

Nature-Based Solutions for Flood Resilience

Region 5 Neches Regional Flood Planning Group

Texas Water Development Board
Freese and Nichols, Inc.
The Nature Conservancy



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Agenda

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Purpose of the NBS for Flood Resilience Guidance Manual
Definition and Examples of NBS for Flood Resilience
Publishing Schedule
Guidance Manual Content
How to Promote NBS through Regional Flood Planning
Key Takeaways

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NBS in the State Flood Plan

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FMP Type	Recommended FMP Count
Low Water Crossing or Bridge Improvement	94
Infrastructure	148
Regional Detention Ponds	73
Regional Channel Improvements	79
Storm Drain Improvements	47
Dam Improvements, Maintenance, and Repair	5
Flood Walls and Levees	4
Coastal Protections	1
Nature-Based Solutions	8
Comprehensive Regional Projects	83
Property or Easement Acquisition	13
Elevation of Individual Structures	4
Flood Readiness and Resilience	53
Other	3
Total	615

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Project Goals

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01

Synthesize Research & Guidance on the use of NBS for Flood Mitigation into a **Single, Statewide Manual** for Texas Communities

02

Provide **Strategies & Tools** to Address Common **Barriers & Challenges**

03

Support The Implementation Of NBS Into The **Regional Flood Planning Process & Community-Driven Efforts**

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Intended Users


Local government officials or representatives charged with planning, developing, or managing community infrastructure or assets

- City Engineers
- Floodplain Managers
- Planners
- Regional Flood Planning Group (RFPG)


Practitioners
Developers



City Engineer CIP Planning (Master Drainage Plans/Studies, Preliminary Engineering, etc.)



RFPG & Technical Consultant Teams Project alternative identification



Floodplain Administrator Example floodplain regulation, polices and incentives for more flood resilient community (e.g. floodplain buffers/setbacks)

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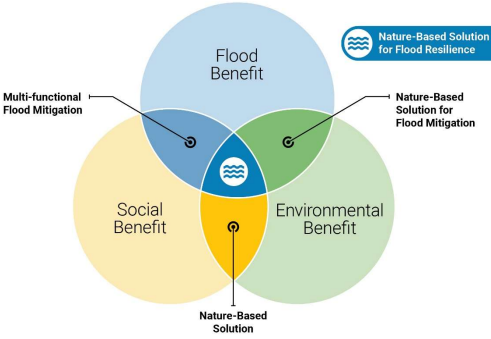
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Defining Nature-Based Solutions (NBS)

NBS use or imitate natural features and/or processes to increase resilience while providing sustainable benefits to people and the environment.

Co-benefits Examples:

- Water Supply and Drought Mitigation
- Water Quality and Public Health
- Urban Heat Reduction and Air Quality
- Recreation and Social Assets



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NBS for Flood Resilience Spectrum

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Traditional (Gray)

Hard, gray, engineered structures built to address development and flood risk reduction objectives

Hybrid

Combination of hard engineering solutions incorporated with natural and nature-based features to accomplish flood risk reduction objectives

Natural

Creation, protection, or restoration of natural systems or processes to accomplish flood risk reduction objectives

Adapted from the International Guidelines on Natural and Nature Based Features for Flood Risk Management

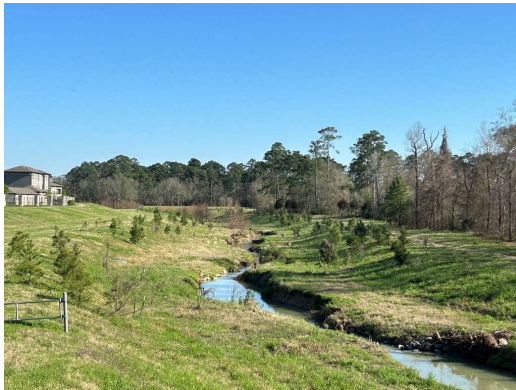
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NBS for Flood Resilience Examples

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Stream and Floodplain Restoration



Wet Pond with Constructed Wetlands




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Structural NBS for Flood Resilience



Watershed

- Stream Restoration
- Floodplain Restoration
- Levee Setback
- Wetland Restoration
- Playa Lake Restoration



Neighborhood

- Bioretention
- Vegetated Swale
- Permeable Pavement
- Vegetative Filter Strips
- Wet Ponds
- Constructed Wetlands
- Tree Trenches
- Rainwater Harvesting
- Stormwater Parks



Coastal

- Beach Nourishment and Dune Restoration
- Coastal Marsh, Seagrass, and Prairie Restoration
- Natural Breakwaters and Oyster Reefs
- Waterfront Parks

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Non-Structural NBS for Flood Resilience

Property Acquisition and Conservation

Regulating Development in Floodplains

Promoting Native Vegetation in Design Criteria

Model Ordinance

Section 01 Purpose

The Model Ordinance to Support Nature Based Solutions is designed to support sustainable development practices and flood risk reduction projects that incorporate nature-based solutions. The purpose of the regulations contained in this Ordinance is to increase resilience of flooding to people and property while providing sustainable benefits to people and the environment within the Municipality. These regulations are designed to promote sustainable development and conservation practices to reduce the impact of development of future flood risk. These regulations are written to be included in an existing zoning ordinance. Language that is variable is indicated by **red text** and commentary is indicated by *blue italic text*.

The language developed in this document is for educational purposes only and is not inclusive nor a substitute for any existing regulations. The information in this document is not a substitute for legal advice. Those wishing to incorporate the ideas presented in this document should consult an attorney.

Section 02 Floodplain Preservation

Floodplain Preservation
Floodplains provide storage for, collect sediment deposits of, and dissipate the energy of flood waters. Preserving the hydrologic connection between a watercourse and its floodplain is necessary to protect the nearby infrastructure. Construction activities within the floodplain such as building, roadways, or utilities, can reduce or block the watercourse's floodplain connection.

This Model Floodplain Preservation Ordinance was developed based on City of San Antonio, Texas Code of Ordinances

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NBS Guidance Manual Schedule

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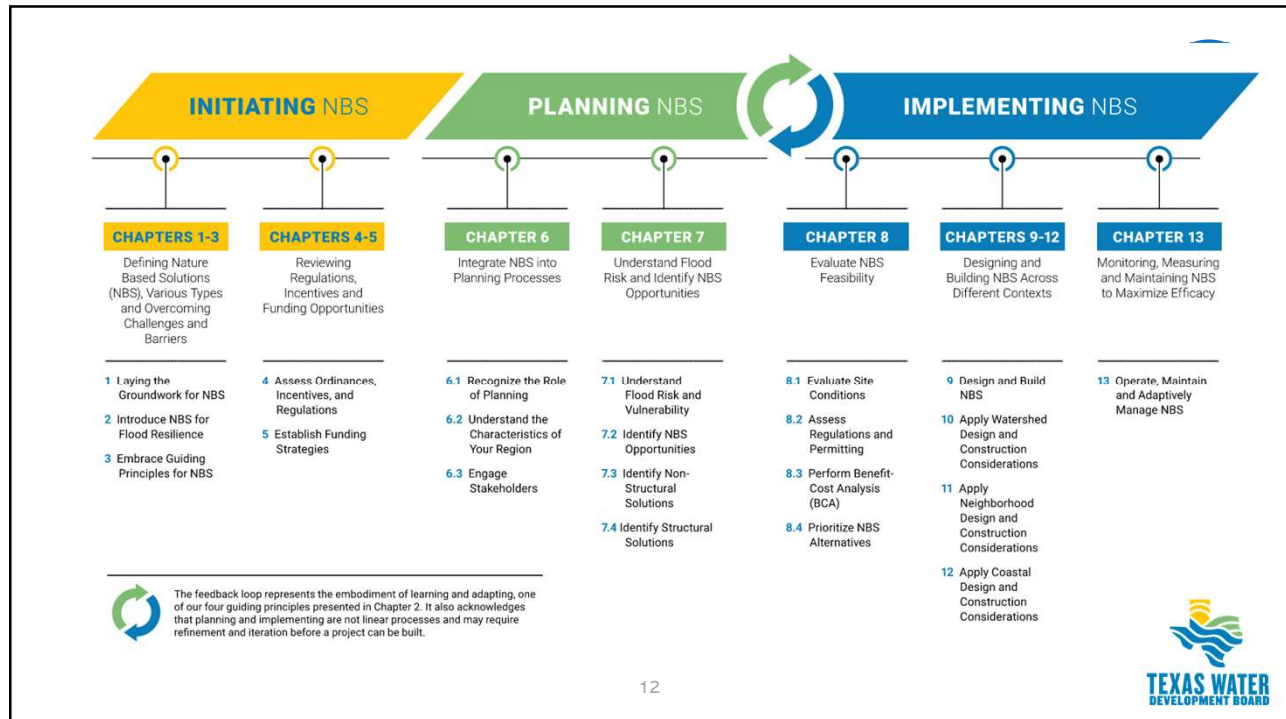
March 2026 Draft Guidance Manual for Public Comment

Summer 2026 Final Guidance Manual Published

<https://www.twdb.texas.gov/flood/research/Nature-based-Solutions-2022/index.asp>



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Promote NBS through Regional Flood Planning

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Task 3	Task 4A	Task 4C	Task 5A
<ul style="list-style-type: none"> Set goal for NBS implementation Recommend NBS floodplain management practices 	<ul style="list-style-type: none"> Discuss NBS opportunities with local sponsors Identify potential FMPs and FMSs 	<ul style="list-style-type: none"> Consider potential for co-benefits when selecting FMEs to evaluate Develop NBS alternatives while performing FMEs 	<ul style="list-style-type: none"> Document project benefits, % NBS by cost Include ecosystem services, co-benefits in project BCAs
NBS Guidance Manual Resource	NBS Guidance Manual Resource	NBS Guidance Manual Resource	NBS Guidance Manual Resource
<ul style="list-style-type: none"> Guiding Principles Example NBS floodplain management practices Model Ordinance for NBS 	<ul style="list-style-type: none"> How to: developing a proactive stakeholder engagement strategy How to: identify structural and non-structural NBS Matrix of flood mitigation, environmental, and social benefits by NBS type 	<ul style="list-style-type: none"> Example alternative prioritization approach Matrix of site suitability characteristics by NBS type One Pager by NBS Type 	<ul style="list-style-type: none"> How to: calculate expected flood damages Monetary value of ecosystem services Conceptual BCA for NBS

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Key FMP Criteria to Capture for NBS

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Nature-Based Solution (% by cost)

- *Engineering Judgement*

Other/Multiple Benefits

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Key Takeaways – NBS for Flood Resilience

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Have more co-benefits than mono-functional flood infrastructure
Should be considered in planning phase, before design begins
Offer additional funding opportunities

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Questions?

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Update from Consultant Team


Neches Regional Flood Planning Group

January 21, 2026

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Regional Flood Plan Updates

- Task 4B – Preparation and Submission of Technical Memorandum
- Task 4C – Performance of FMEs
- Task 5B – Recommendation of List of FMXs to be performed by TWDB



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Task 4B – Preparation and Submission of Technical Memorandum

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Task 4B – Technical Memorandum

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- Submitted on January 7th, 2026
- Receipt of Upload received from TWDB on January 12th, 2026
 - Awaiting Notice of Administratively Complete + Task 5 Notice to Proceed

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Task 4C – Performance of FMEs

Task 5B - Recommendation of List of FMXs to be performed by TWDB

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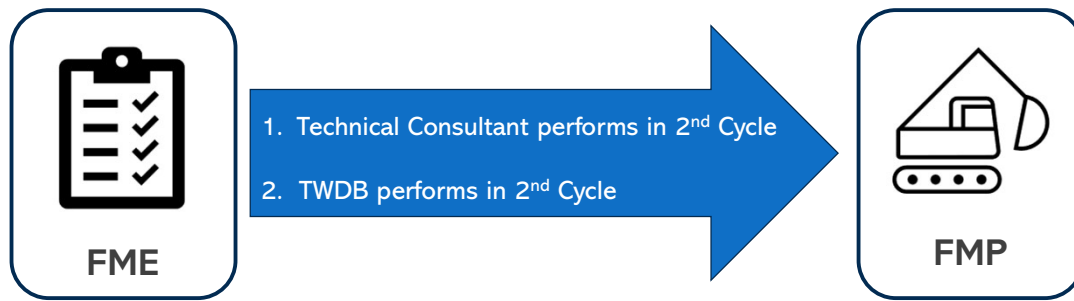
Task 4C – Performance of FMEs

- To perform, within the RFBG's resources and the time available, a portion of currently recommended FMEs to identify additional FMPs for inclusion Regional Flood Plan. Implementing these select FMEs includes the following:
 - Evaluate flood risks in areas with currently limited flood risk data
 - Evaluate flood risk reduction solutions, including feasibility studies
 - Preliminary engineering needed to identify, evaluate, and recommend additional potentially feasible FMPs
- The primary function of each recommended FMP must be flood risk reduction to life and property, and they must include quantifiable flood risk reduction benefits.
- Budget allocated - \$598,675

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Task 4C – Performance of FMEs

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Task 4C – Decision Process Approach

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- The RFPG ultimately directs the work conducted under Task 4C
- Informed by results of Task 2, Task 3, and RFPG input
- Considerations for FME Selection Criteria
 - Focus on FMEs most likely to generate FMPs
 - Maximize number of FMPs
 - Maximize flood risk reduction (Task 2)
 - Structures and population at risk
 - Critical facilities at risk
 - FME requiring only a Benefit/Cost Ratio (BCR) to be an FMP
 - Level-of-effort (cost) to perform FME relative to available budget

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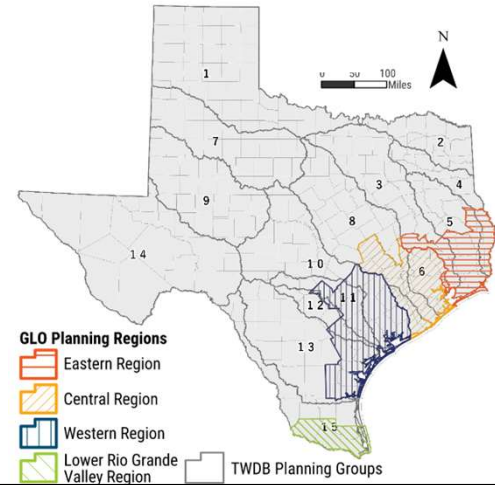
Task 4C – Decision Process Approach

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- Leverage ongoing/previous studies expected to elevate FMEs and generate FMPs
 - Master Drainage Plans
 - GLO Combined River Basin Flood Study

Flood Planning Areas

Texas General Land Office and
Texas Water Development Board



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Task 5B – FMEs for TWDB

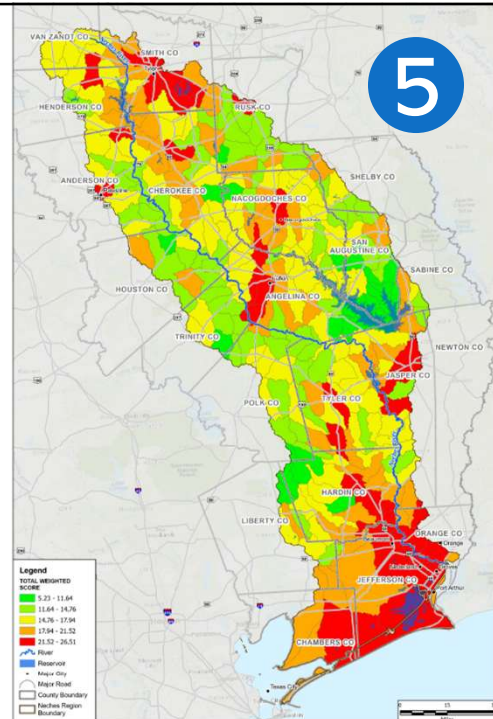
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- TWDB FME Program provides additional funds to perform FMEs for **small/rural communities**
- RFPGs to send a prioritized list of FMEs to TWDB by March 26, 2026
- 2 FMEs are expected to be completed before the Draft RFP due date (May 26, 2027)
 - Community **MUST** affirm project
 - Community **MUST** commit to be engaged
 - RFPG vote in early 2026 for list to send to TWDB

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Task 4C/5B FME Ranking

- Utilize Task 3B Needs Assessment as initial ranking
 - FMEs that intersect areas of high flood mitigation need
- Intersect potentially feasible FMEs with results of the Needs Analysis
- Potential secondary criteria/priorities to consider:
 - Rural areas who do not have funding
 - Highest development potential
 - Regional benefit (multiple sponsors)
 - Sponsor involvement
 - Regional goals



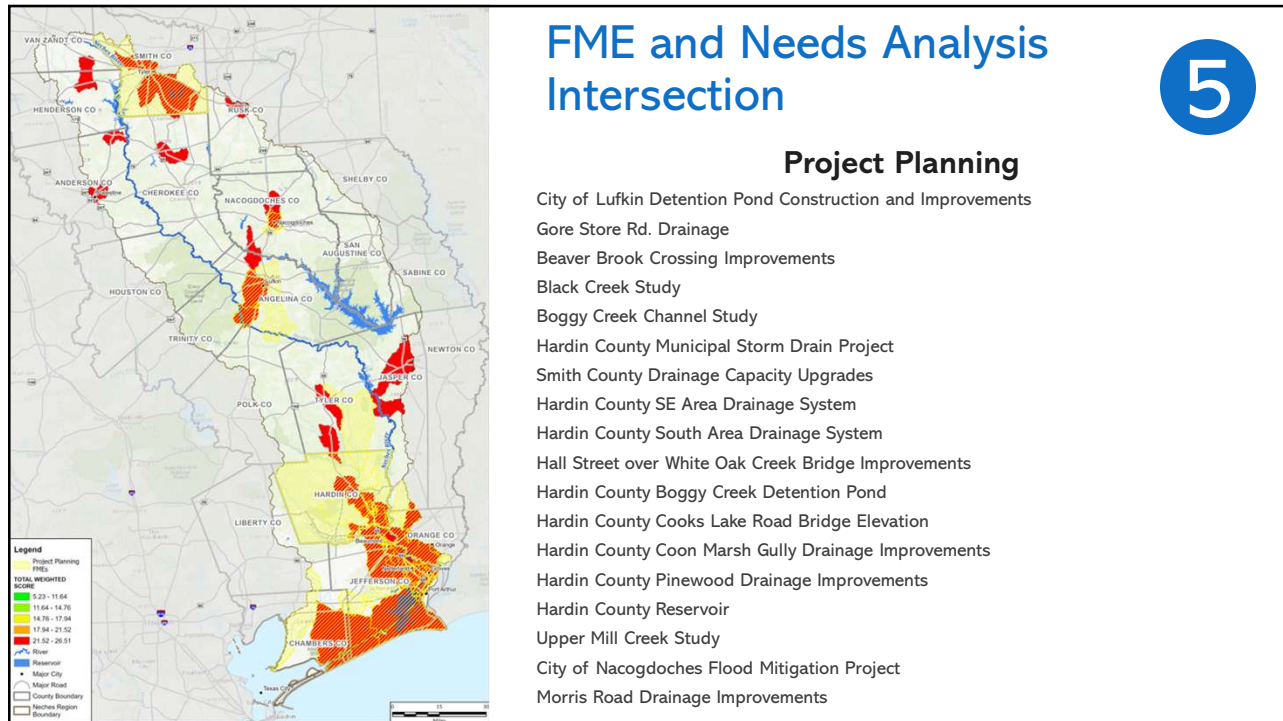
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Task 4C – Review of FMEs

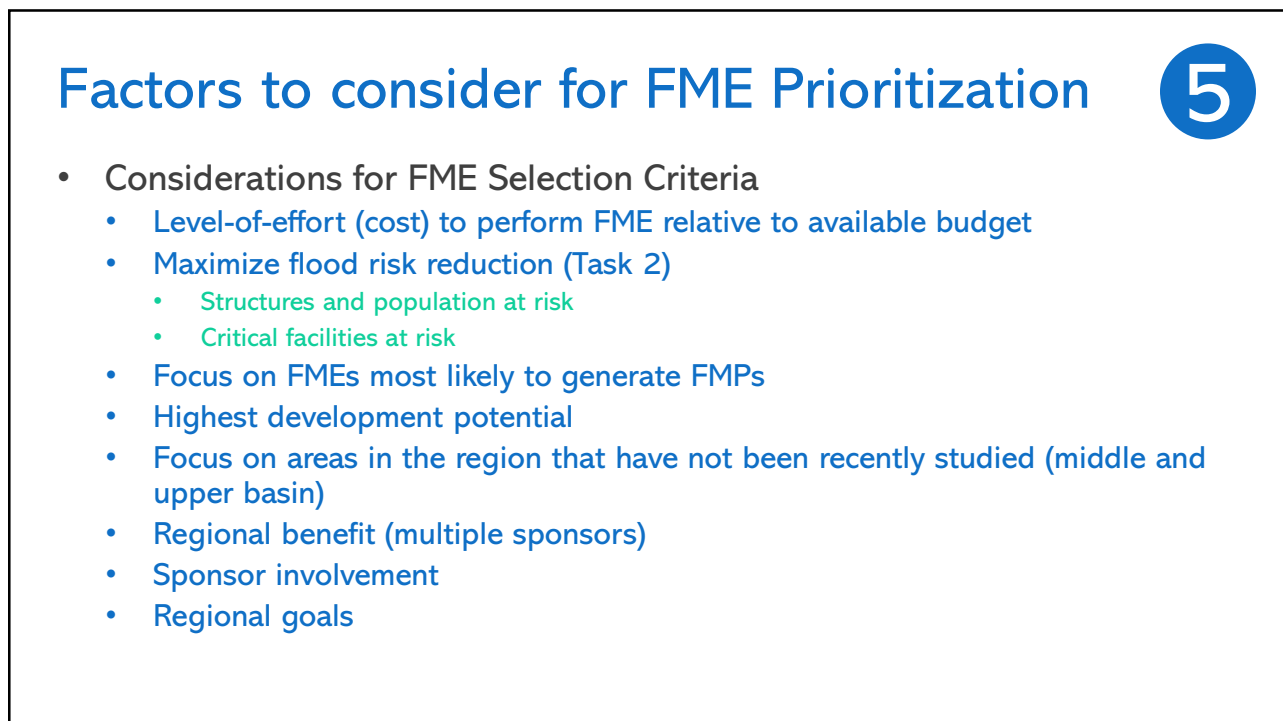
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FME Type	Description	Count
Flood Mapping Updates	Updates to floodplain mapping to include new hydrologic and hydraulic modeling for defining flood hazard areas.	22
Master Drainage Plan	An assessment of a watershed or community to estimate flood risk and recommend flood management and flood mitigation projects.	39
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.	96
Feasibility	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
TOTAL		164

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Cycle 1 FME Weighting Factors

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Which Factors are Most Important When Selecting an FME to perform?



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Scoring Breakdown

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- Reduction in Risk and Exposure
 - Benefits to critical facilities and low water crossings
 - Critical facilities includes schools, shelters, medical facilities, emergency service facilities, etc.
 - RFPG Goals
 - Reduce the number of critical facilities in the 100-year flood risk inundation extents by 15% (25%)
 - Give notice to 100% of affected units of local government and solicit funding applications for improvement or removal of 35% (90%) of Low Water Crossings identified in the latest Regional Flood Plan.

Is a Critical Facility Benefited?	Score		Weight
	Yes	No	
Points	10	0	12%

Is a LWC Benefited?	Score		Weight
	Yes	No	
Points	10	0	12%

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Scoring Breakdown

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- Sponsor Involvement
 - Measure of how engaged a potential project sponsor has been in the Regional Flood Planning process
 - How likely is the sponsor to implement FMPs that are identified as part of the evaluated FMEs

Has sponsor been engaged in the RFP process?	Score		Weight
	Yes	No	
Points	10	0	16%

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Scoring Breakdown

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- Regional Benefit
 - Projects that consist of a large service area
 - Significant reduction in existing flood exposure
 - Projects that benefit multiple entities
 - Larger the benefit area, the large the impact the project may have on a community
 - Smaller projects with lower Level of Service do not score as high

What is the benefit area of the FME (sq. mi)?	Score				Weight
	Significant	Large	Moderate	Low	
Points	10	8	5	2	15%

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Scoring Breakdown

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- Located north of Pine Island Bayou & Not Subject to Recent Studies
 - Replaces the Cycle 1 Criteria of “Overlap with Ongoing Studies”
 - Intended to give more weight to the FMEs located north of the Pine Island Bayou watershed

Does the FME area overlap with an ongoing GLO or FIF Study?	Score		Weight
	Yes	No	
Points	10	0	12%

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Scoring Breakdown

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- Flood Mitigation Needs Score
 - Based off results from Task 3B
 - All selected FMEs spatially intersect areas of high flood mitigation need
 - Task 3B scores of selected FMEs compared with one another for scoring
 - Heavy concentration of high flood mitigation need areas near coast with other areas around urban centers
 - Ex: Lufkin, Tyler, Nacogdoches

Is the FME in an area of High Need according to the Task 4A analysis? (Percentile)	Score					Weight
	80th	60th	40th	20th	0-20th	
Points	10	7	5	3	0	10%

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Scoring Breakdown

5

- Level of Effort/Cost to Complete Study
 - Cost to complete FME compared to overall budget
 - FMEs with high cost are likely not feasible to complete with available funding or would use up majority of allocated budget

Level of effort to complete FME	Score			Weight
	Low	Medium	None/Unknown	
Points	10	5	0	13%

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Prioritization of Results

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- Scoring methodology was implemented to rank FMEs within Neches FPR
- FMEs separated into three categories
 - **Primary FMEs**
 - Will be prioritized to be performed first with available funding
 - **Secondary FMEs**
 - Lower ranked FMEs, but may be performed if budget and schedule allows after primary FMEs are performed
 - **Non feasible FMEs**
 - FME too large (cost/schedule) to completed with available budget
 - Overlapping study that is likely to evaluate and determine FMP for inclusion in current RFP cycle
 - Unknown ability to implement project

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Top 20 FMEs (Rural Applicants)

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Rank	Score	FME Name	Description	Sponsor
2	8.1	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
7	7.6	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
8	7.45	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
9	7.35	Gore Store Rd. Drainage	Construct drainage improvements at crossings on Gore Store Rd. to mitigate damage during future storm events. Channel crossing at Beech Creek will be designed for the 100-year storm.	Hardin
12	7	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
12	7	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
17	6.7	Hardin County Municipal Storm Drain Project	Evaluate project to quantify benefits, evaluate impacts, and begin design.	Hardin
19	6.6	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

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Top 20 FMEs (Rural Applicants)

5

Rank	Score	FME Name	Description	Sponsor
21	6.45	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
22	6.4	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
22	6.4	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
28	6.3	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
31	6.05	City of Lumberton Detention Pond at FM 421	H&H Study to develop alternatives for detention at FM 421	Lumberton
32	6	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
32	6	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
32	6	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 Acres.	Hardin

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Top 20 FMEs (Rural Applicants)

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Rank	Score	FME Name	Description	Sponsor
32	6	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
42	5.85	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
43	5.75	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
48	5.65	Beaver Brook Crossing Improvements	Construct crossing upgrades at the Black Creek crossing to alleviate flow restrictions.	Hardin

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Top 20 FMEs Outside FIF Area (Rural)

5

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2	8.1	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
7	7.6	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
8	7.45	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
9	7.35	Gore Store Rd. Drainage	Construct drainage improvements at crossings on Gore Store Rd. to mitigate damage during future storm events. Channel crossing at Beech Creek will be designed for the 100-year storm.	Hardin
12	7	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
12	7	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
12	7	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
17	6.7	Hardin County Municipal Storm Drain Project	Evaluate project to quantify benefits, evaluate impacts, and begin design.	Hardin
19	6.6	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

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Top 20 FMEs Outside FIF Area (Rural)

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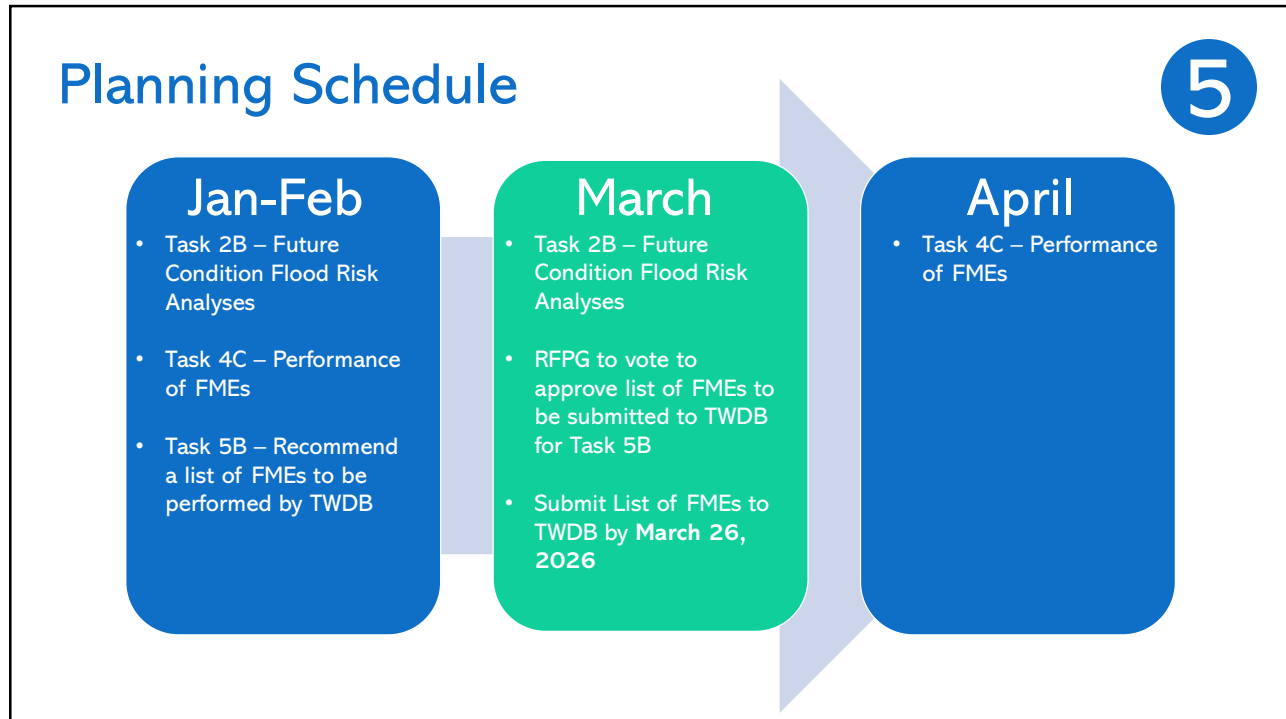
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Top 20 FMEs Outside FIF Area (Rural)

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Rank	Score	FME Name	Description	Sponsor
32	6	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
42	5.85	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
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