

**DRAFT**

# REGION 4 SABINE 2023 REGIONAL FLOOD PLAN

AUGUST 2022

EXECUTIVE SUMMARY

PREPARED FOR THE  
REGION 4 SABINE REGIONAL FLOOD PLANNING GROUP

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## 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 Draft Region 4 Sabine Regional Flood Plan (RFP), which represents the first-ever regionwide floodplain for the Sabine Region. Region 4 is one (1) 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 drainage basins of the state, the planning effort is being carried out at a regional level in each of the State’s fifteen (15) major river basins. The Sabine Regional Flood Planning Area (Region 4), located in east Texas, is one of these regions for which a plan was developed. A summary of major project deliverable milestone dates is presented in **Table ES-1**.

The Texas Water Development Board (TWDB) will compile these regional plans into a single statewide flood plan and will present it to the State Legislature in 2024. An new or updated version of the RFP is expected to occur every five years thereafter similar to the TWDB’s State Water Plan. In this first planning cycle, the TWDB allocated additional funding to each of the 15 regions to perform additional tasks related to additional data collection, public outreach, and performing studies to generate more projects. These tasks were outside of the original scope of the draft and final Flood Plans due in August 2022 and January 2023, respectively; thus, they will be part of the Amended Regional Flood Plans which are due in July 2023.

TABLE ES-1: REGIONAL FLOOD PLAN DEADLINES

Plan Deliverable	Deadline
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 4 RFPG was established by the TWDB on October 1, 2020, to manage the flood planning efforts for the Sabine Flood Planning Region. The TWDB administers the regional planning process through a contract with the planning group’s sponsor, who is selected by the RFPG. The Region 4 sponsor is the Sabine River Authority of Texas (SRATX). The Legislature also allocated funding to be distributed by the TWDB for the procurement of technical assistance to develop the RFPs. Freese and Nichols (FNI) was selected by the RFPG as the technical consultant in the RFPG’s April 2021 meeting to prepare the plan for the Sabine Flood Planning Region.

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 as presented in **Table ES-2**.

TABLE ES-2: SABINE RFPG VOTING MEMBERS

RFPG Voting Members	Interest Group
James (Bill) Bruce	Agriculture Interests
Johnny Trahan	Counties
Francis X. Shannon	Electric Generating Utilities
Clyde V. McKee III	Environmental Interests
Don Carona	Flood Districts
Nikki Davis	Industries
Alton Bradley	Municipalities
Michelle Falgout	Public
Travis Williams	River Authorities
Jeff Rogers	Small Business
Roman D. Griffin	Water Districts
Ross Gordon	Water Utilities
William (Bill) Hughes*	River Authorities

Mr. William (Bill) Hughes, a long-time employee of the Sabine River Authority of Texas (SRATX) was the initial representative for River Authorities interest group and served as the initial chair for the Sabine RFPG until his passing on April 6, 2021 and is recognized for his efforts early in the process for this Regional Flood Plan effort and submittal. Non-voting members serving other interest groups were also included in the planning process and regular RFPG meetings. Those members are shown in **Table ES-3**. Additionally, to satisfy TAC §361.11(f)(9) for a coastal liaison, Orange County Drainage District served as a liaison between the Sabine (Region 4) and the Neches (Region 5) groups. Don Carona (Sabine voting member) or Doug Manning (an employee with the OCDD) provided updates during each meeting.

TABLE ES-3: SABINE RFPG NON-VOTING MEMBERS

Sabine RFPG Non-Voting Members	Interest Group
Colleen Jones	General Land Office
Kathy Saucedo	Texas Commission on Environmental Quality
Manuel Martinez	Texas Department of Agriculture
Andrea Sanders	Texas Division of Emergency Management
Robert (Bob) Baker	Texas Parks and Wildlife
Trey Watson	Texas State Soil and Water Conservation Board
Ryke Moore	Texas Water Development Board

## Chapters Included in the Regional Flood Plan

The TWDB created the scope of work for all groups, and their technical consultants to follow for consistency across the entire state in the 15 flood planning regions. These guidelines are noted as Exhibit C, Technical Guidelines for Regional Flood Planning and each task follows an item in the Texas Administrative Code (TAC) for specific tasks or analyses to perform. Within those guidelines, the following chapters were outlined for the group to perform which coincide with the same numbering system to match the TWDB guidance.

- Chapter 1: Planning Area Description (Task 1)
- Chapter 2: Flood Risk Analyses
  - Existing Condition Flood Risk Analyses (Task 2A)
  - Future Condition Flood Risk Analyses (Task 2B)
- Chapter 3: Floodplain Management Practices and Flood Protection Goals
  - Evaluation and Recommendations on Floodplain Management Practices (Task 3A)
  - Flood Mitigation and Floodplain Management Goals (Task 3B)
- Chapter 4: Assessment and Identification of Flood Mitigation Needs
  - Flood Mitigation Needs Analysis (Task 4A)
  - Identification and Evaluation of Potential Flood Management Evaluations and Potentially Feasible Flood Management Strategies and Flood Mitigation Projects (Task 4B)
  - Prepare and Submit Technical Memorandum (Task 4C)
- Chapter 5: Recommendation of Flood Management Evaluations, Flood Management Strategies and Associated Flood Mitigation Projects (Task 5)
- Chapter 6:
  - Impacts of Regional Flood Plan (Task 6A)
  - Contributions to and Impacts on Water Supply Development and the State Water Plan (Task 6B)
- Chapter 7: Flood Response Information and Activities (Task 7)
- Chapter 8: Legislative, Administrative, and Regulatory Recommendations (Task 8)
- Chapter 9: Flood Infrastructure Financing Analysis (Task 9)
- Chapter 10: Public Participation and Plan Adoption (Task 10)

The guiding principles for Regional Flood Planning, as outlined in Exhibit C Technical Guidelines for Regional Flood Planning, Section 3.1 are outlined in Chapter 10 on **Table 10-1** noting where each item can be found within this Regional Flood Plan.

## Region Overview

The Sabine Regional Flood Planning Area (Region 4) (**Figure ES-1**) encompasses the Texas portion of the Sabine River watershed as the river demarcates the border between Texas and Louisiana. The Sabine River begins in North Texas and flows southeast through Northeast Texas toward the Gulf of Mexico. The river and its tributaries within Texas make up approximately 6,455 stream miles based on data from the TWDB.



**FIGURE ES-1: SABINE (REGION 4) FLOOD PLANNING REGION**

Region 4 encompasses over 7,450 square miles within the state of Texas, 2,306 square miles of drainage area in Louisiana for a total of approximately 9,756 square miles. According to the U.S. Census Bureau, data shows it is one of the state's least populated flood planning areas, with an estimated 616,000 people in 2021 which is approximately about 2% of Texas residents living in the area. However, the region is also characterized by very large volume of water. The region is comprised of 21 counties or portions of counties, containing 71 incorporated municipalities. The Sabine 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.

The Texas Water Development Board (TWDB) has information posted regarding the total amount of water volume that each stream experiences on an annual basis as presented in **Table ES-4** below. At first glance, it is noticeable that the Sabine River basin, highlighted in blue, experiences a large amount of flow compared to the other basins. Other river basins such as the Brazos River, Trinity River, and Neches River also have a fairly substantial amount of volume. However, when comparing the volume of water to the size of the watershed (volume per area) the Sabine far surpasses other regions highlighting the substantial amount of water volume that passes through it.

TABLE ES-4: WATER VOLUME IN TEXAS' MAJOR RIVER BASINS BY AREA

River Basin	Total Basin Area (square miles)	Average Flow Volume (ac-ft per year)	Volume per Area (ac-ft per yr. per sq. mi)	Volume per Area Rank
Brazos	45,573	6,074,000	133.3	9
Canadian	47,705	196,000	4.1	14
Colorado	42,318	1,904,000	45.0	11
Cypress	3,552	493,700	139.0	7
Guadalupe	5,953	1,422,000	238.9	6
Lavaca	2,309	277,000	120.0	10
Neches	9,937	4,323,000	435.0	2
Nueces	16,700	539,700	32.3	13
Red	93,450	3,464,000	37.1	12
Rio Grande	182,215	645,500	3.5	15
<b>Sabine</b>	<b>9,756</b>	<b>5,864,000</b>	<b>601.1</b>	<b>1</b>
San Antonio	4,180	562,700	134.6	8
San Jacinto	3,936	1,365,000	346.8	3
Sulphur	3,767	932,700	247.6	5
Trinity	17,913	5,727,000	319.7	4

When plotted graphically (**Figure ES-2**), it is clear to see that the Sabine (highlighted in gold) experiences a lot of water along its stream. A big reason for this is the heavy and intense rainfall the southern end of the watershed experiences on an annual basis. The lower Sabine region has some of the highest average annual rainfall numbers not only in the state of Texas, but in the continental United States. Furthermore, watershed narrows and funnels south towards and adjacent to Orange, TX before it discharges into Sabine Lake and ultimately into the Gulf of Mexico.

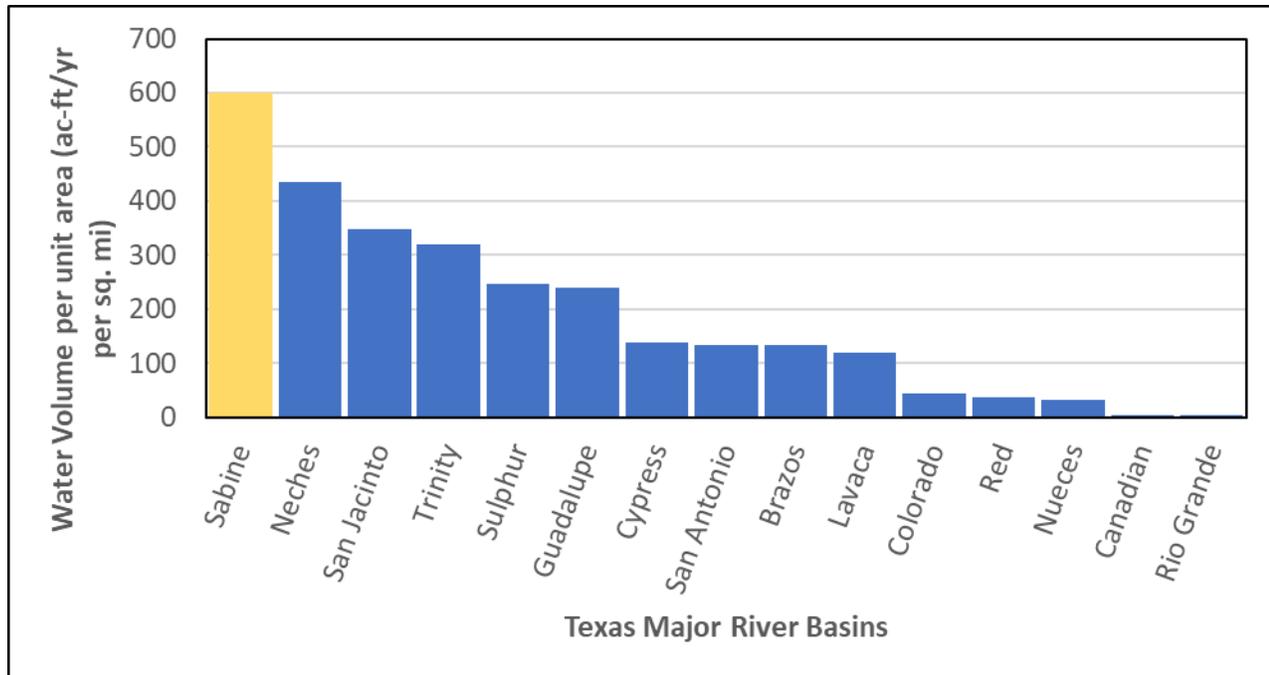


FIGURE ES-2: WATER VOLUME PER UNIT AREA

When comparing the amount of water volume on a per capita basis using the total population in a region, the number is even more staggering as no other region comes close to the amount of water per person the Sabine region experiences.

TABLE ES-5: WATER VOLUME IN TEXAS’ MAJOR RIVER BASINS BY POPULATION

Planning Region	Population (from TWDB)	Avg. Flow Volume (ac-ft per yr.)	Vol. per Area (ac-ft per yr. per person)	Volume per Area Rank
1 & 2 – Red, Sulphur, Cypress	1,119,380	4,890,400	4.4	3
3 – Trinity	7,853,969	5,727,000	0.7	7
<b>4 – Sabine</b>	<b>585,732</b>	<b>5,864,000</b>	<b>10.0</b>	<b>1</b>
5 – Neches	918,370	4,323,000	4.7	2
6 – San Jacinto	6,297,609	1,365,000	0.2	11
7 & 8 – Brazos	3,371,443	6,074,000	1.8	5
9 & 10 – Colorado	2,507,574	1,904,000	0.8	6
11 – Guadalupe	621,166	1,422,000	2.3	4
12 – San Antonio	2,225,430	562,700	0.3	9
13 – Nueces	782,528	539,700	0.7	8
14 & 15 – Rio Grande	2,713,290	645,500	0.2	10

In addition, this region – as well as other regions along the upper Texas coast – has experienced major floods in the last decade alone. Hurricane Harvey, a tropical cyclone which produced the highest amount of rainfall in US history on multiple levels of analysis, devastated the general area in August 2017. According to the the National Oceanic and Atmospheric Administration’s (NOAA) Weather Prediction Center (WPC), the area around Beaumont (Neches, Region 5) and Orange (Sabine, Region 4) actually received some of the highest rainfall totals from the entire event and harshly impacted the area. Furthermore, when evaluating the wettest tropical systems in the US, 4 of the top 6 occurred in the upper Texas coast. This highlights the large amount of rainfall the area experiences, especially from tropical systems, and in turn, the large amount of need required for mitigating floods.

In addition, oil and gas production is an integral component of Texas industry, and the Sabine 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 Region 4, primarily in Gregg, western Rusk, southern Upshur, and southeastern Smith Counties. In the central portion of the basin, gas wells associated with the Texas-Louisiana Salt Basin are more common. In the southern portion of the region, there are concentrations of pipeline networks connecting national trunk systems to refineries on the Gulf Coast, along with associated chemical manufacturing industries. Major rainfall events and tropical systems can greatly impact these industries which have far greater effects than the Sabine region alone. Some of these petrochemical industries have an affect on the national level; therefore, protection of these systems and the necessary funding to do so is vital.

## Key Findings

### Flood Risk, Exposure, and Vulnerability

The region is subject to variable rainfall and multiple flooding types. There are dangers of swift-moving flood waters in riverine areas, especially in the upper portion of the basin where there is more terrain relief and slope. The southern portion of the basin can be susceptible to storm surge and coastal flooding in addition to potential flooding from very heavy rainfall as outlined in the above section. Urban flooding is likely also a source of significant flooding exposure, particularly in larger cities. An analysis was performed to determine three components: risk, exposure, and vulnerability.

An evaluation of flood risk in the region was performed for the 1% annual chance and 0.2% annual chance events, per TWDB requirements. This included evaluating currently mapped FEMA floodplains as well as other sources of flood information. 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 considering current floodplain management criteria. It is noted that the analysis primarily evaluated riverine flooding; thus, there is still residual risk which has not yet been identified as part of this plan.

The analysis concluded that the majority of the currently identified flood risk in Region 4 is either based on out-of-date studies and/or low-detail floodplain maps that are not based on a technical or engineering study. As a result, most of the flood risk across the region is not well quantified, meaning that people, property, and infrastructure items in the region may be unknowingly in harm’s way.

The many infrastructure items identified in Task 1 (Chapter 1) were evaluated against the existing flood risk to determine the number of items deemed to be exposed to flood risk. The analysis determined that of the 375,000 structures which were identified by TWDB to be within the Sabine basin, 9% of them are within the existing 1% annual chance floodplain with 23,000 residential structures at risk. In addition to the number of structures, a total of 470 critical facilities were identified in areas of flood risk.

An additional analysis was also performed to quantify the potential risk that may happen in the future. This included evaluating current drainage and floodplain management criteria to assess what flooding conditions might be in 30-years as well as evaluating the amount and location for population growth. Factors which were included in the future conditions included: population growth, sea level change, and rainfall increases (Atlas 14). A summary of the results of the analysis are shown below.

TABLE ES-6: FUTURE CONDITIONS EXPOSURE INCREASES

Exposure Feature Type	Existing Conditions 1% ACE	Future Conditions 1% ACE	Increase	Existing Conditions 0.2% ACE	Future Conditions 0.2% ACE	Increase
Structures (#)	34,592	79,674	+45,082 (+130%)	48,703	99,250	+50,547 (+104%)
Residential Structures (#)	24,066	65,689	+41,623 (+173%)	34,839	80,739	+45,900 (+132%)
Population (#)	65,006	159,110	+94,104 (+145%)	90,557	198,225	+107,668 (+119%)
Critical Facilities (#)	401	472	+71 (+18%)	470	526	+56 (+12%)
Roadway Segments (mi.)	1,518	1,897	+379 (+25%)	1,897	2,752	+855 (+45%)
Roadway Stream Crossings (#)	4,983	5,486	+503 (+10%)	5,486	7,863	+2,377 (+43%)
Agricultural Areas (sq. mi.)	325	358	+33 (+10%)	358	430	+72 (+20%)

As can be seen in the above table, there is a significant risk to structures and population that already exists and the future conditions analysis estimates additional risk could occur. Therefore, it is critical to construct flood mitigation projects, better identify flood risk identification, and improve communication strategies to the public to help avoid these risks and provide a more resilient future against flood losses.

### Floodplain Management Practices and Flood Protection Goals

In Texas, enforcement of floodplain management regulations is the responsibility of local governments; thus, the Sabine RFPG does not have the authority to enact or enforce floodplain management, land use, or other infrastructure design standards. However, the Sabine RFPG encourages cities and counties without floodplain regulations to adopt standards that at least meet the NFIP minimum requirements and consider adopting higher standards to provide higher levels of protection against loss of life and property due to flooding. Floodplain management regulatory practices could be more beneficial by being more clear, easily interpretable, broadly understood, and consistently enforced. Doing so would provide forward guidance on new development expectations.

Entities were grouped into 1 of 4 categories based on their existing floodplain management practices. These category divisions were set by TWDB in the guidelines. Per TWDB, entities which only meet minimum National Flood Insurance Program (NFIP) standards are considered to have “low” floodplain management practices. All of the counties within the Sabine basin were determined to be a part of the NFIP, but not all municipalities participate. From the review, 12 communities (14%) do not participate in the NFIP and all 12 of those entities are generally smaller communities with lower population and are located in the northern part of the Sabine basin.

Entities which meet NFIP standards and have additional higher or more restrictive floodplain management standards are considered “moderate” in their enforcement. Entities considered to have “strong” standards are those which meet and exceed NFIP standards and are also active in the Community Rating System (CRS) which is a system through the NFIP giving additional credits and reduced insurance premiums in areas for additional floodplain management practices.

Since there are no communities in the Sabine River basin that participate in the CRS program, none were identified as having strong floodplain management practices. A key takeaway from this is the need to move more communities to moderate or strong categories. In order to do this, many of these communities need additional support and/or funding from a federal or state level to help them achieve a better level of floodplain management. This could be in the form of assistance and support to participate in the CRS system and implement new programs in areas to improve their CRS rating over time. An additional item would be the funding necessary to update building codes or local criteria manuals to require freeboard above BFEs. Increasing the level of floodplain management will help to create a more resilient Sabine basin in the future.

TABLE ES-7: FLOODPLAIN MANAGEMENT REGULATIONS SUMMARY

Category	Number of entities
Unknown	22
Low	23
Moderate	45
Strong	0

The Sabine RFPG also discussed goals as part of the Regional Flood Plan. Additional goals the group considered important for a more resilient watershed are outlined in **Table ES-8**.

TABLE ES-8: FLOODPLAIN MANAGEMENT RECOMMENDED STANDARDS

Recommended Standards	Category
RFPG recommends all roadways be designed such that the 5-year HGL is below the top of curb and the 100-year HGL is no more than 1 foot above the top of curb and the 100YR inundation extent is contained within the right-of-way.	<b>Roadways</b>
RFPG recommends all roadways designed without curb and gutter be designed such that the 100YR inundation extent is contained within the right-of-way and at least one navigable lane is maintained.	

Recommended Standards	Category
RFPG recommends all roadways designated as evacuation routes are designed such that the 100YR inundation extent is contained within the right-of-way and at least one navigable lane is maintained in each direction.	
RFPG recommends all communities have Culvert and Bridge Hydrologic & Hydraulic Analysis Requirements	
RFPG recommends all culverts demonstrate no adverse impact for 100YR storm event.	<b>Culvert and Bridge Crossings</b>
RFPG recommends all communities adopt the TxDOT Hydraulic Design Manual most current version; EXCEPT where stricter local standards apply.	
RFPG recommends that all communities require compensatory storage for all fill in the regulatory 100-year floodplain.	
RFPG recommends all communities detain proposed condition peak discharge for the 25-year and 100-year event below or equal to the existing condition peak discharge	<b>Detention</b>
RFPG recommends that communities require all new development in Zone A or unmapped areas to provide a hydrologic and hydraulic study and demonstrate no adverse impacts downstream.	
RFPG recommends all habitable structures in coastal communities are designed such that finished floor elevations are 2 feet, or more, above the BFE including the combined riverine and coastal effects, EXCEPT where stricter local standards apply.	
RFPG recommends 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.	<b>Habitable Structure</b>
RFPG recommends all critical facilities in coastal communities are designed such that finished floor elevations are 2 foot above the highest elevation of either the riverine 500-year or coastal 100-year WSE including the combined riverine and coastal effects	<b>Critical Facilities</b>
RFPG recommends all critical facilities in non-coastal communities are designed such that finished floor elevations are 2 foot above the riverine 100-year WSE.	
RFPG recommends that communities require all dams be designed to TCEQ standards.	<b>Dams</b>
RFPG recommends that communities require all earthen embankments and floodwalls compliant with FEMA 44 CFR 65.10	<b>Levees</b>
RFPG recommends that all new construction consider nature-based and sustainable solutions.	<b>Nature Based Solutions</b>

One of the key recommendations is freeboard, which is an additional vertical distance from the 100-year (1% annual chance) base flood elevation (BFE) to a structure or facility’s finished flood elevation (FFE). NFIP requires structures to be at or above the BFE; however, additional freeboard above that elevation is an additional measure which can lessen the risk to properties. Hence, it was included as a recommended standard under the habitable structures and “critical facilities categories. It was found that 45 of the 93 entities in the basin have additional freeboard requirements in place ranging from 1 foot to 2 feet above the BFE. Another important item in floodplain management is “no adverse impact” which requires proposed construction to prove that it does not negatively affect areas upstream and downstream of the project to not create or add to existing flood risk that an area currently experiences. This item is located in both the culvert/bridge crossing and detention categories.

The Sabine RFPG discussed potential goals for the regional flood plan over a series of monthly meetings from October to December 2021. Some goals have both a short- (within the next 10 years) and long-term (within the next 30 years) goal while others only have a short-term goal. The approved goals are listed in **Table ES-9**.

TABLE ES-9: FLOODPLAIN MANAGEMENT RECOMMENDED STANDARDS

Short Term Goals (10 year)	Long Term Goals (30 year)
Improve 20% of Low Water Crossings to no longer be classified as Low Water Crossing.	Improve 40% of Low Water Crossings to no longer be classified as Low Water Crossing.
Improve flood protection for 15% of critical facilities in flood prone areas.	Improve flood protection for 25% of critical facilities in flood prone areas.
Reduce exposure of existing structures in flood prone areas by elevating, acquiring, relocating, or otherwise providing flood protection to 10% of structures.	Reduce exposure of existing structures flood prone areas by elevating, acquiring, relocating, or otherwise providing flood protection to 20% of structures.
Advance multiple regional flood infrastructure projects designed for larger storm events.	Promote, facilitate, and construct regional infrastructure projects designed for larger storm events.
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 that perform public education and awareness campaigns to better inform the public of flood-related risks on an annual basis.
Increase number of monitoring gages and associated real time reporting technology installed and maintained in the region to 1 in 50% of HUC-10s.	Increase number of monitoring gages and associated real time reporting technology installed and maintained in the region to 1 in 50% of HUC-12s.
Increase number of communities with documented, operational, and funded stormwater asset management plan and maintenance operations to 50%.	
Increase the coverage of flood hazard data in areas identified as having current gaps in flood mapping.	

Short Term Goals (10 year)	Long Term Goals (30 year)
Improve flood hazard data in areas identified as having out of date flood mapping.	
Advance flood protection planning studies and preliminary engineering efforts in flood prone areas.	
Install warning signage at 100% of identified low water crossings in the floodplain and coordinate with TxDOT where applicable.	
Increase number of communities with a comprehensive drainage policy and criteria manuals to reduce flood hazard encouragement and education.	
Increase the number of communities that utilize latest and most appropriate precipitation data as a basis for design criteria.	

### Assessment and Identification of Flood Mitigation Needs

The RFPG conducted a flood mitigation needs analysis based on information generated in the first 3 chapters of this plan. The goal of the analysis guide the effort in determining the flood mitigation needs across the Sabine River basin and identify specific locations where there is a large need for flood mitigation to reduce the overall risk and be in line with the RFP’s overarching goal of reducing the loss of life and property. The factors in this analysis (listed below) were items noted in Chapter 1 which identified different elements within the basin, Chapter 2 which identified existing and future flood risk, and Chapter 3 which outlined the goals the Sabine RFPG wanted to use in accomplishing reduced flood risk.

- Flood risk exposure to buildings
- Critical Infrastructure
- National Flood Insurance Program Participation
- Lack of Hydrologic and Hydraulic Models
- Existing Flood Risk Mitigation Plans
- Historic Flooding Reports
- Low Water Crossings
- Agricultural Areas
- Gaps in Flood Hazard Mapping
- Emergency Need
- Ongoing or Proposed Flood Mitigation Projects
- Social Vulnerability Index (SVI)

This was a geospatial analysis performed across all 196 of the HUC-12 watersheds in the Sabine basin as shown in **Figure ES-3** below. HUC-12s shown in red and orange indicate a large need for flood mitigation. Areas in blue represent a lower need. Areas identified as “low” does not mean that an area has a low risk

of flooding, it simply means that area has a lower or less urgent flood mitigation need than an area which has “high need”.

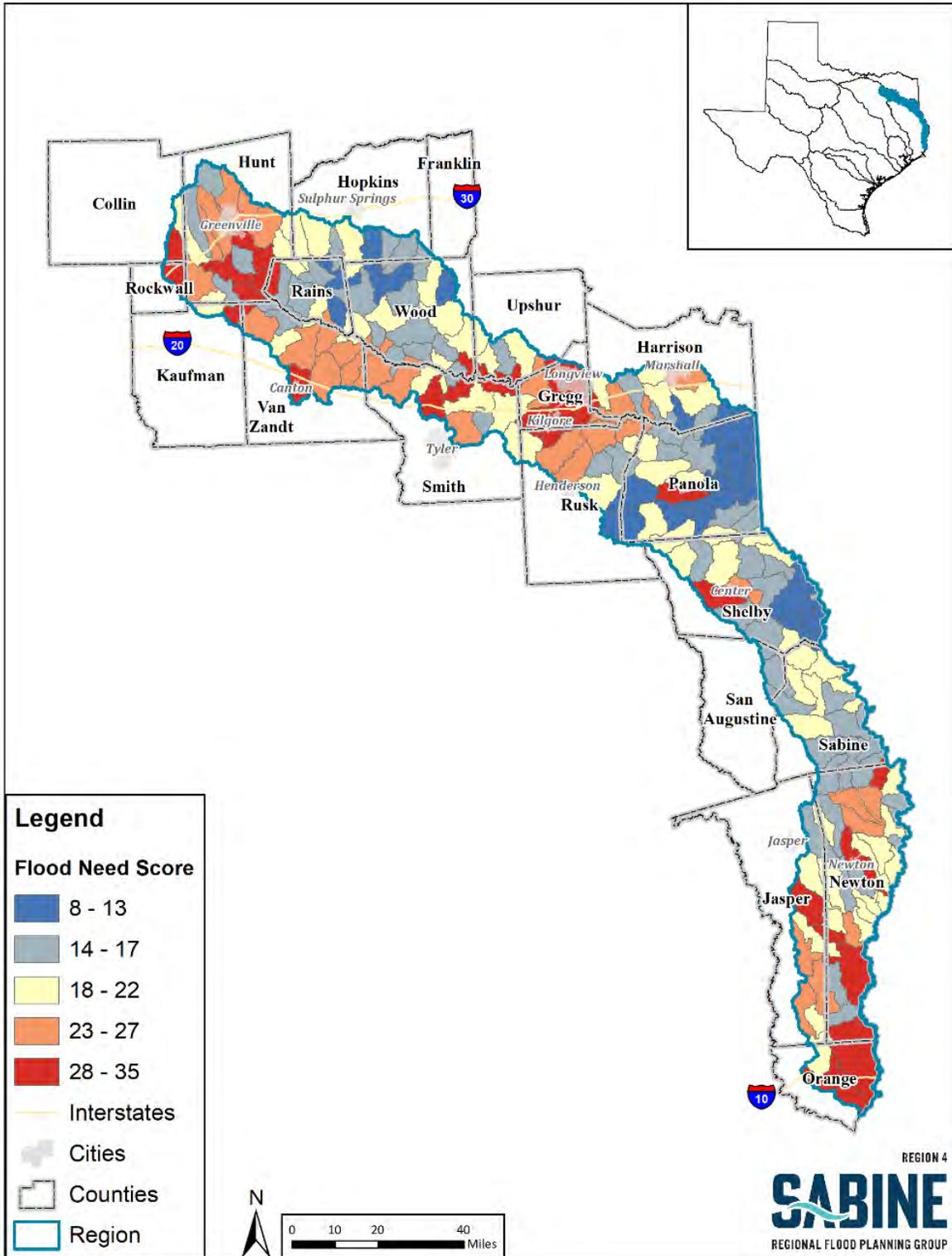


FIGURE ES-3: FLOOD MITIGATION NEED BY WATERSHED

The different factors were discussed with the RFPG over the course of several RFPG meetings and the analysis resulted in a wide array of mitigation needs across the basin. Areas in the lower portion (Orange and Newton Counties) showed a large need for flood mitigation while scattered areas in the upper basin also showed a large need for mitigation.

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. These actions are called Flood Management Evaluations (FMEs), Flood Mitigation Projects (FMPs), and Flood Management Strategies (FMSs), colloquially known as FMXs. Potential actions included the identification of detention basins, flood protection studies, drainage master plans, floodplain mapping, flood risk communication, and others.

### Evaluation and Recommendation of Flood Management Evaluations, Flood Management Strategies, and Associated Flood Mitigation Projects

As part of Task 5, Flood Management Evaluations (FMEs), Flood Management Strategies (FMSs), and Flood Mitigation Projects (FMPs) were further evaluated in order to compile the necessary technical data for the RFPG to decide whether or not to recommend these actions or a subset of these actions.

FMEs were recommended to clearly identify 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. FMSs and FMPs were recommended be 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. In total, 59 FMEs were recommended in the Sabine basin.

TABLE ES-10: RECOMMENDED FME BY EVALUATION TYPE

FME Type	Description	Count	Estimated Cost
Watershed Planning	Floodplain mapping update includes hydrologic and hydraulic modeling to determine flood hazard areas.	15	\$31,570,000
	Drainage master plan includes hydrologic and hydraulic modeling to determine potential flood mitigation alternatives for a county or city.	16	\$9,760,000
Project Planning	Feasibility assessments and impact analyses of potential future flood mitigation projects.	27	\$12,605,000
Other	Floodplain mapping for dam failure hydrologic and hydraulic modeling to determine flood hazard areas in the event of a dam breach.	1	\$500,000
<b>Total</b>		<b>59</b>	<b>\$54,435,500</b>

FMSs and FMPs were recommended be 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 as presented above in **Table ES-8** and **Table ES-9** and detailed more in Chapter 3. The RFPG used criteria (listed below) to determine which identified potential items would be recommended in regional plan in order to ensure that the recommen

ded FMSs and FMPs are sensible so that resources can be directed efficiently and accordingly for implementation.

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

TABLE ES-11: RECOMMENDED FMSS BY STRATEGY TYPE

FMS Type	Description	Count	Cost
Education and Outreach	Implementation of program to educate the public on the hazards and risks of flooding.	14	\$204,475
Flood Measurement and Warning	Installation and operation of stream gauges, monitoring stations, alert systems to provide flood hazard information.	5	\$380,200
Infrastructure Projects	Improvements to or construction of channels, ditches, stormwater pipes, or any other hydraulic structures to mitigate flooding.	1	\$44,000,000
Property Acquisition and Structural Elevation	Administration of program to acquisition and demolition structures and conversion of the land to open space to mitigate flooding.	4	\$300,000
Regulatory and Guidance	Development of ordinances, development criteria, building codes, design standard to prevent new flood risk.	15	\$552,000
Other	Maintenance and inspection of constructed flood infrastructure to maintain design level of service.	10	\$541,000
<b>Total</b>		<b>49</b>	<b>\$45,977,675</b>

TABLE ES-12: RECOMMENDED FLOOD MITIGATION PROJECTS

FMP Name	Description	Sponsor	Cost
Sabine Pass to Galveston Bay Coastal Storm Risk Management Program – Orange County Project	Program comprised of improvements and construction of new infrastructure to reduce the risk of storm surge impacts in Orange County and provide internal pump stations for internal drainage	USACE, GCPD, Orange County, OCDD	\$2,270,100,000
Kilgore Downtown Storm Sewer Master Plan Improvements	Implementation of Downtown Storm Sewer Improvements	City of Kilgore	\$2,242,305

As can be seen by the estimated costs, there is a large amount of funding needed for the Sabine basin to implement these FMEs, FMPs, and FMSs in the future.

## Impacts of the Regional Flood Plan

The step is summarizing 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 impacts from FMSs are more qualitative in nature and are summarized in Chapter 6. Based on the future flood hazard analysis, over 135,000 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 more stringent floodplain management criteria and standards than the minimum ones set by the National Flood Insurance Program (NFIP) with FEMA. Regulation of development, implementation of higher standards, and use of best available data are all interdependent strategies for avoiding potential increases in flood risk and 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 Sabine River Basin.

In Chapter 2, 100% of HUC-12 watersheds and 99% of the region area by area were identified as being in need of better identifying the flood risk or updates to existing flood risk information. After the completion of recommended FMEs, 1 percent of the region area will be in need of flood risk identification, a reduction of 7,351 square miles (99%). The 1% of the region represents presents small portions of counties which intersect the Sabine basin but are not significantly within the basin. However, there is the possibility that flood studies in those counties and flood planning regions may bring the total closer to 100%.

TABLE ES-13: 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	34,592	48,703	32,974	46,539	1,618 (-4.7%)	2,164 (-4.4%)
Residential Structures	24,066	34,839	23,283	33,011	783 (-3.3%)	1,828 (-5.2%)
Critical Facilities	401	470	392	461	9 (-2.2%)	9 (-1.9%)
Population	65,006	90,557	62,631	86,801	2,375 (-3.7%)	3,756 (-4.1%)
Low Water Crossings	107	132	106	131	1 (-0.9%)	1 (-0.8%)
Road Length (Miles)	1,518	1,897	1,489	1,840	29 (-1.9%)	57 (-3.0%)

Impacts to water supply were also evaluated as part of Task 6B. 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 4 primarily covers the North East Texas (Region D) and East Texas (Region I) RWPA regions it partially covers Region C, Region G. Of the actions analyzed, none of the recommended flood management actions were deemed to have an impact on water supply.

### **Administrative, Regulatory, and Legislative Recommendations**

The Sabine RFPG is provided an opportunity to make recommendations to improve floodplain management and mitigation within the region. The Sabine RFPG discussed draft recommendations during the April, May, and June 2022 meetings. A total of 17 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.

#### ***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.
- Establish a process to take BLE data to regulatory information .
- Review and Update TxDOT design criteria.

#### ***Flood Planning Recommendations***

- Develop guidance and a process for emergency needs
- 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).
- Consider prioritizing FMEs which establish FEMA effective floodplains for a community.
- Develop publicly available, statewide database of all the GIS deliverables associated with the development of the State Flood Plan.
- Incorporate State and Federal Agencies in the Regional Flood Planning process as a non-voting RFPG member.
- Update Future Population Projections.

Upon implementation of the legislative recommendations, there will be a continued stream of funding for studies and flood mitigation projects under TWDB's FIF program as well as opportunities to generate

local funding for capital improvement projects. Administrative recommendations include providing support to the smaller communities who may not have the resources or capabilities as larger regions to pursue different funding avenues. Another important recommendation is the inclusion of state and federal agencies into the planning process as it would be beneficial to both the agencies as well as the flood planning process.

### Flood Infrastructure Financing Analysis

The Sabine RFPG recommended a total of 110 flood mitigation actions to address flood risk across the planning region. Combined, these flood mitigation actions are anticipated to cost approximately \$2.4 billion to implement. 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. The breakdown of costs for recommended flood mitigation actions are shown in **Table ES-14** and is further detailed in Chapter 9.

TABLE ES-14: TOTAL COST OF RECOMMENDED FLOOD MITIGATION ACTIONS

Flood Mitigation Action Type	Number of Recommended Actions	Anticipated Total Cost of Implementation
FME	59	\$54,435,500
FMS	49	\$45,977,675
FMP	2	\$2,272,342,305
<b>Total</b>	<b>110</b>	<b>\$ 2,372,754,980</b>

The costs presented in the above table represent the estimated cost of the Regional Flood Plan and includes and both the local and federal/state share of the project.

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. Furthermore, in nearly all of the responses from the survey conducted in 2021 it was noted that the lack of funding was a major hindrance and a primary cause of inadequate or deficient drainage infrastructure. The Sabine RFPG surveyed sponsors to determine how much local funding is available to contribute to these actions. Overall, there is an estimated \$1.295 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 40% 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, as well as other avenues and studies like TWDB's Flood Infrastructure Fund program, will continue to identify more projects and studies needed to further flood mitigation efforts in the Sabine Region to reduce the overall risk to life and property in the planning area.