMPs were reviewed to identify the residual, post-project and future risks associated with each FMP. While it is expected that the implementation of recommended FMPs will reduce current and future levels of flood risk in the region, it is not possible to protect against all potential flood risks. There is potential for future increases in flood risk due to lack of maintenance or catastrophic failures. Routine maintenance of infrastructure is required to maintain its design level of service – failure to adequately maintain the infrastructure could increase the flooding risk throughout the project area.

CHAPTER 5
RECOMMENDATION OF FLOOD MANAGEMENT EVALUATIONS AND FLOOD MANAGEMENT STRATEGIES AND ASSOCIATED FLOOD MITIGATION PROJECTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

CHAPTER 5. RECOMMENDATION OF FLOOD MANAGEMENT EVALUATIONS, FLOOD MANAGEMENT STRATEGIES, AND FLOOD MITIGATION PROJECTS

The following chapter discusses the process used to recommend flood mitigation projects (FMP), flood management strategies (FMS), and flood management evaluations (FME) for inclusion in the regional flood plan. The chapter also details each of the recommended actions and their reason for recommendation.

Chapter 5.A. Evaluation and Recommendation Process

The RFPG evaluated the identified potential flood mitigation actions and recommended those that met the TWDB requirements and had no objections from stakeholders or the RFPG, with the understanding that not all recommendations may be performed in the same planning cycle as they are identified. The recommendations of flood mitigation actions were completed through a multi-step process described in **Figure 5-1** and **Figure 5-2.**

The potential list of actions was screened based on the technical data available, conformance with TWDB requirements, and alignment with the adopted flood mitigation and floodplain management goals. It should be noted that recommendation of flood mitigation actions does not serve as a specific endorsement of the actions, but rather a recommendation that the actions be eligible for future funding through TWDB. **Figure 5-1** outlines the screening process used for recommending FMEs. **Figure 5-2** outlines the screening process used for recommending FMSs and FMPs.

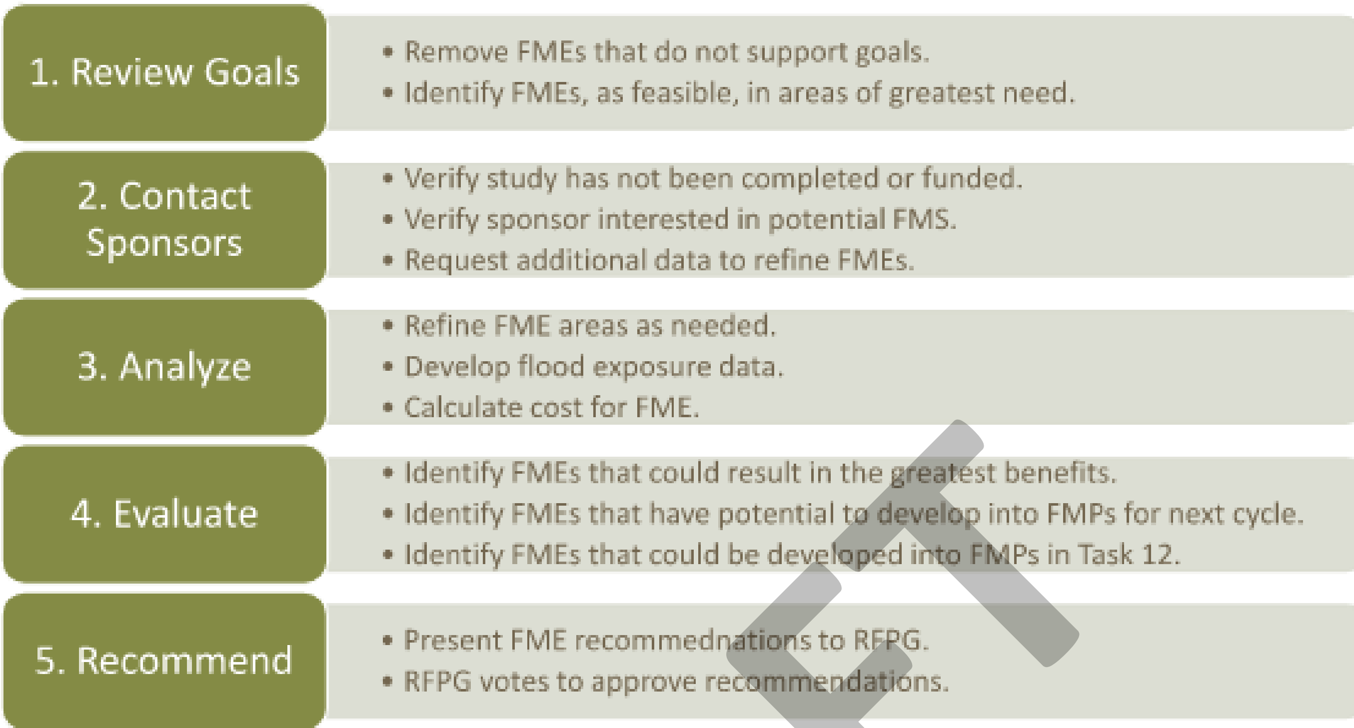


FIGURE 5-1: FME SCREENING PROCESS

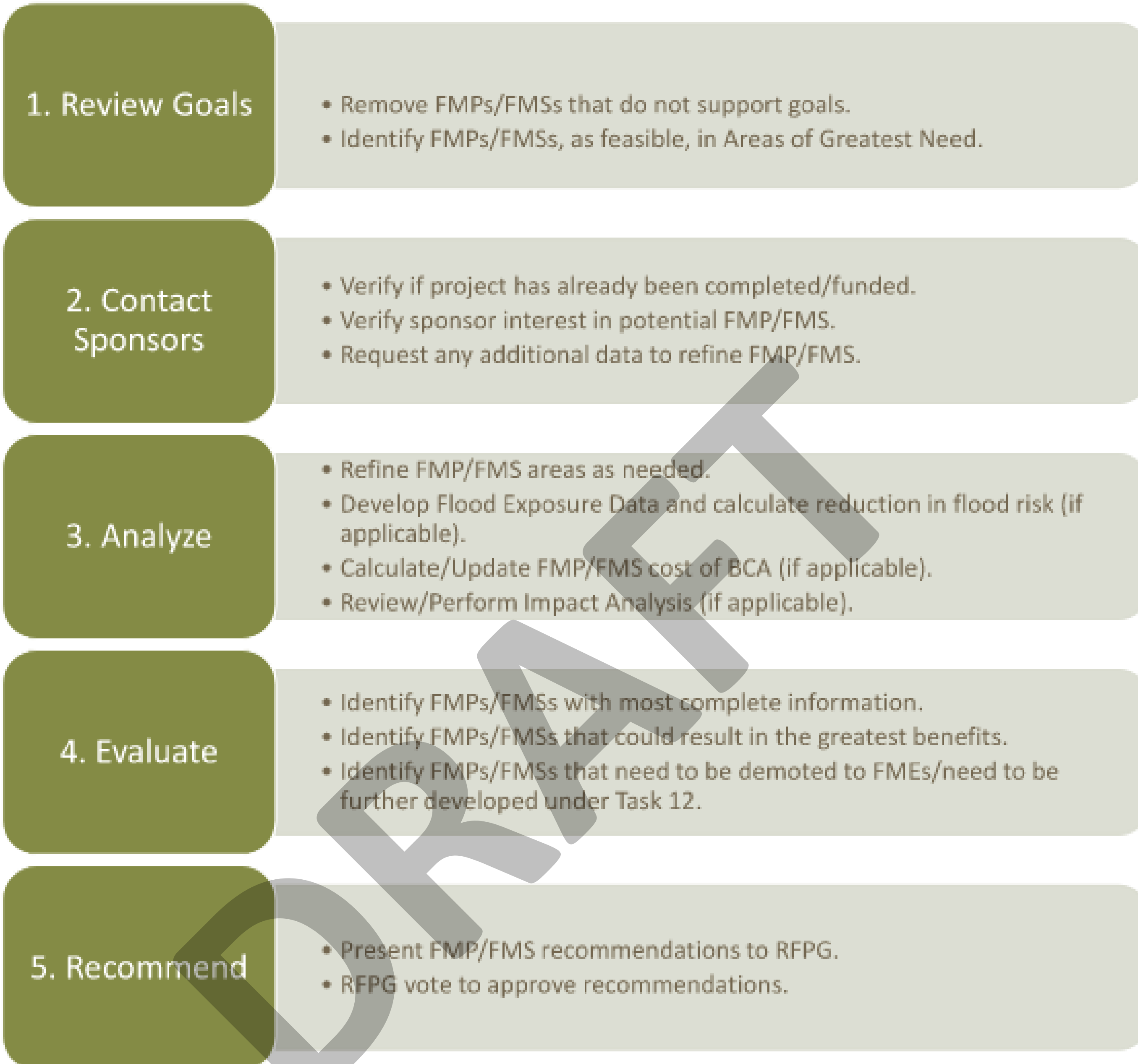


FIGURE 5-2: FMS AND FMP SCREENING PROCESS

Chapter 5.B. Flood Management Evaluations

5.B.1. Summary of Recommendation Process

The FMEs identified in **Chapter 4** were screened using the process shown in **Figure 5-1**. As highlighted in **Chapter 2**, much of the flood planning region is considered to have an inundation mapping gap. Based on these significant gaps, the RFPG recommended all FMEs that met TWDB requirements. The recommended FMEs will aid in a better understanding of flood risk within the region and help to better evaluate specific flood risk mitigation solutions within the FPR. All recommended FMEs, at a minimum, should identify and investigate one solution to mitigation for flood events associated with a 1% ACE.

The majority of the recommended FMEs were based on input from sponsors relating to the development of more accurate flood risk information, the further evaluation of conceptual flood mitigation solutions, and aid in identifying flood mitigation projects and their prioritization. Other FMEs were identified based on the findings of the flood mitigation needs analysis, which identified areas with the greatest flood risk knowledge gaps and greatest known flood risk.

Specific project recommendations identified from FMEs cannot be defined at this time. However, the recommended actions will help with the development of projects that can be incorporated in future RFPs.

5.B.2. Recommended FMEs

Following the process outlined in **Figure 5-1**, the Neches RFPG voted to recommend FMEs on June 22, 2022. All 157 FMEs identified in **Chapter 4** as potentially feasible were recommended by the RFPG and fall into four main categories: Flood Mapping Updates, Master Drainage Plans, Project Planning, and Feasibility Assessments.

Since the adoption of the Final Regional Flood Plan in January 2023, there have been six additional FMEs identified for inclusion in the Amended Regional Flood Plan. Many of these additional FMEs were sourced from the currently ongoing Regional Watershed Plan FIF study taking place in Jefferson County. The sole exception, Channel 100-A Concrete Repair, was initially identified as an FMP in the Final Regional Flood Plan before being transferred to an FME for the Amended Regional Flood Plan upon receiving feedback from stakeholders. The Neches RFPG voted to recommend these new FMEs on May 24, 2023.

Two FMEs, Upper Johns Gulley Upgrade Drainage Channel (FME ID 051000112) and Shreveport Additional Pumping Equipment (FME ID 051000141), have been removed due to information being received from the sponsor that the studies have progressed to the design phase or have otherwise been completed. Additionally, four FMEs initially identified in the Final Regional Flood Plan had been promoted to become FMPs in the Amended Regional Flood Plan and have thus been removed from the list of FMEs. These four previously identified FMEs include Tevis Diversion (FME ID 051000122), South Park Diversion (FME ID 051000126), Blanchette Diversion (FME ID 051000127), and Delaware Diversion (FME ID 051000142).

As previously stated, much of the region contains flood mapping gaps, specifically related to NFHL detailed mapping. Flood mapping updates will help better define flood risk within the region as they are implemented. It is recommended that BLE data be leveraged to help develop flood hazard mapping that can be used for regulatory floodplain purposes.

Master drainage plans were recommended because they not only help identify flood risk within communities but also assist in the development of projects to mitigate flood risk and provide a road map for future drainage-related activities. These evaluations can be used to help develop and identify projects which can be incorporated into future flood planning efforts.

A number of counties within the Neches Flood Planning Region also have area within the neighboring Sabine, Trinity, and San Jacinto regions. Flood mapping updates and master drainage plans recommended for these counties are applicable to the entire county extent. It should be noted that the cost for FMEs recommended in multiple regions are only inclusive of area that falls within the Neches Flood Planning Region. FMEs categorized as project planning are generally studies or preliminary designs to address a specific known flood need. These FMEs currently lack the details necessary to be included as an FMP. Further evaluating these projects in greater detail will result in a potentially feasible FMP for consideration during future flood planning efforts.

Feasibility studies are similar to project planning actions in the sense that they are focused on addressing a specific known flood need. However, feasibility studies focus on evaluating the practicality of a proposed project. They evaluate several factors including design alternatives, associated costs, project implementation, potential impacts, and benefits of the identified project.

The extent of the recommended FMEs is shown in **Map 19** in **Appendix 5-A**. The list of recommended FMEs is included in **Table 15** in **Appendix 5-B**. Additionally, one-page summaries for each recommended FME are included in **Appendix 5-C**.

Table 5-1 shows the distribution of recommended FMEs. The majority of recommended FMEs are project planning.

TABLE 5-1: RECOMMENDED FLOOD MANAGEMENT EVALUATION DISTRIBUTION

FME Type	Description	Count	Cost
Flood Mapping Updates	Updates to floodplain mapping to include new hydrologic and hydraulic modeling for defining flood hazard areas.	22	$34,679,046
Master Drainage Plan	An assessment of a watershed or community to estimate flood risk and recommend flood management and flood mitigation projects.	37	$29,421,728
Project Planning	Evaluate identified potential flood mitigation projects to define costs, quantify flood reduction benefits, demonstrate no adverse impacts, and evaluate design alternatives. Evaluation may require the creation or updating of hydrologic and hydraulic models.	91	$23,768,879
Feasibility	Develop flood mitigation project alternatives for a discrete high flood risk area, estimate construction costs for alternatives, and determine flood reduction benefit for	7	$1,026,171

FME Type	Description	Count	Cost
	alternatives. Evaluation may require creation of H&H modeling.		
	TOTAL	**157**	**$88,895,824**

Chapter 5.C. Flood Mitigation Strategies

5.C.1. Summary of Recommendation Process

The FMSs identified in **Chapter 4** were screened using the process shown in **Figure 5-2.** FMSs are broader in application than the level of detailed analysis necessary for an FME or FMP. However, FMSs should mitigate flood events associated with the 1% ACE where feasible and should demonstrate no negative impact to neighboring areas. For recommending FMSs, the Neches RFPG set the following criteria which is consistent with TWDB requirements:

- Support at least one regional floodplain management and flood mitigation goal
- Provide mitigation for flood events and measurable reductions in flood impacts
- No adverse impact for neighboring communities and water supply
- If contributing to water supply, may not result in an overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan
- Provide a regional benefit (1.0 square mile)

Due to the varying nature of the RFPG's potential utilization of FMSs, some of these requirements may not be applicable to certain types of FMSs, specifically non-structural FMSs.

5.C.2. Recommended FMSs

Following the process outlined in **Figure 5-2**, the Neches RFPG voted to recommend FMSs on June 22, 2022. All 147 FMSs identified in **Chapter 4** as potentially feasible were recommended by the RFPG. The extents of the recommended FMSs are shown in **Map 21** in **Appendix 5-A**. The list of recommended FMSs is included in **Table 17** in **Appendix 5-B**. Additionally, one-page summaries for each recommended FMP are included in **Appendix 5-C**.

Table 5-2 shows the distribution of recommended FMSs by type. The largest categories of recommended FMSs are "Infrastructure" and "Regulations". Recommended FMSs summarized by the "Other" type include topographical map updates and multi-county coordination actions.

TABLE 5-2: RECOMMENDED FLOOD MANAGEMENT STRATEGY DISTRIBUTION

FMS Type	Description	Count	Cost
Education and Outreach	Implementation of program to educate the public on the hazards and risks of flooding.	25	$581,100
Flood Measurement and Warning	Installation and operation of stream gauges, monitoring stations, alert systems to provide flood hazard information.	17	$8,719,000
Property Acquisition and Structural Elevation	Administration of program to acquire and demolish structures and convert the land to open space to mitigate flooding.	18	$53,955,000
Regulatory and Guidance	Development of ordinances, development criteria, building codes, design standard to prevent new flood risk.	31	$1,974,600
Infrastructure Projects	Establish program, plan, or standards to facilitate future infrastructure improvements.	54	$109,650,000
Other	Maintenance and inspection of flood infrastructure to ensure its design level of service is maintained.	2	$157,000
	TOTAL	**147**	**$175,036,700**

Chapter 5.D. Flood Mitigation Projects

5.D.1. Summary of Recommendation Process

The FMPs identified in **Chapter 4** were screened using the process shown in **Figure 5-2.** To qualify as an FMP, a project must be defined in a sufficient level of detail which meets the technical requirements of the regional flood planning project *Scope of Work* and TWDB associated *Technical Guidelines*. The Neches RFPG considered the following criteria when recommending FMPs:

- Support at least one regional floodplain management and flood mitigation goal
- Primary purpose is flood risk reduction/mitigation
- Consists of a discrete project
- Implementation will result in:
    - Quantifiable Flood Risk Reduction Benefits
    - No Adverse Impact for Neighboring Communities and Water Supply
    - No overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan
    - Regional Benefit (project area greater than or equal to 1.0 square mile)

Following the process detailed above, the Neches RFPG voted to recommend the initial 5 FMPs on June 22, 2022. Following the submission of the Final Regional Flood Plan in January 2023, 22 additional FMPs were identified during the Amendment period with one of the initial 5 FMPs (Channel 100-A Concrete Repair) being moved to become an FME upon receiving feedback from the stakeholder. The Neches RFPG voted to recommend these additional FMPs on May 24, 2023. All 26 FMPs identified in **Chapter 4** as potentially feasible were recommended by the RFPG. The extents of the recommended FMPs are shown in **Map 20** in **Appendix 5-A**. The list of recommended FMPs is included in **Table 16** in **Appendix 5-B**. Additionally, one-page summaries for each recommended FMP are included in **Appendix 5-C**.

Table 5-3 shows the distribution of recommended flood mitigation projects. By quantity, most recommended projects are comprehensive in scope. These comprehensive projects involve various improvements which include levee improvements, installation of new pump stations, joint construction of storm sewer improvements and detention pond construction, and/or the construction of new flood walls and other assorted flood infrastructure.

TABLE 5-3: RECOMMENDED FLOOD MITIGATION PROJECTS DISTRIBUTION

FMP Type	Description	Count	Cost
Channel	Channel extensions and upgrades to increase capacity of water conveyance.	6	$456,040,216
Comprehensive	Improve existing levees, build new pump stations, construct/reconstruct floodwalls to higher elevations, detention construction.	16	$3,359,098,233
Detention	New detention pond construction	4	$511,701,636
	TOTAL	**26**	**$4,326,840,085**

5.D.2. FMP Evaluation

5.D.2.a. Initial Evaluation

Each of the FMPs identified in **Chapter 4** were evaluated to ensure conformance with TWDB requirements. Based on review of the supporting studies and H&H models, it was determined that the primary purpose of each FMP was flood mitigation. Each FMP was identified as a discrete project, and did not have any anticipated impacts to water supply or water availability allocations.

5.D.2.b. No Negative Impacts Determination

Each recommended FMP must demonstrate that no negative impacts on a neighboring area would result from its implementation. No negative impact means that a project will not increase flood risk of surrounding properties for the 1% ACE water surface elevation and peak discharge. The following requirements, per the *Technical Guidelines*, should be met to establish no negative impact, as applicable:

1. Stormwater does not increase inundation in areas beyond the public right-of-way, project property, or easement.

2. Stormwater does not increase inundation of storm drainage networks, channels, and roadways beyond design capacity.
3. Maximum increase of 1D water surface elevations must round to 0.0 feet (<0.05 ft) measured along the hydraulic cross-section.
4. Maximum increase of 2D Water Surface Elevations must round to 0.3 feet (<0.35 ft) measured at each computation cell.
5. Maximum increase in hydrologic peak discharge must be <0.5 percent measured at computation nodes (sub-basins, junctions, reaches, reservoirs, etc.). This discharge restriction does not apply to a 2D overland analysis.

If negative impacts are determined to be present, mitigation measures may be utilized to alleviate such impacts. Projects with design level mitigation measures already identified may be included in the RFP and can be finalized at a later stage to conform to the "No Negative Impact" requirements prior to funding or execution of a project. This specifically applies to projects that have sought grant assistance from other programs such as FEMA BRIC. It should be noted that these grant assistance programs require projects not violate state water code or result in negative impacts to others. Two identified FMPs in the region that utilized FEMA BRIC applications include the Bayou Din Detention Basin project and the Channel 100-A Concrete Repair project.

A general description of the scope of work and summary of the expected impacts of the proposed improvements for each potentially feasible FMP is provided below. Based on the review of the evaluations performed by engineers who evaluated the proposed projects, it was determined that all potentially feasible FMPs conform to the no negative impact requirements. However, determination of no negative impact should be verified to ensure the projects function as evaluated, especially due to the recent release of Atlas-14 rainfall.

5.D.3. Recommended FMPs

The following sections are intended to provide brief summaries of each of the 26 flood mitigation projects recommended during the current planning cycle of the Neches RFP. Supporting documentation for each of these projects is included in **Appendix 5-E**. A table detailing the models and documentation used to verify no negative impact for each project is included in **Table 5-4.**

TABLE 5-4: FMP NO NEGATIVE IMPACT VERIFICATION

Project Name	No Negative Impact Model/Documentation
Bayou Din Detention Basin	HEC-RAS 6.1 Model (**Model ID 050000000002**), Bayou Din Drainage Improvements Technical Memorandum (**Appendix 5-E**)
Bessie Heights Drainage Ditch Extension Project	HEC-RAS 6.0 Model (**Model ID 050000000001**), No Negative Impact Verification Memorandum (**Appendix 5-E**)

Port Arthur and Vicinity Coastal Storm Risk Management Project	Sabine Pass to Galveston Bay, Texas Coastal Storm Risk Management and Ecosystem Restoration Final Integrated Feasibility Report and Environmental Impact Study (**Appendix 5-E**)
Orange County Coastal Storm Risk Management Project	Sabine Pass to Galveston Bay, Texas Coastal Storm Risk Management and Ecosystem Restoration Final Integrated Feasibility Report and Environmental Impact Study, Sabine Pass to Galveston Bay Orange CSRM Levee Memorandum (**Appendix 5-E**)
Black Fork Creek Improvement Project	HEC-RAS 6.3.1 Model (**Model ID 050000000003**)
Sandy Creek Improvement Project	HEC-RAS 6.3.1 Model (**Model ID 050000000004**)
Sour Lake Channel Improvements	HEC-RAS 6.3.1 Model (**Model ID 050000000005**)
Rosedale Improvement System	HEC-RAS 6.3.1 Model (**Model ID 050000000006**)
Nome Conveyance Improvements	HEC-RAS 6.3.1 Model (**Model ID 050000000007**)
Pevitot Gully Improvement System	HEC-RAS 6.3.1 Model (**Model ID 050000000008**)
Willow Marsh Bayou Phelan Blvd Detention	HEC-RAS 6.3.1 Model (**Model ID 050000000009**)
Willow Marsh Main Improvement System	HEC-RAS 6.3.1 Model (**Model ID 050000000010**)
Willow Marsh Downstream	HEC-RAS 6.3.1 Model (**Model ID 050000000011**)
Tyrrell Park Improvements	HEC-RAS 6.3.1 Model (**Model ID 050000000012**)
Green Pond Flow Diversion	HEC-RAS 6.3.1 Model (**Model ID 050000000013**)
Lucas/Delaware Diversion	InfoWorks ICM 2021.6 Model (**Model ID 050000000014)**, Drainage Study for Regional Improvements Near South and Central Beaumont (**Appendix 5-E**)
South Park Diversion	InfoWorks ICM 2021.6 Model (**Model ID 050000000015)**, Drainage Study for Regional Improvements Near South and Central Beaumont (**Appendix 5-E**)

Tevis Diversion	InfoWorks ICM 2021.6 Model (**Model ID 050000000016)**, Drainage Study for Regional Improvements Near South and Central Beaumont (**Appendix 5-E**)
Blanchette Diversion	InfoWorks ICM 2021.6 Model (**Model ID 050000000017)**, Drainage Study for Regional Improvements Near South and Central Beaumont (**Appendix 5-E**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
Tyrrell Park Detention	InfoWorks ICM 2021.6 Model (**Model ID 050000000018)**, Drainage Study for Regional Improvements Near South and Central Beaumont (**Appendix 5-E**)
Virginia Street Detention	InfoWorks ICM 2021.6 Model (**Model ID 050000000019)**, City of Beaumont Master Drainage Plan (**Appendix 5-E**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
Delaware Hilcorp Detention Diversion	InfoWorks ICM 2021.6 Model (**Model ID 050000000020)**, City of Beaumont Master Drainage Plan (**Appendix 5-E**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
Borley Heights Relief Project	HEC-RAS 4.1 Model (**Model ID 050000000021**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
East China Relief Project	HEC-RAS 4.1 Model (**Model ID 050000000022**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
South Nome Relief Ditch	HEC-RAS 4.1 Model (**Model ID 050000000023**), No Negative Impact Verification Memorandum (**Appendix 5-E**)
Ditch 505 Detention	HEC-RAS 4.1 Model (**Model ID 050000000024**), No Negative Impact Verification Memorandum (**Appendix 5-E**)

5.D.3.a. Bayou Din Detention Basin

The Bayou Din Detention Basin is an FMP that is sponsored by Jefferson County Drainage District 6 (JCDD6). This project was developed in support of a FEMA BRIC application. Areas within the Bayou Din watershed have experienced extensive, widespread flooding numerous times within recent years. The flooding is attributed to several storms, notably Hurricane Harvey in 2017 and Hurricane Imelda in 2019. These flooding events resulted in damages to real and personal property. Submerged roads prevented motorists and emergency responders from moving freely, presenting an immediate threat to public health and safety. Residential, commercial, and industrial areas throughout the region were inaccessible for prolonged periods as floodwaters receded.

The primary focus of this project is the installation of a new 640-acre detention basin on Bayou Din which will mitigate the risk of flooding in the area of Fannett, Texas to include Green Acres, Cheek, the Winzer Road area, the Bayou Din Drive area, Grand Oak Estates, and adjacent communities. The project will also mitigate flood risk to vital industrial facilities within the watershed, such as the Goodyear Tire and Rubber plant. The project's scope also includes a series of channel improvements to include improvements to Ditch 407 (the primary outfall for Green Acres) and Kidd Gully (which serves as the primary outfall for Kidd Road) along with various crossing improvements. The project's total cost is estimated at $85,000,000 and a benefit cost analysis conducted for the project yielded a benefit-cost ratio of 4.9.

Hydrologic and hydraulic (H&H) models sufficient enough to determine pre-mitigation conditions for the 10-, 25-, 50-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10-, 25-, 50-, 100-, and 500-year storm events. The Hydrologic Engineering Center River Analysis System (HEC-RAS) was used for the hydrologic and hydraulic analysis of the project area. The extents of the project are listed in **Figure 5-3** in addition to **Map 22** in **Appendix 5-A**.

The Bayou Din Drainage Improvements Technical Memorandum found in **Appendix 5-E** was used to verify that the project results in no negative impact to the existing conditions within the project service area. The model itself was submitted to the Texas Disaster Information System (TDIS) in September 2022. The estimated flood risk reduction benefits following the implementation of the Bayou Din Detention Basin project includes removal of an estimated 101 structures from the 1% ACE floodplain, 41 of which are residential structures. This correlates to an estimated 286 individuals removed from the 1% ACE flood risk. Additionally, 97 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

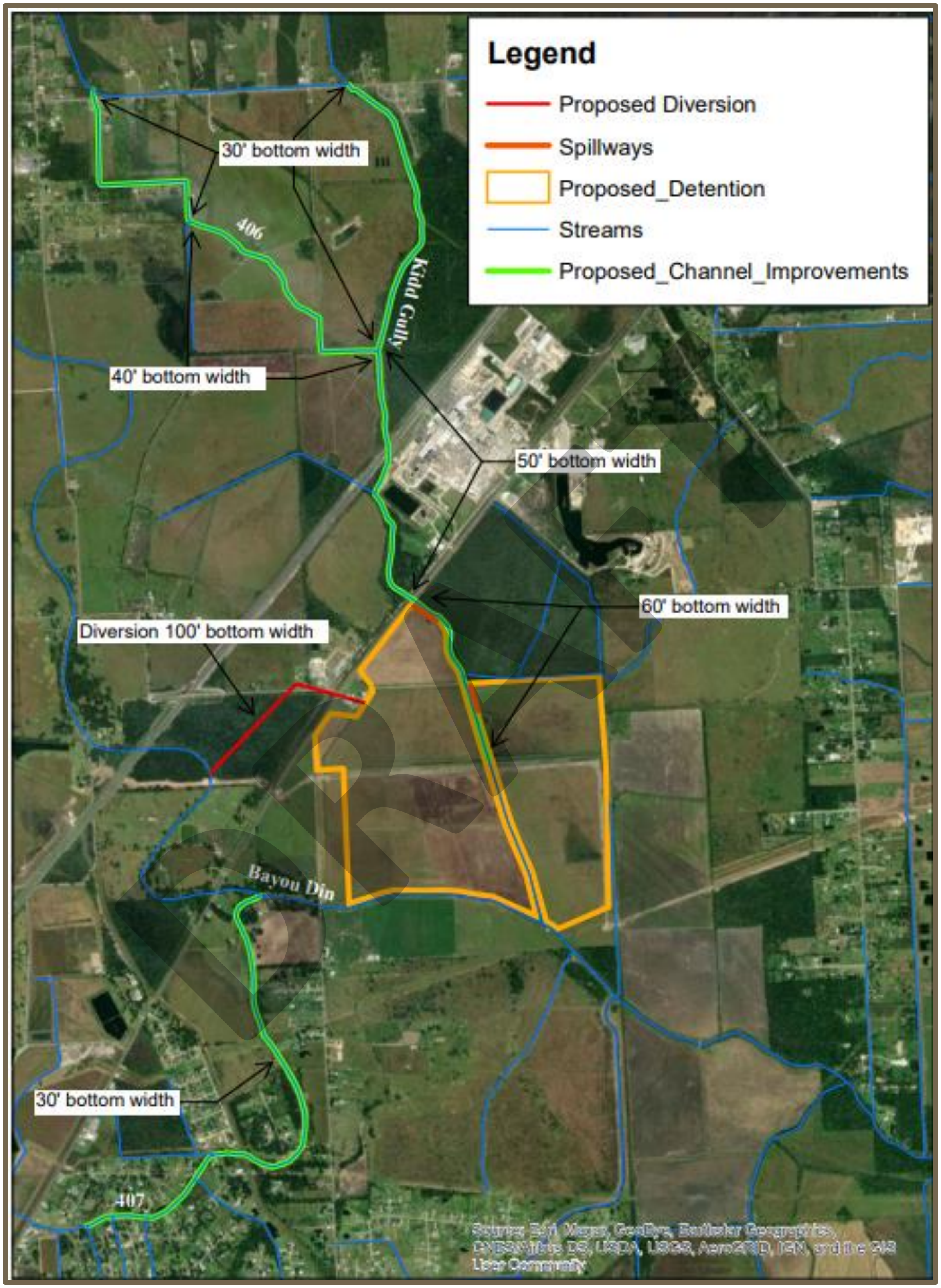


FIGURE 5-3: BAYOU DIN DETENTION BASIN PROJECT EXTENT

5.D.3.b. Bessie Heights Drainage Ditch Extension Project

The Bessie Heights Drainage Ditch Extension Project is an FMP that is sponsored by the Orange County Drainage District (OCDD). The project is located within Orange County on the northwest side of Bridge City, Texas. There is a concentration of residential development in the area and the area itself has been subject to significant flooding in the past due to its location on the Gulf Coastal plain, proximity to the Cow Bayou watershed, flat terrain, and the restricted capacity of the existing Bessie Heights Drainage Ditch.

The project is designed to help reduce structural flooding in residential developments within the project area. The project consists of the construction of an extension channel to improve discharge from the existing Bessie Heights Drainage Ditch, improvements to the existing Bessie Heights Drainage Ditch south of FM 1442, and a short extension of the BH Road Ditch to connect it to the proposed Bessie Heights Drainage Ditch extension. **Table 5-5** summarizes the improvements associated with this project. The extents of the project are shown in **Figure 5-4** in addition to **Map 22** in **Appendix 5-A**.

The models used as the basis for this analysis were developed as part of the USACE study of internal drainage for the Sabine Pass to Galveston Bay Hurricane Flood Protection Program. The hydraulic model used a Rain-on-Grid two-dimensional models developed in HEC-RAS 6.0 and the terrain is based on LiDAR data available from the Texas Natural Resource Information System (TNRIS). The HEC-RAS 6.0 model supporting the FMP was utilized and reviewed to verify that the project results in no negative impact to the existing conditions of the project service area; additionally, the model was submitted to TDIS in September 2022. NOAA Atlas-14 rainfall data was used to complete the analysis for the 10-, 25-, 50-, and 100-year storm events. No data on the project's performance against the 500-year storm was included. The analysis completed by LJA Engineering concludes that there is no adverse impact associated with this project.

TABLE 5-5: BESSIE HEIGHTS DITCH IMPROVEMENT CONFIGURATION

Ditch/Location	Bottom Width	Side Slope
BH Road Ditch	20'	3:1
Bessie Heights Ditch, FM 1442 to Relief Ditch	40'	3:1
Bessie Heights Ditch Extension, EAST of power line corridor	50'	3:1
Bessie Heights Ditch Extension, West of power line corridor	60'	4:1

The ditch improvements result in an average water surface elevation reduction of 3- to 6-inches. The estimated flood risk reduction benefits following the implementation of the project includes removal of an estimated 8 residential structures from the 1% ACE floodplain which corresponds to a population of 10 individuals removed from the 1% ACE flood risk. Additionally, 3 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

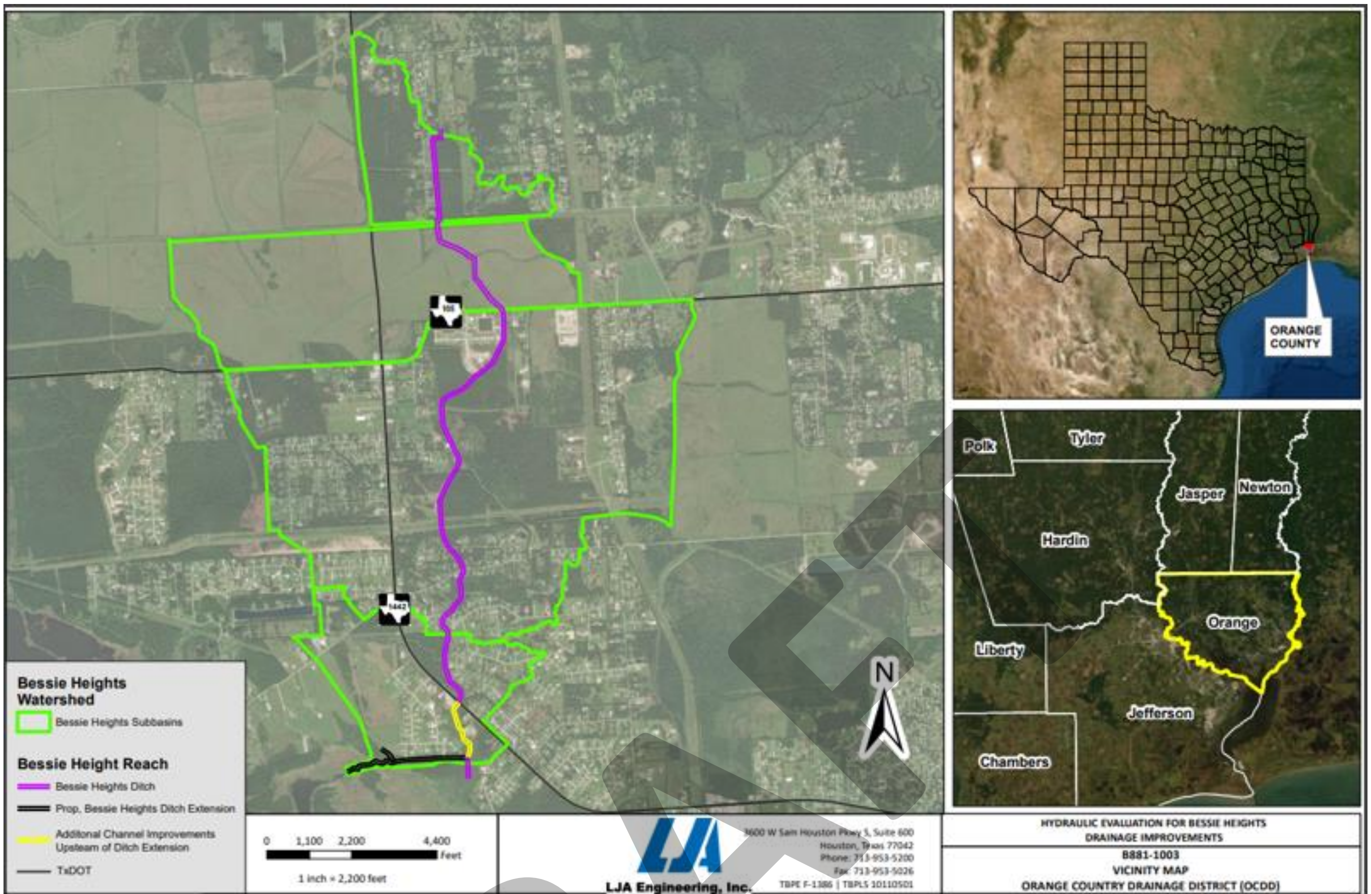


FIGURE 5-4: BESSIE HEIGHTS DRAINAGE DITCH EXTENSION PROJECT EXTENT

5.D.3.c. Port Arthur and Vicinity Coastal Storm Risk Management Project

The Port Arthur and Vicinity Coastal Storm Risk Management Project is an FMP that is both sponsored federally by the U.S. Army Corps of Engineers and locally by Jefferson County Drainage District 7 (JCDD7). The project is one of three components of the wider Sabine Pass to Galveston Bay Coastal Storm Risk Management (CSRM) Program. This project is aimed to reduce risk from coastal storm surge and flood damage for residents and businesses within coastal hazard zones in Jefferson County.

The city of Port Arthur and its vicinity contain several residential properties in addition to a critical concentration of industrial infrastructure tied to the oil and gas industry. Being near the coast, any damage incurred to a residential or industrial property in Port Arthur by severe flooding is likely to result in a loss of property, loss of life, and/or catastrophic economic loss. To reduce these adverse impacts, USACE has proposed a comprehensive list of improvements to include new earthen levees, new floodwalls, new vehicle closure structures, and additional erosion protection throughout the system. The project area is divided into 6 separate contracts; most of the project is in the Pre-construction Engineering and Design (PED) phase which is anticipated to be complete at the end of 2023. As of writing, a final alignment of the project has not been determined yet; while **Figure 5-5** shows a preliminary alignment of the project to detail where the work may be constructed, the exact location of the proposed improvements may change as more data is acquired. USACE maintains a website with updated project details, https://www.swg.usace.army.mil/S2G/PortArthur/.

The models used as support for the Port Arthur and Vicinity Coastal Storm Risk Management Project were developed by USACE and are not publicly available. A FOIA was submitted to USACE in March 2022, but no response had been received as of writing. The Feasibility Report found in **Appendix 5-E** was leveraged to verify that the project results in no negative impact to its existing service area. The estimated flood risk reduction benefits following the implementation of the project includes removal of an estimated 3,275 structures from the 1% ACE floodplain, 2,308 of which are residential structures. This correlates to an estimated 8,315 individuals removed from the 1% ACE flood risk. Additionally, 441 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

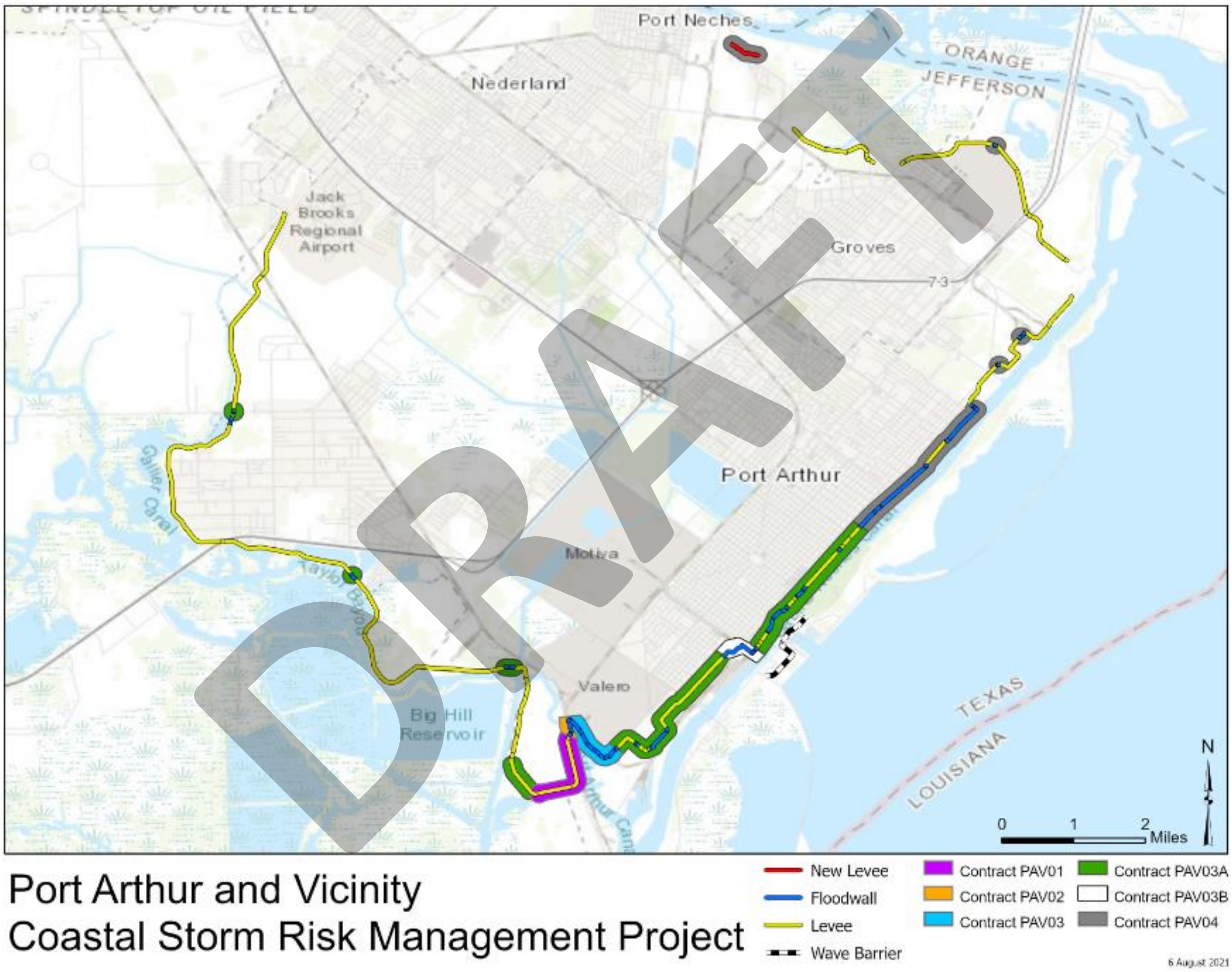


FIGURE 5-5: PORT ARTHUR AND VICINITY COASTAL STORM RISK MANAGEMENT PROJECT AREA

5.D.3.d. Orange County Coastal Storm Risk Management Project

The Orange County Coastal Storm Risk Management Project is an FMP that is both sponsored federally by the U.S. Army Corps of Engineers and locally by Orange County Drainage District and the Gulf Coast Protection District (GCPD). While the Gulf Coast Protection District will operate and maintain the system after construction, Orange County Drainage District has been engaged throughout the development of the project. This project provides coastal storm surge protection and flood damage risk reduction for the people and property within existing coastal flood hazard areas in Orange County. A special note on this project is that it is split between the Neches region and the adjacent Sabine region; the Neches region includes the project extent adjacent to the city of Bridge City. The bulk of the project extent that includes improvements near the cities of West Orange and Orange is included within the confines of the Sabine region.

Within Orange County, USACE has proposed a system of new earthen levees, concrete floodwalls, gravity drainage structures, and closure structures located at road and railroad crossings. The project alignment within the Neches region as of March 2022 includes new earthen levees, new floodwalls, and new pump stations. The project also consists of coastal marsh and forested wetlands restoration as mitigation of environmental impacts. **Figure 5-6** shows the project alignment as of March 2022 in comparison to the previous alignment from the 2017 Feasibility Report completed by the Texas General Land Office (GLO). This project is in the pre-construction engineering and design (PED) phase and the project alignment may be further refined before construction. USACE maintains a website with updated project details, https://www.swg.usace.army.mil/S2G/OrangeCounty/.

The models used as support for the Orange County Coastal Storm Risk Management Project were developed by USACE and are not publicly available. A FOIA was submitted to USACE but no response had been received as of writing. The Feasibility Report was leveraged along with a memorandum from USACE to verify that the project results in no negative impact to its existing service area. Both documents can be found in **Appendix 5-E.** The estimated flood risk reduction benefits following the implementation of the project includes removal of an estimated 201 structures from the 1% ACE floodplain, 136 of which are residential structures. This correlates to an estimated 357 individuals removed from the 1% ACE flood risk. Additionally, 175 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

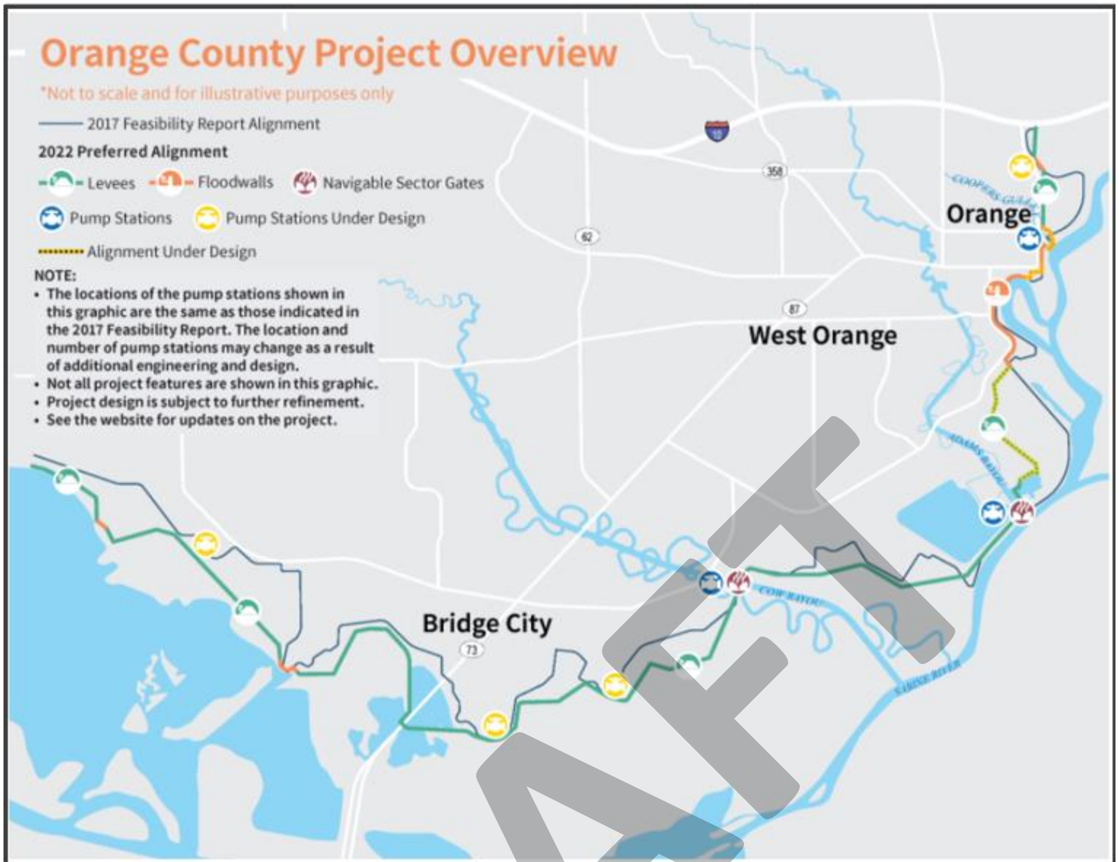


FIGURE 5-6: ORANGE COUNTY COASTAL STORM RISK MANAGEMENT PROJECT

5.D.3.e. Black Fork Creek Improvement Project

The Black Fork Creek Improvement Project is sponsored by the City of Tyler and studies the upper Black Fork Creek watershed. The study area includes Downtown Tyler, the historic Azalea District neighborhood, and the northeastern portion of the city. The urban center of the city is prone to flooding and has limited undeveloped space for stormwater control measures. Areas within the Black Fork Creek watershed have experienced extensive, widespread flooding numerous times within recent years. These flooding events resulted in damage to real and personal property.

The project proposes to develop the decommissioned Hogg Middle School track field into a 65 acre-feet dual-use stormwater detention facility. The pond is designed as an offline stormwater diversion system to mitigate the risk of flooding for historic homes in the Azalea District neighborhood and homes and businesses along this tributary of Black Fork Creek down to E. Commerce Street. Flows will be conveyed from Black Fork Tributary D-5 via a box culvert system east down Shaw Street, and the pond outfall combines with the existing system in Fannin Avenue draining north to the creek. The pond is designed as a three-sided walled structure with a sloped approach access on the north side. The project will also mitigate flood risk to vital hospital facilities within the watershed, such as the CHRISTUS Trinity Mother Frances Emergency and Trauma Services. The project's total estimated cost is $22,234,300. A BCR of the project can be found in **Appendix 5-D.**

Hydrologic and hydraulic (H&H) models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10-, 100-, and 500-year storm events. The Hydrologic Engineering Center River Analysis System (HEC-RAS) 6.3.1 was used for the hydrologic and hydraulic analysis of the project area.

The estimated flood risk reduction benefits following the implementation of the Tyler Flood Study – Azalea District project includes removal of an estimated 12 structures from the 1% ACE floodplain, 10 of which are residential structures. This correlates to an estimated 29 individuals removed from the 1% ACE flood risk. Additionally, 33 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The extents of the project are shown in **Figure 5-7,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

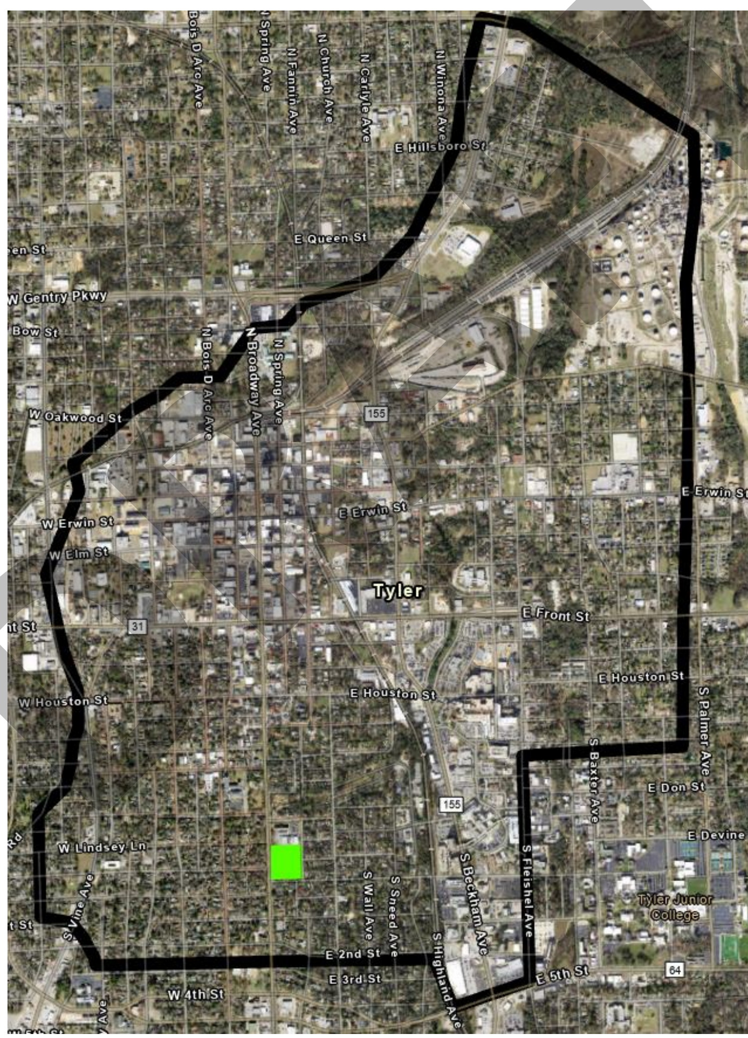


FIGURE 5-7: BLACK FORK CREEK IMPROVEMENT PROJECT EXTENT

5.D.3.g. Sandy Creek Improvement Project

The Sandy Creek Improvement Project is an FMP that is sponsored by the City of Jasper. The project area is located near the confluence of Sandy Creek and Little Sandy Creek to the east of Jasper. The existing topology and the limited capacity of Sandy Creek often leads to a significant portion of the City of Jasper being inundated by floodwaters during major storm events.

The project is designed to provide relief to the city of Jasper by storing incoming floodwater and delaying the time of peak flow in Sandy Creek. The proposed improvements consist of two detention ponds adjacent to Sandy Creek, which are accompanied by new flow regulation structures and inflow/outflow culverts for each pond. The ponds provide approximately 1,200 ac-ft of storage, and the entire project is estimated to cost a total of $224,924,330.

Hydrologic and hydraulic (H&H) models sufficient enough to determine pre-mitigation conditions for the 100-year and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 100-year and 500-year storm events. The hydrologic analysis for the project was conducted in version 4.10 of the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS 4.10) using NOAA Atlas 14 precipitation data recorded for the City of Jasper and its vicinity. Version 6.3.1 of the Hydrologic Engineering Center River Analysis System (HEC-RAS 6.3.1) was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-8** in addition to **Map 20** in **Appendix 5-A**.

The model created in HEC-RAS 6.3.1 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Sandy Creek Improvement Project includes removal of an estimated 16 structures from the 1% ACE floodplain, 13 of which are residential structures. This correlates to an estimated 160 individuals removed from the 1% ACE flood risk. Additionally, 43 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

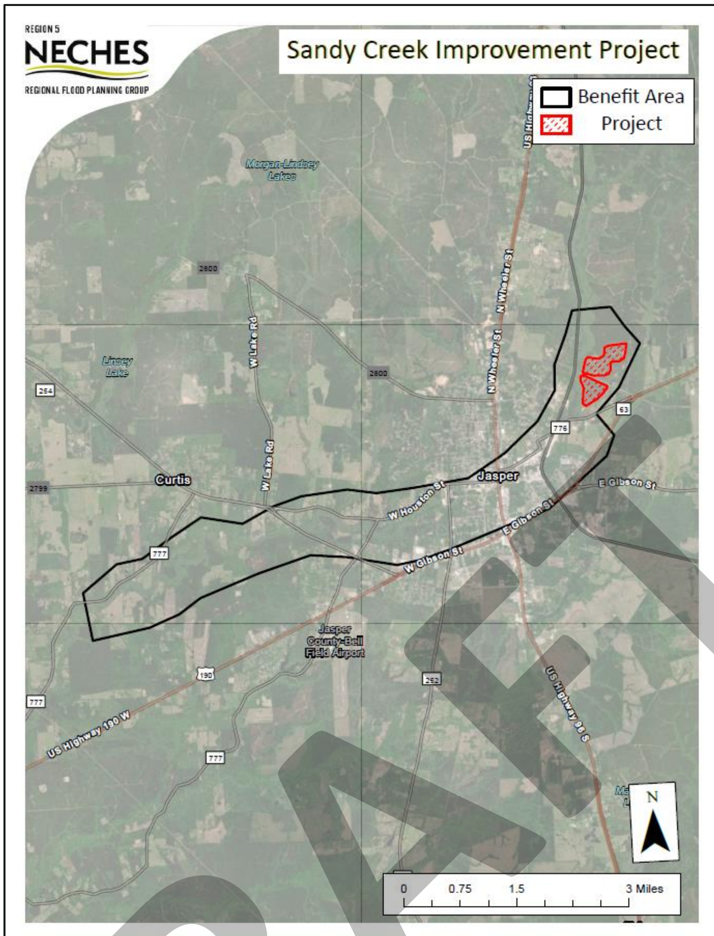


FIGURE 5-8: SANDY CREEK IMPROVEMENT PROJECT EXTENT

5.D.3.h. Sour Lake Channel Improvements

Located in Pine Island Bayou and sponsored by Jefferson County Drainage District 6, the Sour Lake Channel Improvements project proposes a new 100-ft wide channel in the City of Sour Lake to redirect flow from traveling south along a tributary of Jackson Creek, to traveling east to Clemmons Gully. This redirection of flow provides flood risk benefit by taking advantage of lower water levels in Little Pine Island Bayou, the ultimate outfall of Clemmons Gully.

The project was studied as part of the Jefferson County DD6 Regional Watershed Study. A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylor's Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

The primary channel widening for the Sour Lake project extends from 0.6 miles west of S. Fannin St. to 1.2 miles northeast of HWY 105 for a total of 4.7 miles. Two additional stretches of channel improvements are proposed to help alleviate local flood risk in the City of Sour Lake. The northern channel extends 0.75 miles south from W Crosby St. to the primary channel, and the southern channel extends from 0.1 miles north of Milholland Rd. to the primary channel. A typical section of the channel improvements is included in **Figure 5-9**.

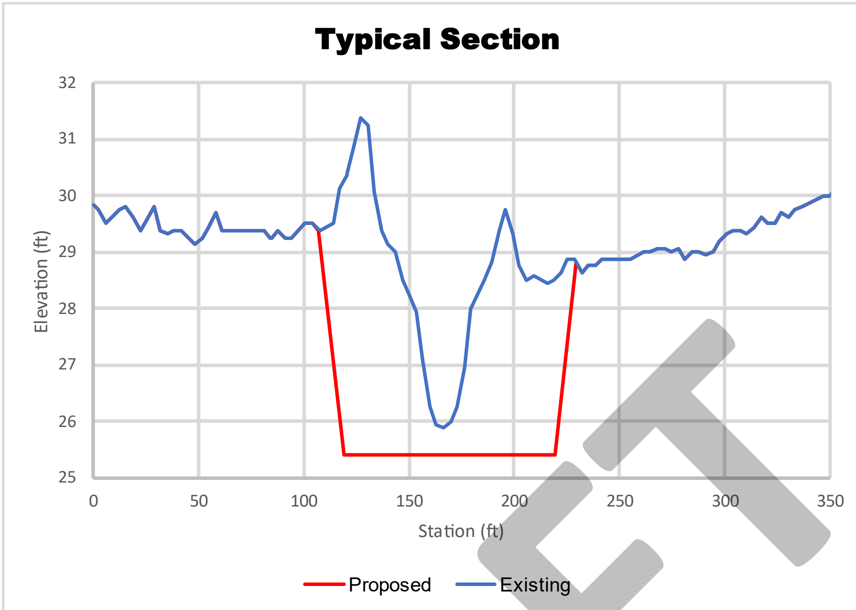


FIGURE 5-9: SOUR LAKE CHANNEL IMPROVEMENTS TYPICAL SECTION

The estimated flood risk reduction benefit following the implementation of the Sour Lake project includes removal of an estimated 59 structures from the 1% ACE floodplain, 38 of which are residential structures. This correlates to an estimated 515 individuals removed from the 1% ACE flood risk. Additionally, 170 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $63,303,926, and a benefit cost ratio can be found in **Appendix 5-D**. A figure of the project area is shown in **Figure 5-10**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

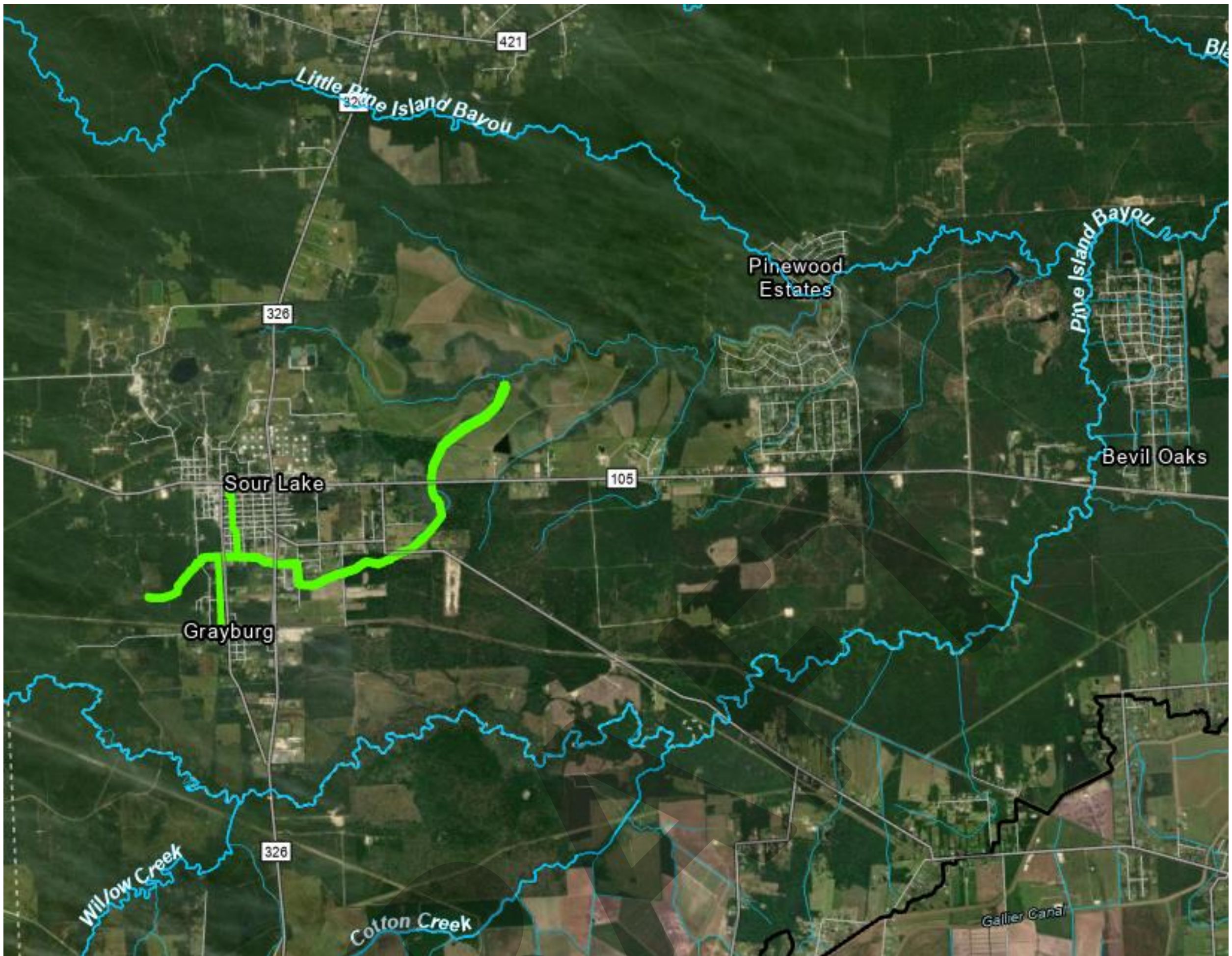


FIGURE 5-10: SOUR LAKE CHANNEL IMPROVEMENTS PROJECT EXTENT

5.D.3.i. Rosedale Improvement System

The Rosedale Improvement System is in the Pine Island Bayou watershed and is sponsored by Jefferson County Drainage District 6 as part of their Regional Watershed Study. The project proposes the widening and deepening of existing channels and detention ponds, mostly in the area northwest of the intersection of HWY 96 and HWY 105 but with some improvements south of HWY 105 and East of HWY 96.

A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylor’s Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

The main source of flood risk for the Rosedale area is overflow from Pine Island Bayou, which flows from west to east on the north side of the Rosedale Improvements project. Because of this, flap gates are recommended on the existing siphons across the LNVA canal.

The existing drainage pattern in the Rosedale project area directs most of the runoff to a point location about four miles upstream of US-287. Because the roadway crossing at US 287 is restrictive, much of the water, during large storms, accumulates behind the roadway and overflows south into the Rosedale community. The proposed solution, therefore, includes widened and deepened channels that divert some runoff to a point location downstream of US-287. This allows less water to accumulate behind US-287 and improves flood risk in the Rosedale community. An image of the typical section for Rosedale is shown in **Figure 5-11**.

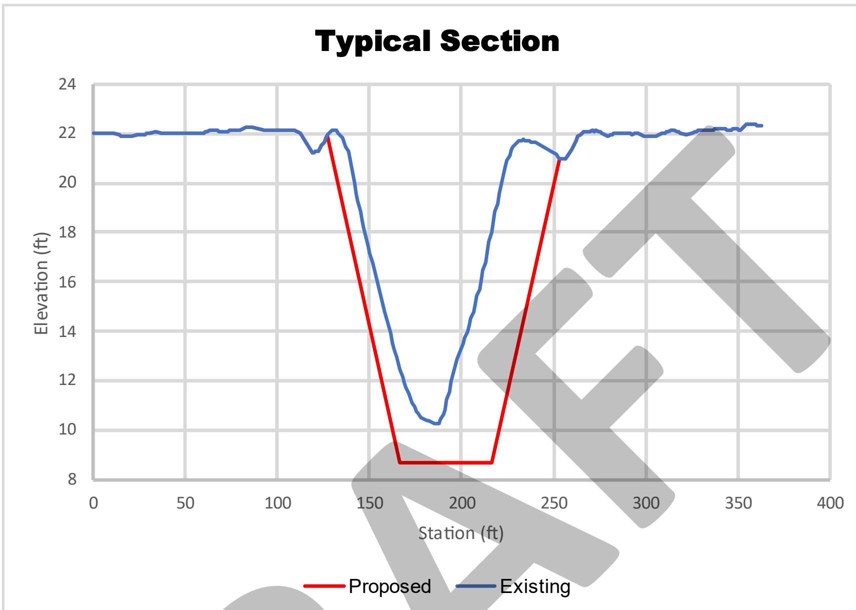


FIGURE 5-11: ROSEDALE IMPROVEMENT SYSTEM TYPICAL SECTION

Because the channels were improved, detention was proposed to mitigate increased flow rate. Three proposed detention ponds were placed adjacent to the LNVA canal; the first is on the most upstream end of the improvements, about one mile south of HWY 105. The second is south of the LNVA canal, about 1.5 miles north of HWY 105, along the canal, and the third is directly east of the second and extends east to N. Major Dr.

The estimated flood risk reduction benefit following the implementation of the Rosedale Improvements project includes removal of an estimated 194 structures from the 1% ACE floodplain, 145 of which are residential structures. This correlates to an estimated 421 individuals removed from the 1% ACE flood risk. Additionally, 372 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $308,620,428, and a benefit cost ratio can be found in **Appendix 5-D**. A figure of the project area is shown in **Figure 5-12,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

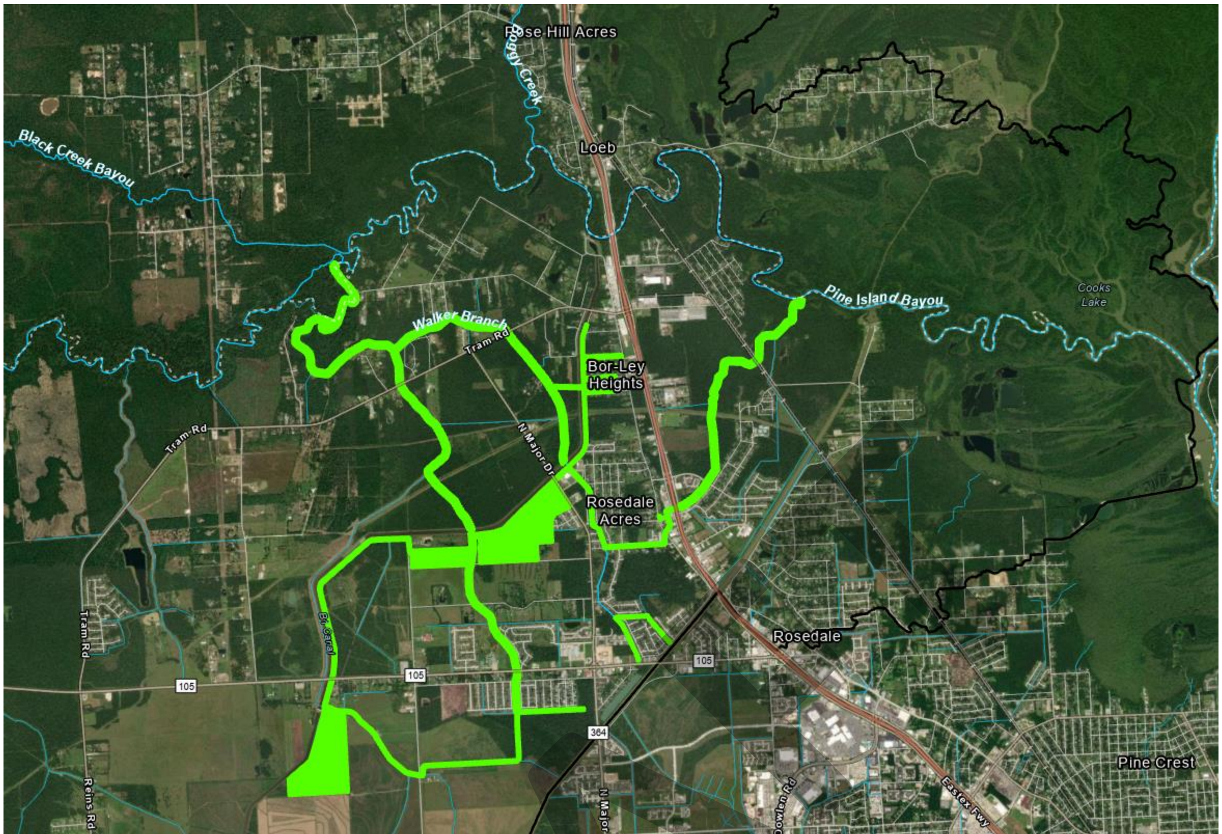


FIGURE 5-12: ROSEDALE IMPROVEMENT SYSTEM PROJECT EXTENT

5.D.3.j. Nome Conveyance Improvements

The City of Nome, located along HWY 90 in the Pine Island Bayou watershed, is another project sponsored by Jefferson County Drainage District 6. The main source of flood risk for this area was undersized drainage infrastructure, particularly under US-90 and along channels 1000 and 1105.

A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylor’s Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

The proposed Nome conveyance improvements includes channelization along Channel 1105 from south of SH90 to the confluence with Channel 1100. Similarly, channel widening was proposed along Channel 100 from SH 90 to upstream of SH 326, where a detention pond was proposed to mitigate increased flow rates from the improved channel conveyance. The ultimate outfall of the detention basin is to Channel 1207-A, a tributary to Willow Creek, near SH 326. A typical section of the channel improvements is included in **Figure 5-13**.

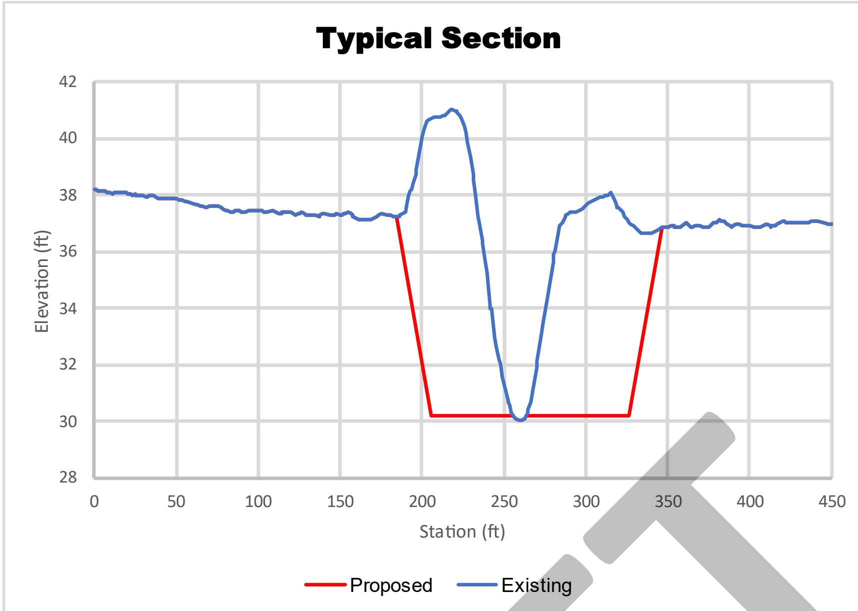


FIGURE 5-13: NOME CONVEYANCE IMPROVEMENTS TYPICAL SECTION

The estimated flood risk reduction benefit following the implementation of the Nome Conveyance Improvements project includes removal of an estimated 11 structures from the 1% ACE floodplain, 8 of which are residential structures. This correlates to an estimated 11 individuals removed from the 1% ACE flood risk. Additionally, 39 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $163,293,623, and a benefit cost ratio can be found in **Appendix 5-D**. A figure of the project benefit is shown in **Figure 5-14**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

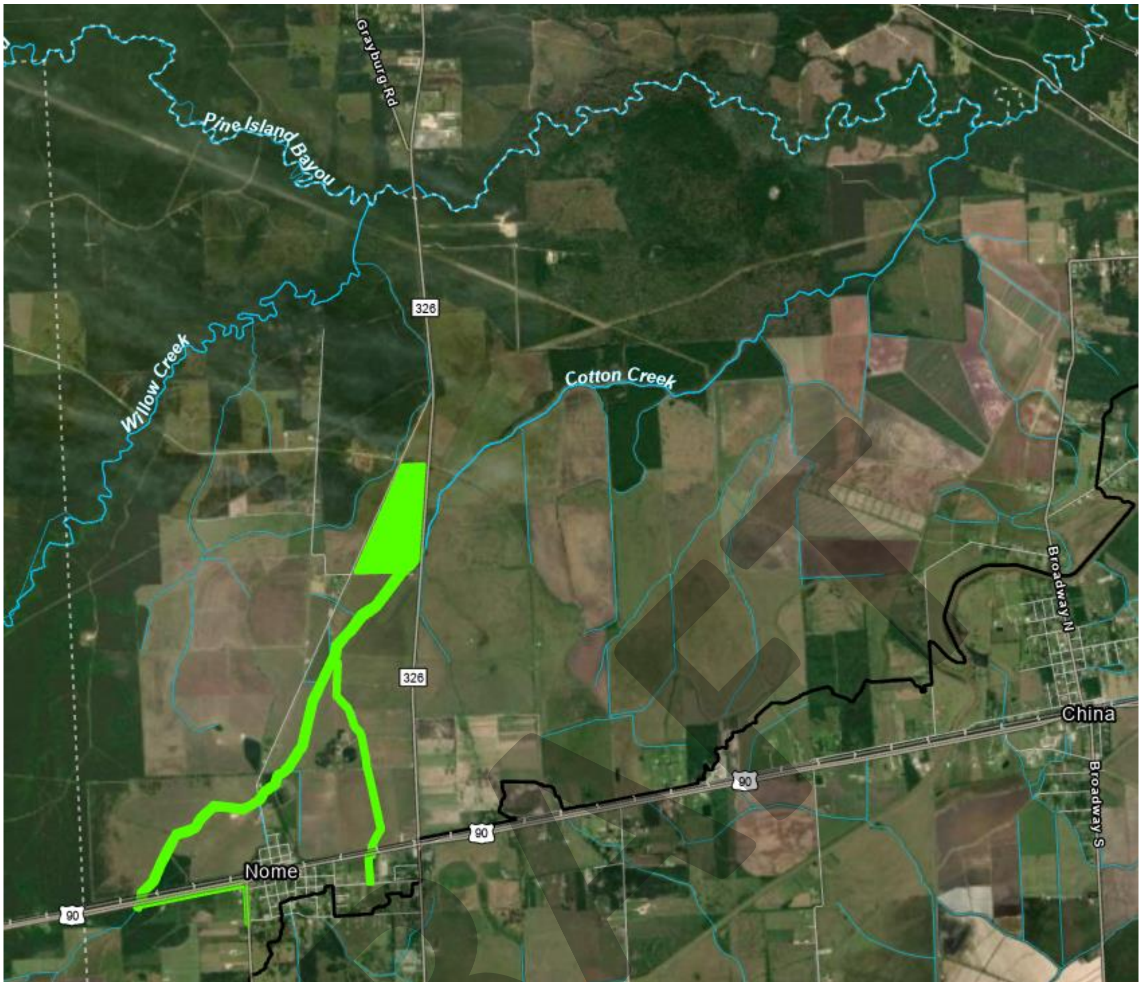


FIGURE 5-14: NOME CONVEYANCE IMPROVEMENTS PROJECT EXTENT

5.D.3.k. Pevitot Gully Improvement System

The Pevitot Gully Improvement System project is in Hillebrandt Bayou and is sponsored by Jefferson County Drainage District 6. This area was studied as part of the Jefferson County Regional Watershed Study. A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-yr rainfall data to analyze existing conditions for the Hillebrandt and Taylor's Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

For the Pevitot Gully project area, it was found that two roadways, I-10 and HWY 124, were obstructing flow along Pevitot Gully and Ditch 309, which drain south to Bayou Din. Therefore, improved channel conveyance, beginning upstream of I-10, was proposed along both Pevitot Gully and Ditch 309 to help move water through the obstructions and reduce flood risk to the overland areas. The improvements to Ditch 309 extended about 1.3 miles to the confluence with Pevitot Gully, and the improvements extended another 1.7 miles to the confluence of Ditch 304. Improved roadside ditches were also proposed along the I-10 east-bound feeder road and along Industrial Road, to help alleviate flood risk in these areas. A typical section for the Pevitot Gully improvement project is shown in **Figure 5-15.**

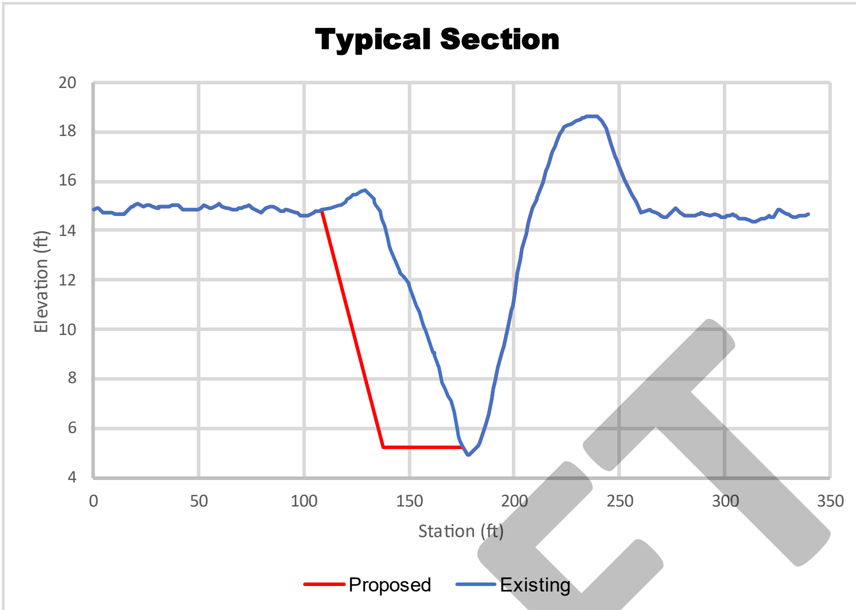


FIGURE 5-15: PEVITOT GULLY IMPROVEMENT SYSTEM TYPICAL SECTION

Detention basins were proposed as part of the Pevitot Gully project to help mitigate increased flow rates from the improved channel conveyance. The upstream detention basin was proposed northwest of I-10, and another basin was proposed along Ditch 309, south of the Gulfspan Industrial site.

The estimated flood risk reduction benefit following the implementation of the Pevitot Gully project includes removal of an estimated 27 structures from the 1% ACE floodplain, 3 of which are residential structures. This correlates to an estimated 245 individuals removed from the 1% ACE flood risk. Additionally, 80 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $319,970,815, and a benefit cost ratio can be found in **Appendix 5-D**. A figure of the project area is shown in **Figure 5-16**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

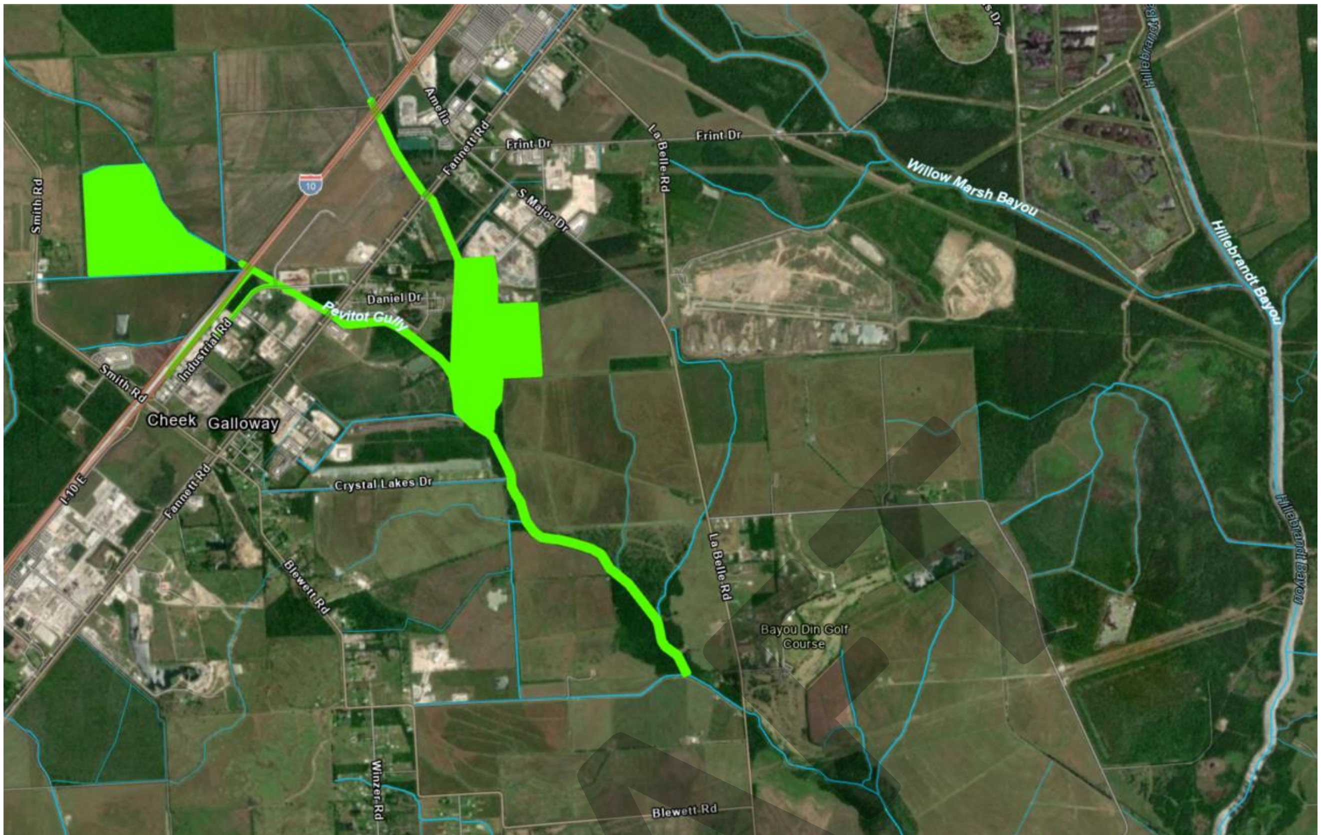


FIGURE 5-16: PEVITOT GULLY IMPROVEMENT SYSTEM PROJECT EXTENT

5.D.3.l. Willow Marsh Phelan Detention

The Willow Marsh Phelan Detention project is in Hillebrandt Bayou and is the most upstream of the three proposed projects along Willow Marsh Bayou that were developed as part of the Jefferson County Drainage District 6 Regional Watershed Study. A HEC-RAS 6.3.1 rain on grid model was created to analyze Atlas 14 100-year existing conditions for the Hillebrandt and Taylors Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

Analysis of existing conditions revealed the Union Pacific Railroad, located just south of Phelan Blvd., as an obstruction to flow along Willow Marsh Bayou. As a result, this project proposes two inline detention basins upstream of Phelan Blvd, along with improved channelization of Willow Marsh Bayou from Phelan Blvd. to Washington Blvd. A typical section of the channel improvement is shown in **Figure 5-17**. In addition to channelization, the project also includes an upsized railroad crossing and improved roadside ditches along the railroad.

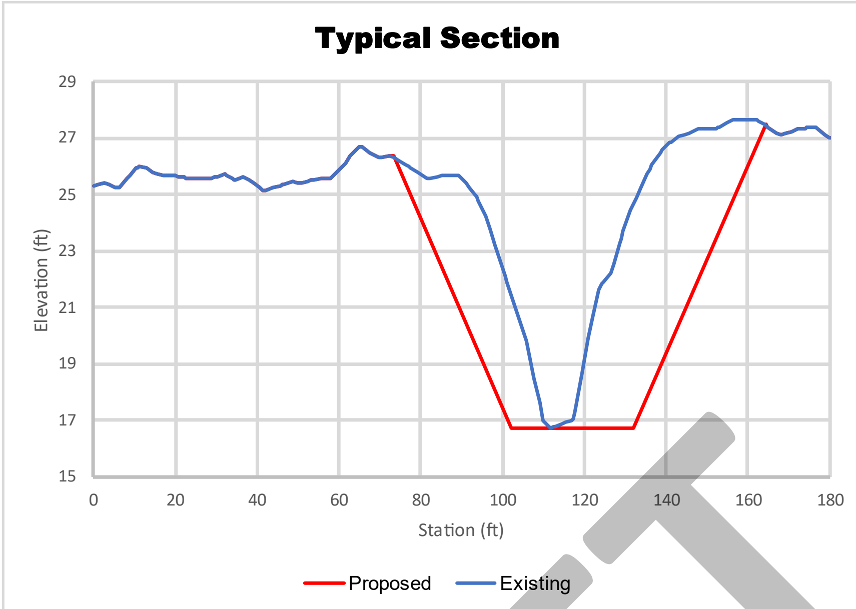


FIGURE 5-17: WILLOW MARSH PHELAN DETENTION TYPICAL SECTION

The estimated flood risk reduction benefit following the implementation of the Willow Marsh Phelan Detention project includes removal of an estimated 14 structures from the 1% ACE floodplain, 4 of which are residential structures. This correlates to an estimated 35 individuals removed from the 1% ACE flood risk. Additionally, 51 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $203,869,200, and a benefit cost ratio can be found in **Appendix 5-D**. The proposed Willow Marsh Phelan project extents are shown in **Figure 5-18**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

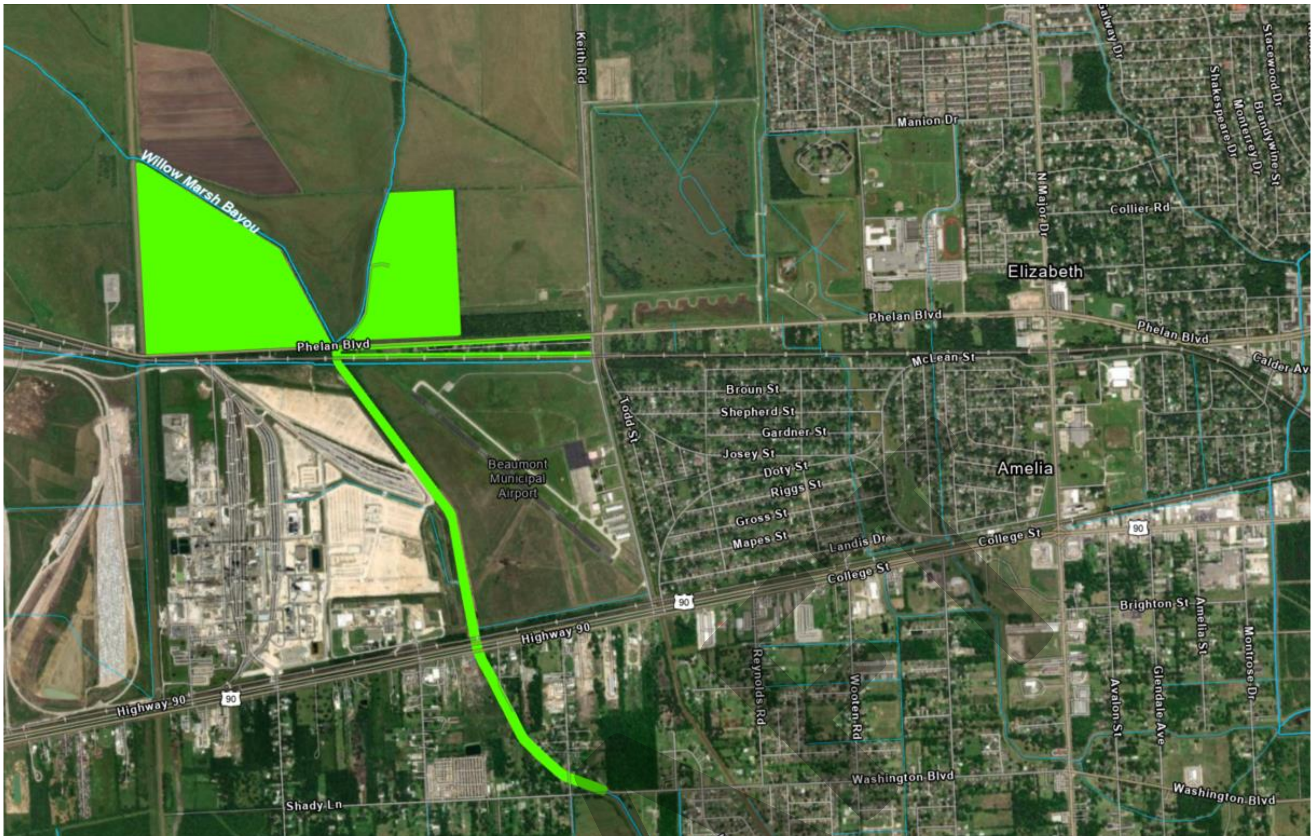


FIGURE 5-18: WILLOW MARSH PHELAN DETENTION PROJECT EXTENT

5.D.3.m. Willow Marsh Main Improvement System

The Willow Marsh Main Improvement System is in Hillebrandt Bayou and is the second most upstream of three proposed projects along Willow Marsh Bayou. Sponsored by Jefferson County Drainage District 6 and analyzed as part of the Jefferson County Regional Watershed Study, the Willow Marsh Main project proposes offline detention basins and channelization along the Bayou from Washington Blvd. to South Major Drive.

A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylors Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

The proposed improvements include a 100’ wide channel bottom and four offline detention basins. A typical section of the channel improvements is shown in **Figure 5-19**.

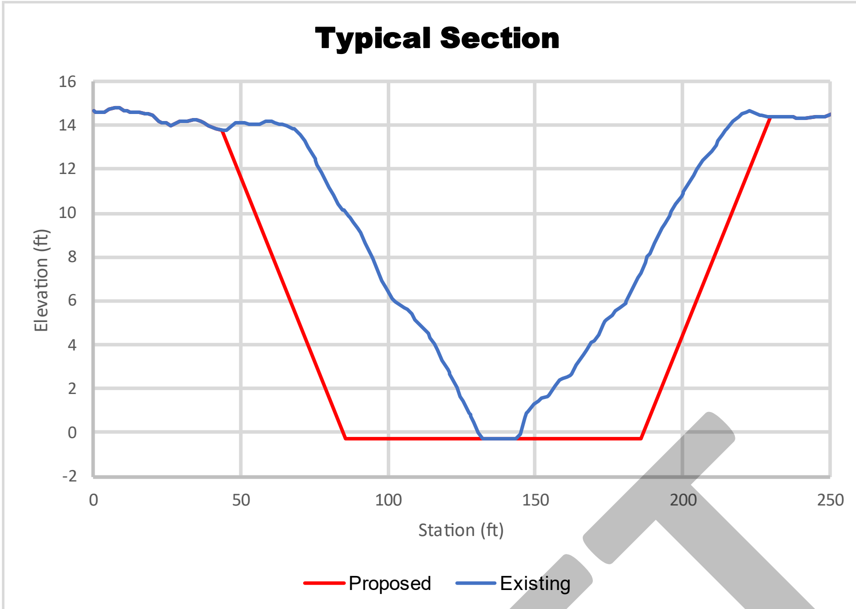


FIGURE 5-19: WILLOW MARSH MAIN IMPROVEMENT SYSTEM TYPICAL SECTION

As a result of the increased detention volume and channel improvements, the project decreases flow rates that discharge into Hillebrandt Bayou and lowers flood risk for the surrounding areas. The estimated flood risk reduction benefit following the implementation of the Willow Marsh Main Improvement System project includes removal of an estimated 102 structures from the 1% ACE floodplain, 65 of which are residential structures. This correlates to an estimated 239 individuals removed from the 1% ACE flood risk. Additionally, 361 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $1,136,334,277, and a benefit cost ratio can be found in **Appendix 5-D**. The proposed Willow Marsh Main project extents are shown in **Figure 5-20,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

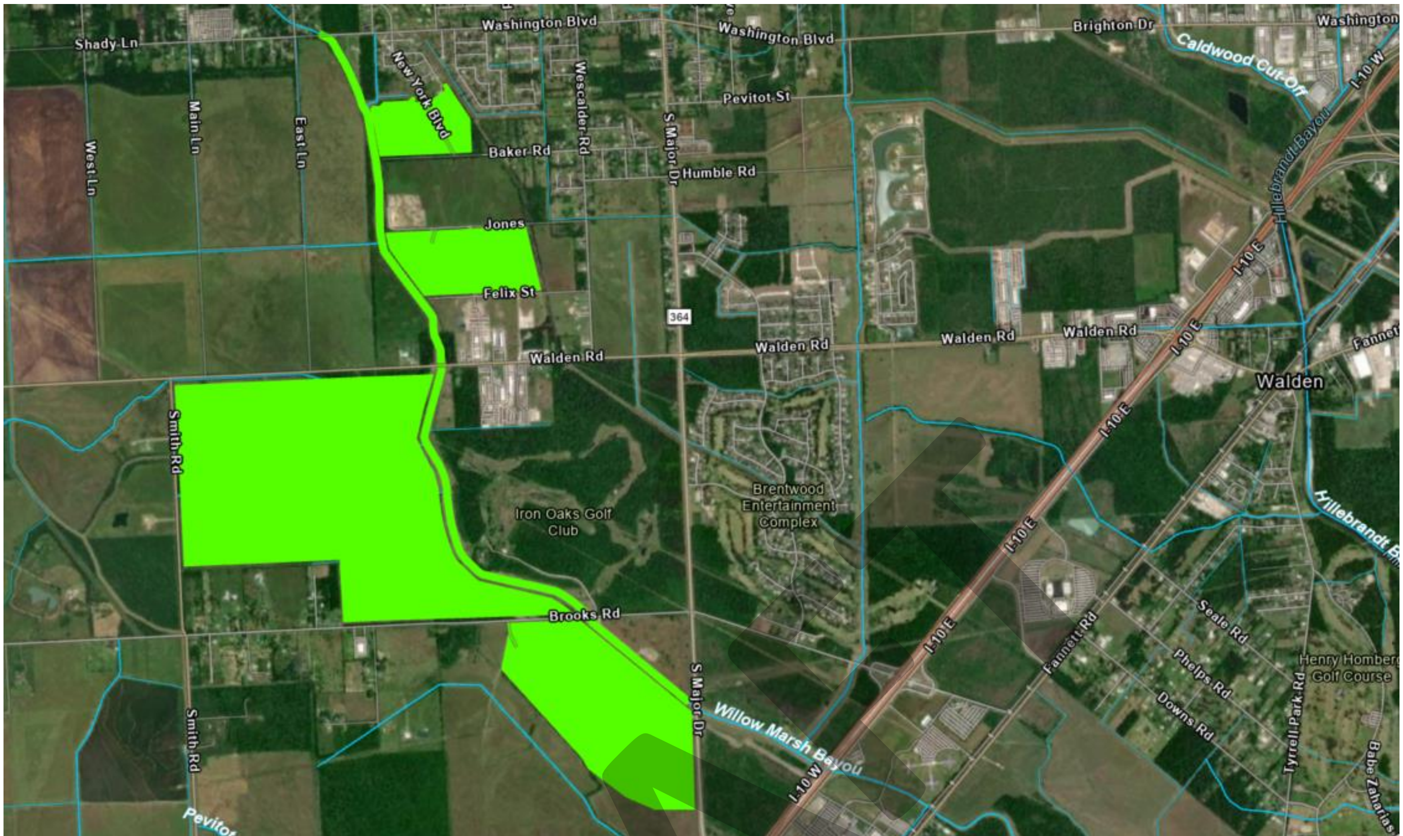


FIGURE 5-20: WILLOW MARSH MAIN IMPROVEMENT SYSTEM PROJECT EXTENT

5.D.3.n. Willow Marsh Downstream Improvement System

The Willow Marsh Downstream Improvement System is in Hillebrandt Bayou and is the most downstream of the three proposed projects along Willow Marsh Bayou. Sponsored by Jefferson County Drainage District 6 and analyzed as part of the Jefferson County Regional Watershed Study, the Willow Marsh Bayou Downstream project includes an offline detention basin and channel improvements along the Bayou from South Major Drive to Hillebrandt Bayou.

A HEC-RAS version 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylors Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

From the existing conditions model, it was evident that I-10 and SH 124 caused restrictions to flow through the bayou. Therefore, the proposed 150-ft wide channel improvements also include upsizing the drainage crossings through SH 124. **Figure 5-21** shows a typical section of the proposed channel widening.

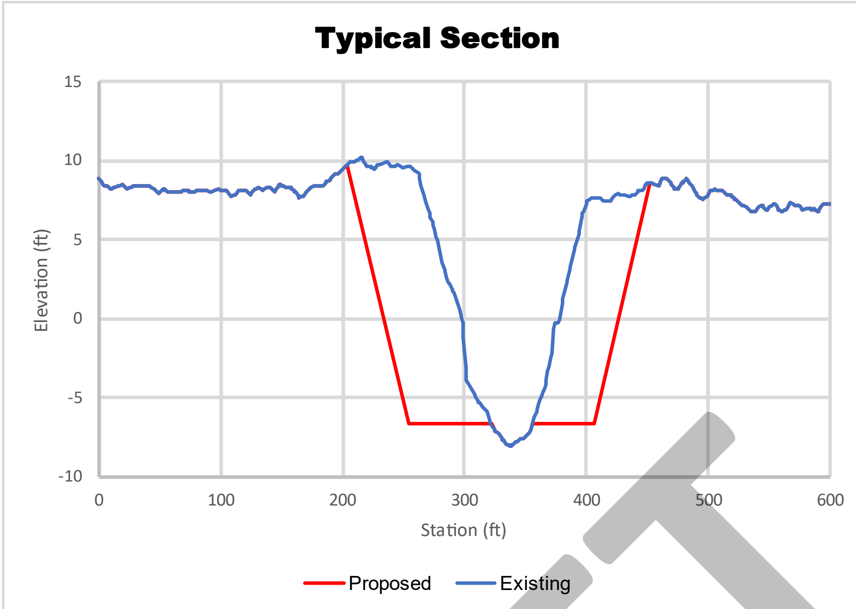


FIGURE 5-21: WILLOW MARSH DOWNSTREAM TYPICAL SECTION

The estimated flood risk reduction benefit following the implementation of the Willow Marsh Downstream project includes removal of an estimated 25 structures from the 1% ACE floodplain, 12 of which are residential structures. This correlates to an estimated 96 individuals removed from the 1% ACE flood risk. Additionally, 129 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $118,142,723, and a benefit cost ratio can be found in **Appendix 5-D**. The proposed Willow Marsh Downstream project extents are shown in **Figure 5-22**, in addition to **Map 20** in **Appendix 5-A**.Figure 5-18. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

FIGURE 5-22: WILLOW MARSH DOWNSTREAM PROJECT EXTENT

5.D.3.o. Tyrrell Park Improvements

The proposed Tyrrell Park Improvements project is in Hillebrandt Bayou and was sponsored and studied by Jefferson County Drainage District 6 as part of their Regional Watershed Study. A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylors Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

The existing conditions analysis showed the Tyrrell Park area to be affected by tailwater from Hillebrandt Bayou, which flows from northwest to southeast on the east side of Tyrrell Park. The project proposes a redirection of flow from the existing Channel 108-B alignment, which flows north across Roberts Rd. and into Hillebrandt Bayou, to flow South along Seale Rd. and across Tyrrell Park to Channel 105 that outfalls to Hillebrandt Bayou approximately 1.5 miles downstream of the original outfall. This redirection of flow, along with channel improvements and improvements to roadside ditches throughout the neighborhood, resulted in lowered flood risk in the project area. A typical section of the Tyrrell Park channel improvements is shown in **Figure 5-23**.

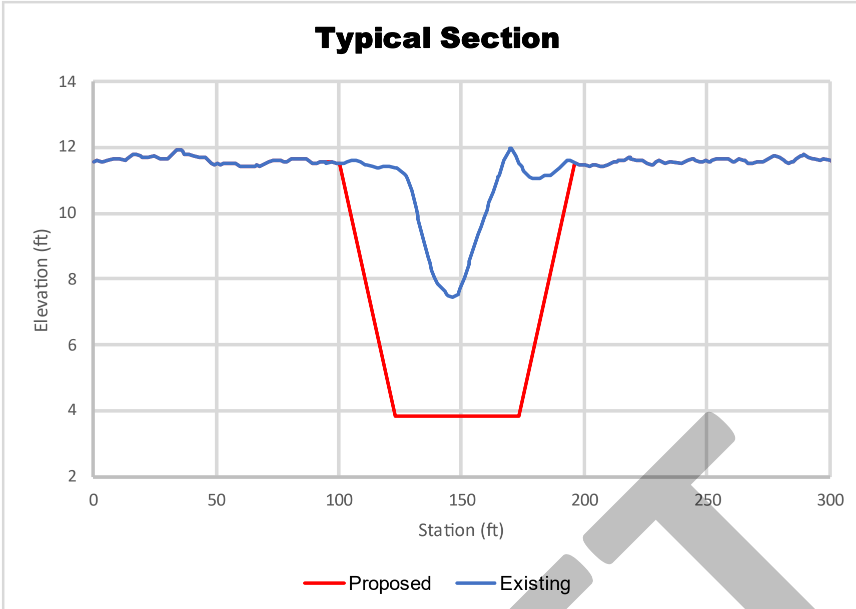


FIGURE 5-23: TYRRELL PARK IMPROVEMENTS TYPICAL SECTION

The estimated flood risk reduction benefit following the implementation of the Tyrrell Park Improvements project includes removal of an estimated 18 structures from the 1% ACE floodplain, 14 of which are residential structures. This correlates to an estimated 82 individuals removed from the 1% ACE flood risk. Additionally, 76 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $25,095,036, and a benefit cost ratio can be found in **Appendix 5-D**. The proposed Tyrrell Park Improvements project extents are shown in **Figure 5-24**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

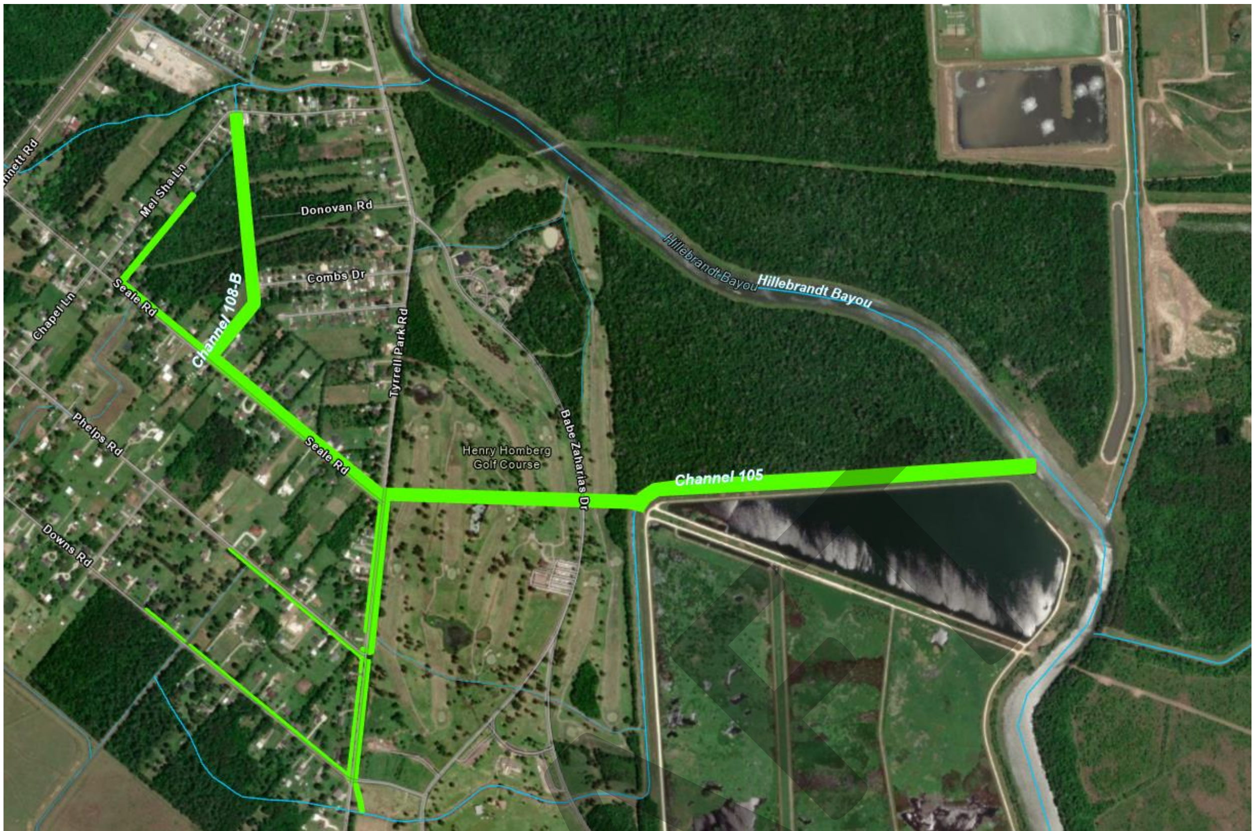


FIGURE 5-24: TYRRELL PARK IMPROVEMENTS PROJECT EXTENT

5.D.3.p. Green Pond Flow Diversion

The Green Pond Flow Diversion project is in the Taylors Bayou watershed and was analyzed as part of the Jefferson County Drainage District 6 Regional Watershed Study. A HEC-RAS 6.3.1 rain on grid model was created using NOAA Atlas 14 100-year rainfall data to analyze existing conditions for the Hillebrandt and Taylors Bayou watersheds using a uniform hyetograph in the mesh area. Losses and land use were included in the model using an infiltration layer and land use layer, respectively. Breaklines, refinement regions, 2D connections, and boundary condition lines were added where appropriate.

There is an existing regional detention facility covering a large area east of Green Pond Gully. The facility retains floodwater with spillways and control structures along an approximately 48,000-foot earthen berm. The proposed project includes the construction of an additional approximately 12,400-foot-long berm east of the existing detention berm, along with a flow regulation structure outfalling to Channel 505-B. Additionally, a flow diversion channel is proposed north of the new berm to divert stormwater from flowing south to flowing west to the existing Green Pond detention facility. A backflow prevention structure is also proposed to prevent flood water from flowing east.

Coupled with the proposed diversion would be an internal collector channel within the existing Green Pond facility to utilize the available storage volume more effectively. This channel will begin collecting water starting on the north side of the detention facility and carrying it south and west adjacent to the existing berm. The proposed total length of the internal collector channel is approximately 65,900 feet.

Because the project includes the construction of a berm, causing obstruction to existing flow, there was impact upstream of the berm. Therefore, the mitigation strategy implemented was for this land to be acquired by the sponsor.

The estimated flood risk reduction benefit following the implementation of the Greens Pond Flow Diversion project includes removal of an estimated 43 structures from the 1% ACE floodplain, 36 of which are residential structures. This correlates to an estimated 64 individuals removed from the 1% ACE flood risk. Additionally, 26 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The estimated cost of the project is $7,779,088, and a benefit cost ratio can be found in **Appendix 5-D**. The proposed Green Pond project extents are shown in **Figure 5-25**, in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in Appendix 5-C.

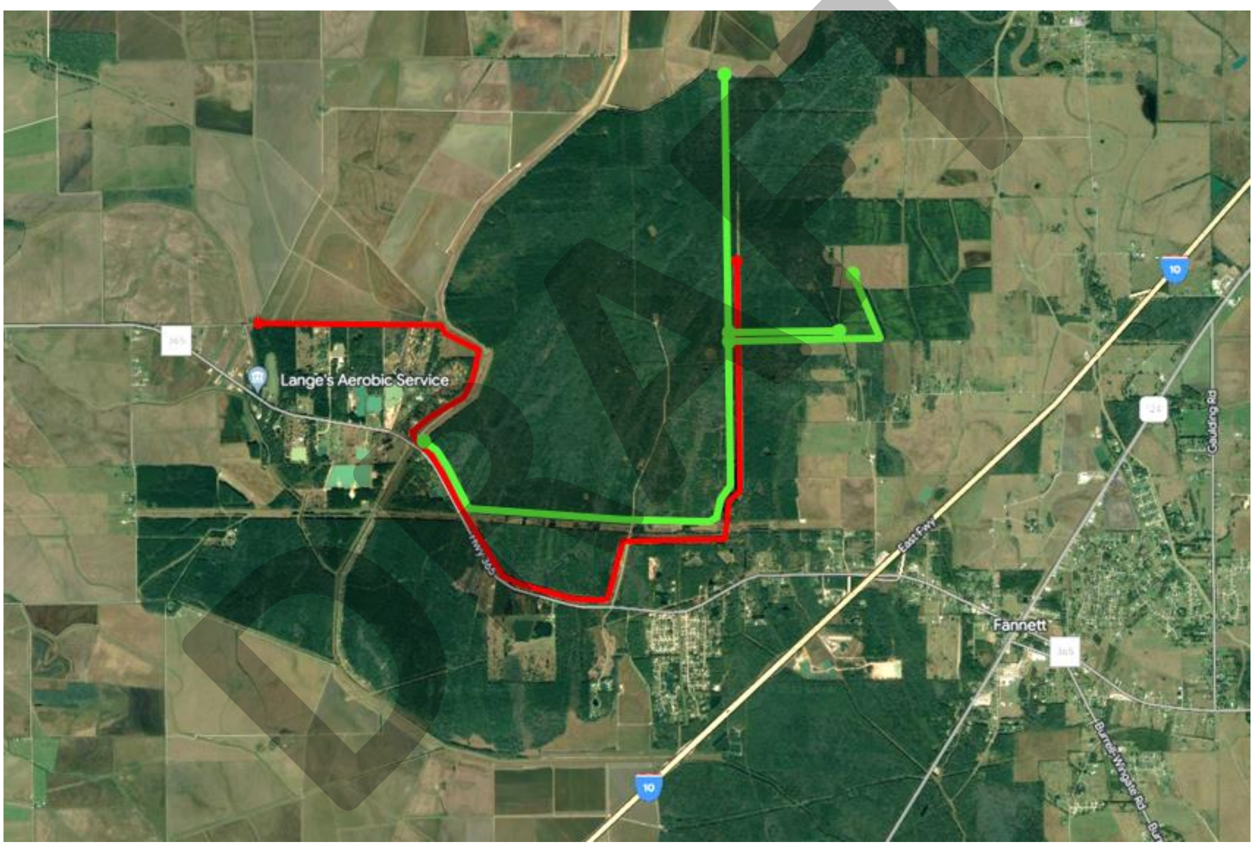


FIGURE 5-25: GREEN POND FLOW DIVERSION PROJECT EXTENT

5.D.3.q. Lucas Diversion

The Lucas Diversion project is an FMP that is sponsored by Jefferson County Drainage District 6. The project area is in the northern side of Beaumont with the improvements extending from DD6 Channel 100 to DD6 Channel 010. Many residential and commercial properties within the project area have suffered flooding damage from past major storm events.

The project is designed to redirect water from Channel 100 and Channel 122 to Channel 010. Channel 010 is at the northern end of the project and outfalls to the Neches River. Storm sewer improvements consisting of dual 12’x10’ RCBs are to be implemented along Delaware Street, West Lucas Drive, Lufkin Street, and Charles Street. The project consists of nearly 7.1 miles of storm sewer upgrades and provides 103.2 acre-feet of additional storm sewer capacity that contributes to increased conveyance. The project is estimated to have a cost of $130,286,230. A BCR of the project can be found in **Appendix 5-D.**

Atlas 14 standard rainfall data was provided by Jefferson County Drainage District 6 except for the 5- and 15-minute rainfall durations, which were created based on NOAA data. A rainfall hyetograph for the 10-, 100-, and 500-year storm events were developed based on 5-minute increments with the peak of the storm at hour 12. Hydraulic models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10-, 100-, and 500-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-26** in addition to **Map 20** in **Appendix 5-A**.

A Drainage Study prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Lucas Diversion project includes removal of an estimated 595 structures from the 1% ACE floodplain, 550 of which are residential structures. This correlates to an estimated 2845 individuals removed from the 1% ACE flood risk. Additionally, 1361 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

FIGURE 5-26: LUCAS DIVERSION PROJECT EXTENT

5.D.3.r. South Park Diversion

The South Park Diversion project is an FMP that is sponsored by Jefferson County Drainage District 6. The project is in the southeast side of the city of Beaumont with the extent of the improvements running adjacent to Lamar University. A significant amount of development in the area has been subject to flood hazard due to existing undersized drainage systems.

The project is designed to divert water from existing drainage systems by installing storm sewer improvements ranging from 8'x8' to 10'x10' RCBs along West Lavaca Street, Campus Street, Ector Street, Highland Avenue, Florida Avenue, and Jim Gilligan Way. The project will mitigate flood risk not only to nearby commercial and residential properties but also to the campus of Lamar University. The project is anticipated to have a cost of $99,908,750. A BCR of the project can be found in **Appendix 5-D**.

Atlas 14 standard rainfall data was provided by Jefferson County Drainage District 6, except for the 5- and 15-minute rainfall durations, which were created based on NOAA data. Rainfall hyetographs for the 10-, 100-, and 500-year storm events were developed based on 5-minute increments with the peak of the storm at hour 12. Hydraulic models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10, 100-, and 500-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-27** in addition to **Map 20** in **Appendix 5-A**.

A Drainage Study prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the South Park Diversion project includes removal of an estimated 373 structures from the 1% ACE floodplain, 321 of which are residential structures. This correlates to an estimated 1225 individuals removed from the 1% ACE flood risk. Additionally, 296 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

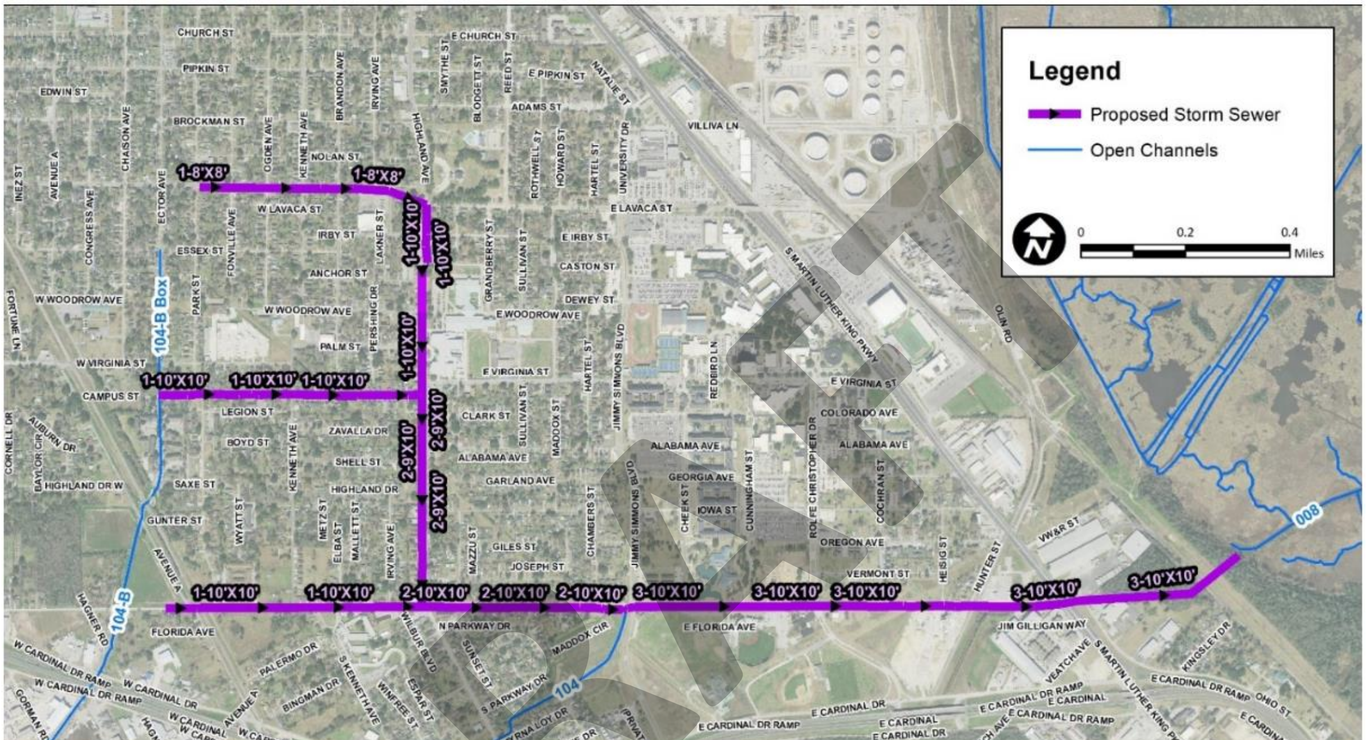


FIGURE 5-27: SOUTH PARK DIVERSION PROJECT EXTENT

5.D.3.s. Tevis Diversion

The Tevis Diversion project is an FMP that is sponsored by Jefferson County Drainage District 6. The project area is in the center of the city of Beaumont with the extent of the improvements running eastward from DD6 Channel 115 before eventually outfalling into the Neches River. Channel 115 has historically been overtopped in past flooding events because it did not have enough capacity for larger storm events. The overtopping of the channel often led to downstream properties suffering extensive flood damage.

The project is designed to redirect water from Channel 115 to the Neches River by installing storm sewer improvements including dual 12’x10’ RCBs along Sawyer Street, South Street, Jaguar Drive, Pecos Street, Center Street, Laurel Street, and Tevis Street. The project will mitigate flood risk not only to properties in the vicinity of the proposed improvements but also to areas downstream of Channel 115, due to the flow reduction. The project is anticipated to have a cost of $97,327,200. A BCR of the project can be found in **Appendix 5-D**.

Atlas 14 standard rainfall data was provided by Jefferson County Drainage District 6 except for the 5- and 15-minute rainfall durations which were created based on NOAA data. Rainfall hyetographs for the 10-, 100-, and 500-year storm events were developed based on 5-minute increments with the peak of the storm at hour 12. Hydraulic models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10, 100-, and 500-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-28** in addition to **Map 20** in **Appendix 5-A**.

A Drainage Study prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Tevis Diversion project includes removal of an estimated 394 structures from the 1% ACE floodplain, 284 of which are residential structures. This correlates to an estimated 1986 individuals removed from the 1% ACE flood risk. Additionally, 216 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

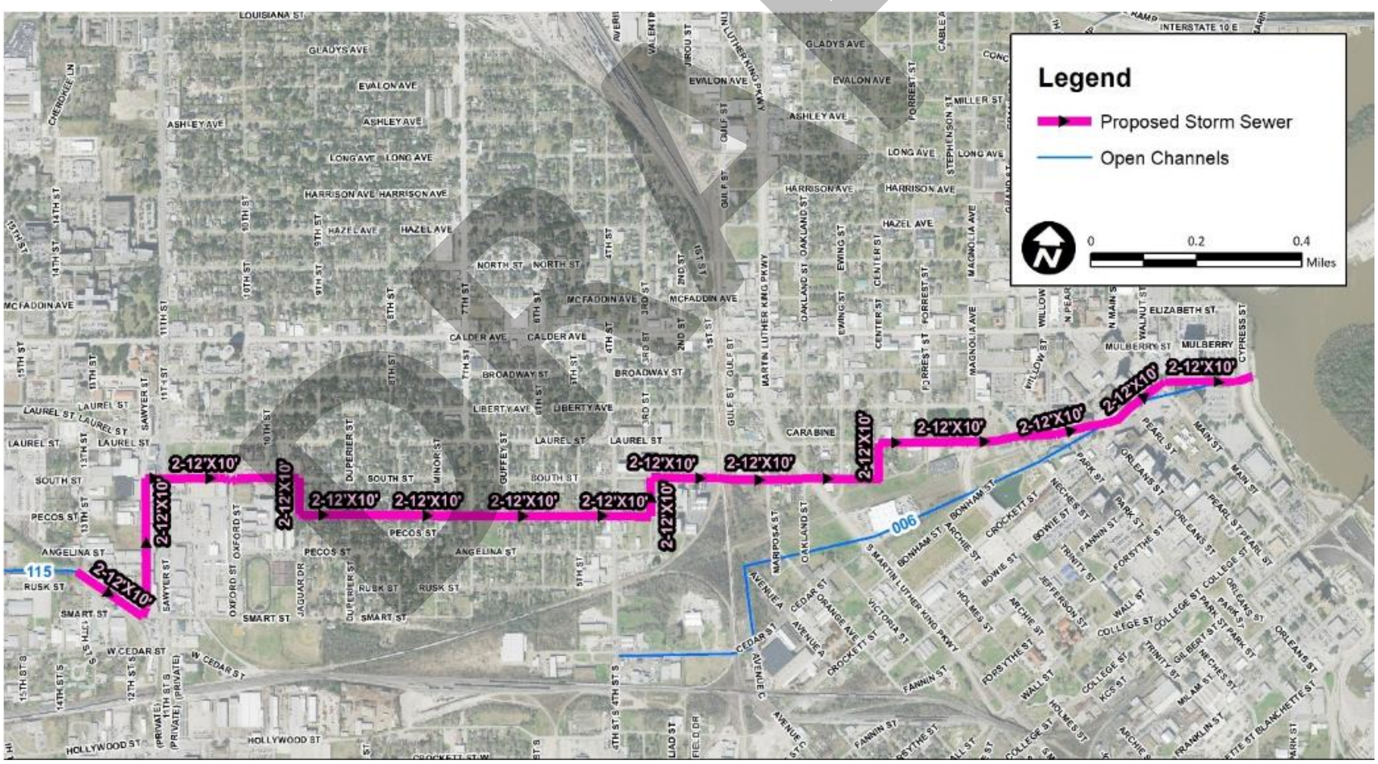


FIGURE 5-28: TEVIS DIVERSION PROJECT EXTENT

5.D.3.t. Blanchette Diversion

The Blanchette Diversion project is an FMP that is sponsored by Jefferson County Drainage District 6. The project area is in the eastern side of the city of Beaumont with the improvements extending from DD6 Channel 110-B to the Neches River. The project is located in a heavily developed area of Beaumont that has experienced flooding hazard due to the inadequate capacity of the existing storm sewer system for larger storm events.

The project is designed to redirect water from Channel 110-B to the Neches River by installing storm sewer improvements mostly consisting of dual 12'x10' RCBs along Roberts Street, Avenue D, Irma Street, Neches Street, and Blanchette Street. A secondary component of the project involves linking the proposed improvements to the existing storm sewer systems along Cartwright Street and Terrell Avenue via 10'x5' RCB laterals. The project consists of nearly 6.2 miles of storm sewer upgrades and provides 80.2 acre-feet of additional storm sewer capacity that contributes to increased conveyance. The project is anticipated to have a cost of $99,173,000. A BCR of the project can be found in **Appendix 5-D.**

Atlas 14 standard rainfall data was provided by Jefferson County Drainage District 6 except for the 5- and 15-minute rainfall durations which were created based on NOAA data. Rainfall hyetographs for the 10-, 100-, and 500-year storm events were developed based on 5-minute increments with the peak of the storm at hour 12. Hydraulic models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10-, 100-, and 500-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-29** in addition to **Map 20** in **Appendix 5-A**.

A Drainage Study prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Blanchette Diversion project includes removal of an estimated 550 structures from the 1% ACE floodplain, 442 of which are residential structures. This correlates to an estimated 2005 individuals removed from the 1% ACE flood risk. Additionally, 348 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

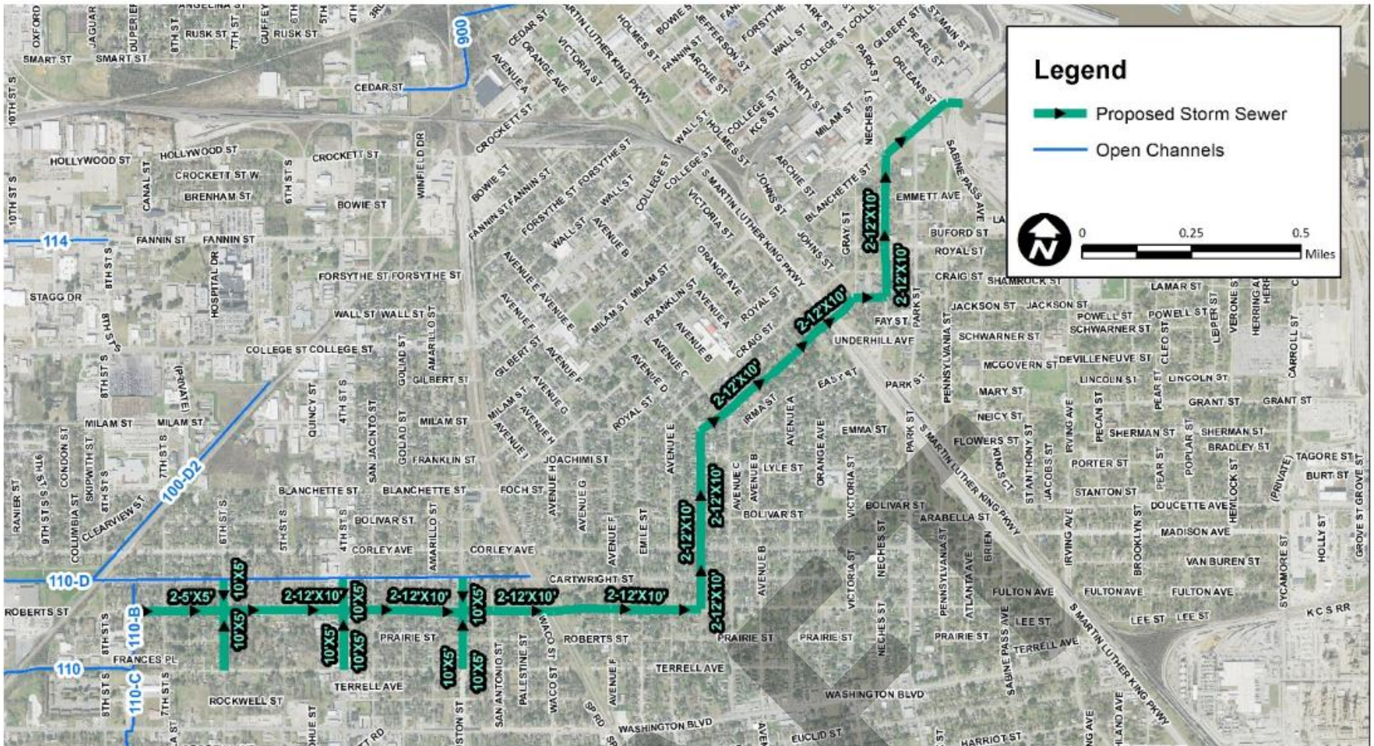


FIGURE 5-29: BLANCHETTE DIVERSION PROJECT EXTENT

5.D.3.u. Tyrrell Park Detention

The Tyrrell Park Detention project is an FMP that is sponsored by Jefferson County Drainage District 6. The project area is on the southern side of the city of Beaumont immediately adjacent to I-10. This project is composed of eight different detention basins, each one designed to store stormwater that would otherwise threaten to spill over into the nearby properties. The basins' locations were strategically chosen to conform with topography and minimize conflicts with existing utilities and oil/gas pipelines.

All eight detention basins were assumed to be dry bottom basins with pilot channels and 3:1 side slopes. All basins combine to have a total storage volume of approximately 3,220 ac-ft with Basin 3 possessing the highest storage volume with 1,286 ac-ft and Basin 6 possessing the lowest storage volume with 161 ac-ft. The project is anticipated to have a cost of $187,974,220. A BCR of the project can be found in **Appendix 5-D.**

Atlas 14 standard rainfall data was provided by Jefferson County Drainage District 6 except for the 5- and 15-minute rainfall durations which were created based on NOAA data. Rainfall hyetographs for the 10-, 100-, and 500-year storm events were developed based on 5-minute increments with the peak of the storm at hour 12. Hydraulic models sufficient to determine pre-mitigation conditions for the 10-, 100-, and 500-year storm events were developed. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 10-, 100-, and 500-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-30** within the yellow box in addition to **Map 20** in **Appendix 5-A**.

A Drainage Study prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 was used to verify that the project resulted in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Tyrrell Detention project includes removal of an estimated 231 structures from the 1% ACE floodplain, 207 of which are residential structures. This correlates to an estimated 331 individuals removed from the 1% ACE flood risk. Additionally, 23 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

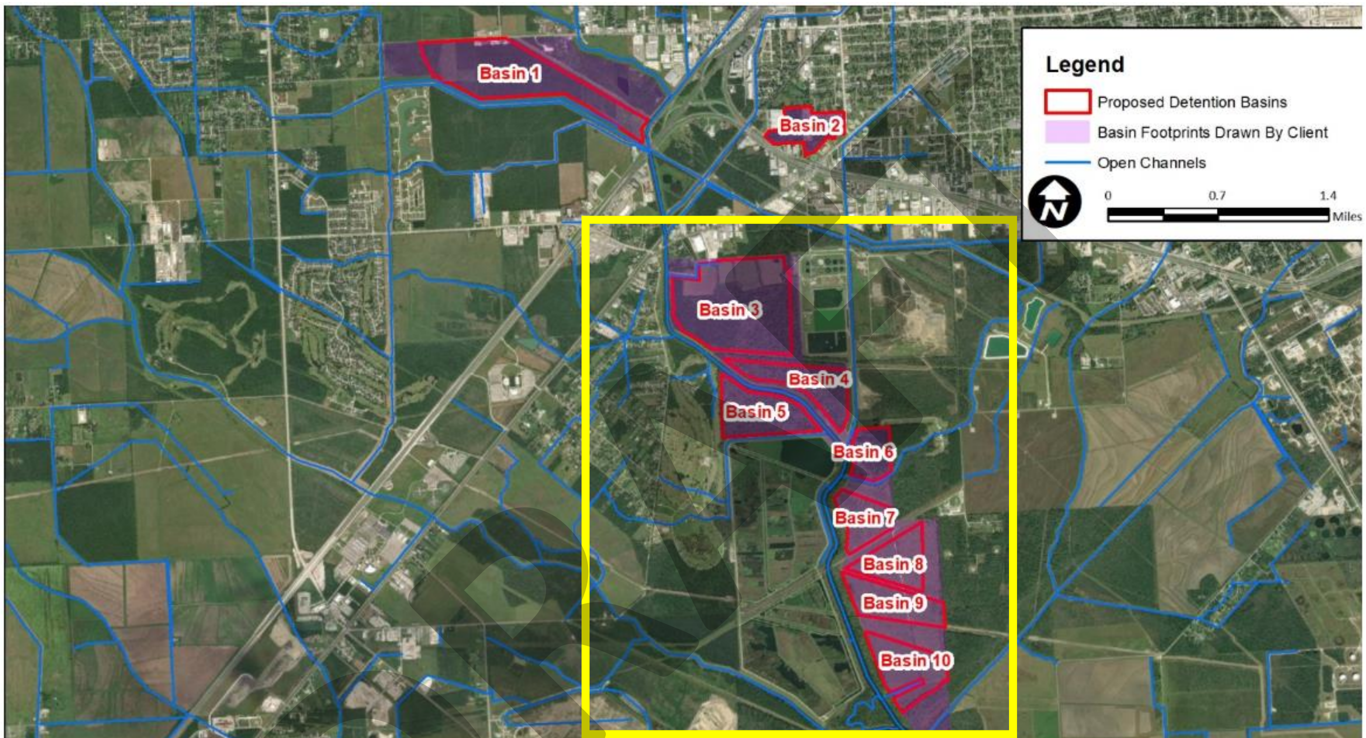


FIGURE 5-30: TYRRELL PARK DETENTION PROJECT EXTENT

5.D.3.v. Virginia Street Detention

The Virginia Street Detention project is an FMP sponsored by Jefferson County Drainage District 6. The project area is located near the southeastern edge of Beaumont and is comprised of both residential and commercial properties north and south of Cardinal Drive. Although the project area is already serviced by a collection of roadside ditches, storm sewer systems, detention basins, and open channels, the area suffers flooding during higher storm events due to the elevated tailwater conditions in DD6 Channel 106-A and Channel 104-B.

The project is designed to increase conveyance and provide additional storm sewer capacity to alleviate the elevated tailwater conditions. Storm sewer improvements are to be implemented starting at the intersection of West Virginia Avenue and St Louis Street. The 8’x4’ RCB connects to an 8’x5’ RCB at Beale Street before outfalling into an existing inline detention basin for DD6 Channel 104-B along Avenue A. There are several proposed detention basins, in addition to the storm sewer improvements. Basins are proposed to be placed both to the east and west of Bob Street in addition to one along DD6 Channel 106-A, one at the intersection of Avenue A and Florida Avenue, and another along Channel 106-A near Mercantile Street. The project is anticipated to have a cost of $9,760,000. A BCR of the project can be found in **Appendix 5-D.**

Rainfall hyetographs were developed for the 2-, 5-, 10-, 25- and 100-year storm events in HEC-HMS 4.0 from the USGS Water Resources Investigations Report 94-4044 (Asquith, 1998) rainfall depth-duration-frequency data for Jefferson County. Hydraulic models sufficient to determine pre-mitigation conditions for the 2-, 5-, 10-, 25- and 100-year storm events were created. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 2-, 5-, 10-, 25- and 100-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-31**, in addition to **Map 20** in **Appendix 5-A**.

A Hydrology and Hydraulics Memorandum prepared by Lockwood, Andrews, and Newman, Inc. for Jefferson County Drainage District 6 in December 2022 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Virginia Street Detention project includes removal of an estimated 199 structures from the 1% ACE floodplain, 174 of which are residential structures. This correlates to an estimated 689 individuals removed from the 1% ACE flood risk. Additionally, 89 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

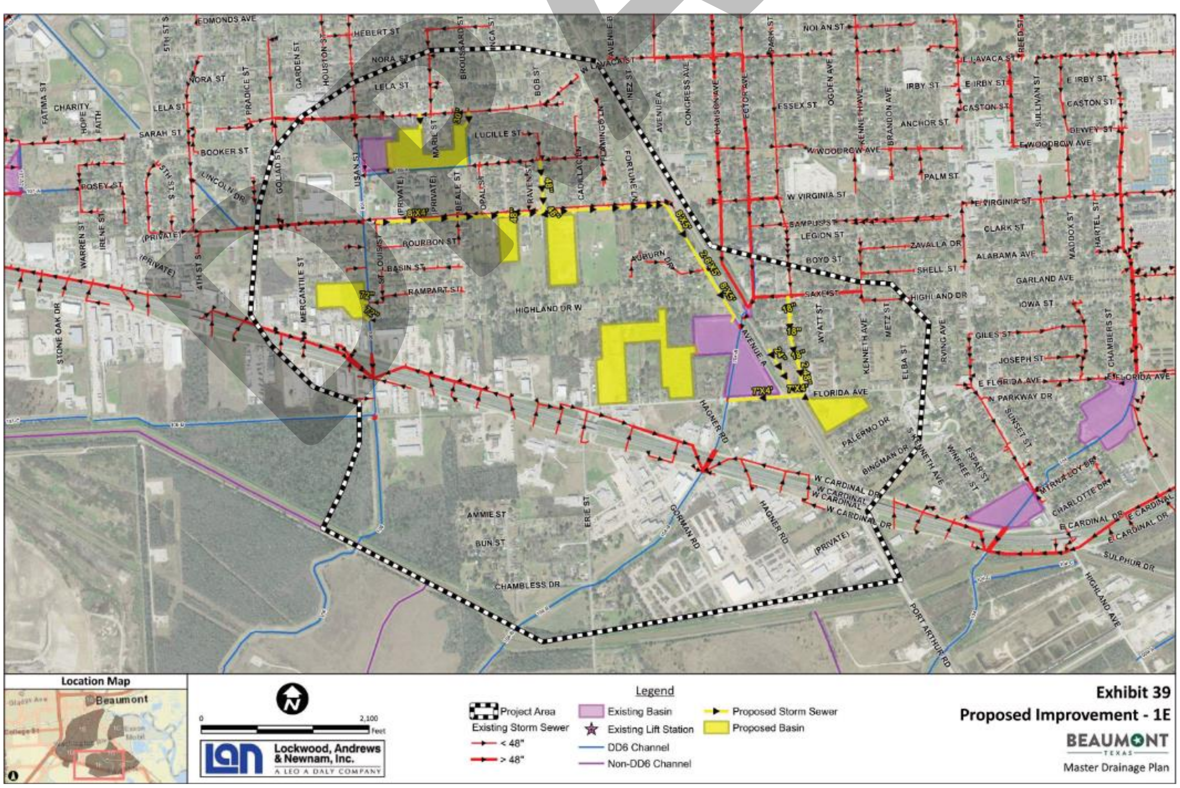


FIGURE 5-31: VIRGINIA STREET DETENTION PROJECT EXTENT

5.D.3.w. Delaware Hilcorp Detention

The Delaware Hilcorp Detention project is an FMP that is sponsored by Jefferson County Drainage District 6. The project area is located on the west side of the city of Beaumont with most of the proposed improvements being immediately adjacent to or running alongside Delaware St. The project area has been noted to be significantly influenced by tailwater conditions on Hillebrandt Bayou which results in water ponding on the nearby streets during major storm events.

The project is designed to provide relief to Hillebrandt Bayou and provide capacity to the existing channels so that they can intake higher flows from adjacent neighborhoods. The proposed improvements consist of two detention ponds off Delaware Street in addition to new storm sewer conduits ranging from 48” RCPs to triple 8’x6’ RCBs. The project consists of 13,545 linear feet of storm sewer upgrades, which provide a collective 4.3 ac-ft of additional storm sewer capacity. The project is estimated to cost a total of $11,460,000. A BCR of the project can be found in **Appendix 5-D.**

Rainfall hyetographs were developed for the 2-, 5-, 10-, 25- and 100-year storm events in HEC-HMS 4.0 from the USGS Water Resources Investigations Report 94-4044 (Asquith, 1998) rainfall depth-duration-frequency data for Jefferson County. Hydraulic models sufficient to determine pre-mitigation conditions for the 2-, 5-, 10-, 25- and 100-year storm events were created. These same models were used to evaluate the effectiveness of the structural mitigation concepts and determine post-mitigation (post-project) conditions for the 2-, 5-, 10-, 25- and 100-year storm events. InfoWorks ICM 2021.6 was used for the hydraulic analysis of the project area. The extents of the project are shown in **Figure 5-32** in addition to **Map 20** in **Appendix 5-A**.

A Master Drainage Plan prepared by Lockwood, Andrews, and Newman, Inc. for the city of Beaumont in August 2019 was used to verify that the project results in no negative impact to the existing conditions within the project service area. The estimated flood risk reduction benefits following the implementation of the Delaware Hilcorp Detention project includes removal of an estimated 229 structures from the 1% ACE floodplain, 148 of which are residential structures. This correlates to an estimated 681 individuals removed from the 1% ACE flood risk. Additionally, 574 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

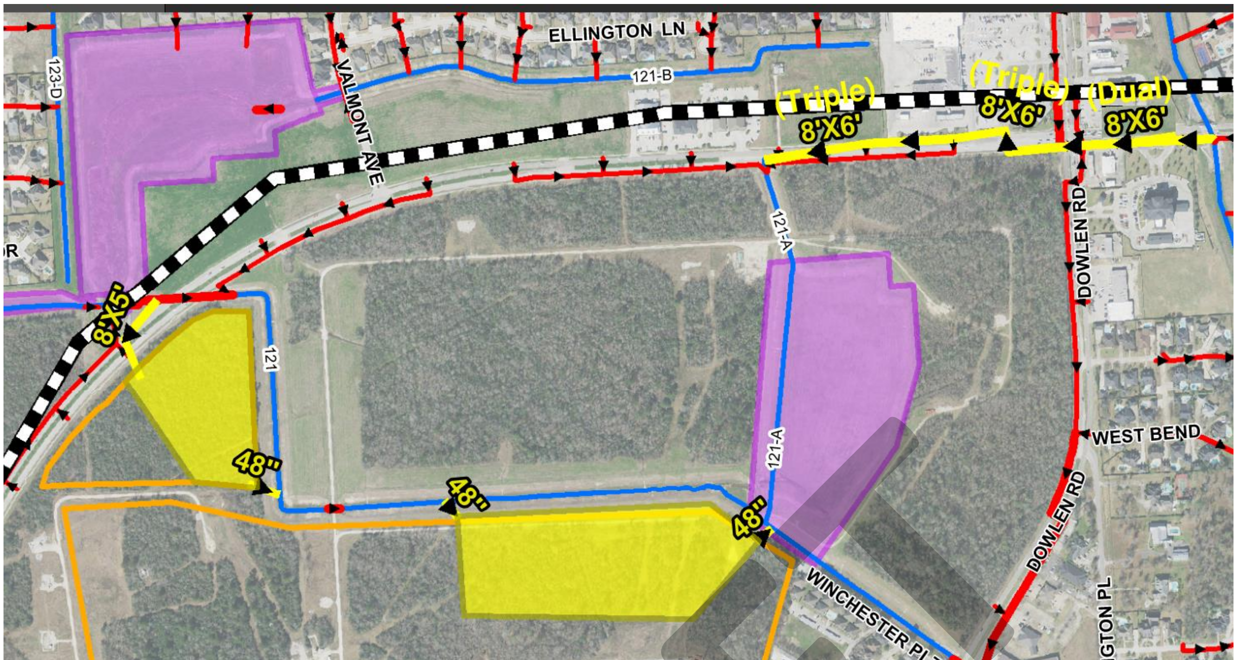


FIGURE 5-32: DELAWARE HILCORP DETENTION PROJECT EXTENT

5.D.3.x. Borley Heights Relief Project

The Borley Heights Relief project is sponsored by Jefferson County Drainage District 6 and studies the Borley Heights neighborhood located within Beaumont, TX. The study area includes four drainage areas with a combined area of 180.02 acres. The main source of flood risk for this area is a restrictive canal crossing that causes storm runoff to flow through a ditch with inadequate capacity and then through an undersized drainage structure.

The project proposes to include three new crossings under the canal, the construction of a diversion ditch to be located on the west side of the canal, the construction of concrete-lined receiving ditches along the canal, and improvements to Ditch 1002-B. The project's total estimated cost is $4,577,210. A BCR of the project can be found in **Appendix 5-D.**

U.S. Geological Survey Lidar Point Cloud and ground survey data were used to develop terrain models, which were used to develop drainage areas. These drainage areas were utilized with HEC-HMS 4.0 to develop runoff for each identified drainage area. Atlas 14 precipitation was used to develop the 5-,10-, 50-, 100-, and 500-year storm events for existing and proposed conditions. These peak flows were input into a HEC-RAS 4.1 model to calculate water surface profiles for both existing and proposed conditions.

The estimated flood risk reduction benefits following the implementation of the Borley Heights Relief project includes removal of an estimated 157 structures from the 1% ACE floodplain, 155 of which are residential structures. This correlates to an estimated 277 individuals removed from the 1% ACE flood risk. Additionally, 6 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The extents of the project are shown in **Figure 5-33,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

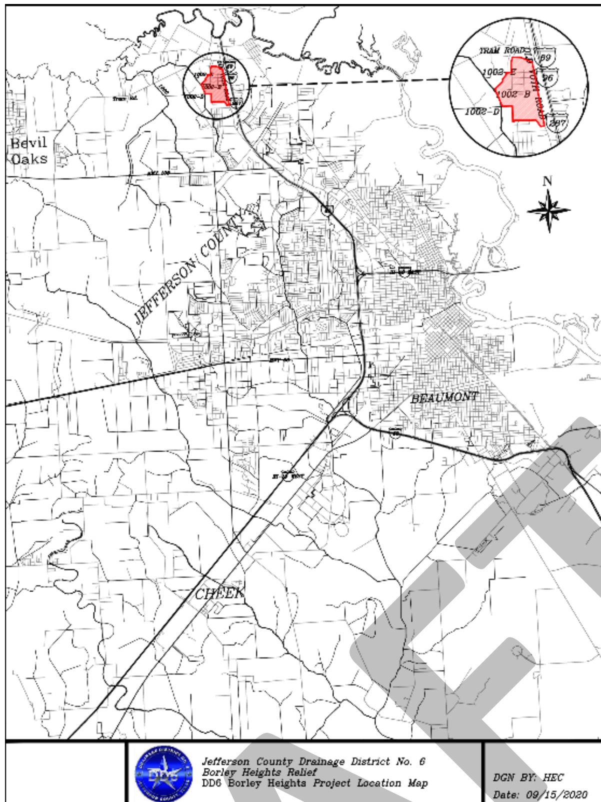


FIGURE 5-33: BORLEY HEIGHTS RELIEF PROJECT EXTENT

5.D.3.y. East China Relief Project

The East China Relief project is sponsored by Jefferson County Drainage District 6 and studies several drainage areas located to the east of the City of China, TX. The study area includes four drainage areas with a combined area of 2,901 acres. The main sources of flood risk for this area are inadequate ditches, an inadequate canal flume crossing, and a 78-inch corrugated metal pipe that impedes the conveyance of flow downstream.

The project proposes the construction of a linear detention upstream of the canal, in addition to a concrete block-lined channel downstream of the canal crossing. An adequately sized structure under Turner Road is also included as part of the proposed improvements. The project's total estimated cost is $2,853,160. A BCR of the project can be found in **Appendix 5-D.**

U.S. Geological Survey Lidar Point Cloud and ground survey data were used to develop terrain models which in turn were used to develop drainage areas. These drainage areas and associated parameters were input to HEC-HMS 4.1 to develop runoff for each identified drainage area. Atlas 14 precipitation was used to develop the 5-,10-, 50-, 100-, and 500-year storm events for existing and proposed conditions. These peak flows were input into a HEC-RAS 4.1 model to calculate water surface profiles for both existing and proposed conditions.

The estimated flood risk reduction benefits following the implementation of the East China Relief project includes removal of an estimated 22 structures from the 1% ACE floodplain, 16 of which are residential structures. This correlates to an estimated 21 individuals removed from the 1% ACE flood risk.

Additionally, 4 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The extents of the project are shown in **Figure 5-34,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

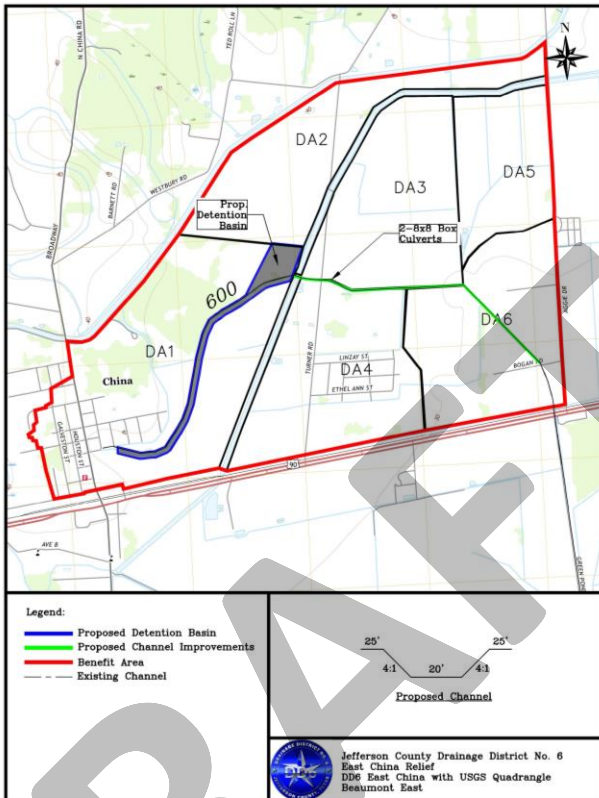


FIGURE 5-34: EAST CHINA RELIEF PROJECT EXTENT

5.D.3.z. South Nome Relief Ditch

The South Nome Relief Ditch project is sponsored by Jefferson County Drainage District 6 and studies drainage areas located both within and to the south of the City of Nome, TX. The study area includes eight drainage areas with a combined area of 3,876 acres. The main source of flood risk for this area is a restrictive canal crossing that causes water to pond into residential properties within the City of Nome.

The project proposes improvements to the channels above the canal crossing and adding three 60-inch structures under the canal. A detention basin is also proposed to be constructed below the canal crossing to dampen the increased flows. The project's total estimated cost is $2,286,770. A BCR of the project can be found in **Appendix 5-D.**

U.S. Geological Survey Lidar Point Cloud and ground survey data were used to develop terrain models which were used to develop drainage areas. These drainage areas and their associated parameters were input to HEC-HMS 4.1 to develop runoff for each identified drainage area. These peak flows were input into a HEC-RAS 4.1 model to calculate water surface profiles for both existing and proposed conditions.

The estimated flood risk reduction benefits following the implementation of the Borley Heights Relief Project includes removal of an estimated 22 structures from the 1% ACE floodplain, 16 of which are residential structures. This correlates to an estimated 96 individuals removed from the 1% ACE flood risk. Additionally, 9 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The extents of the project are shown in **Figure 5-35,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

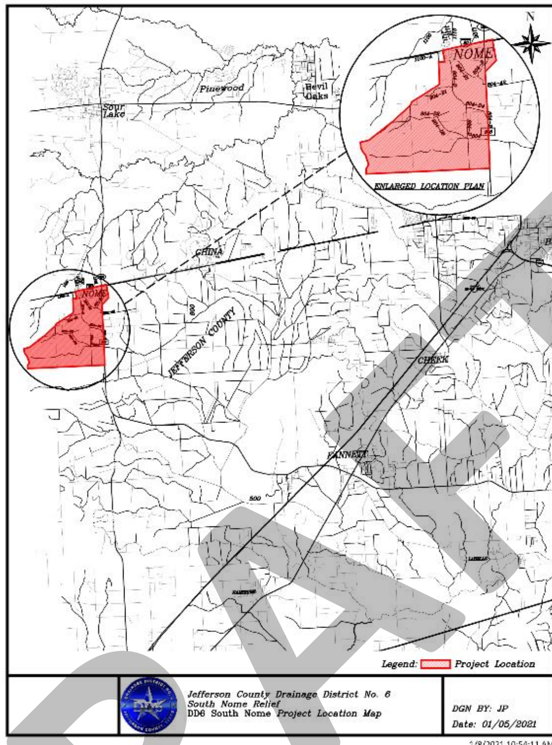


FIGURE 5-35: SOUTH NOME RELIEF DITCH PROJECT EXTENT

5.D.3.aa. Ditch 505 Detention

The Ditch 505 Detention project is sponsored by Jefferson County Drainage District 6 and studies drainage areas located near the census-designated place (CDP) of Fannett, TX. The study area is located immediately north of I-10 and along Ditch 505. A considerable concentration of commercial and residential development that has historically experienced flooding is located downstream of the project area. The purpose of this project is to mitigate flood damages in these areas.

The project proposes a detention basin to be placed adjacent to I-10. A control structure is included with the pond and is sized to allow the detention basin to fill for the 100-year event with adequate freeboard. The project’s total estimated cost is $13,803,086. A BCR of the project can be found in **Appendix 5-D.**

The hydrologic and hydraulic models for this project were developed by Jefferson County Drainage District 6 and were used as the basis for the hydrologic and hydraulic analysis. No edits were made to the models for existing conditions, but the 2017 LiDAR data was used to verify the contributing drainage area. For proposed conditions, the detention basin was designed in Civil 3D using 2017 LiDAR before the basin was modeled in the existing HEC-HMS 4.2 model as a reservoir element. The basin had a stage-storage relationship developed and was analyzed using a variable tailwater curve.

The estimated flood risk reduction benefits following the implementation of the Ditch 505 Detention project includes removal of an estimated 2 structures from the 1% ACE floodplain, 1 of which is a residential structure. This correlates to an estimated 3 individuals removed from the 1% ACE flood risk. Additionally, 7 structures have been projected to have reduced area within the 1% ACE floodplain but will not be fully removed from flood risk following the proposed improvements. The extents of the project are shown in **Figure 5-36,** in addition to **Map 20** in **Appendix 5-A**. For a summary and additional information on this project, please refer to the one pager attached in **Appendix 5-C**.

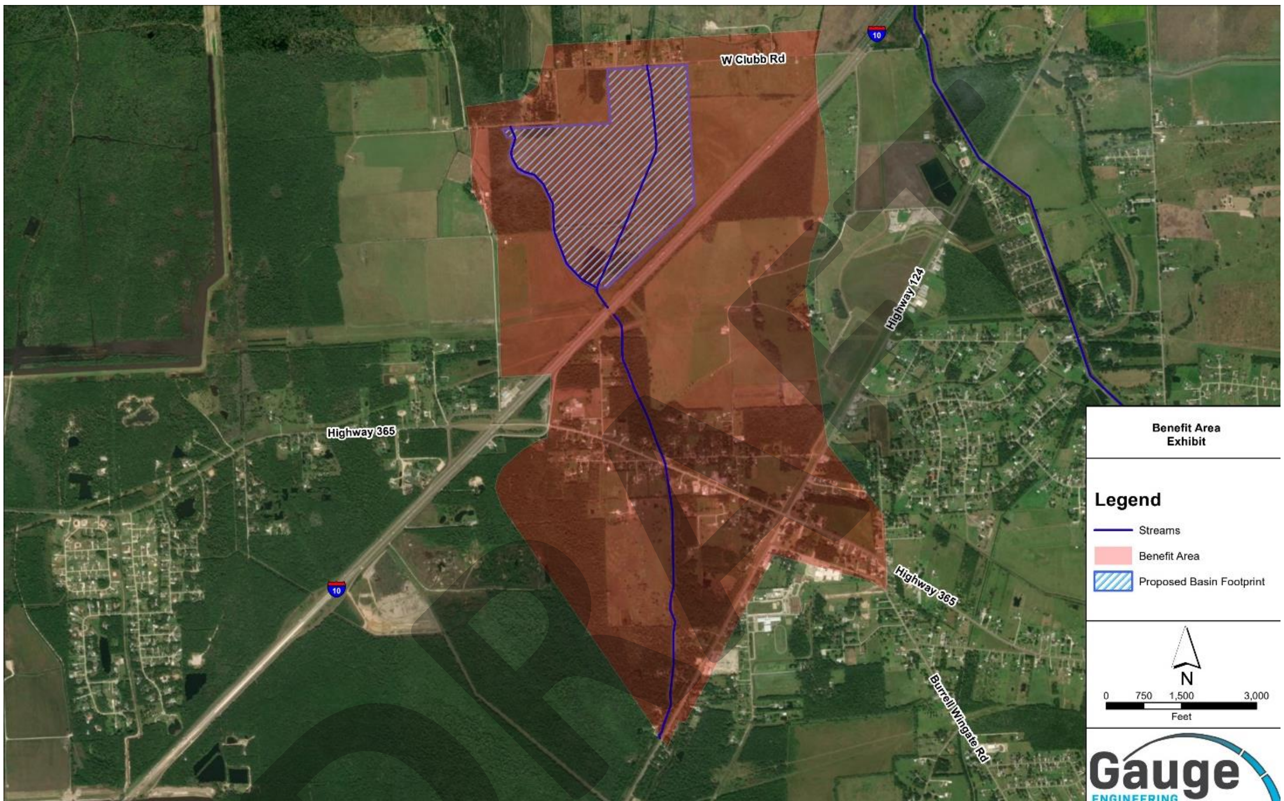


FIGURE 5-36: DITCH 505 DETENTION PROJECT BENEFIT EXTENT

5.D.4. Required Flood Mitigation Project Details

The FMPs identified and recommended by the Neches RFPG will be included in Texas's first ever State Flood Plan in a single statewide ranked list. To enable the ranking of all recommended projects in a single list, the RFPGs provided project details for each project identified. The specific criteria to be used in the state ranking will be determined during the State Flood Planning phase via a transparent process with public input. General project details provided for each project that will be used in the final ranking criteria developed by TWDB include:

- Project Type
- Pre-Project Depth of Flooding
- Community Need
- Flood Risk Reduction
- Flood Damage Reduction
- Critical Facilities Damage Reduction

- BCR
- Water Supply Benefit
- Social Vulnerability
- Nature-Based Solution
- Multiple Benefit
- Life and Safety (Injury/Loss of Life)
- Estimated Cost
- Mobility
- Implementation Obstacles
- Environmental Benefit
- Environmental Impact
- Operations and Maintenance

The complete list of project details for each FMP is included in **Appendix 5-D**. In addition to providing project details, the Neches RFPG classified recommended FMPs based on two criteria: Flood Intended Use Plan (FIUP) Project Category and Rural Applicant Classification. The definitions and classification process for both can be found in the TWDB 2020 Flood Intended Use Plan and are briefly described below.

FIUP Project Category describes the development stage of a project or study.

- Category 1: Planning of entire watersheds to inform the development of structural and non-structural mitigation strategies.
- Category 2: Planning, acquisition, and design efforts in relation to an identified flood mitigation project.
- Category 3: Projects that have already received federal funding contingent on matching with local funds.
- Category 4: Projects that can be implemented quickly and will immediately protect life and property.

All recommended FMPs, excluding the Orange County and Port Arthur elements of the Sabine Pass to Galveston CSRM, have been identified as Category 2 projects. As the Orange County and Port Arthur projects of the Sabine Pass to Galveston CSRM have both received federal funding, both projects have been identified as Category 3 projects.

A project classifies as a Rural Applicant if any of the following conditions are met:

- All entities within the project benefit area are outside metropolitan statistical areas and have populations < 10,000.
- A district or municipality with a service area of 10,000 or less in population.
- A county in which no urban area exceeds 50,000 in population.

None of the recommended FMPs were identified as Rural Applicants.

5.D.4.a. Project Details Evaluation Severity Evaluation

The following sections detail the methodology used to ascertain details for each of the five recommended projects in the Neches region. First, the existing severity of each project was evaluated to include average depth of flooding for structures and the portion of communities exposed to severe flood risk. The severity evaluation was followed by an analysis of flood risk reduction benefits that calculated how many structures and roads were removed from flood risk after project implementation.

Other details evaluated for these projects included but was not limited to the ability of residents to evacuate in the case of a severe storm, potential benefits to water supply, protection of existing natural resources, and the presence of any environmental benefits. As mentioned previously, all project details will be used in the final ranking criteria developed by TWDB to ultimately rank all projects included in the State Flood Plan.

Severity Evaluation

The severity of flood risk in the existing conditions of the project area was analyzed. The average depth of flooding for structures was reviewed whenever it was available from the models supporting the individual FMPs. Otherwise, existing flood inundation extents captured from FMP models were used to ascertain the existing risk to structures from flooding. The affected population was another metric determined to characterize existing risk; the population within the floodplain was compared to the total population of the affected community. The sponsor of the FMP was determined to represent the affected community, and the entire population of that jurisdiction was used as the baseline.

Flood Risk Reduction Evaluation

The flood reduction benefits provided by the implementation of the proposed FMPs, including structures and critical facilities removed from 1% ACE flood risk in addition to increased access to transportation, were determined. The pre- and post-flood depths on roadways were used to determine the rating for this category in conjunction with the classification of the road with flood benefits. Using the TxDOT road classifications, emphasis was given to Major Collectors, Principal Arterials, and Interstates, as all are major thoroughfares for emergency vehicles.

Life and Safety Evaluation

Different components were considered to characterize the risk of fatalities or injuries caused by flooding. An area hazard rating was calculated by considering the speed of onset of flooding, land use, and the extent of the local flood warning system. Together, these metrics indicated the ability of residents to evacuate a flood prone area. The categories used to evaluate the vulnerability of life and safety are shown in **Table 5-6**.

TABLE 5-6: LIFE AND SAFETY VULNERABILITY EVALUATION

Parameter	Low risk area	Medium risk area	High risk area
Speed of Onset	Onset of flooding is very gradual (many hours)	Onset of flooding is gradual (an hour or so)	Rapid flooding
Nature of Area	Multi-story apartments	Typical residential area, commercial and industrial properties	Bungalows, mobile homes, busy roads, parks, single story
Flood Warning System	Flood warning system in place for all possible sources of flooding	Flood warning system in place for some of the possible sources of flooding	No flood warning system

Other Benefits

Flood mitigation projects often have benefits beyond flood risk reduction. The following benefits can be expected from the recommended FMPs and FMSs:

- Water Quality: Implementation of vegetation or flood infrastructure that could provide improvements to water quality or reduction of risk to water and wastewater treatment plants that could prevent overflow during storm events.
- Habitat, Biodiversity, and Ecology: Preservation or creation of habitats, wetland areas, or wildlife corridors.
- Air Quality: Creation of open space or recreation areas or addition of vegetation that improve air quality.
- Natural Resources: Protection of natural resources.
- Agricultural Resources / Properties: Reduction of flood risk to agricultural property.

The Bayou Din Detention Basin project, the Black Fork Creek Improvement Project, and the Port Arthur and Orange County elements of the Sabine Pass to Galveston Bay CSRM were determined to provide benefits in 2 or 3 of the above categories, in addition to flood risk reduction benefit. All other recommended FMPs were determined to only provide flood risk reduction benefits.

Environmental impacts and benefits were reviewed for each recommended FMP. The recommended FMPs were determined to have no adverse environmental impacts. Potential benefits provided to water supply through the flood mitigation projects identified were explored but all recommended FMPs were determined to have no interaction with water supply. Further information on additional benefits of the RFP is included in **Chapter 6**.

CHAPTER 6
IMPACT AND CONTRIBUTION OF THE REGIONAL FLOOD PLAN

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

CHAPTER 6. IMPACT AND CONTRIBUTION OF THE REGIONAL FLOOD PLAN

The following sections describe the impacts and contributions of this plan to various aspects of water resources. Implementation of the plan as recommended assumes all flood mitigation projects (FMP), flood management strategies (FMS), and flood management evaluations (FME) outlined in **Chapter 5** are fully funded and completed. Avoidance of future flood risk due to policy recommendations and potential future recommendations of all identified projects, strategies, and evaluations is also described in this chapter as most FMPs, FMSs, and FMEs only require sponsor approval to be recommended by the Neches RFPG.

Chapter 6.A. Impacts of Regional Flood Plan

The overall impacts of the RFP include potential impacts to areas at risk of flooding; structures and populations in the floodplain; low water crossings; water supply; and impacts on the environment, agriculture, recreational resources, water quality, erosion, sedimentation, and navigation. This chapter aims to compare these risks with the potential estimated positive and negative benefits of implementing the RFP. Additionally, in the second part of this chapter, potential contributions to impacts on water supply development and the State Water Plan are assessed.

The impact of the RFP also includes how additional future flood risk will be avoided through implementation of recommended improvements to the region's floodplain management policies. These details are provided to highlight the importance of stakeholder involvement and support in maximizing the plan's effectiveness during amendment periods and future cycles.

6.A.1. Relative Reduction in Flood Risk

The impacts on existing conditions were determined based on a before-and-after RFP implementation comparisons of the information provided as part of the Existing Flood Risk Analysis outlined in **Chapter 2**. The comparison of 1 percent and 0.2 percent ACE data with and without the RFP quantifies how much of the region's existing flood risk will be reduced through implementation of the RFP as recommended.

6.A.1.a. Reduction in Flood Risk Identification Needs

The avoidance of future flood risk begins with identifying flood risk exposure through new studies. Beyond addressing the immediate need of closing knowledge gaps, execution of regional watershed studies created by the region will provide a foundation for effective FMP identification and recommendation in future planning cycles. In **Chapter 4**, 100% of the region area was identified as needing flood risk identification or updates to existing flood risk information. After the completion of recommended FMEs, the entire region will have updated flood risk identification information. With the completion of these recommended FMEs, identified flood risk exposure is anticipated to increase across the region. While an increase in quantified exposure may not initially indicate progress in fulfilling the RFP's, identification of new flood exposure through studies is a critical step in proposing solutions in the form of new FMEs, FMSs, and FMPs.

6.A.1.b. Reduction in Flood Risk Exposure

FMPs positively impact flood risk exposure by removing or reducing population and infrastructure from flood risk. Five FMPs are recommended for implementation and **Table 6-1** summarizes the estimated reduction in flood risk exposure to structures, population, and low water crossings in the 1 and 0.2 percent ACE floodplains from implementation. Some potential FMPs did not have quantified benefits due to the limited details included in current available studies. These projects were recommended as FMEs for further evaluations and may be included as an FMP in a future planning cycle once benefits and impacts can be quantified. A special note on **Table 6-1** is that five of the recommended FMPs: Bessie Heights Drainage Ditch Extension Project, Borley Heights Relief Project, Ditch 505 Detention, Delaware Hilcorp Detention Diversion, and Virginia Street Detention only contained inundation data up to the 1% ACE event.

TABLE 6-1: REDUCTION IN FLOOD RISK EXPOSURE DUE TO RECOMMENDED FMPS

Flood Exposure Region-wide	Existing Conditions		After Implementation		Reduction in Exposure	
	1% ACE	0.2% ACE	1% ACE	0.2% ACE	1% ACE	0.2% ACE
Total Structures	34,728	77,717	28,686	69,821	6,042	7,896
Residential Structures	25,145	60,323	20,604	53,929	4,541	6,394
Critical Facilities	479	2,082	390	1,872	89	210
Population	65,717	158,275	49,137	135,703	16,580	22,572
Low Water Crossings	165	173	165	173	0	0
Road Length (Miles)	1,505	2,454	1,429	2,418	76	36

6.A.1.c. No Adverse Impact

The recommended FMPs will not negatively affect neighboring areas located within or outside of the flood planning region. All recommended FMPs were previously modeled to ensure "no negative flood impact" on upstream, downstream, or neighboring areas. These impact analyses were conducted outside of the flood planning process and were performed at a planning level. The local sponsor will ultimately be responsible for ensuring the final project design has no negative flood impact prior to initiating construction.

6.A.2. Avoidance of Future Flood Risk

The following sections describe how additional, future flood risk may increase if no changes are made to floodplain policies. Impacts of the RFP on existing flood risk that also impact future flood risk are not included in the discussion.

Floodplain management recommendations and goals were established by the RFPG in **Chapter 3**. While most of the RFP focuses on the current cycle, the flood mitigation and floodplain management goals establish a long-term vision to achieve target metrics. Of the 25 goals set forth by the RFPG, the short-term and long-term goal of reducing the exposure of existing and future structures in the 100-year flood risk inundation extents by elevating, acquiring, relocating or otherwise providing flood protection by

10% and 30%, respectively, will be impactful in helping communities in the region avoid increases in flood hazard exposure. Additionally, the short-term and long-term goal of new regional infrastructure projects utilizing larger storm events (>100-year) as the basis of their design will help assure infrastructure is able to handle increases in precipitation as a result of future climate change.

Based on the future flood hazard analysis from **Chapter 2**, over 88,000 new residential structures are projected to be constructed in flood hazard areas to accommodate population growth over the next 30 years. The potential flood risk of new structures can be reduced by communities adopting more comprehensive floodplain management criteria and standards. Regulation of development, implementation of higher standards, and use of best available data are all interdependent strategies for avoiding potential increases in flood exposure over time. The goal listed above will be realized through execution of FMSs recommended in this plan and in future planning cycles. **Table 6-2** lists the recommended FMSs that will contribute to achieving the RFPG's floodplain management goals in the current planning cycle. Through these development regulations, the Regulatory and Guidance FMSs have the potential to reduce flood risk for newly constructed buildings in the Neches River Basin.

TABLE 6-2: FLOODPLAIN MANAGEMENT POLICY IMPACTS DUE TO RECOMMENDED FMSS

FMS ID	FMS Name	FMS Description
052000061	City of Diboll Ordinance and Regulation Update	Update building code and subdivision ordinance to include restrictions on the distance a structure can be built from active streams and creeks.
052000063	City of Cuney Seek NFIP Participation	Pass appropriate Resolutions and Ordinances for participation in the National Flood Insurance Program.
052000066	City of Reklaw Improved Enforcement of Ordinances	Improve the long-range management and use of flood-prone areas by the adoption and enforcement of local ordinances to regulate new development within the floodplain. Review and revise ordinances, when needed.
052000078	JCDD7 Storm Water Management Plan	Help to establish and allow District to enforce development regulations within existing flood zones.
052000079	City of Daisetta Property Construction Ordinance	The city shall adopt a land-use ordinance which prohibits building residential or commercial structures in the 100-year floodplain.
052000080	City of Daisetta Property Elevation Ordinance	The city shall adopt a land use ordinance which requires any structure within the 100-year floodplain to be elevated 2 feet above base flood elevation.
052000081	City of Hardin Subdivision Ordinance Implementation	Implement subdivision ordinance regulations concerning building in flood-prone areas.
052000083	City of Nacogdoches Codes and Ordinances Update	Review and update, if necessary, all City codes and ordinances pertaining to floodplain management to ensure their compliance with state and federal

FMS ID	FMS Name	FMS Description
		laws and to achieve cohesion with the mitigation strategies contained herein.
052000084	OCDD Drainage Criteria Manual and Regulations Enforcement	Implement and enforce the Drainage Criteria Manual and Regulations for regulation of the effects of new developments and stormwater runoff.
052000085	OCDD Support/Create Stricter Floodplain Ordinances	Work with Communities to support ordinances or create ordinances that help to protect new structures from being built in the floodplain or floodway
052000087	City of Linsdale Natural Runoff Policies Implementation	Incorporate “natural run-off” policies. Calculate cumulative effect of development, increase capacity of storm water drainage systems, institute regular drain system maintenance.
052000088	City of Linsdale No Adverse Impact Implementation	Incorporate "no adverse impact” design requirements in community development. Provide awareness to stakeholders and design engineers; building code adoption and plan approval process.
052000089	City of Troup Floodplain Ordinance Update	Adopt and enforce a stricter floodplain ordinance that no new structures are allowed in the 100-year floodway. Adopted by City Council action.
052000090	Trinity County Dam/Levee Failure Data Collection	Develop and implement standard operating procedures for collecting and sharing data to provide extent of dam/levee failure
052000091	Van Zandt County Higher Standards Incorporation	Incorporate Higher Standards for Hazard Resistance in Local Application of the Building Code.

6.A.3. Other Impacts

The sections below describe the anticipated impacts of the plan on each of the following categories: socioeconomic, recreational, environment, agriculture, water quality, erosion, sedimentation, and navigation.

6.A.3.a. Socioeconomic Impacts

The American Psychological Association defines socioeconomic advantage or disadvantage relative to a person’s access to social resources and ability to participate in society. Studies of socioeconomic status can reveal inequities in access to resources which could prevent accessing the services to plan, respond and recover from flood events. Flooding does not only result in damaged infrastructure and property, but also has an adverse social impact. The short-term and long-term impacts on physical and mental health result in changes to the livelihoods of affected citizens creating greater socioeconomic disparity.

Socioeconomic impacts were taken into consideration to evenly distribute flood risk reduction benefits among all groups across the flood planning region as much as practical. The region has a diverse population with wide ranging economic levels. Processes in developing the appropriate FMSs, FMPs, and FMEs included reducing impacts from flood events and improving the lives of all socioeconomic groups ensuring the most disadvantaged were well represented. This effort can be seen in the locations of FMSs, FMPs, and FMEs identified throughout the flood planning region and the many city-wide, county-wide, and watershed-wide recommended FMSs and FMEs.

6.A.3.b. Recreational Impacts

Using natural or man-made water bodies for recreation is highly valued in the Neches region and throughout Texas. Many waterfront parks are designed to be flooded with minimal damage during storm events. These floodplains and wetlands can support tourism, recreation, and freshwater fisheries. Recreational benefits can also accompany flood mitigation projects. Along the Neches River, many flood control reservoirs are utilized for recreation including boating and fishing, notably Lakes Palestine, B.A. Steinhagen and the Sam Rayburn Reservoir. The FMPs recommended by the RFPG will not impact the recreational use in these areas.

Erosion prevention efforts included in the RFP also provide recreational benefits, since all land within the streambed is state-owned property and publicly available for recreational activities such as camping, fishing or boating. Recommended FMPs and FMSs that provide channel improvements protect streambeds and adjacent communities from erosion.

Additionally, the list of recommended FMSs includes the development of property acquisition programs in Angelina, Liberty, San Augustine, and Shelby Counties which could provide recreational benefit for the respective communities by opening opportunities for the creation of common gathering spaces such as parks. While parks and camping areas are valuable assets to the region, there are potential disadvantages to using the floodplain for recreation as flash flooding in these areas could be dangerous to recreational users. Therefore, consideration must be made to include adequate warning systems for individuals using these facilities.

6.A.3.c. Environmental Impacts

The FMPs and FMSs recommended by the RFPG are not anticipated to negatively impact the environment. The property acquisition FMSs mentioned above will remove structures from flood risk through demolition and will benefit the environment by eliminating the release of pollutants associated with flooded homes and septic systems such as viruses, bacteria, and mold. Although the intended use for the land is after demolition is unknown, one possible use would be as local park space, which would benefit the environment by promoting the development of habitats for native plant and animal species.

6.A.3.d. Agricultural Impacts

Flooding or excess precipitation can wash nutrients downstream or result in loss of crops. Livestock can be swept away, drowned, injured by flood waters, or exposed to contaminated flood waters which can result in health issues. After the implementation of the RFP, about 0.1 square miles of agricultural land is anticipated to be removed from the 1% ACE flood hazard area as a result of recommended FMPs in the region. Several of the recommended FMPs are in areas of high development, which serves to explain the low amount of agricultural area removed.

TABLE 6-3: REDUCTION IN AGRICULTURAL LAND DUE TO RECOMMENDED FMPS

Flood Exposure Region-wide	Existing Conditions		After Implementation		Reduction in Exposure	
	1% ACE	0.2% ACE	1% ACE	0.2% ACE	1% ACE	0.2% ACE
Agricultural Land (sq. mi.)	119	167	119	167	0	0

6.A.3.e. Water Quality Impacts

Water-quality concerns within the flood planning region are high nutrient loads, high bacterial and salinity levels, and low dissolved oxygen. The reduction in flooded structures and mitigation of flooded agricultural land mentioned in the previous sections will improve water quality. The list of recommended FMEs includes actions relating to detention ponds. An ancillary benefit of detention ponds is the increased retention time for runoff, allowing for more particulates to settle before reaching larger water bodies. Another benefit of flood risk reduction projects is reduced risk to water treatment plants and wastewater treatment plants. Reduced flood risk lowers the likelihood of potential flooding and overflow from these facilities, resulting in improved water quality downstream.

6.A.3.f. Erosion and Sedimentation Impacts

The recommended FMPs and FMSs include action linked to channel improvement and retention pond projects. These projects improve sediment control by reducing channel erosion and increasing retention times to allow more sediment particles to be removed from flood waters. The RFP does not include any impacts to erosion on the Neches River.

6.A.3.g. Navigation Impacts

The Sabine-Neches Waterway is the second longest inland waterway on the Gulf Coast. The Sabine-Neches Navigation District is the local governing body of the waterway with the federal sponsor being the US Army Corps of Engineers (USACE). The implementation of recommended FMPs and FMSs in the RFP will not impact navigation on the Neches River nor the Sabine-Neches Waterway.

Chapter 6.B. Contributions to and Impacts on Water Supply

RFPs must include a region-wide assessment of the potential contributions and impacts that implementation of FMSs and FMPs would have to water supply development and the State Water Plan. The Neches FPR is contained almost entirely within the East Texas Regional Water Planning Region (Region I) with the exception of a small area of Van Zandt County that is included in Region C and the far southwest and coastal areas of the basin included in Region H**. Figure 6-1** shows all Water Planning Areas and the Neches Flood Planning area.

Examples of FMPs and FMSs that could potentially impact water supply include structures located over aquifer recharge zones or changes to reservoir operations such as lowering the conservation pool to create additional flood storage. Each recommended FMS and FMP was reviewed and it was determined that no negative anticipated measurable impacts to water supply, water availability, or strategies in the State Water Plan would occur from implementation. It was also determined that the recommended FMSs and FMPs would not provide measurable benefits to water supply, water availability, or strategies.

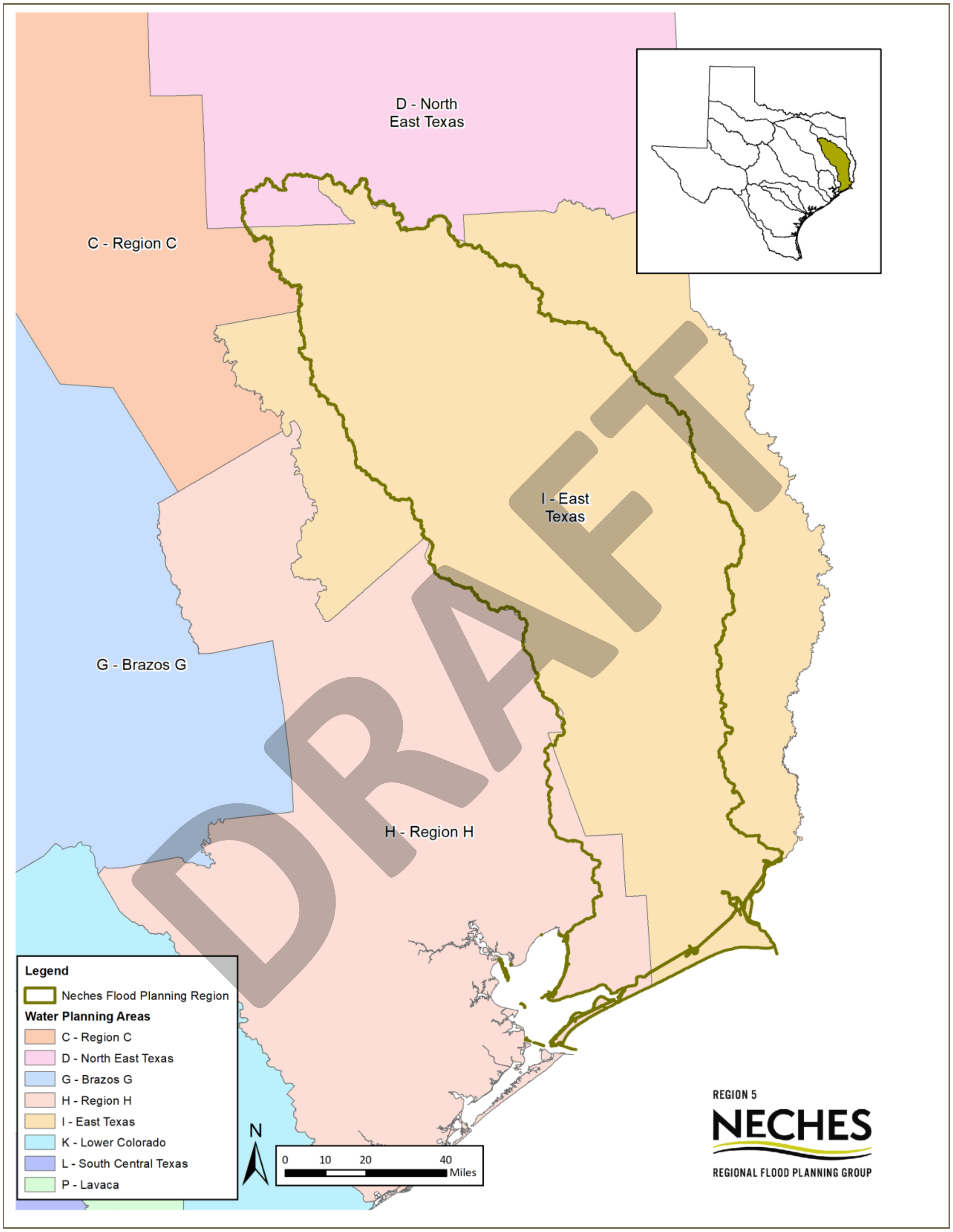


FIGURE 6-1: WATER PLANNING AREAS AND NECHES FLOOD PLANNING REGION

CHAPTER 7
FLOOD RESPONSE INFORMATION AND ACTIVITIES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICIES

CHAPTER 7. FLOOD RESPONSE INFORMATION AND ACTIVITIES

This information was developed for the Neches FPR by using historical data from previous flood events and data from stakeholder survey responses. Per Title 31 TAC §361.72(a)(4), the RFPG did not perform analyses or other activities related to planning for disaster response or recovery activities.

Emergency Management is made up of four phases: mitigation, preparedness, response, and recovery. They can be summarized as follows:

Flood Mitigation: The implementation of actions, including both structural and non-structural solutions, to reduce flood risk to protect against the loss of life and property.

Flood Preparedness: Actions, aside from mitigation, that are taken before flood events to prepare for flood response activities.

Flood Response: Actions taken during and in the immediate aftermath of a flood event.

Flood Recovery: Actions taken after a flood event involving repairs or other actions necessary to return to pre-event conditions.

FIGURE 7-1: FOUR PHASES OF EMERGENCY MANAGEMENT

Hazard mitigation is an on-going process that occurs before, during, and after disasters and seeks to break the cycle of damage and restoration in hazardous areas. The role of flood preparedness is to ensure appropriate actions are taken ahead of forecasted events so that loss of life and property can be minimized. Some actions associated with preparedness include activation of Emergency Operation Centers (EOC), notifying and assembling essential personnel, reviewing disaster preparedness plans, performing drills and exercises related to response efforts, public notifications/warnings, and assessing potential vulnerabilities within the communities. During the response phase, disaster plans are implemented, search and rescues may occur, and low water crossing signs may be erected. In the recovery phase, evaluation of flood damage, rebuilding of damaged structures, and debris removal all occur. Since flood mitigation is the primary focus of the regional flood planning process, this chapter highlights the regional status of the last three phases of flood emergencies: preparedness, response, and recovery.

Chapter 7.A. Entities Assisting in Emergency Management

Responsibility for flood preparedness, response, and recovery is shared between federal, state, and local government agencies, private-sector stakeholders, and the public. While direct responsibility for flood response activities rests with local governments and agencies (represented by the entities with flood-related authority), additional agencies involved include:

- Local Police Departments
- Local Fire Departments
- Local Emergency Management
- Texas Department of Public Safety (TxDPS)
- Texas Army National Guard (TXARNG)
- TxDOT
- Mobilized neighboring state law enforcement/search and rescue
- U.S. Geological Survey (USGS)
- National Weather Service (NOAA-NWS) Gulf Coast River Forecast Center
- U.S. Army Corps of Engineers (USACE)
- U.S. Forest Service (USFS)
- Federal Emergency Management Agency (FEMA)

7.A.1. Federal Agencies Roles and Activities

The Federal Emergency Management Agency (FEMA) is a federal agency within the U.S. Department of Homeland Security (DHS) and its mission is to help people before, during, and after disasters. FEMA is the official public source for regulatory flood hazard information which is produced in support of the National Flood Insurance Program (NFIP). FEMA has an active role in emergency preparedness and offers funds for training of response personnel. FEMA also has a large role in response and recovery efforts, with on-the-ground support of disaster recovery being a main charter of the agency.

FEMA’s mission is helping people before, during, and after disasters. FEMA helps people and communities to be more prepared for flood by developing the capabilities needed to prevent, protect against, respond to, recover from, and mitigate against disasters. FEMA helps communities prepare for floods by publishing the type of risks that exists in the community on the Map Service Center (MSC). This is the official public source for flood hazard information produced in support of the National Flood Insurance Program (NFIP). The DHS also maintains ready.gov, a website designed with a goal of promoting preparedness through public involvement. FEMA provides funds for training of response personnel throughout the United States and its territories as part of the agency's preparedness effort. FEMA also has a large role in response and recovery efforts, with on-the-ground support of disaster recovery being a main charter of the agency. FEMA also provides assistance with rebuilding efforts by providing post disaster recovery fund and low-interest loans.

The U.S. Army Corps of Engineers (USACE) is composed of several districts which are within the Neches FPR. These include the Galveston and Fort Worth Districts. USACE is involved in many emergency management actions, one of which being the Flood Risk Management Program (FRMP). This program was established in May 2006 and its two primary purposes are to reduce overall flood risk and convene and facilitate dialog at all levels of government and with other key interests.

The National Oceanic and Atmospheric Administration (NOAA) is a scientific and regulatory agency within the United States Department of Commerce which has many functions. Some of its functions include weather forecast and severe weather forecast. NOAA also maintains historical weather data and works with communities to help determine the likelihood of future flood events.

The National Weather Service's (NWS) mission is to provide weather, hydrologic, and climate forecasts and warnings for the United States for the protection of life and property and the enhancement of the national economy. NWS plays a large role in the preparedness of storm events by providing forecast data through its two hydrologic services, the River Forecast Center (RFC) and the NWS Weather Forecast Offices (WFOs).

7.A.2. State Agencies Roles and Activities

The Texas General Land Office (GLO) is the oldest state agency in Texas. Through the Community Development and Revitalization division, the GLO works to rebuild Texas communities by putting Texans back in their homes, restoring critical infrastructure, and mitigating future damage through resilient community planning. It is the lead state agency for managing disaster recovery grants through the U.S. Department of Housing and Urban Development (HUD). More than $14 billion have been allocated for recovery and mitigation following Hurricanes Rita, Dolly, Ike, the 2015 and 2016 floods, Hurricane Harvey, the 2018 South Texas floods, and the 2019 disasters. These grants are used for a wide variety of activities including housing redevelopment, infrastructure repair, and long-term planning. The GLO has also used planning funds to conduct regionally minded studies in coordination with local communities to promote sound long-term recovery and mitigation efforts. Some of these studies include the Combined River Basin Flood Study, Texas Coastal Resiliency Master Plan, Sabine Pass to Galveston Study, Texas Coastal Infrastructure Study, Coastal Texas Protection and Restoration Feasibility Study (Corps Study), and Storm Surge Suppression Study. Each of these studies are part of the GLO's Hurricane Preparedness and Planning initiative.

The Texas Division of Emergency Management (TDEM), a division of the Texas Department of Public Safety (TxDPS), is charged with coordinating state and local responses to natural disasters and other emergencies in Texas. TDEM is intended to ensure the state and its local governments respond to and recover from emergencies and/or disasters and implement plans and programs to help prevent or lessen the impact of future emergencies and disasters. There are six TDEM regions within Texas. Their role is to carry out emergency preparedness activities and coordinate response operations. TDEM offers local officials emergency planning, training, and exercises which are taught through a variety of emergency management training courses. The Neches FPR is split between TDEM regions 1 and 2 as shown in **Figure 7-2**.

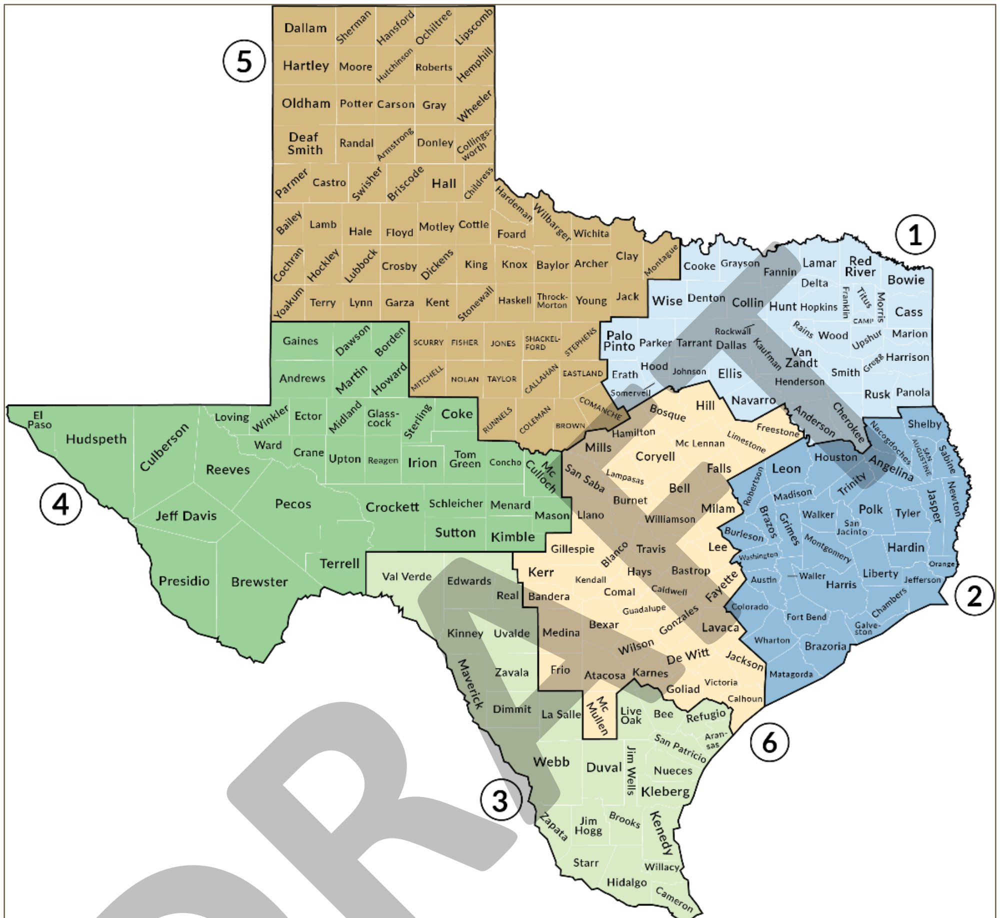


FIGURE 7-2: TDEM REGIONS

The Texas Department of Transportation (TxDOT) is a government agency in the state of Texas. TxDOT is most commonly known for its role on the state's highway system, which is often a major conveyor of stormwater. TxDOT roads are often key evacuation routes for communities; TxDOT correspondingly provides real time road closure and low water crossing information during and after a flood event.

The mission of the Texas Water Development Board (TWDB) is to lead the state's efforts in ensuring a secure water future for Texas and its citizens. TWDB provides water planning, data collection /dissemination, financial assistance, and technical assistance services to the citizens of Texas.

River Authorities/Districts in the state of Texas are public agencies established by the state legislature and given authority to develop and manage the waters of the state. The three river authorities in the region have the power to conserve, store, control, preserve, utilize, and distribute the waters of a designated geographic region for the benefit of the public.

7.A.3. Local Government Roles and Activities

Cities, or municipalities, are generally responsible for local response, recovery, and preparedenss for flood disasters. Public Works departments manage utilities including operating back-up generators for water and sewer plants. Road and maintenance crews monitor road conditions and, in the event of flooding, close roadways to prevent vehicles from entering high water. City officials also update their citizens through social media posts and public alerts before, during, and after events.

County governments provide oversight for the building and maintenance of roads, bridges and other county infrastructure in addition to providing emergency management services. There are 24 counties represented within the Neches region. During flood events, counties will provide the public with critical information, close flooded roadways, perform high water rescues, and coordinate emergency operations.

Drainage districts are special purpose districts established to own and maintain drainage infrastructure within their jurisdiction. Districts construct, improve, and maintain infrastructure as well as establish discharge rates into facilities they operate and maintain. After flood disasters, the districts may remove debris and sediment within channels to restore conveyance.

Chapter 7.B. Flood Preparedness in the Neches Flood Planning Region

The role of flood preparedness is to ensure appropriate actions are taken ahead of forecasted events so that loss of life and property can be minimized. In May 2021, a web-based survey was sent out to various stakeholders in the Region. One of the focuses of the survey was to gather information related to flood preparedness. The responses provide indicate an emphasis on flood measurement and public alert systems. The received responses pertaining to flood preparedness are shown in **Table 7-1**. Additional flood preparedness activities within the Neches FPR include Hazard Mitigation Plans and the Southeast Texas Flood Coordination Study.

TABLE 7-1: FLOOD EMERGENCY PREPAREDNESS SURVEY RESPONSES

Entity	Emergency Preparedness Activities Undertaken
City of Beaumont	Flood Gages
	Flood Warning Signs
	Public Emergency Alert System
	Public-Facing Website
	Rain/Stream Gages with Alerts
City of Bevil Oaks	Flood Gages
	Public Emergency Alert System
	Rain/Stream Gages with Alerts
City of Ivanhoe	Public Emergency Alert System
	Public-Facing Website
City of San Augustine	Public-Facing Website
City of Vidor	Public Emergency Alert System
Chambers County	Flood Warning Signs

Entity	Emergency Preparedness Activities Undertaken
	Public Emergency Alert System
	Public-Facing Website
Hardin County	Flood Gages
	Forecasting Tools for Floods
	Public Emergency Alert System
	Public-Facing Website
Henderson County	Flood Gages
	Flood Warning Signs
	Public Emergency Alert System
Jefferson County Drainage District 6	Cameras
	Flood Gages

As survey results indicate, the lower portion of the Neches FPR has an extensive network of gages which are monitored by a variety of stakeholders. There are two types of gages, rain and stream, that are used to help prepare and predict flood risk. A rain gage is a meteorological instrument to measure the precipitating rain in a given amount of time per unit area. Stream gauging is a technique used to measure the discharge, or the volume of water moving through a channel per unit time, of a stream. The height of water in the stream channel, known as a stage or gage height, can be used to determine the discharge in a stream.

7.B.1. Southeast Texas Regional Alerting & Information Network (SE Texas R.A.I.N)

The Southeast Texas Regional Alerting & Information Network (SE Texas R.A.I.N.) is a web-based public informational resource which compiles and presents information necessary to make important preparedness and response decisions during threatening weather conditions. This regional project was conceived in the aftermath of Hurricane Harvey in 2017, with a geographic scope that spans the southerly portions of the Neches and Sabine River watersheds.

The SE TEXAS RAIN website displays rainfall, streamflow, and stream and reservoir levels in major streams, bayous, and reservoirs compiled from many data sources which include the USGS and NWS Gulf Coast River Forecast Center. The system relies on a network of river and reservoir gaging stations.

The purpose of the SE TEXAS RAIN website is to present river stage and site condition information in a user-friendly format which is applicable to residents and emergency managers in the southeast Texas region. This information also assists Emergency Management Offices, county governments and local and regional governments to advise the public of rising water conditions in reservoirs, rivers, and bayous.

The site includes rainfall and river level maps, hydrographs and cross-sections, and flow rate data for multiple gauges across the region. It also provides relevant emergency management contacts, links to informational resources, and option to subscribe for automated alerts.

7.B.2. Jefferson County Drainage District No. 6 Alert II – Early Flood Detection System

Jefferson County Draiange District No. 6’s Alert II – Early Flood Detection System at its core relies on a network of gauge stations located at various positions throughout the District’s watersheds. These gauge stations possess sensors that transmit crucial data during times of heavy rainfall and/or tropical storms and hurricanes. The stations also have capabilities to measure wind speed/direction, barometric pressure, air temperature, and humidity. From this system, the District is able to view the full scope of drainage throughout the 5 watersheds in its area.

The website for the Alert II- Early Flood Detection System is intended to provide information collected from the stations in an accessible and user-friendly format. The information is used not only by the District but also other government agencies to include the National Oceanic and Atmospheric Administration (NOAA) and the United States Geological Survey (USGS).

7.B.3. Southeast Texas Flood Coordination Study

In 2019, Lamar University initiated the Southeast Texas Flood Coordination Study (FCS) to address storm-related disaster concerns with the future intention to serve as a communication conduit, geospatial and infrastructure data collaborative, economic and research resource, and educational outlet along the Gulf Coast. Various counties, river authorities, cities, drainage districts, industries, state agencies, and federal agencies are active participants in this study.

In 2020, Lamar University was awarded $100,000 from the Lower Neches River Authority and $100,000 by the Sabine River Authority of Texas to collaborate with the Southeast Texas Flood Control District (FCD), the University of Texas, the Texas Division of Emergency Management, the Texas Department of Transportation, and various other entities on a flood coordination study. The project is designed to help the region improve its resilience during large-scale flooding events.

In addition to facilitating flood information and knowledge exchange, the FCS works on several projects. In 2021, the FCS was further funded as part of the Lamar University Center of Resiliency established by the State Legislature. The largest project undertaken in 2021 and 2022 was the installation of 73 Department of Homeland Security (DHS) flood sensors in the lower portion of the Neches River watershed. The network of sensors alert of high water levels and are used to forecast chances of flooding and help emergency responders know how to re-route emergency supplies to areas most in need.

7.B.4. Southeast Texas Alerting Network (STAN)

The Southeast Texas Alerting Network (STAN) serves the residents of Jefferson, Orange, Hardin, and Jasper Counties. Local emergency management uses STAN to send two types of messages to the public:

1. Emergency messages: In the case of an event that warrants public action, local emergency management can send emergency messages describing what actions need to be taken in response to the emergency.

2. Outreach messages: Additionally, emergency management uses STAN to send local notifications to the community, such as notices of water outages, street closures or traffic notices.

7.B.5. NOAA River Flood Forecasting

Most governmental entities and citizens within the region primarily rely upon the National Oceanic and Atmospheric Administration (NOAA) for forecasting of riverine flooding and flash flooding events through the National Weather Service (NWS). The NWS issues watches, advisories, and warnings for both flooding and flash flooding as well as hazardous weather and excessive rainfall outlooks.

7.B.6. Hazard Mitigation Plans

In the Neches FPR's data collection effort and survey in 2021, the region requested local emergency management and emergency response plans that were publicly available. Some emergency plans are protected by law and are not available for public consumption. Most portions of local Emergency Operations Plans (EOPs) are in a category of information considered "For Official Use Only" and are governed by rules which limit dissemination to the broader public. Certain EOP annexes, or Emergency Service Functions, have higher levels of classification than others which prohibit distribution to non-official sources.

In addition to the plans provided by local entities, the region also obtained Emergency Management plans, Hazard Mitigation Plans, and other regional and local flood planning studies from County and local jurisdictions. An emergency management plan is a course of action developed to mitigate the damage of potential events that could endanger an organization's ability to function. Such a plan should include measures that provide for the safety of personnel and, if possible, property and facilities. Hazard mitigation planning reduces loss of life and property by minimizing the impact of disasters. It begins with state and local governments identifying natural disaster risks and vulnerabilities that are common in their area; after identifying these risks, governments develop long-term strategies for protecting people and property from similar events. Mitigation plans are key to breaking the cycle of disaster damage and reconstruction. Most of the counties in the Region have a Hazard Mitigation Plan; however, some of the jurisdictions may be updating their hazard mitigation plans currently. Having an up-to-date HMP is key in assessing risk and in developing mitigation actions. **Table 7-2** lists the Hazard Mitigation Plans made available to the flood planning process.

TABLE 7-2: HAZARD MITIGATION PLANS

Jurisdiction	Year
Anderson County	2018
Angelina County	2019
Chambers County	2017
Cherokee County	2020
Hardin County	2022
Harris County	2020
Henderson County	2020
Jasper County	2019
Jefferson County Drainage District 6	2016

Jurisdiction	Year
Jefferson County Drainage District 7	2017
Liberty County	2017
Orange County Drainage District	2017
Polk County	2018
San Augustine County	2018
Smith County	2018
Trinity County	2019
Van Zandt County	2019

7.B.7. Lamar University Hurricane Preparedness Annex

The Lamar University Hurricane Preparedness Annex provides guidance on preparation for, response to, and recovery from the impacts of a tropical storm or hurricane. This Annex supports the existing policies established at the University with an "all-Hazards" approach and emergency management operations structure, utilizing the National Incident Management System (NIMS) and the Incident Command System (ICS), to provide support for timely managerial focus on response operations and to support a transition for recovery operations.

7.B.8. InFRM Flood Decision Support Toolbox (FDST)

The Interagency Flood Risk Management (InFRM) Flood Decision Support Toolbox (FDST) is a publicly available interactive flood inundation tool designed to support planning for emergency preparedness and efforts for emergency response. The FDST contains flood inundation data for 13 gage locations in the Neches basin and utilizes maps that automatically update to reflect the most recent flood forecast from the National Weather Service (NWS). Additionally, the FDST also possess capabilities of simulating water elevations of various storm severity near the stream gage locations that are included in the toolbox. These simulations can be used by emergency response officials to examine flood extents and flood depths at specific locations in their communities.

Chapter 7.C. Flood Response in the Neches Flood Planning Region

A section of the May 2021 survey focused on collecting data on flood response in the region. Flood response measures in the region include:

- Public facing websites
- Portables traffic message boards
- Public Emergency Alert System
- Crew(s) set up barricades or close gates
- Outdoor siren/message speaker system
- Swift water rescue team

Many of the mitigation and preparatory actions are done in conjunction with the relevant entities who put these actions into practice.

As discussed in **Chapter 1**, the Neches region is frequently affected by high intensity rainfall events, with the most severe caused by tropical storms hitting the coastal portion of the region. In many instances, these tropical disturbances travel inland and result in excessive rainfall far away from the coast. While both the coastal and inland portions of the region are exposed to flood risk from riverine or local sources, the coastal portion has to prepare for storm surge and the flooding of a naturally wide floodplain; the inland portion is more significantly affected by flash floods that result in road closures.

With the region being constantly affected by flooding, local entities have taken actions to respond and prepare for flooding emergencies, select examples of past flood response and preparedness activities are included in **Table 7-3**.

TABLE 7-3: EXAMPLES OF FLOOD RESPONSE AND RECOVERY ACTIVITIES

Activity Description	Category	Entity	Location	Year
Flooding/ Road Closures and Signage	Response	City of Lufkin	West Frank Avenue	2021
Flooding/ Road Closures and Signage	Response	City of Lufkin	South First St (southbound)	2021
Flooding/ Road Closures and Signage	Response	City of Lufkin	Tom Holland Rd	2015
Flooding/ Road Closures and Signage	Response	City of Lufkin	S Loop 287	2015
Flooding/ Road Closures and Signage	Response	City of Nacogdoches	CR 353	2015
Flooding/ Road Closures and Signage	Response	City of Nacogdoches	Highway 7	2015
Flooding/ Road Closures and Signage	Response	City of Nacogdoches	CR 620	2015
Flooding/ Road Closures and Signage	Response	City of Nacogdoches	North Street	2021
Flooding/ Road Closures and Signage	Response	City of Lufkin	TX-103	2018
EOC Flood Response Incident Command	Response	TXDPS, TDEM, OEM	Jefferson County	2017
EOC Flood Response Incident Command	Response	TXDPS, TDEM, OEM	Hardin County	2017
EOC Flood Response Incident Command	Response	TXDPS, TDEM, OEM	Liberty County	2017
EOC Flood Response Incident Command	Response	TXDPS, TDEM, OEM	Orange County	2017
EOC Flood Response Incident Command	Response	TXDPS, TDEM, OEM	Jasper County	2017
Lumberton High School Flood Response Staging Area	Response	TXDPS, TDEM, OEM	City of Lumberton	2017

The widespread emergency response to Hurricane Harvey in 2017 is captured by the multiple incident commands issued by emergency management offices in the counties in proximity to the coast. As noted earlier, the upper portion of the watershed is affected by more localized flood-related emergencies such as road closures caused by a rapid accumulation of rainfall.

7.C.1. Southeast Texas Regional Planning Commission 9-1-1 Emergency Network

The South East Texas Regional Planning Commission (SETRPC) is a voluntary association of local governments that serves an area composed of Hardin, Jasper, Jefferson, and Orange Counties. The Planning Commission was established in June 1970 under authority provided by the Texas Legislature in 1965. Its membership is open to all general and special purpose local governmental bodies in the four-county region and is governed by an Executive Committee composed of elected officials from the various entities. SETRPC has several divisions, one of which is focused on emergency response. With the assistance of local elected officials from Hardin, Jefferson, and Orange counties, the 9-1-1 Emergency Communications System went online in December of 1991. SETRPC was the first regional 9-1-1 system to fully implement Enhanced 9-1-1 in all its three-county service areas.

Chapter 7.D. Flood Recovery in the Neches Flood Planning Region

The most common flood recovery activity within the region is debris removal at culvert entrances and bridges, which, if not remedied, compounds the next flood emergency. This activity is primarily conducted by cities, counties, and TxDOT. A lack of coordination between the responsible entities for debris removal at these facilities is a commonly reported problem by cities and counties.

FEMA is the primary agency that provides funding and support for recovery efforts after severe flooding emergencies within the region. Cities, counties, and individuals coordinate rebuilding efforts through FEMA, which are aided by relief funds and low-interest loans.

Additionally, recovery efforts for flood damaged housing and infrastructure in the Neches FPR has been a major undertaking during the most recent half decade. Funding for recent flood recovery efforts has been provided by the U.S. Department of Housing and Urban Development (HUD), and administered statewide by the Texas General Land Office Community Development and Revitalization division (TX-GLO-CDR).

Using 2017 Hurricane Harvey as a prime example, HUD allocated $5.024 billion in disaster recovery funds to the State of Texas. According to HUD federal financial tracking, as of June 2022 approximately 48% of the State's $5 billion allocation has been utilized, predominantly based on expenditures for housing recovery. Infrastructure funding expenditures is tracking at roughly 10% implementation as of June 2022.

Roughly 20% of the statewide total disaster recovery allocation for Hurricane Harvey, or $1 billion, was allocated to the Neches FPR. Approximately 77% of this amount was dedicated to housing recovery in the form of housing reconstruction, repair, and buyouts. As of June 2022, these housing recovery projects have been predominantly focused on housing reconstruction and repair, and have been implemented in roughly equal proportion across the southerly portions of the Neches FPR that was impacted by Hurricane Harvey.

The remaining 23% was dedicated to infrastructure recovery primarily in the form of road reconstruction, drainage and flood control improvements, water system repairs, and emergency equipment repair. **Table 7-4** provides an overview of specific Harvey disaster infrastructure recovery allocations for the Region.

TABLE 7-4: NECHES FPR - HURRICANE HARVEY INFRASTRUCTURE DISASTER RECOVERY ALLOCATION TOTALS

County	Total
Jefferson County	$42,382,472
Hardin County	$17,860,588
Orange County	$12,934,201
Chambers County	$10,569,142
Liberty County	$5,326,793
Jasper County	$1,598,067
Tyler County	$757,503

Sources: HGAC CDBG-DR Harvey MOD, SETRPC CDBG-DR Harvey MOD, DETCOG CDBG-DR Harvey MOD

Specific examples of disaster recovery projects to be funded through these allocations include water system improvements for the City of Beaumont; water system improvements for the Cities of Groves and Port Arthur; drainage projects in Jefferson County implemented by DD6 and DD7; road repair, drainage projects, emergency systems and equipment repair in Hardin County; drainage improvements in the City of Lumberton, and school reconstruction and water system improvements in Sour Lake.

7.D.1. Southeast Texas Regional Planning Commission Disaster Recovery Division

As previously mentioned, SETRPC has several divisions, one of which is focused on flood recovery. The Disaster Recovery Division has worked with various agencies to provide disaster related recovery efforts following natural disasters in the Southeast Texas area. Some of SETRPC's recent projects have in partnership with the Texas General Land Office (GLO) and have consisted of providing quality assurance and quality control (QAQC) expertise in the area of application submissions for single family housing repair and reconstruction services provided directly by the GLO. SETRPC has also worked with the GLO in the development of plans to distribute and administer Community Development Block Grants for Disaster Recovery (CDBG-DR) funding allocated to the state from the U.S. Department of Housing and Urban Development (HUD).

CHAPTER 8
ADMINISTRATIVE, REGULATORY, AND LEGISLATIVE RECOMMENDATIONS

TABLE OF CONTENTS

APPENDICES

Appendix 8-A: Bibliography

CHAPTER 8. ADMINISTRATIVE, REGULATORY, AND LEGISLATIVE RECOMMENDATIONS

Texas Administrative Code (TAC) 361.43 states, "The RFPGs must develop and include:

1. Legislative recommendations that they consider necessary to facilitate floodplain management and flood mitigation planning and implementation;
2. Other regulatory or administrative recommendations that they consider necessary to facilitate floodplain management and flood mitigation planning and implementation;
3. Any other recommendations that the RFPG believes are needed and desirable to achieve its regional flood mitigation and floodplain management goals;
4. Recommendations regarding potential, new revenue-raising opportunities, including potential new municipal drainage utilities or regional flood authorities, that could fund the development, operation, and maintenance of floodplain management or flood mitigation activities in the region.

The recommendations presented in this chapter address items that benefit and/or can be implemented at the local, regional, or state levels and include suggested changes to the flood planning process for the TWDB to consider in the next regional and state flood planning cycle.

Chapter 8.A. Legislative Recommendations

8.A.1. Continue biennial appropriations to the Flood Infrastructure Fund (FIF)

Senate Bill 7, established by the 86th Texas Legislature in 2019, created the Flood Infrastructure Fund (FIF). The FIF program, approved by Texas voters through a constitutional amendment, provides financial assistance in the form of loans and grants for flood control, flood mitigation, and drainage projects. The Texas Legislature approved a one-time appropriation of $793 million.

According to TWDB's State Flood Assessment, statewide flood mitigation costs over the next 10 years are estimated to be more than $31.5 billion; however, that estimate is derived from limited stakeholder data. Therefore, the RFPG recommends continued appropriations to the FIF which will further enhance public safety and help achieve the Regional Flood Plan and State Flood Plan goals of reducing the risk and impact to life and property.

8.A.2. Increase state funding for technical assistance to develop accurate watershed models and floodplain maps

Chapter 4 highlights that much of the Neches FPR does not have adequate flood inundation maps. Similarly, according to TWDB's State Flood Assessment, much of Texas is either unmapped or uses out-of-date flood insurance rate maps, leading to widespread misunderstanding about true flood risk. Therefore, the RFPG recommends that the State Legislature should continue to provide funding/support to local governments to allow them to update their maps to FEMA standards.

8.A.3. Allow counties the opportunity to establish drainage utilities and to collect drainage utility fees in unincorporated areas.

As defined by the Texas Constitution Local Government Code, Title 13, Subtitle A, Chapter 552, municipalities have the statutory authority to establish public utilities to provide services to their residents, including drainage. Subchapter C establishes the "cost of service" for drainage systems and includes acquisition, construction, repair, maintenance, project implementation, and administration. Although counties have floodplain management responsibilities, they do not have the authority to establish drainage utilities, and fees. This limits their ability to fund drainage related activities. Therefore, the RFPG recommends that the State grant counties the authority to enhance their role in floodplain management and much of the ongoing development in Texas, much of which takes place outside of municipal city limits.

8.A.4. Incentivize jurisdictions to work together to provide regional flood mitigation

The Regional Flood Planning process has illustrated that flooding occurs within watersheds that span multiple jurisdictions. This requires cooperation and coordination with multiple stakeholders across different local governments and regional entities. Additionally, large scale mitigation projects are necessary to reduce flood risks within multiple communities, thus requiring jurisdictions to work together on implementing these projects. The TWDB should incentivize and encourage watershed management planning and project implementation to enhance flood safety and manage costs. One way to do this is to add points to the TWDB, General Land Office (GLO), and other agency project evaluation processes. Another is the creation of regional drainage districts.

8.A.5. Incentivize buy-out programs to convert frequently flooded properties/neighborhoods into natural beneficial use areas

A common strategy to address repeated flooding are property buyout programs. These programs acquire private lands through purchase and the land is maintained in an undeveloped state for public use. Buyout programs are usually funded by federal entities such as the Federal Emergency Management Agency (FEMA) or the Department of Housing and Urban Development (HUD). These funds are typically administered by the state or local governments. Once a property is acquired, the land is maintained as an open space for the conservation of natural floodplain functions. Generally allowable land uses as indicated in Title 44 of the Code of Federal Regulations (CFR) Part 80 include:

- Parks for outdoor recreation,
- Wetlands management,
- Nature reserves
- Unimproved, unpaved parking lots.

Often time buyout programs can create several economic challenges for communities such as reduced investment, development, and economic activity. Therefore, it is recommended that programs are designed to incentivize the conversion of buyout properties into neighborhood parks to provide value to residents and municipalities.

8.A.6. Incentivize conservation easements for land in the 100-year floodplains

Communities that participate in the National Flood Insurance Program (NFIP) have Flood Hazard Boundary Maps (FHBMs) which depict areas of flood hazard. These areas are known as Special Flood Hazard Areas (SFHA). All development within the areas mapped as the 100-year year floodplain are subject to development regulations, which are regulated by the town, city, or government entities that is responsible for issuing or denying floodplain development permits. Although floodplain development projects must demonstrate that the proposed development is reasonably safe from flood damage and will not result in physical damage to any other property, developments are still surrounded by risk that was not removed as part of the project. Therefore, the RFPG recommends that there are incentives for preserving natural storage to maintain existing floodplain conditions.

8.A.7. Establish grant programs for the ongoing operations and maintenance (O&M) of existing flood mitigation and other drainage infrastructure

Operations and maintenance (O&M) are key but often overlooked components of flood infrastructure. Adequate maintenance practices assure infrastructure continues to function as designed. Additionally, it can extend infrastructure’s useful life preventing expensive replacement costs. Although infrastructure owners are aware of the importance of appropriate operation and maintenance, several of the entities within the Neches FPR do not have the appropriate budget to adequately perform these activities. Additionally, many of the existing grant programs focus on the establishment of new assets. Therefore, the RFPG recommends that grant programs are established for the ongoing operations and maintenance (O&M) of existing flood mitigation and other drainage infrastructure.

Chapter 8.B. Regulatory and Administrative Recommendations

8.B.1. Develop model floodplain management standards and ordinances

As illustrated in **Chapter 3**, there is much variability in common floodplain management standards and ordinances across the Neches FPR. These standards and ordinances are effective tools that communities can use to help prevent the loss of life and property. TWDB, FEMA, state agencies, and other organizations, such as the Texas Floodplain Management Association (TFMA), support professional education, training, and technical assistance programs. Programs can be crafted to include model ordinances that illustrate the value of enhanced standards, criteria, and regulations (stormwater detention, buffer zones, etc.) to minimize development in the floodplain and protect existing downstream property owners from unmanaged development. Additionally, implementation guidance can be developed for these model ordinances to encourage consistent interpretation by each county within the region.Therefore, the RFPG recommends that model floodplain management standards and ordinances are developed.

8.B.2. Provide support for ongoing education/training for floodplain management

The TWDB should partner with floodplain management organizations such as TFMA to develop and promote public flood risk education and outreach materials. Public outreach that provides opportunities for flood risk education and awareness helps to support public safety and flood mitigation measures in a variety of ways. A well-informed public can make better informed choices in their personal lives on issues that involve flood risk and more likely to support public policies and mitigation measures to reduce that risk. These outreach materials and education can reach an even wider audience by partnering with organizations like Texas Association of Counties that have broader reaches to smaller communities and those that may not have dedicated Floodplain Administrators with technical backgrounds.

8.B.3. Provide technical assistance to smaller jurisdictions

There are a total of 79 communities within the Neches FPR, with 65 having a population less than 10,000. Often time these communities do not have the technical, administrative, or financial resources to effectively pursue flood management evaluations, flood mitigation projects, flood management strategies, or even apply for funding. Therefore, the RFPG recommends that technical assistance is provided to these smaller jurisdictions so they can address flooding needs within their communities. Technical assistance can include:

- Assistance in preparing funding applications
- Expanding consideration and priority for FMEs that establish initial FEMA effective floodplains
- Provisions of a funding mechanism for smaller communities to acquire funds for studies that help identify flood mitigation projects and flood mitigation strategies
- Revisit scoring criteria for funding stormwater and flood-related projects to assure equitable distribution to rural, less populated areas of the state

8.B.4. Increase public education efforts

The regional flood planning effort is intended to be a grass roots effort, which requires community engagement and feedback. As part of this, effort should be made to promote public education and outreach related to flood awareness and flood safety. This will not only help educate the public about flood related issues, but also increase the amount of participation in the regional flood planning process.

8.B.5. Establish a process to take BLE data to regulatory information

Much of the flood risk defined for the Neches FPR was developed from Base Level Engineering (BLE) data. BLE is an efficient modeling and mapping approach that aims to provide technically credible flood hazard data at various geographic scales such as community, county, watershed, and/or state level. Currently the state and FEMA are heavily investing in BLE across the state and there is a need to clearly communicate to local jurisdictions how to make this data regulatory or, if desired, improve upon it to make it eligible for incorporation into a detailed study on a Flood Insurance Rate Map (FIRM). The steps for both paths remain unclear to many local jurisdictions and this large investment could be further leveraged, especially in the RFP process. Therefore, the RFPG recommends that a process be established to leverage the BLE data and use it for regulating development within the floodplains.

8.B.6. Establish a process to utilize BLE data for evaluation of FMPs

Several requirements must be met for a potential FMP to be included in the RFP. These requirements include detailed hydrology and hydraulics (H&H) modeling to demonstrate no adverse impact, benefit-cost analysis (BCA), and flood risk and damage reduction metrics. Throughout the first round of regional flood planning, it has become evident that several potential projects have not been studied to the level necessary for inclusion in the plan. This is in part due to the limited resources some of the smaller communities throughout the region have. As previously discussed, the state and FEMA have heavily invested in BLE. These models provide extensive coverage within the Neches FPR, but do not contain some of the necessary details (watershed specific hydrology and roadway crossing) that are critical to evaluate of potential projects. However, TWDB should establish a process through which BLE models can be utilized to evaluate potential FMPs.

8.B.7. Review and Update TxDOT design criteria

TxDOT is not a participant in the NFIP and does not in all cases design roadways in a manner consistent with minimum NFIP requirements. It is recognized that, by their nature, it is often not feasible or practicable to design and construct roadways to provide a level of flood protection equivalent to or greater than the 1% ACE storm event. However, as a matter of policy and practice, TxDOT should strive to meet this standard, especially for critical infrastructure such as evacuation and emergency routes. By not acting on this recommendation, newly built transportation infrastructure could be at risk of extreme event flooding or cause adverse impacts to surrounding properties.

Chapter 8.C. Flood Planning Recommendations

8.C.1. Promote nature-based projects

According to FEMA, nature-based solutions are sustainable planning, design, environmental management and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience. Other commonly used terms to designate this design paradigm are “green infrastructure”, “natural infrastructure”, and Engineering with Nature® (term used by the USACE). As stated in FEMA’s 2021 *Building Community Resilience with Nature Based Solutions* guide, in stormwater management the terms “green infrastructure” and “low impact development” (LID) are sometimes used interchangeably.

This approach offers significant monetary and non-monetary benefits, often at a lower cost than more traditional infrastructure. Additionally, they can help reduce some of the costs associated with traditional infrastructure, such as reduced operation and maintenance costs. Since nature-based solutions provide a variety of co-benefits, a single project may be eligible for many different private, state, and federal grant programs. Therefore, the RFPG recommends that project scoring for nature-based solutions be given a competitive chance compared to non-nature-based projects.

8.C.2. Utilize alternative statewide Social Vulnerability Index (SVI) than the one developed by the U.S. Center for Disease Control (CDC)

The Social Vulnerability Index (SVI) is used as a proxy for resilience for this initial flood planning cycle. It is a measure of the capacity to weather, resist, or recover from the impacts of a hazard in the long term as well as the short term. Vulnerability depends upon many factors such as land use, extent and type of construction, the nature of populations (mobility, age, health), and warning of impending hazardous events and willingness and ability to take responsive actions.

This initial flood planning cycle is utilizing the U.S. Center for Disease Control (CDC) and Prevention SVI metrics to evaluate the regions vulnerability and resilience. TWDB is designating areas as having a high SVI if the value is 0.75 or above. As illustrated in **Chapter 2**, there is only one county out of 24 that has an average SVI of 0.75 or above. The RFPG does not feel that the current dataset to measure vulnerabilities is representative of the region's ability to recover from flood events. Therefore, the RFPG recommends that an alternative statewide SVI index other than the current one is used to evaluate populations vulnerability.

8.C.3. Reassess requirements for potentially feasible Flood Mitigation Projects (FMP) that present challenges for inclusion of FMPs in regional flood plans

The initial regional flood planning cycle is not likely to include a significant number of identified or recommended FMPs. This is largely due to the strict requirements that must be met for a project to be included in the plan. While it is understood that TWDB is focused on funding projects that are well developed, consideration should be given to well-developed projects that may be lacking single items that can be fulfilled early in the design process.

8.C.4. Develop publicly available, statewide database of all the GIS deliverables associated with the development of the State Flood Plan

A large component of the RFP process consists of electronic geospatial data deliverables. These deliverables include entities, watersheds, streams, existing flood infrastructure (wetlands, ponds, lakes, dams, levees, sea barriers, tunnels, pipes, culverts, etc), existing flood hazards with the region, gaps in inundation boundary mapping, high-level, region-wide flood exposure identifying who and what might be harmed within the region. This is the first time a region wide data collection effort has been done and this information should be made accessible to the local communities across the state. Therefore, the RFPG recommends TWDB develop an online dashboard of all the GIS deliverables associated with development of the State Flood Plan.

8.C.5. Incorporate FEMA in the Regional Flood Planning process as a nonvoting RFPG member

The RFP process engages a variety of different audiences including the public, community officials and leaders, drainage districts, river authorities, and other state agencies. One area that is lacking involvement is from federal agencies such as FEMA. FEMA is a critical component of floodplain management and provides tools and resources to help communities navigate the National Flood Insurance Program (NFIP) requirements and implement higher standards of floodplain management. Incorporating FEMA into the RFP process will help shape some of the discussions related to floodplain management practice recommendations, goals, and assessments of flood management evaluations, strategies, and projects. It will also help strengthen the relationship with the local community.

8.C.6. Adjust population estimates to include transient population within each region

Oil and gas production is an integral component of Texas industry, and the Neches River Basin is no exception. Much of this industry is supported by individuals who may not reside in the area and are not captured in the region’s population count. Similarly, those involved in the construction industry can spend several years within a community and aren’t counted as part of that community’s population. Special consideration should be given to these populations as they are likely to not be aware of risks that exists within the community, or they can be temporarily housed in areas that may be prone to flooding. Therefore, the RFPG recommends that population counts be adjusted to include transient population that exists within each region.

8.C.7. Future Population Projections

Future population projections are prepared by TWDB as part of the Regional Water Planning process. Population projections, particularly in the lower FPR, are not representative of the current growth occurring. This is likely attributed to the fact that Texas is leading the nation in population growth. TWDB should revisit the future population projection estimates and verify they are capturing current growth trends within the state and FPRs.

8.C.8. Expanding scope of flood mitigation needs analysis

The flood mitigation needs analysis conducted for the region examined how many structures, including critical facilities, were located within flood-prone areas. However, identifying how many structures are at risk of flooding is often not enough to quantify the full impact flooding may have for the area. Different structures often have differing property values – the value of a structure in a rural area in the region may be starkly different than that of a structure located in a highly developed and urbanized area. Additionally, industrial buildings, if damaged by severe flooding events, also need to consider the costs associated with lost production and any necessary repair efforts. Therefore, it is encouraged that individual structure values and the cost of lost industrial production and repair are included as part of the factors to be analyzed for the flood mitigation needs analysis for future planning cycles.

8.C.9. Establish flood responses and flood warning activities that consider the needs of the disabled community

Flood warning and flood response measures are often invaluable tools communities use to save lives during flood events. However, conventional flood responses and flood warning measures are not effective for all populations, especially for those who may be disabled. In order to better protect life, an effort should be made to expand the accessibility of flood responses and flood warning activities used by communities in the region. An example of this can include offering accessible alerts, warnings, and preparedness information to individuals who are deaf, blind, hard of hearing, deaf-blind, or low vision.

CHAPTER 9
FLOOD INFRASTRUCTURE FINANCING ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

CHAPTER 9. FLOOD INFRASTRUCTURE FINANCING ANALYSIS

The focus of this chapter is to indicate how sponsors propose to finance recommended FMEs, FMSs, and FMPs. The Neches RFPG surveyed local government, regional authorities, and other political subdivisions that were identified as potential sponsors of recommended flood management evaluations (FMEs), flood management strategies (FMSs), and flood mitigation projects (FMPs). The complete list of actions recommended by the Neches RFPG is discussed in **Chapter 5.**

Chapter 9.A presents an overview of common sources of funding for flood management and flood mitigation efforts. **Chapter 9.B** discusses the methodology and results of the financing survey distributed to stakeholders in the region.

Chapter 9.A. Flood Infrastructure Funding Sources

Communities across the state utilize a variety of funding sources for their flood management efforts, including local, state, and federal sources. This section discusses some of the most common avenues of generating local funding and discusses various state and federal financial assistance programs available to communities.

Table 9-1 summarizes the local, state, and federal sources discussed in this chapter.

Through the RFPG's initial stakeholder outreach efforts, the Neches RFPG sought to understand the landscape of local funding for flood efforts in the planning region. Many communities, particularly smaller and more rural communities, reported that they did not have any local funding sources for flood management activities. Those communities that did report having local funding indicated that the primary source was utilizing a general fund or dedicated fees, specifically stormwater or drainage utility fees.

This section primarily focuses on the funding mechanisms available to municipalities and counties as a large majority of the FME, FMS, and FMP sponsors are mostly comprised of municipalities and counties within the region. Special purpose districts are briefly discussed as there may be opportunities to create more districts in the region. Funding avenues for other types of local and regional entities, such as river authorities, are not discussed in detail herein.

TABLE 9-1: COMMON SOURCES OF FLOOD FUNDING IN TEXAS

Source	Federal Agency	State Agency	Program Name	Grant (G)	Loan (L)	Post-Disaster (D)
Federal	FEMA	TDEM	**Hazard Mitigation Grant Program (HMGP)**	G		D
	FEMA	TWDB	**Flood Mitigation Assistance (FMA)**	G		
	FEMA	TDEM	**Building Resilient Infrastructure and Communities (BRIC)**	G		
	FEMA	TCEQ	**Rehabilitation of High Hazard Potential Dam Grant Program**	G		
	FEMA	*To Be Determined*	**Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM)**		L	
	FEMA	TDEM	**Public Assistance (PA)**	G		D
	HUD	GLO	**Community Development Block Grant – Mitigation (CDBG-MIT)**	G		D
	HUD	GLO	**Community Development Block Grant Disaster Recovery Funds (CDBG-DR)**	G		D
	HUD	TDA	**Community Development Block Grant (TxCDBG) Program for Rural Texas**	G		
	USACE		**Partnerships with USACE, funded through Continuing Authorities Program (CAP), Water Resources Development Acts (WRDA), Floodplain Management Services Program (FPMS), or other legislative vehicles***			
	EPA	TWDB	**Clean Water State Revolving Fund (CWSRF)**	G**	L	
State		TSSWCB	**Structural Dam Repair Grant Program**	G		
		TWDB	**Flood Infrastructure Fund (FIF)**	G	L	
		TWDB	**Texas Water Development Fund (Dfund)**		L	
		TSSWCB	**Operation and Maintenance (O&M) Grant Program**	G		

Source	Federal Agency	State Agency	Program Name	Grant (G)	Loan (L)	Post-Disaster (D)
		TSSWCB	**Flood Control Dam Infrastructure Projects - Supplemental Funding**	G		
Local			**General fund**			
Local			**Bonds**			
Local			**Stormwater or drainage utility fee**			
Local			**Special-purpose district taxes and fees**			

**Opportunities to partner with USACE are not considered grant or loan opportunities, but shared participation projects where USACE performs planning work and shares in the cost of construction.*
***The CWSRF program offers principal forgiveness, which is similar to grant funding.*

9.A.1. Local Funding

A community's general fund (for cities and counties) revenue stems from sales, property, and other taxes. The general fund is typically the primary fund used by a government entity to support most departments and services such as transportation, police, fire, parks and recreation, trash collection, and local government administration. Due to the high demands on this fund for many local needs, there is often not a significant amount of the general fund available for funding flood projects.

Dedicated fees such as stormwater or drainage fees are an increasingly popular tool for local flood-related funding. Municipalities can establish a stormwater utility (sometimes called a drainage utility), which is a legal mechanism used to generate revenue to finance a city's cost to provide and manage stormwater services. To provide these services, municipalities assess fees to users of the stormwater utility system. Impact fees, which are collected to cover a portion of the expense to expand storm water systems necessitated by new development, can also be used as a source of local funding for flood-related efforts.

Another source for local funding to support flood management efforts includes special districts. A special district is a political subdivision established to provide a single public service such as water supply, drainage, or sanitation within a specific geographic area. Examples of these special districts include Water Control and Improvement Districts (WCIDs), Municipal Utility Districts (MUDs), Drainage Districts (DDs), and Flood Control Districts (FCDs). Each of the different types of districts are governed by different state laws, which specify the authorities and process for creation of a district. Districts can be created by various entities including but not limited to the Texas Legislature, the Texas Commission on Environmental Quality, county commissioners' courts, and city councils. Depending on the type of district, the districts may have the ability to raise revenue through taxes, fees, or issuing bonds to fund flood and drainage-related improvements within a district's area. Orange County Drainage District collects stormwater/drainage fees, and representatives from Hardin County and Jefferson County Drainage District 6 have confirmed in the stakeholder survey their respective entities collect permitting fees. RFPG member input also communicated that the City of Port Neches and Jefferson County Drainage District 7 collect stormwater fees.

Lastly, municipalities and counties have the option to issue debt through general obligation bonds, revenue bonds, or certificates of obligation, which are typically paid back using any of the previously mentioned local revenue mechanisms.

Overall, local governments have various options for raising revenue to support local flood-related efforts; however, each avenue presents its own unique challenges and considerations. It is important to note that municipalities have more authority to establish various revenue options in comparison to counties. Of the communities that do have access to local funding, the amount available is generally much lower than the total need, leading local communities to seek out state and federal financial assistance programs.

9.A.2. State Funding

Today, communities have a broader range of state and federal funding sources and programs available due to new grant and loan programs that had not previously existed. There are two primary state agencies currently involved in providing state funding for flood projects: the TWDB and the Texas State Soil and Water Conservation Board (TSSWCB). It is important to note that state and federal financial assistance programs discussed herein are not directly available to homeowners and the general public. Local governments apply on behalf of their communities to receive and implement funding for flood projects in their jurisdiction.

9.A.2.a. Texas Water Development Board (TWDB)

Flood Infrastructure Fund (FIF)

The TWDB's Flood Infrastructure Fund (FIF) is a new funding program passed by the Texas Legislature and approved by Texas voters through a constitutional amendment in 2019. The program provides financial assistance in the form of low or no interest loans and grants (cost match varies) to eligible political subdivisions for flood control, flood mitigation, and drainage projects. FIF rules allow for a wide range of flood projects, including structural and nonstructural projects, planning studies, and preparedness efforts such as flood early warning systems. After the first State Flood Plan is adopted, only projects included in the most recently adopted state plan will be eligible for funding from the FIF. FMEs, FMSs, and FMPs recommended in this RFP will be included in the overall State Flood Plan and will thus be eligible for this funding source.

Texas Water Development Fund (DFund)

The TWDB also manages the Texas Water Development Fund (DFund) program, which is a state-funded streamlined loan program that provides financing for several types of infrastructure projects to eligible political subdivisions. This program enables the TWDB to fund projects with multiple eligible components (water supply, wastewater, or flood control) in one loan at low market rates. Financial assistance for flood control may include structural and nonstructural projects, planning efforts, and flood warning systems.

9.A.2.b. Texas State Soil & Water Conservation Board (TSSWCB)

The Texas State Soil & Water (TSSWCB) has three state-funded programs specifically for flood control dams: the Operation and Maintenance (O&M) Grant Program, the Flood Control Dam Infrastructure Projects - Supplemental Funding program, and the Structural Repair Grant Program. The O&M Grant Program is a grant program for local soil and water conservation districts (SWCD) and certain co-sponsors of flood control dams. This program reimburses SWCDs 90% of the cost of an eligible operation and maintenance activity as defined by the program rules; the remaining 10% must be paid with non-state funding. The Flood Control Dam Infrastructure Projects - Supplemental Funding program was newly created and funded in 2019 by the Texas Legislature. Grants are provided to local sponsors of flood control dams, including SWCDs, to fund the repair and rehabilitation of the flood control structures, to ensure dams meet safety criteria to adequately protect lives downstream. The Structural Repair Grant Program provides state grant funds to provide 95% of the cost of allowable repair activities on dams constructed by the United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS), including match funding for federal projects through the Dam Rehabilitation Program and the Emergency Watershed Protection (EWP) Program of the Texas NRCS.

9.A.3. Federal Funding

Federal funding currently accounts for a large share of total available funding for flood projects throughout the state. Federal funding programs have greater access and availability to large funding amounts appropriated by Congress. Commonly utilized funding programs administered by seven different federal agencies are discussed in this section. The funding for these programs originates from the federal government; however, many of the programs involve a state agency partner playing a key role in the management of the program. Each funding program has its own unique requirements, eligible applicants, eligible project types, and application/award timelines. More information regarding each program and these details can be found in the hyperlinks in the following sections.

9.A.3.a. Federal Emergency Management Agency (FEMA)

Common FEMA-administered federal flood-related funding programs include Flood Mitigation Assistance (FMA), Building Resilient Infrastructure and Communities (BRIC), Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM), the Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program, the Hazard Mitigation Grant Program (HMGP), the Public Assistance (PA) program, and the Cooperating Technical Partners (CTP) Program.

Flood Mitigation Assistance (FMA)

Flood Mitigation Assistance is a nationally competitive grant program that provides funding to states, local communities, federally recognized tribes, and territories. FMA is administered in Texas by the Texas Water Development Board (TWDB). Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program. Funding is typically a 75% federal grant with a 25% local match. Projects mitigating repetitive loss and severe repetitive loss properties may be funded through a 90% federal grant and 100% federal grant respectively. FEMA's FMA program now includes a disaster initiative called Swift Current. The program was released as a pilot initiative in 2022 and explored ways to make flood mitigation assistance more readily available during disaster recovery. Similar to traditional FMA, the program mitigates repetitive losses and substantially damaged buildings insured under the NFIP. Swift Current's pilot initiative made funding available in Louisiana, Mississippi, New Jersey, and Pennsylvania and the Infrastructure Investment and Jobs Act (IIJA) is expected to provide funding nationwide in the future.

Building Resilient Infrastructure and Communities (BRIC)

The Building Resilient Infrastructure and Communities (BRIC) is a new nationally competitive grant program implemented in 2020. The program supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is administered in Texas by the Texas Division of Emergency Management (TDEM). Funding is typically a 75% federal grant with a 25% local match. Small, impoverished communities and U.S. Island territories may be funded through a 90% federal grant and 100% federal grant, respectively.

Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM)

Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) is a new revolving loan program enacted through federal legislation in 2021 to provide needed and sustainable funding for hazard mitigation projects. The program is designed to provide capitalization grants to states to establish revolving loan funds for projects to reduce risks from disaster, natural hazards, and other related environmental harm. At the time of the publication of this plan, the program has not yet been implemented in Texas.

Rehabilitation of High Hazard Potential Dam (HHPD)

FEMA's Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program, administered in Texas by the Texas Commission on Environmental Quality (TCEQ), provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. The cost share requirement is typically no less than 35% state or local share.

Hazard Mitigation Grant Program (HMGP)

Under the Hazard Mitigation Grant Program (HMGP), FEMA provides funding to state, local, tribal, and territorial governments so they can rebuild from a recent disaster in a way that reduces, or mitigates, future disaster losses in their communities. The program is administered in Texas by TDEM. Funding is typically a 75% federal grant with a 25% local match. While the program is associated with Presidential Disaster Declarations, the HMGP is not a disaster relief program for individual disaster victims or a recovery program that funds repairs to public property damaged during a disaster. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster.

Public Assistance (PA)

The FEMA Public Assistance (PA) program provides supplemental grants to state, tribal, territorial, and local governments, and certain types of private non-profits following a declared disaster so communities can quickly respond to and recover from major disasters or emergencies through actions such as debris removal, life-saving emergency protective measures, and restoring public infrastructure. Funding cost share levels are determined for each disaster and are typically not less than 75% federal grant (25% local match) and typically not more than 90% federal grant (10% local match). In Texas, FEMA PA is administered by the TDEM. In some situations, FEMA may fund mitigation measures as part of the repair of damaged infrastructure. Generally, mitigation measures are eligible if they directly reduce future hazard impacts on damaged infrastructure and are cost-effective. Funding is limited to eligible damaged facilities located within PA-declared counties.

Cooperating Technical Partners (CTP)

The Cooperating Technical Partners (CTP) program is an effort launched by FEMA in 1999 to increase local involvement in developing and updating Flood Insurance Rate Maps (FIRMs), Flood Insurance Study reports, and associated geospatial data in support of FEMA's Risk Mapping, Assessment and Planning (Risk MAP) Program. To participate in the program, interested NFIP-participating communities, state or regional agencies, universities, territories, tribes, or nonprofits must complete training and execute a partnership agreement. Working with the FEMA regions, a program participant can develop business plans and apply for grants to perform eligible activities.

9.A.3.b. Housing and Urban Development (HUD)

HUD administers the following three federal funding programs: Community Development Block Grant – Disaster Recovery (CDBG-DR), Community Development Block Grant – Mitigation (CDBG-MIT), and Community Development Block Grant (TxCDBG) for rural Texas.

Community Development Block Grant – Disaster Recovery (CDBG-DR)

Following a major disaster, Congress may appropriate funds to the Department of Housing and Urban Development (HUD) under the Community Development Block Grant – Disaster Recovery (CDBG-DR) program when there are significant unmet needs for long-term recovery. Appropriations for CDBG-DR are frequently very large, and the program provides 100% grants in most cases. The CDBG-DR is administered in Texas by the Texas General Land Office (GLO). The special appropriation provides funds to the most impacted and distressed areas for disaster relief, long term-recovery, restoration of infrastructure, housing, and economic revitalization.

Community Development Block Grant – Mitigation (CDBG-MIT)

The Community Development Block Grant – Mitigation (CDBG-MIT) is administered in Texas by the GLO. Eligible grantees can use CDBG Mitigation (CDBG-MIT) assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks. The primary feature differentiating CDBG-MIT from CDBG-DR is that unlike CDBG-DR which funds recovery from a recent disaster to retore damaged services, systems, and infrastructure, CDBG-MIT funds are intended to support mitigation efforts to rebuild in a way which will lessen the impact of future disasters.

Community Development Block Grant (CDBG)

The Community Development Block Grant (CDBG) program provides annual grants on a formula basis to small rural cities and to counties to develop viable communities by providing decent housing and suitable living environments in addition to expanding economic opportunities principally for persons of low- to moderate-income. Funds can be used for public facilities such as water and wastewater infrastructure, street and drainage improvements, and housing. In Texas, the CDBG program is administered by the Texas Department of Agriculture (TDA).

9.A.3.c. U.S. Army Corps of Engineers (USACE)

USACE works with non-Federal partners (States, Tribes, counties, or local governments) throughout the country to investigate water resources and related land problems and opportunities and, if warranted, develop civil works projects that would otherwise be beyond the sole capability of the non-Federal partner(s). Partnerships are typically initiated or requested by the local community to their local USACE District office. Before any project or study can begin, USACE determines whether there is an existing authority under which the project could be considered, such as the US Army Corps of Engineers Continuing Authorities Program (CAP), or whether Congress must establish study or project authority and appropriate specific funding for the activity. New study or project authorizations are typically provided through periodic Water Resource Development Acts (WRDA) or via another legislative vehicle. Congress will not provide project authority until a completed study results in a recommendation to Congress of a water resources project, conveyed via a Report of the Chief of Engineers (Chief's Report) or Report of the Director of Civil Works (Director's Report). Opportunities to partner with USACE are not considered grant or loan opportunities, but shared participation projects where USACE performs planning work and shares in the cost of construction. USACE also has technical assistance opportunities such as the Floodplain Management Services Program (FPMS) and the Planning Assistance to States Program available to local communities.

9.A.3.d. U.S. Environmental Protection Agency (EPA)

The Clean Water State Revolving Fund (CWSRF) provides financial assistance in the form of loans with subsidized interest rates and opportunities for partial principal forgiveness for planning, acquisition, design, and construction of wastewater, reuse, and stormwater mitigation infrastructure projects. Projects can be structural or non-structural. Low Impact Development (LID) projects are also eligible. The CWSRF is administered in Texas by TWDB.

9.A.3.e. U.S. Department of Agriculture (USDA)

The USDA's Natural Resources Conservation Service (NRCS) provides technical and financial assistance to local government agencies through the Emergency Watershed Protection Program, the Watershed Protection and Flood Prevention Program, watershed surveys and planning, and watershed rehabilitation. The Emergency Watershed Protection (EWP) program, a federal emergency recovery program, helps local communities recover after a natural disaster by offering technical and financial assistance to relieve imminent threats to life and property caused by floods and other natural disasters that impair a watershed. The Watershed Protection and Flood Prevention Program helps units of federal, state, local and tribal government protect and restore watersheds; prevent erosion, floodwater, and sediment damage; further the conservation development, use and disposal of water; and to advance the conservation and proper use of land in authorized watersheds. The focus of the Watershed Surveys and Planning program is funding watershed plans, river basin surveys and studies, flood hazard analyses, and floodplain management assistance aimed at identifying solutions that use land treatment and nonstructural measures to solve resource problems. Lastly, the Watershed Rehabilitation Program helps project sponsors rehabilitate aging dams that are reaching the end of their design lives. This rehabilitation addresses critical public health and safety concerns. The USDA also offers various Water and Environmental grant and loan funding programs, which can be used for water and waste facilities, including stormwater facilities, in rural communities.

9.A.3.f. Special Appropriations

On occasion and when the need is large enough, Congress may appropriate funds for special circumstances such natural disasters or pandemics. A few examples of recent special appropriations from the federal government that can be used to fund flood-related activities are discussed in this section.

In 2021, the American Rescue Plan Act (ARPA) provided for a substantial infusion of resources to eligible state, local, territorial, and tribal governments to support their response to and recovery from the COVID-19 pandemic. Coronavirus State and Local Fiscal Recovery Funds (SLFRF), a part of ARPA, delivers $350 billion directly to state, local, and tribal governments across the country. Some of the authorized uses include improving stormwater facilities and infrastructure. Although not a direct appropriation to local governments like ARPA, the 2021 Infrastructure Investment and Jobs Act (IIJA), also called the Bipartisan Infrastructure Law (BIL), authorizes over $1 trillion for infrastructure spending across the U.S. and provides for a significant infusion of resources over the next several years into existing federal financial assistance programs as well as creating new programs.

Chapter 9.B. Barriers to Funding

Local communities in the Neches FPR identified several barriers to accessing or seeking funding sources for flood management activities including lack of knowledge of funding sources, lack of expertise to apply for funding, and no local funds available for local match requirements. As opposed to some other types of infrastructure, flood projects do not typically generate revenue and many communities do not have steady revenue streams to fund flood projects, as discussed in Section 9.A.1. Consequently, communities struggle to generate funds for local match requirements or loan repayment. Complex or burdensome application or program requirements in addition to prolonged timelines also act as barriers to accessing state and local financial assistance programs. Even as communities are able to overcome these various barriers, the high demand for state and federal funding, particularly for grant opportunities, means that need far outstrips supply, leaving many local communities without the resources they need to address flood risks.

Chapter 9.C. Flood Infrastructure Financing Survey

As part of the effort behind this chapter, relevant information was collected from the sponsors of the recommended FMEs, FMSs, and FMPs that have capital costs. A funding survey was used to catalog this information; the primary goal of this surveying effort was to comprehend the funding needs of local sponsors and aid in proposing what role the state at large should have in financing the recommended FMEs, FMSs, and FMPs.

The RFPGs collected information from sponsors by sending a PDF tabular list of FMEs, FMSs, and FMPs currently identified for their respective entities via e-mail. The table included the identification number, type, name, description, and total estimated cost for each FME, FMS, and FMP listed. The sponsors were asked to complete the columns titled 'Anticipated Source of Funding', 'Percent Funding to be Financed by Sponsor' and 'Other Funding Needed' for each FME, FMS, and/or FMP.

9.C.1. Flood Infrastructure Financing Survey Results

The Flood Infrastructure Funding survey was sent to the 69 entities identified as sponsors of FMEs, FMSs, and FMPs. Of the 69 entities surveyed, 13 responded with information on how much funding they would need from federal and state sources to adequately finance their identified FMEs, FMSs, and/or FMPs. This represents a response rate of about 19%; most entities that responded to the survey specified the entirety of the funding they require for their flood management and flood mitigation actions will have to come from state and/or federal sources. The sole exception to this was Jefferson County Drainage District 7; the entity indicated that they will be able to finance 25% of the costs of their actions via local funds but will be reliant upon grant funding to cover the other 75% of the costs. **Table 9-2** summarizes the survey results by each flood mitigation and flood management action type. **Appendix 9-A** presents the results of the survey for each FME, FMS, and FMP, respectively.

It should be noted that due to the low initial response rate, the survey does not represent a significant percentage of respondents and therefore does not accurately represent the total need for state and federal funding in the Neches region. To assess the remaining need, it was estimated that 100% of total costs are required from state and federal sources in the form of loans and grants. This is representative of the high level of financial support needed captured in the responses to the initial stakeholder outreach which confirmed that many communities, particularly smaller and more rural communities, do not have any local funding available for flood management activities. Those communities that did report having local funding indicated relatively little local funding available in relation to overall need.

With additional time provided in the second cycle of regional flood planning, it is anticipated that a greater response rate may be obtained. No further responses to the financing survey were received prior to the submission of the amended RFP in July 2023.

TABLE 9-2: FLOOD INFRASTRUCTURE FINANCING SURVEY SUMMARY

Flood Mitigation Action	Potential Funding to be Financed by Local Sponsor	Other Funding Needed (State/Federal)	Total Flood Mitigation Action Cost
FME	$1,563,000	$87,332,824	$88,895,824
FMS	$1,038,500	$173,998,200	$175,036,700
FMP	$402,706,290	$3,924,133,795	$4,326,840,085
Total	**$405,307,790**	**$4,185,464,819**	**$4,590,772,609**

Overall, there is an estimated $4,590,772,609 in total funding required and $4,185,464,819 in state and federal funding needed to implement the recommended FMEs, FMSs, and FMPs in this RFP. This number does not represent the amount of funding needed to mitigate all risks in the region and solve flooding problems in their totality. This number simply represents the funding needs for the specific identified studies, strategies, and projects in this cycle of regional flood planning. Future cycles of regional flood planning will continue to identify more projects and studies needed to further flood mitigation efforts in the Neches region.

Financing information was found on both the Orange County Coastal Storm Risk Management Project and the Port Arthur and Vicinity Coastal Storm Risk Management Project; the information acquired on these two projects is included in the funding splits detailed in **Table 9-2**. Both projects are comprehensive in scope and incorporate a variety of improvements to include new levees, new pump stations, new floodwalls, and other flood infrastructure. The Port Arthur project has a budget split of 35% to be covered by Jefferson County Drainage District 7 (~$302,750,000) with 65% to be covered by Federal funding (~$562,250,000). The Orange County Coastal Storm Risk Management Project has an extent within the Neches region and an extent within the adjacent Sabine region. The entire cost of the project is used for the funding divide between local and federal sponsors. 35% of the Orange County project cost is allocated to be covered by local sponsors (~$836,560,000) with the remaining 65% to be provided with Federal funding (~$1,553,620,000). As the Orange County Coast Storm Risk Management Project has its project area shared with the adjacent Sabine region, the cost of the project was divided between the two regions via area; the portion of the Orange County project within the Neches FPR was estimated to cost a total of $119,900,000. This divided cost is reflected in the FMP costs shown in **Table 9-2**.

Financing information was also acquired for several projects sponsored by Jefferson County Drainage District 6. The Blanchette Diversion project was noted to have federal funding of approximately $47,000,000 with the Green Pond Flow Diversion project being federally funded for $500,000. Other projects were identified as having 75% federal funding with a 25% local match; these projects include Virginia Street Detention, Delaware Hilcorp Detention Diversion, Borley Heights Relief Project, East China Relief Project, South Nome Relief Ditch, and Ditch 505 Detention. The divided costs of these specific FMPs are reflected in **Table 9-2.**

CHAPTER 10
ADOPTION OF PLAN AND PUBLIC PARTICIPATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix 10-A: Comments Received on Draft Regional Flood Plan and Responses

Appendix 10-B: Bibliography

CHAPTER 10. ADOPTION OF PLAN AND PUBLIC PARTICIPATION

This chapter describes the various public participation, outreach, education, and information activities conducted by the Neches Regional Flood Planning Group (RFPG). All activities and events discussed in this section were performed in direct support of the regional flood planning effort and demonstrate the RFPG's commitment to ensuring that the public is provided with timely, accurate information regarding the flood planning process and that opportunities to provide input are available as often as possible. The chapter details the plan adoption process followed by the RFPG; the process explains the required hearing, receipt of comment, comment response, and final adoption of the regional flood plan (RFP). Development of the Neches RFP is governed by 39 overarching guidance principles, as described in 31 TAC §362.3. **Table 10-1** details where each of the guidance principles are satisfied in the RFP.

TABLE 10-1: TWDB REGIONAL FLOOD PLANNING GUIDANCE PRINCIPLES

	Guidance Principle ("The regional and state flood plans…")	RFP Section(s)
1	Shall be a guide to state, regional, and local flood risk management policy	Chapter 3
2	Shall be based on the best available science, data, models, and flood risk mapping.	Chapter 2
3	Shall focus on identifying both current and future flood risks, including hazard, exposure, vulnerability and residual risks; selecting achievable flood mitigation goals, as determined by each RFPG for their region; and incorporating strategies and projects to reduce the identified risks accordingly	Chapter 2, Chapter 3, Chapter 4, Chapter 5
4	Shall, at a minimum, evaluate flood hazard exposure to life and property associated with 0.2 percent annual chance flood event (the 500-year flood) and, in these efforts, shall not be limited to consideration of historic flood events	Chapter 2
5	Shall, when possible and at a minimum, evaluate flood risk to life and property associated with 1.0 percent annual chance flood event (the 100-year flood) and address, through recommended strategies and projects, the flood mitigation goals of the RFPG (per item 2 above) to address flood events associated with a 1 percent annual chance flood event (the 100-year flood); and, in these efforts, shall not be limited to consideration of historic flood events	Chapter 4, Chapter 5
6	Shall consider the extent to which current floodplain management, land use regulations, and economic development practices increase future flood risks to life and property and consider recommending adoption of floodplain management, land use regulations, and economic development practices to reduce future flood risk	Chapter 3, Chapter 4, Chapter 5
7	Shall consider future development within the planning region and its potential to impact the benefits of flood management strategies (and associated projects) recommended in the plan	Chapter 1, Chapter 2, Chapter 6
8	Shall consider various types of flooding risks that pose a threat to life and property, including, but not limited to, riverine flooding, urban flooding, engineered structure failures, slow rise flooding, ponding, flash flooding, and coastal flooding, including relative sea level change and storm surge	Chapter 2

	Guidance Principle ("The regional and state flood plans…")	RFP Section(s)
9	Shall focus primarily on flood management strategies and projects with a contributing drainage area greater than or equal to 1.0 (one) square miles except in instances of flooding of critical facilities or transportation routes or for other reasons, including levels of risk or project size, determined by the RFPG	Chapter 4, Chapter 5
10	Shall consider the potential upstream and downstream effects, including environmental, of potential flood management strategies (and associated projects) on neighboring areas. In recommending strategies, RFPGs shall ensure that no neighboring area is negatively affected by the regional flood plan	Chapter 4, Chapter 5
11	Shall include an assessment of existing, major flood mitigation infrastructure and will recommend both new strategies and projects that will further reduce risk, beyond what existing flood strategies and projects were designed to provide, and make recommendations regarding required expenditures to address deferred maintenance on or repairs to existing flood infrastructure	Chapter 1, Chapter 4, Chapter 5
12	Shall include the estimate of costs and benefits at a level of detail sufficient for RFPGs and sponsors of flood mitigation projects to understand project benefits and, when applicable, compare the relative benefits and costs, including environmental and social benefits and costs, between feasible options	Chapter 4, Chapter 5
13	Shall provide for the orderly preparation for and response to flood conditions to protect against the loss of life and property and reduce injuries and other flood-related human suffering;	Chapter 7
14	Shall provide for an achievable reduction in flood risk at a reasonable cost to protect against the loss of life and property from flooding	Chapter 4, Chapter 5, Chapter 6
15	Shall be supported by state agencies, including the TWDB, General Land Office, Texas Commission on Environmental Quality, Texas State Soil and Water Conservation Board, Texas Parks and Wildlife Department, and the Texas Department of Agriculture, working cooperatively to avoid duplication of effort and to make the best and most efficient use of state and federal resources	Chapter 10
16	Shall include recommended strategies and projects that minimize residual flood risk and provide effective and economical management of flood risk to people, properties, and communities, and associated environmental benefits	Chapter 4, Chapter 5, Chapter 6
17	Shall include strategies and projects that provide for a balance of structural and nonstructural flood mitigation measures, including projects that use nature-based features, that lead to long-term mitigation of flood risk	Chapter 4, Chapter 5, Chapter 6
18	Shall contribute to water supply development where possible	Chapter 6
19	Shall also follow all regional and state water planning guidance principles (31 TAC §358.3) in instances where recommended flood projects also include a water supply component	Chapter 6
20	Shall be based on decision-making that is open to, understandable for, and accountable to the public with full dissemination of planning results except for those matters made confidential by law	Chapter 10

	Guidance Principle ("The regional and state flood plans…")	RFP Section(s)
21	Shall be based on established terms of participation that shall be equitable and shall not unduly hinder participation	Chapter 10
22	Shall include flood management strategies and projects recommended by the RFPGs that are based upon identification, analysis, and comparison of all flood management strategies the RFPGs determine to be potentially feasible to meet flood mitigation and floodplain management goals	Chapter 4, Chapter 5
23	Shall consider land-use and floodplain management policies and approaches that support short- and long-term flood mitigation and floodplain management goals	Chapter 3
24	Shall consider natural systems and beneficial functions of floodplains, including flood peak attenuation and ecosystem services	Chapter 1, Chapter 3
25	Shall be consistent with the National Flood Insurance Program (NFIP) and shall not undermine participation in nor the incentives or benefits associated with the NFIP	Chapter 3
26	Shall emphasize the fundamental importance of floodplain management policies that reduce flood risk	Chapter 3
27	Shall encourage flood mitigation design approaches that work with, rather than against, natural patterns and conditions of floodplains	Chapter 3, Chapter 4, Chapter 5
28	Shall not cause long-term impairment to the designated water quality as shown in the state water quality management plan as a result of a recommended flood management strategy or project	Chapter 6
29	Shall be based on identifying common needs, issues, and challenges; achieving efficiencies; fostering cooperative planning with local, state, and federal partners; and resolving conflicts in a fair, equitable, and efficient manner	Chapter 10
30	Shall include recommended strategies and projects that are described in sufficient detail to allow a state agency making a financial or regulatory decision to determine if a proposed action before the state agency is consistent with an approved regional flood plan	Chapter 4, Chapter 5
31	Shall include ongoing flood projects that are in the planning stage, have been permitted, or are under construction	Chapter 1
32	Shall include legislative recommendations that are considered necessary and desirable to facilitate flood management planning and implementation to protect life and property	Chapter 8
33	Shall be based on coordination of flood management planning, strategies, and mitigation projects with local, regional, state, and federal agencies projects and goals	Chapter 10
34	Shall be in accordance with all existing water rights laws, including but not limited to, Texas statutes and rules, federal statutes and rules, interstate compacts, and international treaties	Chapter 6

Guidance Principle ("The regional and state flood plans…")		RFP Section(s)
35	Shall consider protection of vulnerable populations	Chapter 4, Chapter 5
36	Shall consider benefits of flood management strategies to water quality, fish and wildlife, ecosystem function, and recreation, as appropriate	Chapter 6
37	Shall minimize adverse environmental impacts and be in accordance with adopted environmental flow standards	Chapter 6
38	Shall consider how long-term maintenance and operation of flood strategies will be conducted and funded	Chapter 9
39	Shall consider multi-use opportunities such as green space, parks, water quality, or recreation, portions of which could be funded, constructed, and or maintained by additional, third-party project participants	Chapter 4, Chapter 5

Chapter 10.A. Neches RFPG Website

A website was developed for the first planning cycle of the Neches Regional Flood Plan in order to maintain contact with the public and to provide members of the RFPG with resources for plan development. The site (https://nechesfloodplanning.org/) provides visitors with an overview of the regional planning process in Texas and specific information on the Neches FPR and Planning Group. The site also provides information and announcements for meetings of the Neches RFPG in addition to downloads of past meeting materials and minutes.

Chapter 10.B. Texas Water Development Board Website

The Texas Water Development Board (TWDB) provides information on the regional flooding planning process including background information, current planning documents, and relevant rules and statutes on its regional planning webpage (https://www.twdb.texas.gov/flood/planning/index.asp). Upcoming meetings, minutes of previous meetings, and contact information are available on this website as well.

Chapter 10.C. Planning Group Activities

As required by 31 TAC §361.21, the Neches RFPG conducted all business in meetings posted and held in accordance with the Texas Open Meetings Act, the Public Information Act, and Texas Government Code Chapter 551. The Neches RFPG posted all materials presented or discussed at regular meeting for public inspection prior to and following public meetings. Additional notice requirements specific to Regional Flood Planning referenced in 31 TAC §361.21 were also followed. The plan was developed in accordance with 31 TAC §361.50 and the flood planning guidance principles outlined in 31 TAC §361.20 (31 TAC §362.3). The plan includes an explanation of how it satisfies each of the guidance principles including a demonstration that there will be no negative impact to neighboring areas.

The Neches RFPG has accommodated public participation throughout the planning process and will vote to adopt the RFP after all public comments have been addressed. The RFPG will address public comments in the final version of the RFP due January 2023 and indicate whether changes to the plan were made in response to comments in accordance with all administrative rules, the Contract, statute and the RFPG bylaws. The draft plan will be available for public inspection online on the Neches RFPG website (https://nechesfloodplanning.org/). A hard copy of the draft plan will be available for public inspection in at least three publicly accessible locations within the region; the draft RFP will be made available at the City of Beaumont, the City of Port Arthur, the City of Lufkin, and the City of Tyler. Public meetings will be held to receive comment on the draft plan and hard copies will be available to review for at least 30 days prior to the first meeting and 30 days following the first meeting.

10.C.1. Regular Regional Planning Group Meetings

The Neches RFPG held monthly meetings to obtain updates from the Technical Consultant team, discuss proposals, and provide approval of components of the draft Neches Regional Flood Plan. These meetings were open to the public in accordance with the Texas Open Meetings Act. All regular Neches RFPG meetings were held at LNVA's administrative office located in Beaumont, Texas; while most RFPG members attended the meetings in-person, a virtual attendance option was made available for most meetings. All meetings provided a posting of meeting materials typically 3 days prior to the date of the meeting itself. Meeting materials that discussed floodplain management goals or the process to identify potential FMEs and potentially feasible FMSs and FMPs were required to be posted 7 days prior to the meeting date.

Table 10-2 summarizes each of the regular RFPG meetings, held to date as part of the first planning cycle. Included as part of these summaries are key discussions and votes held at each meeting. Meeting materials and public notices can be accessed under the 'MEETINGS' tab on the Neches RFPG website (https://nechesfloodplanning.org/).

TABLE 10-2: SUMMARY OF REGULAR RFPG MEETINGS

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
October 28, 2020	Regular Meeting	• Regional flood planning overview presentation • Additional voting and non-voting positions that may be needed to ensure adequate representation • Opened the floor to public comments, no comments were given	• Adopted the Neches RFPG group bylaws • Selected the Chair of Region 5 Neches RFPG • Selected Lower Neches Valley Authority (LNVA) as the designated planning group sponsor • Authorized the RFPG sponsor to apply for grant funds and enter a contract with the TWDB on behalf of the RFPG

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
January 7, 2021	Regular Meeting	• Recommended adding four additional non-voting positions • Updates on status of application for RFP Grant Funds • Scope of Work posted with TWDB RFA • Technical Consultant procurement process • Development and hosting of a public website • Receiving and routing requests for public comment/participation in future meetings • Opened the floor to public comments (no comments were given)	• Selected Vice Chair of Region 5 Neches RFPG • Selected Secretary for Region 5 Neches RFPG • Selected additional voting members-at-large • Selected the Region 4. Sabine RFPG liaison • Selected the Region 3 liaison • Approved the Selection Review Committee members
January 27, 2021	Regular Meeting	• Statements of Qualification received offering professional engineering consulting services for the development of a RFP • Requirements set forth in Texas Government Code §2254	• No votes held
February 9, 2021	Regular Meeting	• Interview firms in response to Request for Qualifications related to engineering services for the Region 5 Neches RFPG received on January 26, 2021	• No votes held
February 11, 2021	Regular Meeting	• Public input regarding suggestions and recommendations as to issues, provisions, projects, and strategies to consider during the flood planning cycle/development of the RFP (no participants)	• Recommended Freese and Nichols, Inc. to the RFPG Board • Chose the domain name for the Region 5 website

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
March 11, 2021	Regular Meeting	• Update on status of TWDB Sponsor contract and Technical Consultant contract • Non-voting member solicitations • Discussion of visions and principles for the watershed • Discussion of existing 39 guidance principles stipulated by 31 TAC §362.3 • Opened the floor to public comments (no public comments were given)	• Selected the Region 5 liaison to Region 6 (San Jacinto)
May 13, 2021	Regular Meeting	• Opened the floor to public comments (no public comments were given) • Presentation from US Army Corps of Engineers regarding dam operations	• No votes held
June 17, 2021	Regular Meeting	• Technical Consultant previewed methods for obtaining feedback from the public and identified stakeholders • Establishment of a Technical Consultant working committee as recommended by the consultant and nomination members	• Established a working committee to coordinate directly with the Technical Consultant in ongoing developments • Selected the National Public Lands non-voting representative for the RFPG
August 12, 2021	Regular Meeting	• Discussion of potential public outreach meetings to be coordinated by the Consultant in both the upper and lower basins within the region	• No votes held

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
September 22, 2021	Regular Meeting	• Task 2 Technical Memorandum deliverables granted 2-month extension • Discussion regarding Task 1, Task 2A, Task 3A, and Task 3B • Presentation from Texas General Land Office (GLO) East Region Flood Study regarding flood risks within the predetermined study area, developing cost-effective flood mitigation projects, and potential funding sources for identified mitigation projects	• No votes held
October 14, 2021	Regular Meeting	• Discussion of floodplain management goals for inclusion in the RFP • Discussion of process to identify potential FMEs and potentially feasibly FMSs and FMPs	• No votes held
December 15, 2021	Regular Meeting	• Approval of January 2022 Technical Memorandum • Potential modification and/or additions to the flood mitigation and floodplain management goals • Overview of deliverables for March 2022 Technical Memorandum • Confirm date of next Existing Flood Risk Public Meeting (January 11, 2021)	• Authorized the Planning Group Sponsor (Lower Neches Valley Authority) to negotiate and execute an amendment to the RFP Grant contract with the TWDB to incorporate additional funding • Authorized the Planning Group Sponsor to negotiate and execute an amendment to the RFPG subcontract with FNI • Authorized the submission of the January 2022 Technical Memorandum to TWDB

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
January 27, 2022	Regular Meeting	• Potential approach for Mitigation Needs Analysis (Task 4A) • Discussion of identified flood prone areas, flood mapping gap analysis, and population projection methodology (Task 2A/B)	• Re-elected the officers for the Neches RFPG
February 25, 2022	Regular Meeting	• Approval of March 2022 Technical Memorandum • Discussion of potential meeting with Port Arthur City Council to expand public outreach	• Authorized the submission of the March 2022 Technical Memorandum to TWDB
March 24, 2022	Regular Meeting	• Updates on revisions on Floodplain Management Practices (Task 3A) • Updates on Flood Mitigation Needs Analysis (Task 4A) • Updates on identified and evaluated FMEs, FMSs, and FMPs (Task 4B)	• Approval of revisions to the flood mitigation and floodplain management goals
April 20, 2022	Regular Meeting	• TWDB reiterated the draft RFP must be made available for public inspection online and a hard copy must be made available in at least three publicly accessible locations within the region for at least 30 days prior to the first meeting • Presentation of areas where the greatest flood risk knowledge gaps and where the greatest known flood risk exist within the region (Task 4A) • Review of process to recommend FMEs and FMPs	• Approval of administrative expenses incurred by the project sponsor • Approved nomination for Small Business category voting member

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
May 26, 2022	Regular Meeting	• Presentation and discussion of Flood infrastructure funding analysis (Task 9) • Discussion of Administrative, Regulatory, and Legislative Recommendations (Task 8) • Updates on outreach and data collection to support Task 1-9 (Task 11)	• No votes held
June 22, 2022	Regular Meeting	• Discussion of collected information of flood response information and activities • Discussion of newly identified FMEs, FMSs, and FMPs • Recommendation of FMEs, FMSs, and FMPs	• Approval to recommend all identified FMEs, FMSs, and FMPs
July 22, 2022	Regular Meeting	• Approval to submit 2022 Draft Regional Flood Plan to TWDB • Confirm date of first Public Comment meeting on Draft Plan (September 9, 2022)	• Authorized the submission of the Draft Regional Flood Plan to TWDB
August 18, 2022	Regular Meeting	• Discussion of Public Comment Period • Presentation and discussion of Task 12	• No votes held
September 21, 2022	Regular Meeting	• Presentation and discussion of public comments on the Draft Regional Flood Plan • Discussion and recommendation of FMEs to conduct under Task 12	• Approved the FMEs to perform under Task 12
November 17, 2022	Regular Meeting	• Presentation and discussion of comments received on the Draft Regional Flood Plan from TWDB • Discussion on additional FMEs within Beaumont, TX	• No votes held

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
December 15, 2022	Regular Meeting	• Recommendation of additional FMEs within Beaumont, TX • Approval to adopt and submit 2023 Final Regional Flood Plan to TWDB	• Adopt the Final Regional Flood Plan and authorize its submission to TWDB
February 23, 2023	Regular Meeting	• Discussed additional FMPs to be included in the amended Regional Flood Plan	• Elected new slate of officers for the Neches RFPG • Approved nomination for Water Utilities category voting member
March 28, 2023	Regular Meeting	• Discussed preliminary statewide ranking system created for FMEs, FMSs, and FMPs	• No votes held
April 25, 2023	Regular Meeting	• Presentation and discussion of studies being conducted for the cities of Tyler and Jasper as part of Task 12 • Discussion of FMEs to be removed from the Regional Flood Plan per stakeholder feedback	• No votes held
May 24, 2023	Regular Meeting	• Recommendation of additional FMEs and FMPs to be included in the Amended Regional Flood Plan	• Approval to recommend all additional FMEs and FMPs
June 22, 2023	Regular Meeting	• Approval to adopt and submit 2023 Amended Regional Flood Plan to TWDB	• Adopt the Amended Regional Flood Plan and authorize its submission to TWDB

10.C.2. Technical Committee Meeting

For the purposes of discussing technical methodology and task approach with the Technical Consultant, the RFPG formed a Technical Committee that was voted on and established during the meeting held on June 17, 2021. The members of the Region 5 Technical Committee include Ms. Ellen Buchanan, Mr. Scott Hall, Dr. Liv Haselbach, and Dr. Joseph Majdalani Technical Committee meetings were held alongside regular RFPG meetings when further discussion on task methodology and processes was deemed necessary.

Table 10-3 summarizes each of the technical committee meetings, held to date as part of the first planning cycle. No voting actions took place at these meetings. Meeting materials and public notices can be accessed under the 'MEETINGS' tab on the Neches RFPG website (https://nechesfloodplanning.org/).

TABLE 10-3: SUMMARY OF TECHNICAL COMMITTEE MEETINGS

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
July 13, 2021	Technical Committee Meeting	• Potential questions for Public/Stakeholder outreach survey presented • Discussion to improve and expand the survey questions to better capture information provided by stakeholders • Presentation of working list used to contact stakeholders and encourage participation in the survey • Discussion on approach for floodplain management standards and goals	• No votes held
September 9, 2021	Technical Committee Meeting	• Updates on data collection from survey responses • Updates on stakeholder outreach and survey engagement • Presentation and feedback on flood mitigation and floodplain management goals (Task 3B)	• No votes held
November 29, 2021	Technical Committee Meeting	• Discussion of potential revisions to the first draft of the Technical Memorandum due January 2022 • Progress on deliverables for the March 2022 document deadline	• No votes held
February 17, 2022	Technical Committee Meeting	• Presentation and discussion of March 2022 Technical Memorandum submission requirements	• No votes held
May 20, 2022	Technical Committee Meeting	• Announcement of the dissemination of the draft Chapter 1 to the RFPG • Presentation of currently identified FMEs, FMSs, and FMPs	• No votes held

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
September 15, 2022	Technical Committee Meeting	• Review and discuss FMEs to further study under Task 12	• No votes held

10.C.3. Interregional Coordination

Throughout the regional flood planning process, there was ongoing communication between the Neches RFPG and other regional flood planning groups. The TWDB facilitated interaction through Technical Consultant calls. Four calls were hosted by the TWDB throughout the planning process to provide additional guidance and allow time for questions and discussion between the flood planning regions and TWDB. The discussion facilitated by these calls allowed for opportunities for regions to coordinate and discuss shared problems and solutions.

During monthly Neches RFPG meetings, flood planning group members provided updates on the progress of the Sabine, San Jacinto, and Trinity RFPs. These updates helped facilitate discussions concerning timelines and different approaches being used across other flood planning regions. In addition, these discussions allowed group members to express any concerns over inequities experienced between different regions, allowing for the Technical Consultant team to consider different methodologies or conduct further coordination with other regions. From the Neches RFPG, Dr. Liv Haselbach served as the liaison to the San Jacinto Regional Flood Planning Group (Region 6), Mr. John Beard, Jr. served as liaison to the Sabine Regional Flood Planning Group (Region 4), and Ms. Ellen Buchanan served as liaison to the Trinity Regional Flood Planning Group (Region 3). From other regions, Mr. Don Carona represented the Sabine Regional Flood Planning Group and Mr. Stephen Costello represented the San Jacinto Regional Flood Planning Group.

Chapter 10.D. Stakeholder Input

To ensure public input was received and incorporated in the RFP, the RFPGs were required to engage with stakeholders. One of the procedures used to fulfill this requirement and gather data on flooding needs and efforts in the region was a detailed survey targeted specifically to stakeholders. In addition, the detailed survey gave stakeholders access to an interactive web map to aid in identifying areas of flood risk.

The stakeholder survey was developed to be a comprehensive questionnaire with the intent to identify background information, flood infrastructure conditions, existing and pending studies or projects, and current floodplain management policies. As mentioned in **Chapter 7**, the list of stakeholders drew from a variety of categories to include municipalities, counties, Councils of Government (COGs), special districts, such as municipal utility districts (MUDs) and special utility districts (SUDs), and Texas state and federal agencies. **Table 10-4** summarizes the question categories held by the survey.

TABLE 10-4: STAKEHOLDER SURVEY TOPICS

Question Categories	
GIS datasets features	Flood protection projects
Infrastructure or natural features	Resource usage
Program (such as NFIP) participation	Flood risk management standards
Floodplain management activities	Local and regional flood planning information
Development standards	Flood funding
Floodplain management practices	Flood mitigation projects

The survey aided in the formation of several FMEs, mostly flood mapping updates and new master drainage plans, as detailed in **Chapter 4**. In addition, the surveys provided data for flood response preparations and a web-based survey was sent out to each regulatory entity in the region to gather additional information discussed in **Chapter 7**. The region requested local emergency management and emergency response plans, emergency management plans, hazard mitigation plans, and other flood planning studies from counties and local jurisdictions that were publicly available in the Neches RFPG's survey. Furthermore, a Flood Infrastructure Funding (FIF) survey, attached as part of the effort of **Chapter 9,** was sent to the 69 entities identified as sponsors of FMEs, FMSs, and FMPs. The survey's purpose was to ascertain the funding needs of local sponsors and then aid in proposing what the state should do for the financing of the recommended FMEs, FMSs, and FMPs.

Chapter 10.E. Public Comment Meetings

10.E.1. Flood Risk Public Meetings

Public input meetings were held to identify flood risk in the region. These meetings were utilized to receive preliminary feedback to gather general suggestions and recommendations from the public as to the issues and changes that should be considered or addressed in the regional flood planning cycle. In Region 5, three public input meetings have been held as of the draft plan's writing, outlined in **Table 10-5.**

Three separate meetings on existing flood risk were held in the cities of Nacogdoches, Beaumont, and Port Arthur. Public comments were collected during these meetings from both the online survey and the submission of paper comment cards distributed to attendees.

A public survey that included questions and map input was conducted to obtain public input. The public was asked for any information on historical flood events that negatively affected them in addition to being asked for input on what the RFPG should prioritize in establishing regional flood mitigation and floodplain management goals. The public had access to the survey and interactive map on the Neches Regional Flood Plan website; survey participants could denote flood prone areas they were aware of through either point or polygon input. **Figure 10-1** shows the points received as part of the survey input while **Figure 10-2** shows the polygons received as part of the survey input. It is noted that most of the data received was entities in Jefferson County, Hardin County, and Jasper County. All public input was reviewed and considered while drafting the RFP.

TABLE 10-5: SUMMARY OF EXISTING FLOOD RISK PUBLIC MEETINGS

Meeting Date	Meeting Type	Key Discussion Items	Votes Held
September 21, 2021	Public Meeting (Nacogdoches, TX)	• There were no attendees at this meeting	• No votes held
January 11, 2022	Public Meeting (Beaumont, TX)	• Overview of the TWDB Regional Flood Planning effort • Demonstration of the Neches RFPG website and online survey tool • Received public survey responses and public comment at the conclusion of the presentation • Attendance of 30 people	• No votes were held
February 15, 2022	Public Meeting (Port Arthur, TX)	• Overview of the TWDB Regional Flood Planning effort • Demonstration of the Neches RFPG website and online survey tool • Received public survey responses and public comment at the conclusion of the presentation • Attendance of 5 people	• No votes held

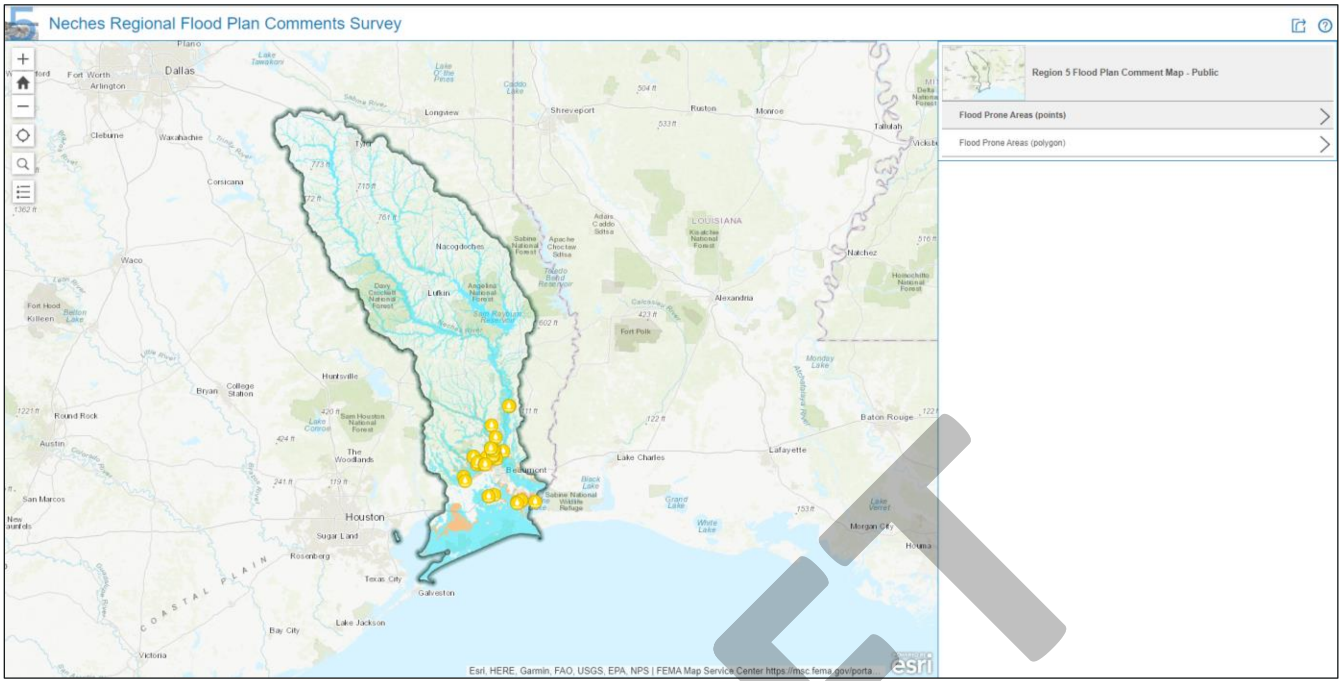


FIGURE 10-1: SURVEY RESPONSE DISTRIBUTION (POINTS)

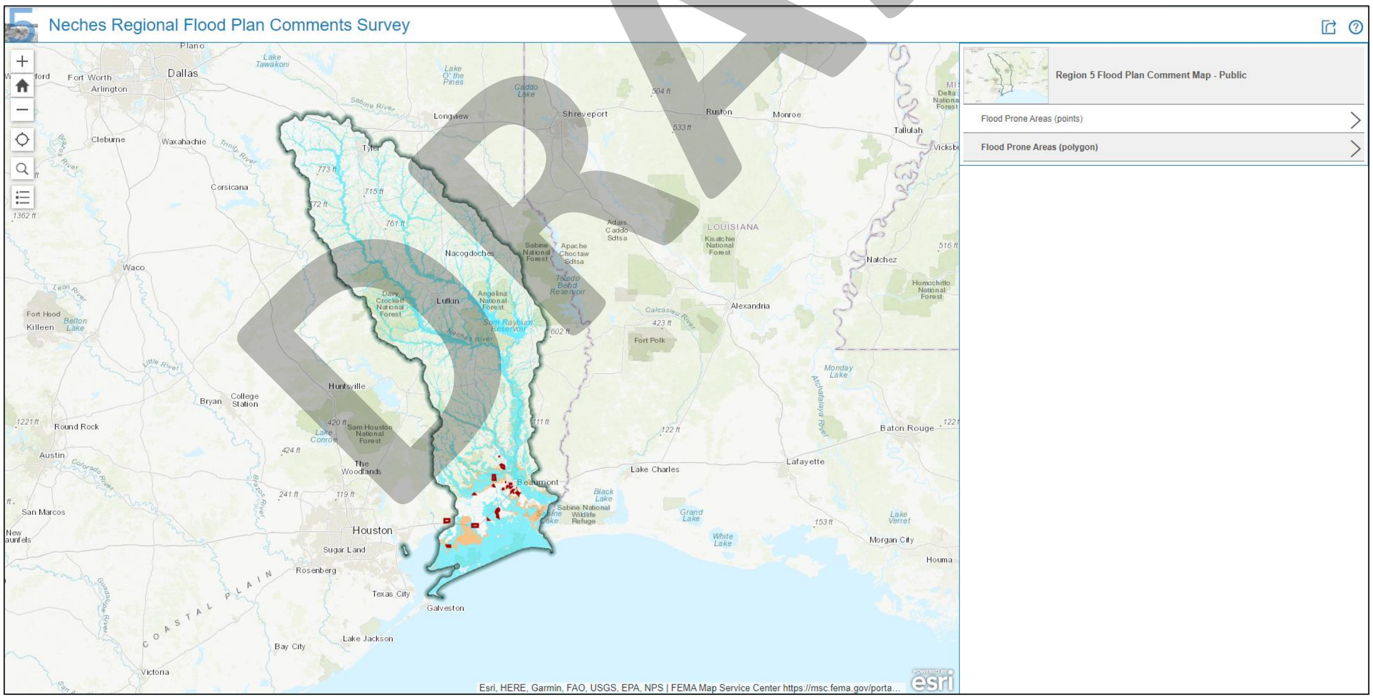


FIGURE 10-2: SURVEY RESPONSE DISTRIBUTION (POLYGONS)

10.E.2. Input on Types of FMEs, FMSs, and FMPs That Should Be Considered

Public input on recommended FMEs, FMSs, and FMPs were received along with comments on the draft plan. Here, the public had the opportunity to provide feedback on general suggestions and recommendations for the types of FMEs, FMSs, and FMPs that should be considered in the RFP. The public also had the opportunity to provide comment on issues and provisions that should be included or incorporated in the current regional flood planning cycle.

The public comments received regarding the recommended FMEs, FMSs, and FMPs strongly emphasized the incorporation of nature-based solutions in these various actions. Once these comments were received, they were summarized for consideration by the Neches RFPG. At the meeting on November 17, 2022, the Neches RFPG reviewed comments and initial responses. Initial responses to comments were also submitted to TWDB on November 10th, 2022.

10.E.3. Input on Draft Plan

The RFPG conducted the required public hearing on the draft plan on September 9th, 2022 in the City of Beaumont. Notice of the public hearing was posted on the RFPG website; additionally, a notification was provided through electronic mail to identified stakeholders within the region. The Flood Planning Regions adjacent to the Neches Flood Planning Region, to include Sabine, Trinity, and San Jacinto, were also notified of the public hearing via electronic mail on August 10, 2022. Hard copies were printed and made available to review for at least 30 days prior to the first meeting and 30 days following the first meeting. Printed copies of the Draft RFP were made available in the City of Beaumont, the City of Lufkin, the City of Port Arthur, and the City of Tyler. A digital version of the Draft RFP was made available on the RFPG website.

Chapter 10.F. Review and Adoption of Final Plan

10.F.1. State and Federal Agency Review

The Draft RFP was submitted to TWDB by the August 1, 2022 deadline. Comments were accepted from the TWDB Executive Director and other state and federal agencies in accordance with the review periods set forth by the regional flood planning guidelines.

10.F.2. Public Review and Comment on Draft Plan

The comments received on the Draft RFP were carefully considered by the RFPG. Public comments were received in addition to comments received from TWDB. Public comments were received until October 9th, 2022. Comments from TWDB were received on October 21, 2022 and are separated into two levels, detailed below:

- **Level 1** comments are directly linked to specific statutes, rules, and contract requirements which govern the creation of the Regional Flood Plan. These comments were required to be addressed for the Final Regional Flood Plan.

- **Level 2** comments are suggested changes by TWDB for the purpose of improving the plan document. These comments included items such as editorial edits and alterations to map symbology to improve clarity.

Modifications were made to the Regional Flood Plan in response to comments received. Initial responses were written for each comment received; these responses were submitted to TWDB on November 10th, 2022. The comments received from the public and TWDB, in addition to formal responses to each comment, can be viewed in **Appendix 10-A.**

10.F.3. Final Regional Flood Plan Adoption

The Final 2023 RFP was adopted by the RFPG during the meeting held on December 15, 2022. The plan and supporting materials will be submitted to the TWDB no later than January 10, 2023 in accordance with the contractual requirements. The complete RFP was developed according to all statute and rule requirements.

Chapter 10.G. Review and Adoption of Amended Plan

10.G.1. Comment on Final Plan

The Final RFP was submitted to TWDB by the January 10, 2023 deadline. A Request for Information (RFI) was sent from TWDB on March 28, 2023 that requested clarification and minor edits on various parts of the Final RFP. The comments found in the RFI are separated into two levels, detailed below:

- **Level 1** comments are directly linked to specific statutes, rules, and contract requirements which govern the creation of the Regional Flood Plan. These comments were required to be addressed for the Amended Regional Flood Plan.
- **Level 2** comments are suggested changes by TWDB for the purpose of improving the plan document. These comments included items such as editorial edits and alterations to map symbology to improve clarity.

Modifications were made to the Final RFP in response to comments received. The Level 1 comments contained within the RFI were addressed with the edits and the responses sent back to TWDB on April 11, 2023. The comments received in the RFI, as well as the responses given for each one, can be viewed in **Appendix 10-A.**

10.G.2. Amended Regional Flood Plan Adoption

The Amended 2023 RFP was adopted by the RFPG during the meeting held on June 22, 2023. The plan and supporting materials will be submitted to the TWDB no later than July 14, 2023 in accordance with the contractual requirements. The complete RFP was developed according to all statute and rule requirements.