Task 4B/5: Identification, Evaluation, and Recommendation of Potential Flood Management Evaluations and Potentially Feasible Flood Management Strategies and Flood Mitigation Projects

Reconstruction of the Bastrop State Park Dam

Overview and Objectives

This chapter focuses on Tasks 4B and 5 as prescribed in the State Flood Plan rules and guidelines. The scope of Task 4B involves the identification and assessment of potential flood management evaluations (FMEs) and potentially feasible flood management strategies (FMSs) and flood mitigation projects (FMPs). Task 5 further evaluates identified FMEs, FMSs, and FMPs through a final recommended list of actions to be incorporated into the Lower Colorado-Lavaca Regional Flood Plan.

Objectives of Tasks 4B and 5

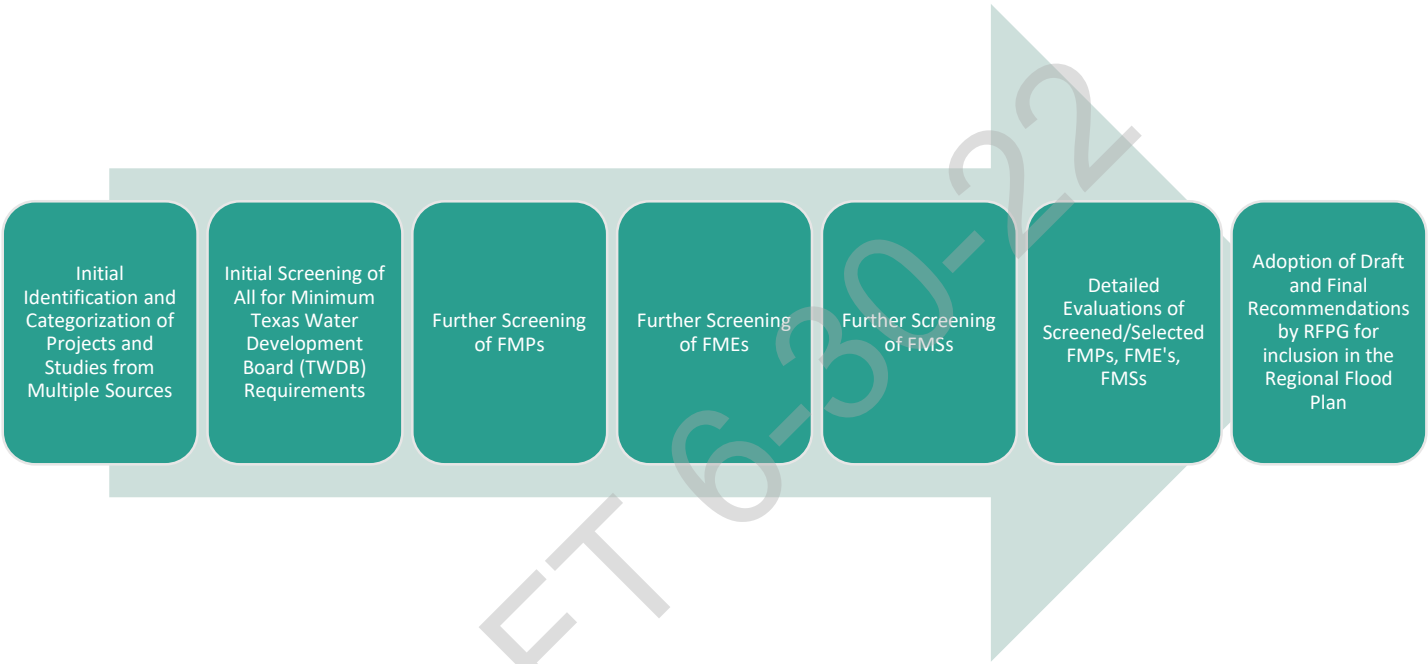
Tasks 4B and 5 build on previous Tasks 1 through 4a with the ultimate objective of recommending FMEs, FMSs, and FMPs that:

- Reduce flood risk identified in *Task 2 – Existing and Future Conditions Flood Risk Analyses*
- Address flood mitigation and floodplain management goals established *in Task 3 – Evaluation and Recommendation of Flood Mitigation and Floodplain Management Practices and Goals*
- Address flood mitigation needs identified in *Task 4a – Flood Mitigation Needs Analysis*

Process Overview of Tasks 4B and 5

The Lower Colorado-Lavaca Regional Flood Planning Group (RFPG) adopted a process for screening and evaluating FMEs, FMSs, and FMPs as summarized in the graphic *Figure 5.1* based on requirements and guidance within the State Flood Plan rules and guidelines, including region-specific interpretations and preferences. The RFPG formed a "Task 5" Technical Committee following state flood plan rules to oversee the process and eventual recommendations from the Technical Consultant team.

Figure 5.1 Process Overview Flow Diagram of Tasks 4B and 5



The state flood plan rules and guidelines allow for region-specific flexibility and interpretation when recommending Regional Flood Plan FMPs, FMEs, and FMSs. The Lower Colorado-Lavaca RFPG's general approach to this flexibility was to be more inclusive as opposed to being more restrictive for this first cycle of the Regional Flood Plan. The following sections summarize the process and draft results of Tasks 4B and 5 for the Lower Colorado-Lavaca Region.

Initial Identification and Categorization of Flood Mitigation and Management Actions

Flood mitigation and management actions were identified from multiple sources and initially categorized as FMPs, FMEs, or FMSs to begin the initial screening process. Actions were categorized based on the available information obtained from each potential sponsor community using industry-standard flood mitigation categories and types and in general accordance with TWDB state flood plan rules and guidelines.

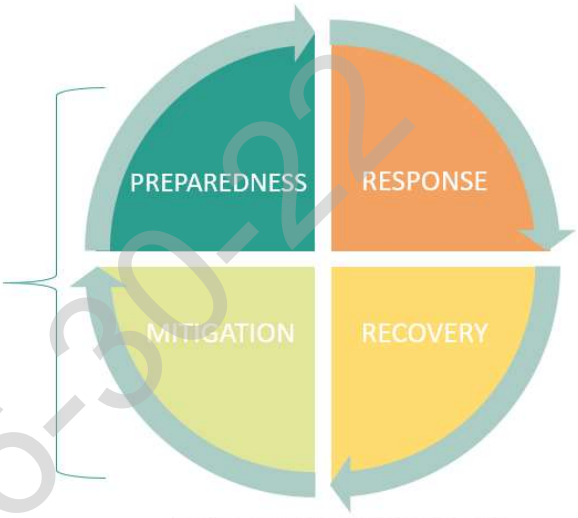
Below is a general description of the categories and types of FMPs, FMEs, and FMSs used for the Lower Colorado-Lavaca Region.

Flood Mitigation Projects (FMPs)

One of the primary objectives of the state flood plan is to identify and fund flood mitigation projects for implementation; therefore, identifying FMPs that meet state flood plan criteria and requirements for inclusion in the state flood plan is priority one. Per the TWDB rules, of the four common phases of emergency management shown in *Figure 5.2*, the regional flood planning process focuses primarily on *mitigation* projects but may also include *preparedness* projects.

Figure 5.2 Four Common Phases of Emergency Management

*"The regional flood planning process will focus primarily on mitigation and may include preparedness with regard to **identifying and recommending FMPs by the RFPG**."*



Four Phases of Emergency Management

By the TWDB definition, a flood mitigation project is "a proposed project that has a non-zero capital cost or other non-recurring costs and that when implemented will reduce flood risk and mitigate flood hazards to life or property."[1] FMPs are further categorized as either structural or non-structural.

Structural FMPs

Structural FMPs is defined as building or modifying infrastructure to change flood characteristics to reduce flood risk. They are infrastructure projects with advanced analysis and 30 – 100 percent design development, including construction plans, specifications, and cost estimates. Structure FMPs include one or a combination of the following project types:

- Culvert/Bridge Improvements
- Channel Improvements
- Flood Detention
- Flood Walls/Levees
- Flood/Levees
- Flood Diversion
- Storm Drain Improvements
- Coastal Protections

Culvert and Bridge Improvements

Typical culvert and bridge improvements address roadway flooding at waterways ranging from large riverine crossings to roadway crossings at smaller creeks and streams. The TWDB rules define low water crossings as roadway creek crossings overtopped by a 50 percent annual chance storm event (2-year storm). Bridges and culverts with insufficient area to convey higher flows tend to overtop frequently, preventing the passage of

[1] Title 31 Texas Administrative Code §361.10(n)

vehicles during high flow times and producing excess backwater that may result in flooding upstream properties. Bridges and culverts that overtop frequently pose a significant threat to public safety as most flood-related deaths occur at these types of crossings. Culvert and bridge improvement FMPs are often part of larger flood risk reduction projects (such as channel widening projects) and not necessarily just single low water crossing projects.

Example of Flooded Low Water Crossing at Bee Creek Road and Bee Creek in Travis County as well as an Example Low Water Crossing Upgrade with Precast Bridge Units, David Moore Drive, Austin

Channel Improvements

Channel improvements generally lower flood levels by improving the hydraulic conveyance of a stream or roadside channel by enlarging, straightening, and/or reducing the channel friction by smoothing the contours and/or lining of the channel banks and removing obstructions. Channel improvements can reduce flood risk to large populations but require significant modifications to mitigate the 1 percent annual chance (100-year) flood. Channel improvement projects typically require land acquisition, can be costly and difficult to implement in urbanized areas and permit due to environmental impacts, and often require ongoing O&M costs. Channel improvements can incorporate nature-based natural channel design techniques to help provide ecological function uplift and reduce environmental impacts as well as erosion risk. In urban settings, channel improvements can include recreational, cultural, and educational features providing socioeconomic benefits.

Example Channel Improvements - Shoal Creek Channel Improvement and Restoration Project, Austin

Flood Detention

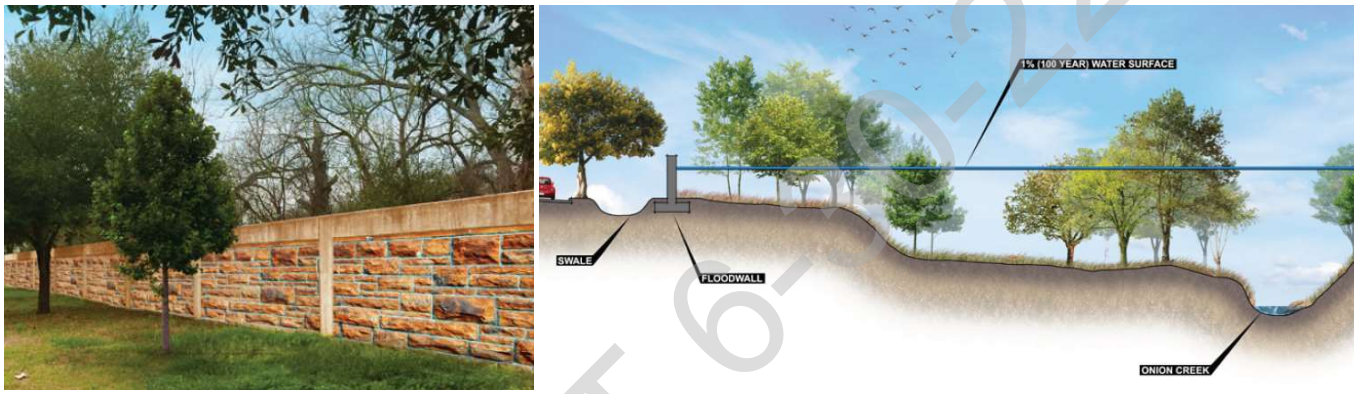
Typical flood detention projects are regional in scale ranging from large flood control reservoirs to smaller regional flood detention ponds. They can provide benefits to relatively large populations and or agricultural areas. Regional flood detention facilities require significant storage volume to mitigate the 1 percent annual chance (100-year) floods, requiring large tracts of land in suitable locations and can be costly and difficult to implement in urban areas. They also require long-term operations and maintenance costs. Flood detention can reduce flood risk and provide additional benefits such as recreation and water supply but can create dam safety risks and environmental impacts.

Example of Large Flood-Control Reservoir - Lake Travis, LCRA and Example Regional Detention - Upper Brushy Creek WCID Flood Detention Structure No. 20

Floodwalls/Levees

Levees and floodwalls confine out-of-bank flows to areas along rivers and streams to reduce flood risk to properties located in the natural flood plain. The confinement of floodwaters using levees or floodwalls

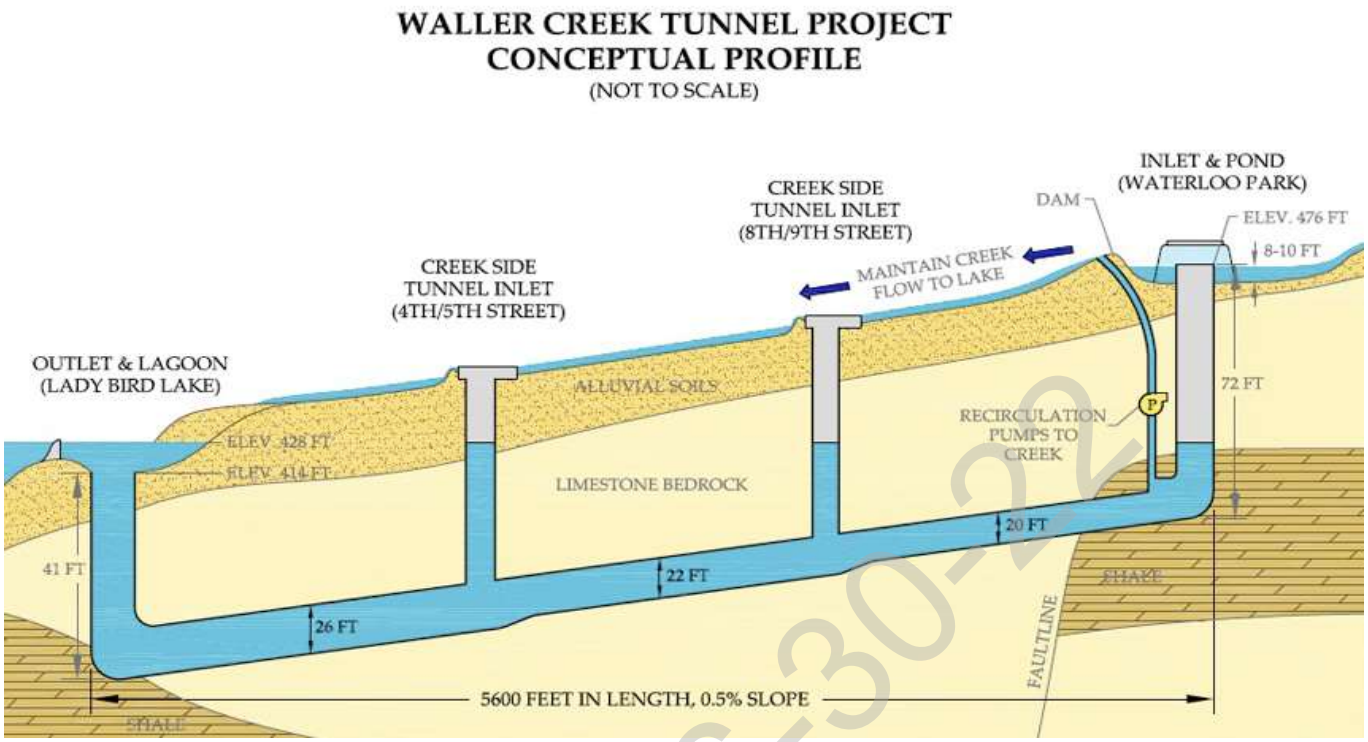
considerably alters the characteristics of flood flows. Reduction of natural valley storage capacity in the floodplain can increase peak discharges for a given flood and increase flood damages downstream of a project. Land must be reserved behind levees or floodwalls for ponding areas, and impounded water must be retained or pumped over the levee. Levees are most applicable where the floodplain is wide and development is located a considerable distance from the channel. Levees can cause catastrophic damage if overtopped, damaged, and fail from a flood greater than their design flood. Therefore, the design flood for levees is typically the 1 percent annual chance (100-year) flood at a minimum, with additional freeboard to reduce the risk of overtopping. Levees and floodwall facilities can require significant land acquisition and be costly and difficult to implement in urban areas. They require closures at the road and railroad crossings and interior drainage measures such as stormwater pump stations. They also require long-term operations and maintenance costs typically associated with Federal Emergency Management Agency (FEMA) certification. Levees and floodwalls can reduce flood risk but can create levee safety risks, environmental impacts, and negative socioeconomic impacts.



Example Floodwall - Floodwall Concepts for Onion Creek Flood Risk Reduction, Austin

Flood Diversions

Typical flood diversion projects include diversion channels or diversion conduits (tunnels). Diversion channels intercept flood waters upstream of populated areas and convey them safely above ground to a discharge point downstream of the populated areas. They require significant land acquisition and can be difficult and costly to build in urbanized areas. Diversion tunnels convey flood waters underground to reduce flood risk to largely populated areas. Due to land costs, surface constraints and impacts, and utility conflicts, they can be a preferred alternative in highly urbanized areas. They require long-term O&M costs. Flood diversions can reduce flood risk but cause downstream hydrologic and environmental impacts.



Example Diversion Tunnel, Source: Austintexas.Gov

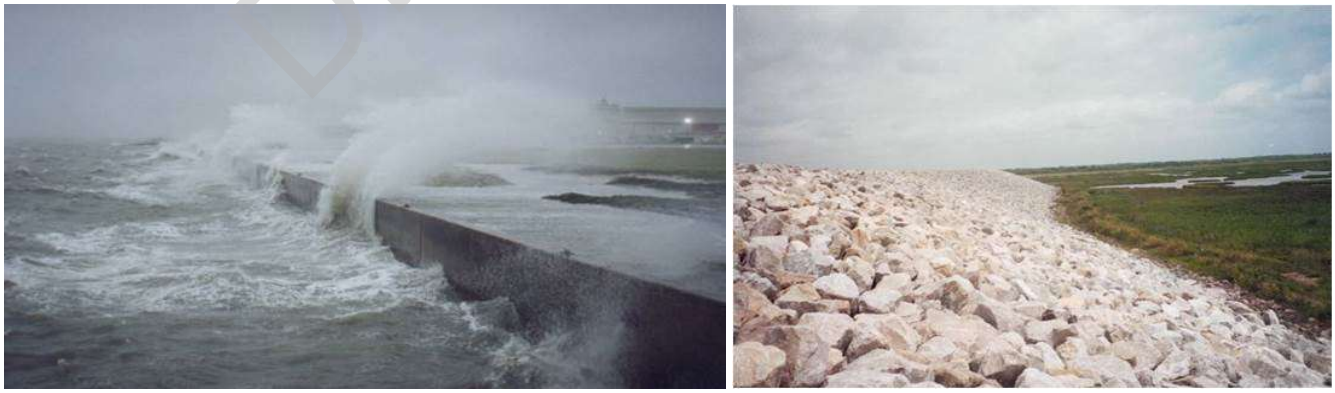
Storm Drain Improvements

Excessive street flow in urbanized areas can cause flooding of residential and commercial structures, traffic safety issues, pavement damage, and in some cases, life loss. Installing new storm drain systems to collect runoff and convey it underground to a receiving stream is a typical solution for improving street flow and diverting stormwater around problem areas. Storm drain improvements can reduce flood risk to large populations but can require significant sizes of conduit or box sections to mitigate the 1 percent annual chance (100-year) floods. Storm drain improvement projects typically require other measures to mitigate increases in flood discharges to downstream areas and can be costly and difficult to implement in urbanized areas.

Example Storm Drain Improvements - Storm Drain Project Area Map, Guadalupe Storm Drain Improvement Project, Austin

Coastal Protections

Coastal flood protections reduce flood risk to large populations from coastal storm surges and combined riverine and coastal effects. Typical coastal protections include coastal levees, dikes, and seawalls and often include beach erosion countermeasures such as riprap revetments. Similar to inland levees and floodwall facilities, coastal protections can require significant land acquisition and can be costly and difficult to implement in urban areas. They require closures at the road and railroad crossings and interior drainage measures such as stormwater pump stations. They also require long-term operations and maintenance costs typically associated with FEMA certification. Coastal protections can reduce flood risk but create levee safety risks, environmental impacts, and negative socioeconomic impacts.



Example Coastal Protections – Sea Wall and Rock Riprap Revetment

Nature-Based Features

FMPs can include nature-based features as part of flood mitigation solutions where applicable, including, but not limited to, stream and coastal restorations, wetlands, natural channel design, other green infrastructure elements, and land preservation. Although nature-based solutions generally do not provide significant flood risk reduction relative to a 1 percent annual chance flood, they can provide some flood mitigation, improve stormwater quality, enhance ecological functions, and reduce riverine and coastal erosion risk.

Example Channel and Bridge Upgrade Project with Natural Channel Design Elements, Fort Branch Creek, Austin

Non-Structural FMPs

Non-structural FMPs are flood mitigation projects or actions that change the way people interact with flood risk and move people out of harm's way. These types of projects do not involve modifications to the watershed or flood infrastructure and therefore do not negatively impact adjacent areas or environmental impacts. Non-structure FMPs include one or a combination of the following project types:

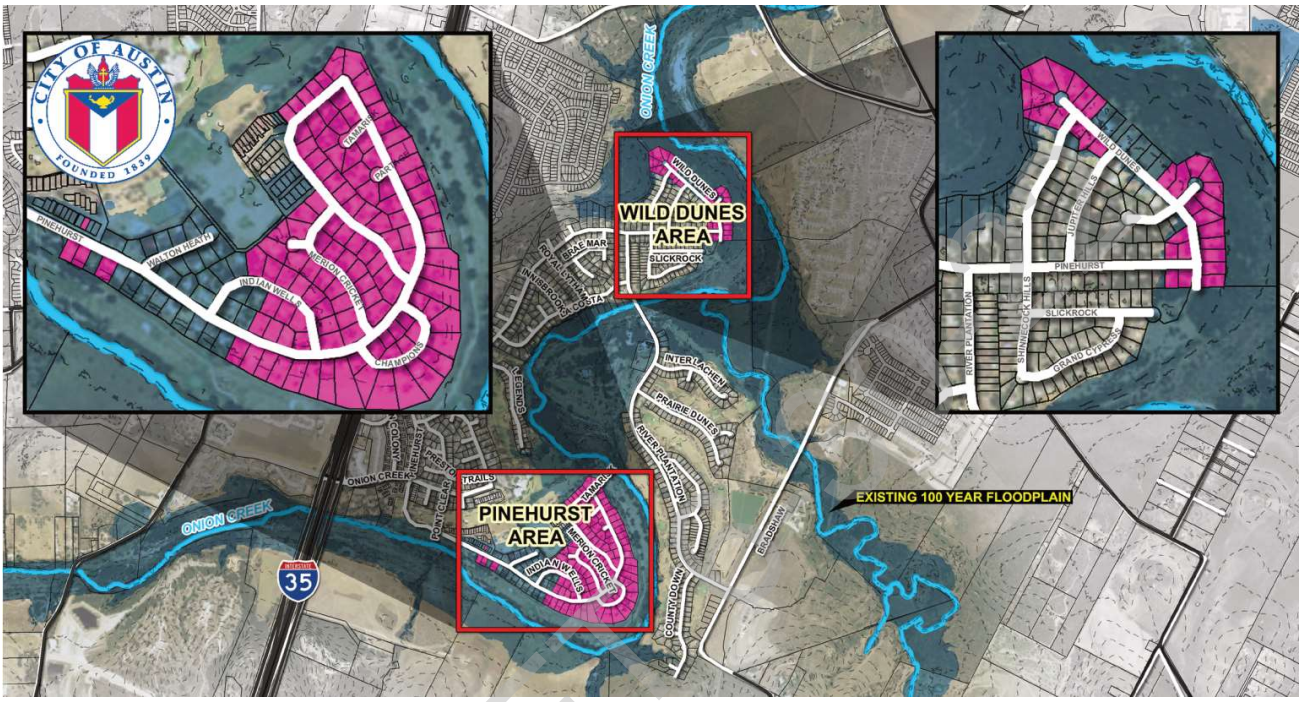
- Regulatory Improvements
- Floodplain Evacuation (Property Acquisition/" Buyouts")
- Flood Warning
- Floodproofing
- Flood Readiness and Resilience

Regulatory Improvements

Adoption of regulations by local governments, such as the minimum FEMA NFIP requirements described in Chapter 3, provides legal measures to control development in flood-prone areas and prevent future drainage-related problems. Regulatory improvements create or improve local regulatory requirements such as floodplain development ordinances and drainage design criteria related to planning, zoning, land development, and building codes. Regulatory improvements include requirements of those proposing new developments or redevelopment to identify flood hazard areas and keep people out of them. This non-structural FMP has a very low capital cost compared to structural FMPs. Regulation of flood-prone land increases the likelihood that such property will be properly used in the best interest of public health, safety, and welfare. However, such regulations offer no relief for existing development.

Floodplain Evacuation

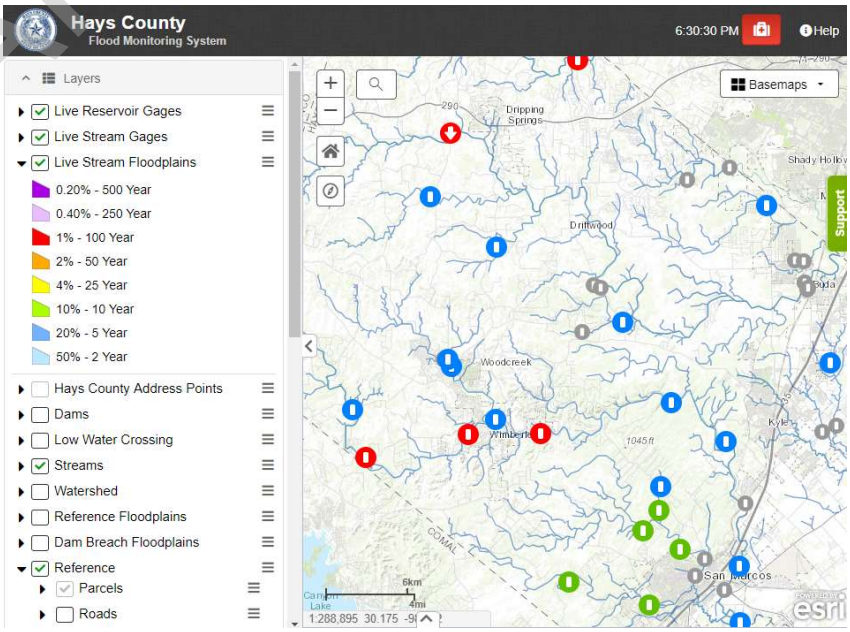
Floodplain evacuation involves acquiring real property at high risk of incurring flood damages and loss of life. Typically referred to as floodplain "buyouts," these can be voluntary or involuntary. One major advantage of this type of FMP is that it *eliminates* flood risk leaving no residual risk. Buyouts are costly upfront but typically have no long-term O&M costs. Buyouts can provide environmental enhancements by creating open space, riparian restoration, and park land, but can also have negative socioeconomic impacts.



Example: Floodplain Evacuation - Onion Creek Buyout Program, Austin

Flood Warning

Typical flood warning measures or systems provide means for temporary evacuation of flood hazard areas during floods to reduce flood risk. These types of measures range from simple stream gauges and warning signals to more complex early flood warning systems that can forecast floods and warn large populations to evacuate. Flood warning systems save lives but do not save property. This type of non-structural FMP has low capital costs compared to structural FMPs.



Example: Hays County Flood Monitoring System Online Map Viewer

Floodproofing

Floodproofing typically consists of providing watertight coverings for door and window openings of habitable structures, raising structures in place, raising access roads and escape routes, constructing levees and floodwalls around individual or groups of buildings or critical infrastructure, and waterproofing walls and mechanical and electrical equipment. Floodproofing is more easily applied to new construction and is more applicable where flooding is of short duration, low velocity, infrequent, and shallow depths. Floodproofing is appropriate for locations where other structural flood mitigation alternatives are not feasible. Floodproofing can mitigate the risk of the 1 percent annual chance (100-year) floods but does not eliminate all flood risks.

Example: Wastewater Treatment Facility Floodproofing (Source: RT Group, Inc.)

Flood Readiness and Resilience

Typical flood readiness and resilience projects or actions focus on improving flood preparedness and response to save lives. They include developing flood response plans, flood or hurricane evacuation plans, and flood or dam emergency action plans. This type of non-structural FMP has low capital costs compared to structural FMPs.

Flood Management Evaluations (FMEs)

By TWDB definition, a flood management evaluation (FME) is "a proposed flood study of a specific, flood-prone area that is needed to assess flood risk and/or determine whether there are potentially feasible FMSs or FMPs."[2] There are four general categories of FMEs, as described below. An FME may include any or all of these study elements or phases.

Floodplain Modeling and Mapping/Risk Assessment Studies

These studies quantify flood risk in areas where significant flood risk is thought to exist but do not have flood risk data or insufficient flood risk data. An example of this type of FME is a floodplain modeling and mapping study of a chronic flood-prone area with a certain population at risk that has not been studied before.

Flood Mitigation Alternatives Analysis/Feasibility Studies

These FMEs involve using flood hazard and flood risk data for a known flood problem area to evaluate structural and non-structural flood mitigation alternatives or project types, as the FMP types described above, to provide the greatest flood risk reduction benefit for the least capital cost, considering adverse impacts and other factors. These FMEs include a benefit-cost analysis and evaluations of other factors such as environmental constraints and permitting requirements, land acquisition and utility relocation requirements, constructability and other constraints, and public input and social factors.

Preliminary Engineering Studies

Once a flood-prone area has been studied and a preferred flood mitigation alternative or set of alternatives have been identified from a feasibility study, a preliminary engineering study of these alternatives would develop at least a 30 percent level design, including initial plans, permitting assessments, and refined capital cost estimates. Potential FMPs that have previously been studied within the region but do not meet the standards set by the TWDB for FMPs will fall into this category of FME.

Flood Emergency Preparedness Studies

These FMEs are studies needed to develop flood emergency action plans such as hurricane evacuation plans, flood emergency response plans, or dam breach emergency action plans.

[2] Technical Guidelines for Regional Flood Planning, page 53.

Flood Management Strategies (FMSs)

Proposed actions that did not qualify as an FMP or FME but were similar for communities across the region were initially grouped together as regional or subregional "strategies." The term *flood management strategy* is not typically used in the flood mitigation industry; however, in a few cases, community sponsor-specific strategies were provided to the RFPG that met the TWDB definition. A flood management strategy, by TWDB definition, is "a proposed plan to reduce flood risk or mitigate flood hazards to life or property. A flood management strategy may or may not require associated Flood Mitigation Projects to be implemented".[3] Regional or subregional FMSs generally fell into the following five categories:

- Flood mitigation education and outreach
- Area-wide low water crossing flood mitigation studies and projects
- Identify and fund buyout programs
- Develop regional flood warning measures
- Strengthen flood management regulations

Initial Identification of FMP, FME, and FMS

The initial list of potential actions (FMP, FME, FMS) identified for screening and evaluation were collected from four primary sources:

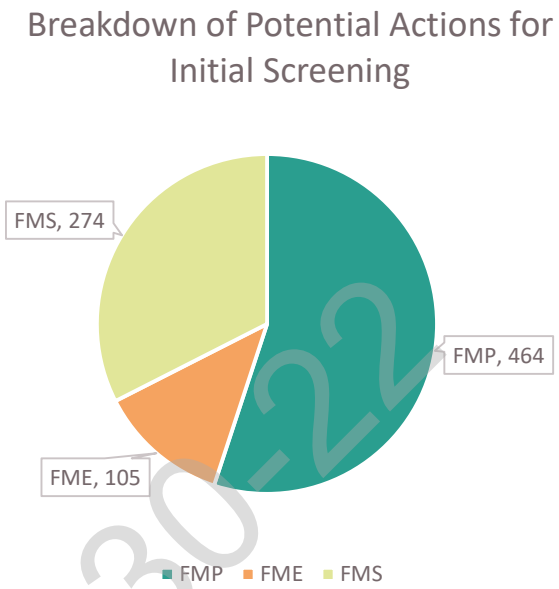
- Data collected from the initial introductory community outreach
- TWDB Flood Protection Planning grant studies
- Community drainage master plans or capital improvement programs (CIPs)
- Hazard Mitigation Plans for each county and community within the region

[3] Title 31 Texas Administrative Code §361.10(k)

Documents from these sources were obtained from online archives of the TWDB, various communities within the region, and the Technical Consultant's archives. These documents were reviewed and potential actions were extracted and then initially categorized.

A total of 843 potential actions were identified and categorized, providing an initial list of potentially feasible FMPs, FMEs, and FMSs to start the screening process. A breakdown of the initial actions collected and categorized is shown in *Figure 5.3*.

Figure 5.3 Breakdown of Potential Actions for Initial Screening



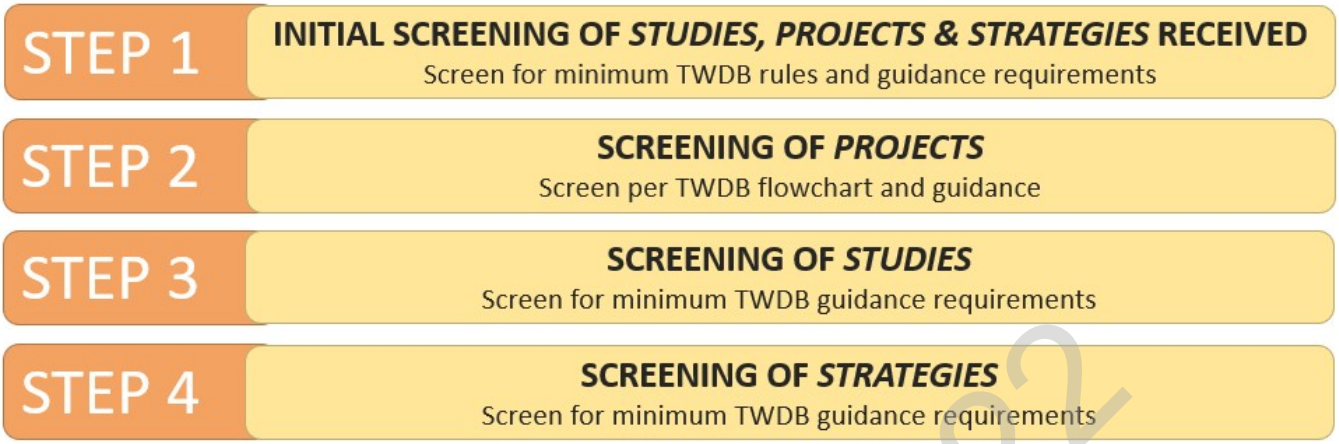
Task 4B: Screening and Evaluation of FMPs, FMEs, and FMSs

The TWDB requirements for Task 4B state that each RFPG is to develop and receive public comment on a "…proposed process to be used by the RFPG to identify and select flood management evaluations, flood mitigation strategies, and flood mitigation projects. This process is to be documented, and such documentation is to be included in the draft and final adopted Regional Flood Plan."

The Lower Colorado-Lavaca RFPG developed and adopted a process over the course of several RFPG meetings. On August 16, 2021, the RFPG received a presentation from the Technical Consultant for the region outlining a proposed process for screening, evaluation, and recommendation of potential FMEs, FMSs, and FMPs. Subsequently, at the October 18, 2021 meeting, the RFPG reviewed and discussed the proposed process and accepted public comment. At its November 15, 2021, meeting, the RFPG adopted the process as displayed in *Figure 5.4*.

The following is a description of the process adopted by the RFPG. The process was developed to conform to the TWDB requirements expressed in the rules, the scope of work for the regional flood planning process, and technical guidelines.

Figure 5.4 Adopted Screening and Evaluation Process



Initial Screening

Each floodplain management and mitigation action was initially screened following steps zero through four above. This process is further explained in the following sections.

Step 0: Verify the FMPs, FMEs, and FMSs are not completed, in progress, or no longer needed

In this initial step, potential FMP, FME, and FMSs were disqualified if they were found to have already been completed or implemented, were in progress, or were no longer needed or wanted by the sponsoring community. This verification was made by the Technical Consultant team based on direct knowledge of the potential actions or by direct community sponsor engagement.

Step 1: Initial screening of FMPs, FMEs, and FMSs for minimum TWDB requirements

This first step was screening based on minimum TWDB rules and guidance requirements for all actions. The screening criteria applied in this step are:

- Study/strategy/project is related to a flood mitigation or floodplain management goal.
- Study/strategy/project meets an emergency need.
- Study/strategy/project addresses a flood problem with a drainage area of 1 square mile or greater.
- Study/strategy/project reduces flood risk for the 1 percent annual chance (100-year) flood.
- Exceptions for a level of flood risk reduction or problem area size include instances of flooding of critical facilities, transportation routes, or other factors as determined by the RFPG.

Step 2: Screening of Projects (FMPs)

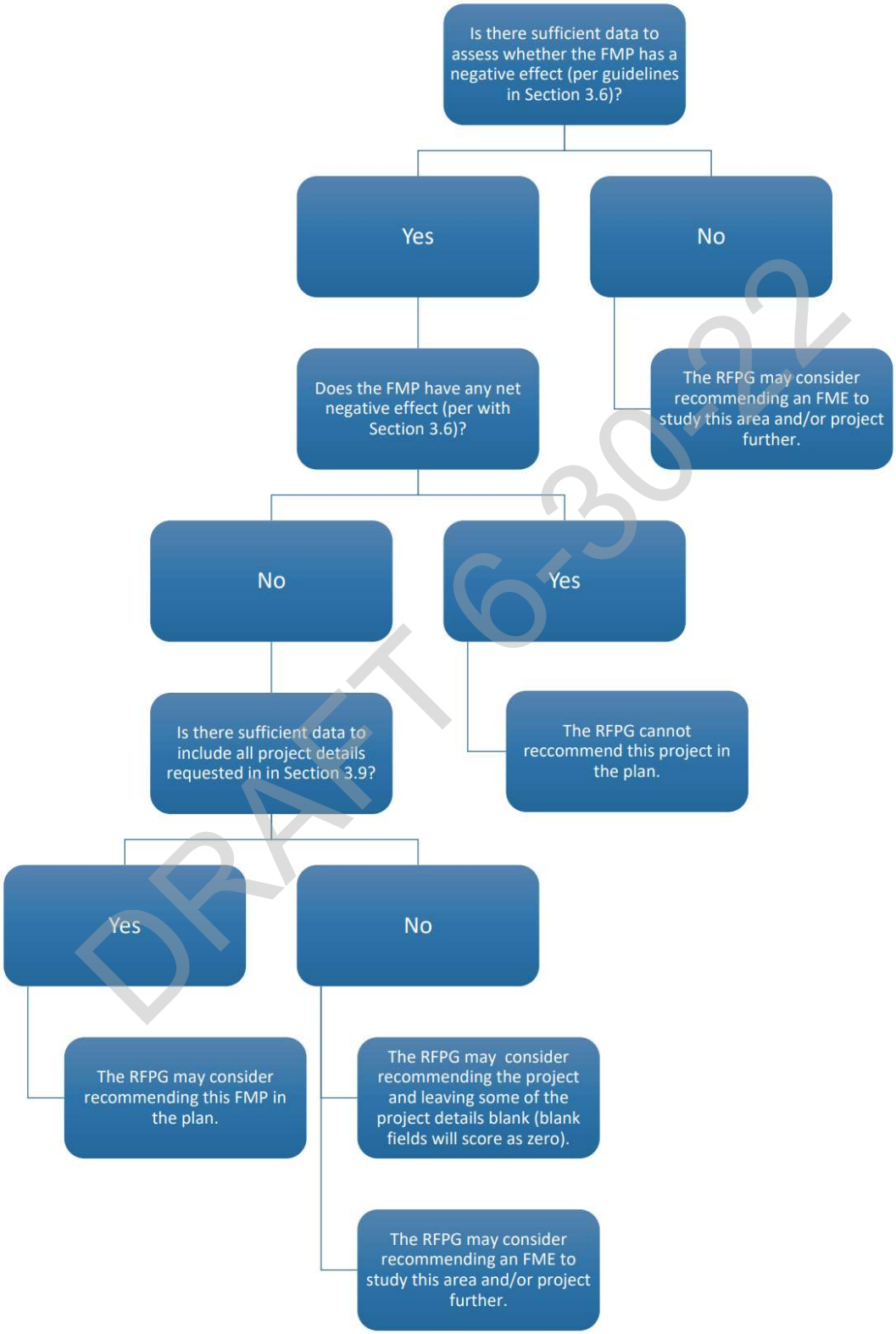
In the second step, potential Flood Mitigation Projects were subjected to a screening-level evaluation based on the TWDB Technical Guidelines for Regional Flood Planning (April 2021) and specifically in *Figure 5.5*.

If a potential FMP does not satisfy this step's screening criteria, it will become a potential Flood Management Evaluation. Three criteria are applied in this step; "sufficient data," “no negative impact,” and “project details.”

- **Sufficient data**: The data upon which an assessment of no negative effect has been made must be reliable and have minimal uncertainty. H&H modeling, mapping, and basis for mitigation analysis must generally meet Section 3.5 of the TWDB technical guidelines.

- **No negative impact:** The potential project must not negatively impact the 1 percent annual chance (100-year) flood event. It must not raise the flood elevation or increase the discharge of the 1 percent annual chance flood event. Any of the following will disqualify the potential project in this screening step:
  - Increases inundation of homes or commercial buildings
  - Increases inundation beyond existing or proposed ROW or easements
  - Increases inundation beyond existing drainage infrastructure capacity
- **Project details:** Data used to define the potential project must include sufficient project details as described in Section 3.9 of TWDB technical guidelines, including but not limited to the following:
  - Flood severity level metrics
  - Flood risk/damage reduction metrics
  - Estimated capital and O&M costs
  - Benefit/cost ratios
  - Environmental benefits/impacts
  - Implementation constraints
  - Water supply benefits

Figure 5.5 Regional Flood Planning Technical Guidelines Figure 5: FMP Flowchart



Step 3: Screening of Studies (FMEs)

In this step, potential studies were screened based on criteria from the TWDB technical guidelines. Each potential study must:

- Be sensible in that it can be implemented with a reasonable amount of resources
- Have a reasonable planning-level cost estimate
- Have willing sponsor(s) identified that are willing to commit resources and some level of potential cost-sharing
- Identify structures, population, and critical facilities at risk within the flood problem area being studied
- Identify roadways impacted by flooding within the flood problem area being studied
- Quantify the area of farm and ranch land at risk within the study area, if applicable

If there is a sufficiently detailed H&H analysis and flood mitigation alternatives analysis, the study may be considered an FMP or FMS.

Step 4: Screening of Strategies (FMSs)

In this step, Strategies are screened based on the following criteria from the TWDB technical guidelines:

- Potential strategies must include a planning-level cost estimate
- Potential strategies must have an identified sponsor(s) willing to commit resources and some level of potential cost-sharing
- Potential strategies must quantify the estimated flood risk being addressed and the potential level of flood risk reduction

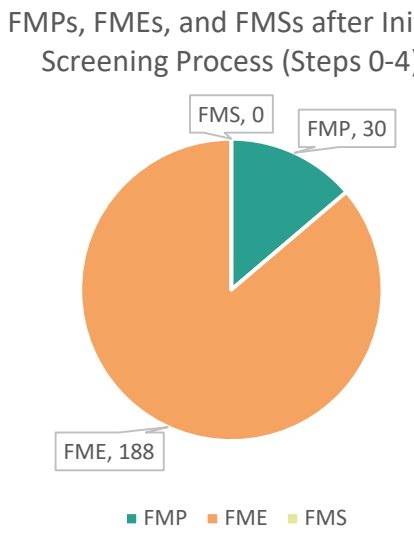
Initial Screening Sponsor Outreach

The RFPG conducted a targeted outreach effort to contact each potential sponsoring community to discuss the initial list of potential actions for potential additions, deletions, or edits to the actions and their attributes and to verify that they are a willing sponsor. A total of 108 potential sponsors were contacted, and approximately 45 responded and met to discuss via online video conferences. Documentation of this outreach effort was captured using the online database Jotform.

Initial Screening Results

Each action was screened based on its category through each minimum criterion described in the process above. Potential FMPs that did not meet the requirements in steps 2-1 were downgraded to FMEs and screened again. Most initial actions were temporarily designated as FMSs were potential actions from existing Hazard Mitigation Plans that were not specific to a specific or quantifiable flood problem or flood risk-benefit and were generally broad ideas or actions that did not meet the minimum requirements for an FMS. As discussed in subsequent sections, these actions were later consolidated into regional strategies. A breakdown of the initial screening process results is shown in *Figure 5.6*.

Figure 5.6 Breakdown of Actions after initial screening steps 0-4



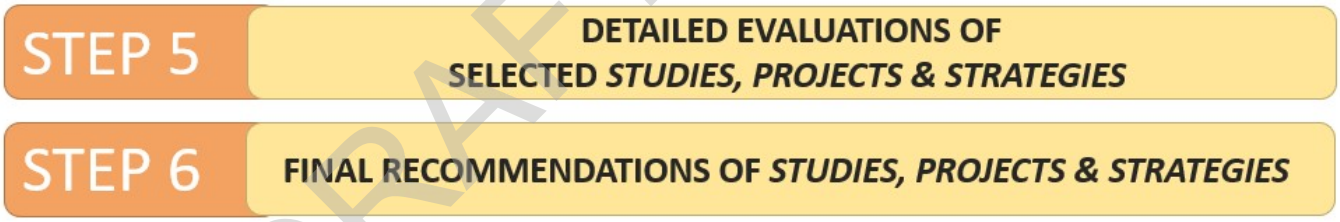
Task 5: Detailed Evaluation and Recommendation of FMPs, FMEs, and FMSs

The objective of Task 5 is for RFPGs to use the information developed in Task 4B to recommend flood mitigation actions for inclusion in the Regional Flood Plan. In essence, Task 5 was a continuation of 4B. As described above, Task 4B was an initial technical evaluation and screening of potential FMEs and potentially feasible FMSs and FMPs. Task 5 and the remainder of Chapter 5 focus on how the RFPG used this information to further evaluate and develop its recommendations for the inclusion of flood mitigation actions in the Regional Flood Plan. This chapter summarizes and documents:

1. Process is undertaken to make final recommendations on flood mitigation actions
2. Potential FMEs and potentially feasible FMSs and FMPs identified and evaluated under Task 4B and whether the RFPG recommends these actions
3. Entities that will benefit from the recommended flood mitigation actions

While there is a significant need across the Lower Colorado-Lavaca Region to improve flood risk awareness and develop and implement actions to reduce existing and future flood risk, not every flood mitigation action can be recommended in the Regional Flood Plan or included in the State Flood Plan. The Lower Colorado-Lavaca RFPG opted to take an inclusive approach to the evaluation and recommendation process. If an evaluation, strategy, or project met the TWDB requirements, was aligned with the Regions' flood mitigation and floodplain management goals, and seemed reasonable, the planning group chose to show deference to the local communities/sponsors and leaned towards including those actions in the Regional Flood Plan.

Figure 5.5 Adopted Evaluation and Selection Process



Step 5: Detailed Evaluations of FMPs, FMEs, and FMSs

Due to the overlap of Tasks 4B and 5, the recommendation process was in many ways an extension of the initial screening process, with a more detailed evaluation of each action, geospatial location, determination of flood risk indicators and risk reduction potential, and reassignment of actions as needed (example: FMP to FME).

Figure 5.7 and *Figure 5.8* expand upon the initial screening process previously described for FMPs/FMSs and FMEs, respectively. These processes were developed following the TWDB rules and requirements that left some evaluation criteria at the discretion of the RFPG. The discretionary evaluation criteria are the following:

- **Level of Service (LOS) to be provided:** If a 1 percent annual chance (100-year) LOS is not feasible, the RFGP can recommend an FMP with a lower LOS.
- **Benefit-Cost Ratio (BCR) for the project:** The TWDB recommends that proposed actions have a BCR greater than one, but the RFPG may recommend FMPs with a BCR lower than one with proper justification.

- **Drainage Area (DA):** The TWDB recommends actions with a DA greater than 1 square mile to encourage regional actions and cooperation, but the RFPG may recommend FMPs with a smaller DA and justification.

Due to many projects being physically and financially constrained, the RFPG decided they did not want to exclude good flood reduction projects based on the level of service or benefit-cost ratio. Similarly, because many of the known flood mitigation projects were identified by local jurisdictions, the drainage areas are often under a 1 square mile, and the RFPG did not want to exclude those from the plan. The RFPG did express a desire to identify and group small individual projects to create larger FMPs within single jurisdictions where allowed and to encourage communities to work together on regional projects. Those efforts are somewhat limited in this first cycle but will be an important aspect of the amended plan due to be submitted in July 2023.

Figure 5.7 FMP and FMS Screening Process

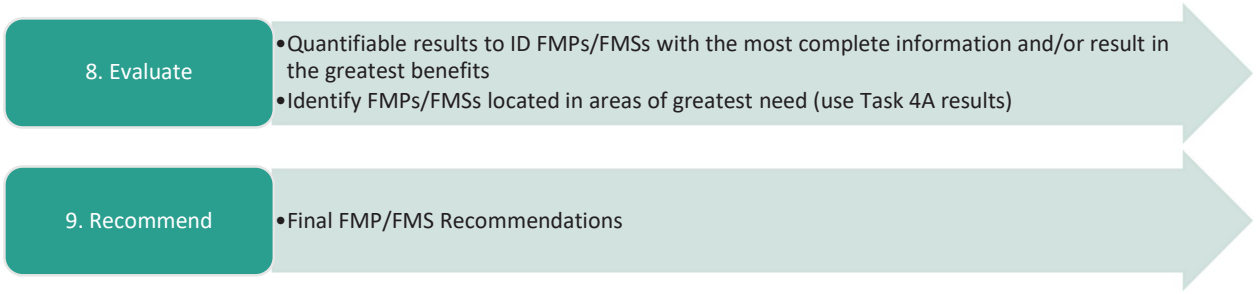
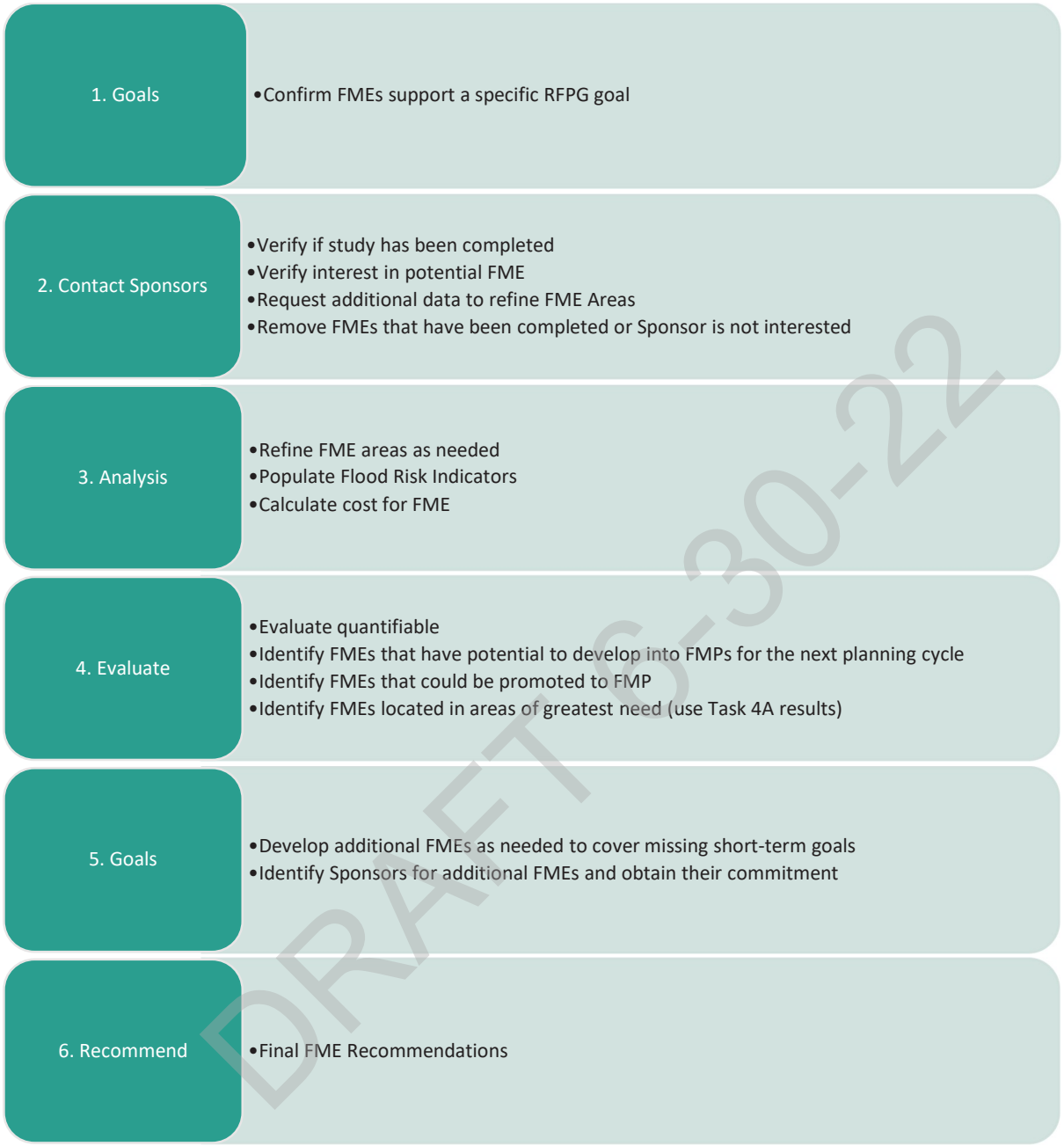

8. Evaluate
•Quantifiable results to ID FMPs/FMSs with the most complete information and/or result in the greatest benefits
•Identify FMPs/FMSs located in areas of greatest need (use Task 4A results)
9. Recommend
•Final FMP/FMS Recommendations

Figure 5.8 FME Screening Process



Costs and Benefit-Cost Ratio

FME Planning Level Cost Estimates

Planning level cost estimates are based on sponsor provided information from community studies with high-level verification and validation of those costs. For actions that did not have a sponsor identified cost, cost estimates were developed using the processes outlined in the following sections. Cost estimates presented are for planning purposes only and are not supported by detailed scopes of work or workhour estimates. Sponsors were provided the opportunity to confirm or alter the costs through the Flood Infrastructure Financing survey discussed in Chapter 9. The RFPG will continue to review costs to improve these estimates moving forward, particularly if additional feedback is received from potential Sponsors. Local sponsors will develop detailed scopes of work and associated cost estimates before submitting future funding applications through the TWDB or other sources.

- **Watershed Planning – Floodplain Modeling and Mapping:** Sponsor-provided costs were utilized for all FMEs entailing flood mapping updates or large-scale hydrologic and hydraulic modeling. The costs provided by Sponsors were reviewed for reasonableness based on the information available and validated before inclusion as cost-level estimates in this plan.
- **Watershed Planning – Drainage Master Plans:** Separate planning level cost estimates were developed for drainage master plans depending on whether the Sponsor is a county or city. After a comparative analysis of previously completed Countywide Studies, it was determined that a uniform cost estimate of $500,000 would be appropriate to provide sufficient funds to broadly evaluate their jurisdiction and develop potential FMEs and FMPs to be included in future Regional Flood Plans. Similarly, previously completed citywide studies were reviewed, three categories were identified for population sizes and a corresponding cost estimate was assigned (*Table 5.1*).

Table 5.1 Citywide Drainage Master Plan Cost Estimate Ranges

Relative City Size	Population (2020 Census)	Cost Estimate
Small	< 25,000	$250,000
Medium	25,000 – 100,000	$500,000
Large	> 100,000	$1,000,000

- **Engineering Project Planning**: These studies consider two components: the evaluation of a proposed project to determine whether implementation would be feasible (conceptual design) and an initial engineering assessment including alternative analysis and up to 30 percent engineering design. Each evaluation area is project-specific and varies due to the wide range of potential improvements in channels, culverts and low water crossings, roads and bridges, storm drain systems, and stream stabilization. Costs were taken from existing plans and studies when available. If estimated construction costs were provided, those costs were escalated to 2020 values based on the study's date. It was estimated that the evaluation effort would equal 15 percent of the total construction cost or a minimum of $150,000. All costs provided by Sponsors were reviewed for reasonableness based on the information available. In instances where a source document or report was not available for the FME or no cost estimate was provided, costs were estimated based on costs for similar FMEs identified and professional judgment of the local area and project type.

Estimated Capital Cost of FMPs and FMSs

Cost estimates for each FMP were taken from associated engineering reports and were adjusted as needed. These costs were escalated using construction cost indices to account for inflation and other changes to the construction market. The cost estimates in *Table 5.2* and *Table 5.3* are expressed in September 2020 dollars (*see Appendix X*).

Currently, the cost for the FMSs is undefined as the RFPG decided to take a regional approach to implementation, and no cost data has been developed.

Benefit-cost Ratios for FMPs

Benefit-Cost Analysis (BCA) is the method by which the future benefits of a hazard mitigation project are determined and compared to its costs. The result is a Benefit-Cost Ratio (BCR), calculated by dividing the project's total benefits, quantified as a dollar amount, by its total costs. The BCR is a numerical expression of the relative "cost-effectiveness" of a project. A project is generally considered cost-effective when the BCR is 1.0 or greater, indicating the benefits of a prospective hazard mitigation project are sufficient to justify the costs (Federal Emergency Management Agency, 2009). However, a BCR greater than 1.0 is not required for inclusion in the Regional Flood Plan, and the RFPG can recommend a project with a lower BCR with appropriate justification.

When a BCR had been previously calculated in an engineering report or study that was used to create an FMP, the previously calculated BCR value was utilized for the FMP analysis. For any FMP that did not already have a calculated BCR value, the TWDB BCA Input Spreadsheet was utilized in conjunction with the FEMA BCA Toolkit 6.0 to generate BCR values.

Willing Sponsors for FMEs, FMPs, and FMSs

Initial efforts to contact potential sponsors consisted of sending surveys to communities. These surveys included actions identified for each community, allowing the community to identify any that are no longer relevant or that they are actively pursuing. These surveys were followed up with calls to inform communities of the survey and its purpose. The Technical Consultant Team leveraged existing relationships to contact communities to supplement this outreach effort to increase community participation and gather additional input.

While these efforts furthered the goal of receiving community feedback on what actions they wanted to pursue, not all communities were able to be reached. Accordingly, the RFPG decided that an affirmative willingness to sponsor a given action would not be a prerequisite for inclusion in the plan. Therefore, all potential actions were considered for inclusion in the plan unless an entity had specifically declined to be listed as a sponsor and no other appropriate potential sponsor was identified. This approach was adopted because:

1. It provides a conservative estimate of the flood mitigation need in the region.
2. Inclusion in the plan does not obligate an entity to sponsor an action; it simply allows an entity to be eligible for funding if they have the interest and capacity to pursue an action.

It is important to note that all sponsors associated with recommended actions were subsequently sent a survey to identify potential funding sources for the actions listed in the plan. This effort is detailed in Chapter 9.

Residual, Post-Project, and Future-Risks of FMPs

The implementation of recommended FMPs is expected to reduce current and future levels of flood risk in the region. While it is not possible to protect against all potential flood risks, the evaluation of FMPs should consider their associated residual, post-project and future risks, including the risk of potentially catastrophic failure and the potential for future increases to these risks due to lack of maintenance.

During project development, communities must balance existing risk and risk reduction, physical and financial constraints, permitting and constructability, and adverse impacts (environmental, flood, community) to identify mitigation measures that make sense.

As a result of finding the right balance, it is not uncommon for flood control projects to be designed to a storm smaller than a 1 percent annual chance (100-year) event. This does not mean projects should not evaluate the 1 percent annual chance (100-year) storm, nor does it mean they will not provide risk reduction for the larger storms; rather, it means the community needs to understand what the residual risk will be. Common examples include flooding in developed areas where limited right-of-way and utility conflicts can limit the size or impart a significant financial burden or creek crossings where bridge construction is not practicable due to topography, right-of-way, and costs.

Figure 5.9 FMP Evaluation Considerations

In general, residual and future risks for 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. Lack of routine maintenance to maintain, repair or replace its design capacity
4. Policy changes that adversely impact budgets, prior plans, assets, and design or floodplain management standards
5. Human behavior is unpredictable, and people may choose to ignore flood warning systems or cross over flooded roadways for a variety of reasons

Insurmountable Constraints of FMPs

Potential project implementation issues include conflicts pertaining to rights-of-way, permitting, acquisitions, utility or transportation relocations, amongst other issues that might be encountered before an FMP can be fully implemented. Such issues are an inherent part of flood mitigation projects, so they do not exclude actions from being considered for the plan.

Because a right-of-way is a public use on private land, it can create issues when securing access to projects for construction and maintenance. The acquisition of right-of-way or other property and utility relocation located near or on property impacted by a project requires close coordination between government agencies, private entities, and landowners. Coordination and early engagement with the appropriate entities are key to facilitating projects.

Most FMPs will require a variety of permits from local to state and federal depending on the scale. Permitting can be a lengthy process; the goal is to identify permitting needs during the project development phase and initiate it as early as practicable during the final design. This will minimize significant design changes and delays in project implementation.

The terms "buyout" and "acquisition" are often utilized interchangeably, but in the context of flood protection, both generally refer to the purchase of private property by the government for public use. In the case of flood acquisitions, the process most often involves purchasing property in a floodplain to reduce repetitive flood damage. Voluntary buyout programs are a specific subset of property acquisitions in which private land is purchased, existing structures are demolished, and the land is returned to an undeveloped state. Voluntary property acquisition is not a simple process and requires agreement by the property owner and local jurisdiction. The process could include other governmental agencies and program requirements if state or federal funding is involved. The process can also be financially burdensome and lengthy.

Utility relocations may include water and wastewater lines, existing storm drain systems, telecommunication, power lines, and similar infrastructure. Depending on the project, the local government and franchise utility owners are usually responsible for utility relocations; however, developers may also assume responsibility for utility relocations. Utility relocation includes removing and reinstalling the utility, including necessary temporary utilities, acquiring necessary right-of-way, and taking necessary safety and protective measures. Utility relocations can take a significant lead time and a significant portion of the total project implementation cost.

Table 5.2 Summary of Recommended FMEs

FME Type		Description	Number
Watershed Planning	Drainage Master Plans, Other Community-Scale Plans	Supports the development and analysis of hydrologic and hydraulic models to evaluate flood risk within a given jurisdiction, evaluate potential alternatives to mitigate flood risk, and develop capital improvement plans	7
	H&H Modeling, Regional Watershed Studies	Supports the development and analysis of hydrologic and hydraulic models to define flood risk or identify flood-prone areas or large-scale studies that are likely to benefit multiple jurisdictions	16
	Flood Mapping Updates	Promotes the development and/or refinement of detailed flood risk maps to address data gaps and inadequate mapping. Create FEMA mapping in previously unmapped areas and update existing FEMA maps as needed	7
Project Planning	Engineering Project Planning	Evaluation of a proposed project to determine whether implementation would be feasible or initial engineering assessment including conceptual design, alternative analysis, and up to 30 percent engineering design	101
Preparedness	Studies on Flood Preparedness	Encourages preemptive evaluations and strategies to better prepare an area in the event of a flood	19

Figure 5.10 Geographical Distribution of Recommended FMEs

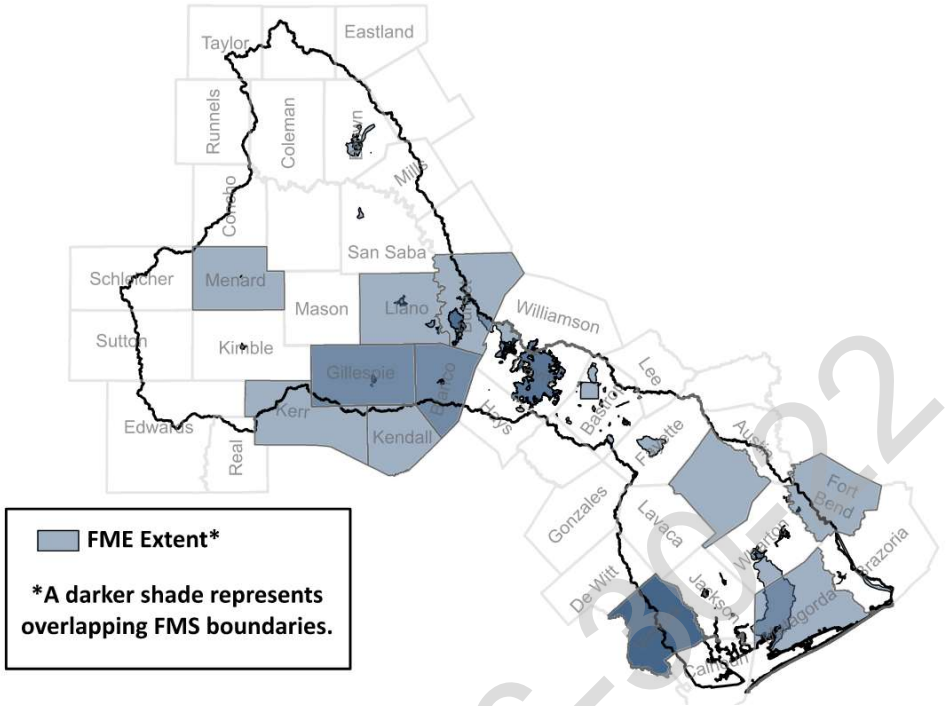
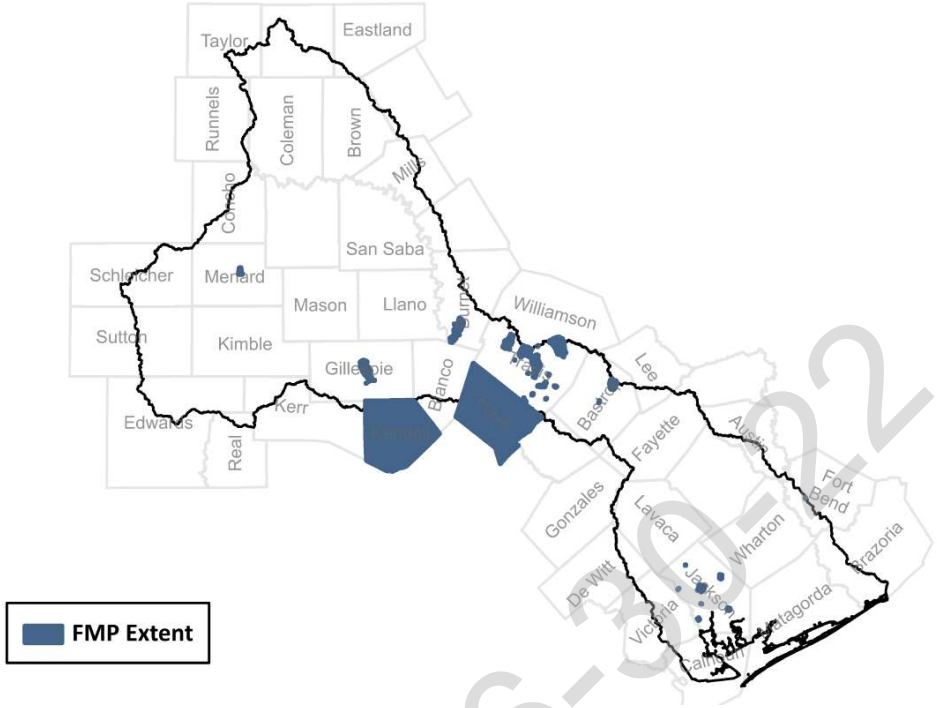


Table 5.3 Summary of Recommended FMPs

FMP Type	General Description	Number of FMPs Identified
Stormwater Infrastructure Improvements	Improvements to stormwater infrastructure, including channels, ditches, ponds, stormwater pipes, etc.	9
Roadway Drainage Improvements	Improvements to roadway drainage infrastructure, including side ditches, culvert crossings, bridge crossings, etc.	12
Regional Detention Facilities	Runoff control and management via detention facilities	0
Property Acquisition	Voluntary acquisition of flood-prone structures	12
Flood Warning Systems	Install gauges, sensors, or barricades to monitor streams and low water crossings for potential flooding and support emergency response	10
Emergency Generators	Purchase and install emergency generators at critical facilities	11

Figure 5.11 Geographical Distribution of Recommended FMEs



Step 6: FMPs, FMEs, and FMSs Recommendations

Technical Committee Formation and Recommendations

The RFPG created a Technical Committee tasked with establishing a selection methodology, implementing the evaluation and selection process, and reporting their findings and recommendations to the RFPG for formal approval. The methodology included screening all potential flood mitigation actions based on the general process described in the Initial Screening sections as well as other evaluation and selection considerations established by the Technical Committee. The reasons for not recommending a particular flood mitigation action were clearly documented as part of the evaluation and recommendation process.

At the Technical Committee meeting on January 27, 2022, the members reviewed, discussed, and approved the process and timeline for reviewing FMEs, FMSs, and FMPs and making recommendations to the full RFPG. The Technical Committee met over several meetings in March, April, May, June, and July 2022.

Initial meetings of the Technical Committee focused on completing the initial screening process to identify potentially feasible evaluations, projects, and strategies. This included discussing how the actions were being categorized, the limitations of the available data, and confirmation of how the discretionary evaluation criteria were applied to each action.

The Technical Committee also worked with the Technical Consultant Team to develop one-page decision document templates for each type of action. The purpose of the decision documents is to provide an easy-to-understand summary of each action for the RFPG and the general public. The summaries include pertinent information such as the type, location, sponsor, and flood risk indicators. Additionally, the summary sheets include information related to potential benefit, costs, and links to the RFPG goals.

On April 28, 2022, the Technical Committee reviewed the initial batch of potential actions for recommendation. That "pilot" batch included three FMSs, one FMP, and 21 FMEs. The FMSs and FMEs were voted on and recommended to the forwarded to the full RFPG for consideration and pending minor changes to the decision documents templates. During this meeting, the technical committee established a process for reviewing, discussing, and making recommendations. In short, the committee agreed that future batches would be reviewed before the meeting at which they were to be considered, and the actions would be brought forward in groups or batches for consideration in a manner similar to a consent agenda. This format allowed each committee member to provide comments on or discuss any of the individual actions and allowed the committee to make recommendations to the RFPG for each batch.

At the May 25, 2022, Technical Committee meeting, the group reviewed and forwarded recommendations for approval to the full RFPG for 124 individual FMEs and 53 FMPs. During the June 9, 2020 meeting, the committee reviewed and recommended one additional FMS, one additional FMP, and seven additional FMEs. Add in other meetings.

RFPG Approval of Recommendations

Flood Management Evaluations (FMEs) Recommendation Approach

In considering potential FMEs for a recommendation, the RFPG sought to determine which FMEs would most likely result in identifying potentially feasible FMSs and FMPs in future planning cycles. Recommended FMEs were also required to demonstrate alignment with at least one regional floodplain management and flood mitigation goal developed under Task 3. Finally, each recommended FME should identify and investigate at least one solution to mitigate the 1 percent annual chance flood. It is the intent that all FMEs with a hydrologic and hydraulic modeling component will evaluate multiple storm events, including the 1 percent annual chance flood. The potential solutions and level of service that will be identified are unknown; however, it is expected that analyses will evaluate potential negative impacts and potential flood risk reduction for the 1 percent annual chance flood to help inform recommended alternatives and to define potentially feasible FMPs under this planning framework. Based on the TWDB requirements, the RFPG identified two main reasons for recommending FMEs.

The first subset of recommended FMEs would increase flood risk modeling and mapping coverage across the region as they are implemented. These types of FMEs have two major implications for the identification of potentially feasible FMSs and FMPs. First, a current and comprehensive understanding of flood risk across the basin is necessary to identify high-risk areas for evaluating and developing flood risk reduction alternatives. Secondly, FMPs, and in some cases, FMSs, require a demonstrated potential reduction in flood risk to be recommended in the Regional Flood Plan. For this metric to be assessed, hydrologic and hydraulic modeling must be available to compare existing and post-project flood risk.

The second subset of recommended FMEs were project planning type FMEs. These FMEs are generally studies or preliminary designs to address a specific, known flood need. These actions include low water crossing improvements, storm drain or channel projects, city or countywide studies, and evaluations of possible buyouts or elevation. While, in many cases, a specific location is known, the actions currently lack some or all the detailed technical data necessary for evaluation and recommendation as an FMP. An example would be an existing study that identifies potential drainage construction projects but does not provide a full negative impacts analysis. Completing these components as part of an FME will result in a potentially feasible FMP for consideration during future flood planning efforts.

Sponsor input was a major driver for choosing not to recommend FMEs. FMEs indicated by the sponsor as being in progress, completed, or lacking the interest to pursue were not recommended. Additionally, some FMEs located near one another were combined into a single FME for a recommendation, a process the RFPG plans to continue as it develops the amended plan (due July 2023).

Recommended Flood Management Evaluations (FMEs)

A total of 150 potential FMEs were identified and evaluated by the RFPG. All of these were recommended, representing a combined total of $33,005,000 of flood management evaluation needs across the Lower Colorado-Lavaca Region. The number and types of studies recommended by the RFPG are summarized in *Table 5.4.* The full list of FMEs and supporting technical data is included in *Table 12*. A map and table of recommended FMEs are presented in *Appendix X*. Overall, the recommended FMEs represent over 15,000 square miles of contributing drainage area. While some are in the upper basin, the FMEs are concentrated in the middle and lower reaches of the Flood Planning Region.

Table 5.4 Recommended FMEs

FME ID	Name	Type	Cost
101000001	Drainage System Improvements	Project Planning	$250,000
101000002	Shiloh Road Bridge West of State HWY 304	Other	$100,000
101000003	Willie May Way in Precinct 4 at Trib	Other	$100,000
101000004	Gotier Trace Low Water Crossings	Project Planning	$100,000
101000005	Lakeview Drive & Tuck Street	Project Planning	$100,000
101000006	Green Valley Drive in Precinct 1	Other	$100,000
101000007	Old McDade Rd in Precinct 4 near Norwood Rd	Other	$100,000
101000008	Clear Springs Lake Dam	Project Planning	$100,000
101000009	Pecan Shores Subdivision	Other	$150,000
101000010	Hidden Shores Subdivision	Other	$150,000
101000011	Waters Edge Terrace Subdivision	Other	$100,000
101000012	Old Sayers Rd & Little Sandy Creek	Other	$100,000
101000013	Paffen Rd & Grassy Creek Draw	Other	$100,000
101000014	Meduna Rd & Barton Oaks Draw 1	Other	$100,000
101000015	Pine Canyon Dr & Wet Weather Creek	Other	$100,000
101000016	Hall Rd & Young's Branch	Other	$100,000
101000017	Friendship Rd & Turner Creek A and B	Other	$100,000
101000018	Patterson Rd & Barton's Creek	Other	$100,000
101000019	Upper Elgin River Rd & Cotton Creek	Other	$100,000
101000020	Old Sayers Rd & Big Sandy Creek	Other	$100,000
101000021	Caldwell Rd & Wet Weather Creek	Other	$100,000
101000022	Farm Street, Pine Street, Chestnut Road, MLK Drive	Other	$250,000
101000023	Gills Branch	Project Planning	$100,000
101000026	Smithville Recreation Center Expansion	Other	$100,000
101000027	FM 812 at Little Alum Creek	Project Planning	$100,000
101000028	FM 812 at Alum Creek South	Project Planning	$100,000
101000029	Magnolia St	Other	$100,000
101000031	County Road 328 at Cow Creek	Other	$100,000
101000032	Mission Hills Street	Other	$100,000
101000034	Lum Rd, Hilltop Rd, FM 2919 N	Project Planning	$100,000
101000035	Drainage Improvements to Crawford Outlet Right-of-Way	Other	$50,000
101000037	Gene and Church Streets	Other	$50,000
101000038	800 Block W San Antonio	Other	$50,000

FME ID	Name	Type	Cost
101000039	South End of Acorn Street	Other	$50,000
101000042	Bowie & Peach Street	Other	$100,000
101000043	Edison & Creek Street	Other	$100,000
101000044	112 W Park	Other	$50,000
101000047	Downtown Fredericksburg Storm Drainage Improvements	Other	$1,500,000
101000048	Trailmoor near Llano Hwy	Other	$250,000
101000050	Drainage Channel near EMS Building	Other	$50,000
101000051	Bob White Trail	Other	$50,000
101000053	N Edison Low Water Crossing	Project Planning	$15,000
101000054	Schubert Low Water Crossing	Other	$50,000
101000055	200 Block N Orange	Other	$50,000
101000056	Crockett Street South of Travis	Other	$100,000
101000057	Cross Mountain West	Other	$100,000
101000058	N Milam at West Travis	Other	$150,000
101000059	Repair of Little Barton Creek Dam	Other	$100,000
101000060	Floodplain/Floodway Audit	Project Planning	$50,000
101000061	Prepare Evacuation Plan	Preparedness	$25,000
101000062	MLK Blvd to Mexico Street	Project Planning	$100,000
101000063	Stormwater Diversion Project	Project Planning	$200,000
101000064	Land Purchase for New EMS/Fire/Police Building	Other	$100,000
101000065	Jackson County Hospital District	Watershed Planning	$100,000
101000066	County Road 480	Other	$100,000
101000067	Various Streets - Install Flood Early Warning System	Project Planning	$50,000
101000068	Lake Junction Dredging	Project Planning	$50,000
101000069	Llano River Erosion	Project Planning	$200,000
101000070	Llano River Channel Maintenance/Improvements	Project Planning	$100,000
101000071	Drainage Ditch Maintenance/Improvements	Project Planning	$100,000
101000072	Prepare Evacuation Plan	Preparedness	$25,000
101000073	Comanche Rancherias Subdivision	Project Planning	$100,000
101000074	Construct Emergency Operation Center	Other	$100,000
101000075	Airport Drainage Improvements	Other	$100,000
101000076	Tres Palacios River	Other	$50,000
101000077	Update Flood Insurance Study & Flood Insurance Rate Maps	Watershed Planning	$250,000
101000078	Hooten Holler in Richland Springs	Other	$100,000
101000080	Community Evacuation Plan	Preparedness	$25,000
101000082	Citywide Drainage Study	Watershed Planning	$250,000
101000083	Community Evacuation Plan	Preparedness	$25,000
101000084	Bee Creek Drainage Improvements	Other	$100,000
101000085	Create emergency evacuation plan	Preparedness	$25,000
101000086	Citywide Drainage Study	Other	$250,000
101000088	Review and Update Floodplain Management Plan	Preparedness	$25,000
101000089	Develop an Emergency Operations and Evacuation Plan	Preparedness	$25,000
101000090	Various Streets - Upgrade Existing Roadway Crossings	Project Planning	$100,000
101000091	Harden City Buildings, Critical Infrastructure	Project Planning	$100,000
101000092	Citywide Drainage Study	Project Planning	$250,000
101000093	Various Streets - Upgrade Existing Roadway Crossings and Bridges	Other	$100,000
101000095	Identify and Buyout Repetitive Loss Properties	Preparedness	$250,000
101000096	Harden county buildings, critical infrastructure, and government buildings	Preparedness	$100,000

FME ID	Name	Type	Cost
101000098	Tres Palacios, Blue Creek, East Mustang Creek	Project Planning	$150,000
101000099	Use Digital Maps of All Hazards and Educate Residents	Preparedness	$100,000
101000100	Pecan Street	Project Planning	$100,000
101000101	Town & Country Drive	Project Planning	$100,000
101000102	Piney Creek Benching	Other	$200,000
101000103	Drainage System Improvements - JC Madison Addition	Other	$100,000
101000104	Citywide Drainage System Improvements	Watershed Planning	$500,000
101000105	Update and Maintain Emergency Management Plan	Preparedness	$25,000
101000106	Various Locations - Upgrade Low Water Crossings	Project Planning	$100,000
101000107	Citywide Drainage Plan	Other	$250,000
101000108	Develop New/Updated Floodplain Maps	Watershed Planning	$250,000
101000109	CR 332 Drainage Improvements	Other	$50,000
101000110	Various Culverts Along Stevenson Slough	Other	$125,000
101000111	Adopt Flood Insurance Rate Maps	Watershed Planning	$250,000
101000112	Willis Creek Detention	Other	$250,000
101000113	Burnet County Flood Early Warning Systems	Preparedness	$100,000
101000114	Shade Grove Flood Study	Other	$100,000
101000116	Whitman Branch Bypass; Oak Ridge Drive Creek	Other	$100,000
101000118	Sandy Oaks Subdivision	Other	$100,000
101000119	Frisch Auf Buyout	Other	$100,000
101000120	Flood Proof Wastewater Treatment Plants	Project Planning	$50,000
101000121	Various Streets - Install Flood Early Warning Systems	Other	$150,000
101000122	Carriage Hills	Other	$100,000
101000123	Post Oak Subdivision	Other	$150,000
101000125	Alum Creek - Tributary 8, Bowie Drive	Other	$100,000
101000126	Flood Proofing Repetitive Loss Structures	Other	$50,000
101000127	Wastewater Treatment Plant Floodproofing	Other	$200,000
101000128	City Hall Hardening and Safe Room	Other	$100,000
101000129	Palmetto Bend Spillway	Other	$250,000
101000130	Relocate Fire Department Building	Other	$250,000
101000131	Police Station Relocation and Safe Room	Other	$250,000
101000136	Highway 36	Other	$100,000
101000137	CR257 at Pecan Bayou (Tenmile Crossing)	Other	$100,000
101000138	Dam Emergency Action Plan	Preparedness	$50,000
101000152	Fallwell Lane Capital Renewal Project - Phase 2	Other	$250,000
101000153	City of Buda Garlic Creek Culvert	Other	$100,000
101000155	Taylor Lane Drainage Improvements	Other	$100,000
101000156	Storm Water Detention at Morris Park	Other	$150,000
101000158	Citywide Storm Drain Infrastructure Modeling	Watershed Planning	$12,600,000
101000159	Wastewater Treatment Plant Flood Study	Watershed Planning	$150,000
101000160	Delaware Creek Flood Study	Watershed Planning	$150,000
101000161	VFW Flood Study	Watershed Planning	$100,000
101000162	Citywide Floodplain Map Update	Watershed Planning	$250,000
101000163	Jones Brothers Park Flooding	Watershed Planning	$100,000
101000164	East Reed Park Road Flooding	Other	$100,000
101000165	Whitman Branch Regional Detention Pond	Other	$150,000
101000166	Ave J Bridge Replacement	Other	$100,000
101000167	Broadway Street at Whitman Branch Low Water Crossing	Other	$100,000
101000168	1431/281 Detention	Other	$150,000
101000169	Backbone Branch Detention Pond	Other	$150,000

FME ID	Name	Type	Cost
101000170	Marble Falls Creek Walk	Other	$100,000
101000171	Citywide Floodplain Remapping	Watershed Planning	$250,000
101000172	2nd Street at Backbone Creek Low Water Crossing	Other	$100,000
101000173	Ave L at Whitman Creek Low Water Crossing	Other	$100,000
101000174	Broadway at Backbone Creek Low Water Crossing	Other	$100,000
101000175	102 Beach Dr Low Water Crossing	Other	$100,000
101000176	124 Sunrise Drive Low Water Crossing	Other	$100,000
101000177	Countywide Floodplain Map Update	Watershed Planning	$250,000
101000178	Low Water Crossing's at 4 locations	Other	$200,000
101000179	Various Streets - Install Flood Early Warning System	Other	$15,000
101000180	Countywide Floodplain Map Update	Watershed Planning	$250,000
101000181	Harris Hollow Neighborhood Flooding	Watershed Planning	$100,000
101000183	South Polk Street Study	Watershed Planning	$150,000
101000184	City-wide Flood Warning Systems	Preparedness	$250,000
101000185	City-wide Drainage Master Plan	Other	$250,000
101000188	City-wide Drainage Master Plan (integrate with Dry Creek Study)	Other	$250,000
101000189	Wastewater Treatment Plant Floodproofing	Project Planning	$250,000
101000190	Devers Creek Regional Detention and Channel Improvements	Project Planning	$250,000
101000192	City-wide Drainage Master Plan	Other	$250,000
101000193	City-wide Drainage Master Plan	Other	$250,000
		Total Cost of FMEs:	**$33,005,000**

Flood Management Projects (FMPs) Recommendation Approach

For consideration as an FMP, a project must be defined sufficiently to meet the technical requirements of the flood planning project scope of work and the associated Technical Guidelines developed by the TWDB. In summary, the RFPG must be able to demonstrate that each recommended FMP meets the following the TWDB requirements:

1. The primary purpose is mitigation (response and recovery projects are not eligible for inclusion in the Regional Flood Plan)
2. Supports at least one regional floodplain management and flood mitigation goal
3. The FMP is a discrete project (not an entire capital program or drainage master plan)
4. Implementation of the FMP results in:
    a. Quantifiable flood risk reduction benefits
    b. No negative impacts to adjacent or downstream properties
    c. No negative impacts on an entity's water supply
    d. No overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan

In addition, the TWDB recommends that, minimally, FMPs should mitigate flood events associated with the 1 percent annual chance (100-year) LOS. However, if a 1 percent annual chance (100-year) LOS is not feasible, the RFGP can document the reasons for its infeasibility and still recommend an FMP with a lower LOS.

Updated construction cost estimates and estimates of project benefits must also be available to define a benefit-cost ratio (BCR) for each recommended FMP. The TWDB recommends that proposed projects have a BCR greater than one, but the RFPG may recommend FMPs with a BCR lower than one with proper justification.

All potentially feasible FMPs with the necessary data and detailed modeling results available to populate these technical requirements were considered for recommendation by the RFPG. Pertinent details about the FMP evaluation are provided in the following section.

Initial Evaluation

The scope of work for each FMP was evaluated to ensure that it would support at least one of the regional floodplain management and flood mitigation goals established in Chapter 3. The goals associated with each FMP are included in *Appendix 3*. Based on a review of supporting information, it was determined that the primary purpose for each FMP is mitigation (rather than a response or recovery project), they are discrete projects, and they do not have any anticipated impacts to water supply or water availability allocations as established in the most recent adopted State Water Plan.

No Negative Impacts Determination

Each identified FMP must demonstrate that there would be no negative impacts on a neighboring area due to its implementation. No negative impact means a project will not increase the flood risk of surrounding properties. Using the best available data, the increase in flood risk must be measured by the 1 percent annual chance (100-year) event water surface elevation and peak discharge. It is recommended that no rise in water surface elevation or discharge should be permissible (without acquiring the affected land or obtaining permission from the effect parties) and that the analysis extent must be sufficient to prove that proposed project conditions are equal to or less than the existing conditions.

For the flood planning effort, no negative impact can be determined if a project does not increase the inundation of infrastructures such as residential and commercial buildings and structures. Additionally, the following requirements, per the TWDB Technical Guidelines, should be met to establish no negative impact, as applicable:

- Does not increase inundation in areas beyond the public right-of-way, project property, or easement
- Does not increase inundation of storm drainage networks, channels, and roadways beyond design capacity
- Maximum increase of 1D Water Surface Elevation must round to 0.0 feet (<0.05 ft) measured along the hydraulic cross-section
- Maximum increase of 2D Water Surface Elevations must round to 0.3 feet (<0.35 ft) measured at each computation cell
- 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 identified, mitigation measures may be utilized to alleviate such impacts. The Regional Flood Plan may include projects with identified design-level mitigation measures. They could be finalized later to conform to the “No Negative Impact” requirements before funding or execution of a project.

Furthermore, the RFPG has the flexibility to consider and accept additional “negative impact” for requirements one through five based on the engineer’s professional judgment and analysis, given that affected entities are informed and accept the impacts. This should be well-documented and consistent across the entire region. However, flexibility regarding negative impact remains subject to TWDB review.

A comparative assessment of pre-and post-project conditions for the 1 percent annual chance (100-year) event flood was performed for each potentially feasible FMP based on their reported hydrologic and hydraulic model results. Study results for floodplain boundary extents, resulting in water surface elevations, and peak discharge

values were reviewed to verify potential FMPs conform to the no negative impacts requirements. The same studies were used to identify reported flood risk reduction.

Level of Service (LOS) and Benefit-Cost Ratio Evaluation

All the recommended FMPs provide some level of flood reduction benefits which are included based on the available information. When a BCR had been previously calculated in an engineering report or study that was used to create an FMP, the previously calculated BCR value was utilized for the FMP analysis. For any FMP that did not already have a calculated BCR value, the TWDB BCA Input Spreadsheet was utilized in conjunction with the FEMA BCA Toolkit 6.0 to generate BCR values.

The RFPG considered the above projects and determined that recommending these FMPs is consistent with the overarching goal of the Regional Flood Plan "to protect against the loss of life and property."

Recommended Flood Management Projects (FMPs)

Due to the high level of detail required for consideration as an FMP, only 53 projects were determined to have enough details available for evaluation and potential recommendation as FMPs. All FMPs were recommended by the RFPG, representing a combined total project cost of $382,899,000. A summary of the recommended FMPs for inclusion in the Regional Flood Plan is presented in *Table 5.5*. Like the FMEs, FMPs are concentrated in the central and lower portion of the basin. A map of project areas for the recommended FMPs is provided in *Appendix X*. Additionally, the required Project Details Spreadsheet, which will be used for evaluation and project ranking by the State, is included in *Appendix X*.

Table 5.5 Recommended FMPs

FMP ID	FMP Name	FMP Type	FMP Description	Cost
103000001	Alum Creek - Cardinal Drive Improvements	LWC upgrade	2 box culverts: 4x3 west, 4 box culverts: 4x2 east, 310 LM raise roadway	$545,000
103000002	Alum Creek - Cardinal Drive Improvements (Tributary 11)	LWC upgrade	5 box culverts: 7x6, 360 LF raised roadway	$719,000
103000003	Alum Creek - Cardinal Drive Improvements (Tributary 87)	LWC upgrade	3 box culverts: 8x6, 100 LF raised roadway	$352,000
103000004	Alum Creek - Ponderosa Loop Improvements	LWC upgrade	3 box culverts: 8x5, 192 LF raised roadway	$431,000
103000005	Gills Branch Flood Mitigation Improvements	Channel	5,050 LF channel benching, 175 LF channel improvements, increased capacity at crossings, landscape walls	$6,373,000
103000006	FM 685 Crossing Improvements	Channel	Integreated with E. Pflugerville Prkwy improvement, 100' wide channel bench 1,700 LF, four 50' span bridge, 810 LF raise road	$8,300,000
103000007	E. Pflugerville Parkway Crossing Improvements	Channel	Integreated with FM685 improvement, 100' wide channel bench 1,700 LF, four 50' span bridge, remove concrete drop structure	$3,100,000
103000008	Highland Park Subdivision Culvert Improvements	LWC upgrade	Add two 8'x4' RCBs; grading US overbank; 1.5' tall 150' long berm	$578,000
103000009	Cele Road Crossing Improvements	LWC upgrade	Four 50' span bridge, 1160 LF raise road	$4,300,000
103000010	Gregg Lane Crossing Improvements	LWC upgrade	Four 50' span bridge, 870 LF raise road	$5,500,000

FMP ID	FMP Name	FMP Type	FMP Description	Cost
103000011	Cameron Road Crossing Improvements	LWC upgrade	Six 50' span bridge, 1520 raise road, channel grading	$3,100,000
103000012	McNeil Drainage Improvements	Storm Drain	Drainage improvements and detention throughout the neighborhood to keep the roadway from overtopping during storm events and allowing residents to enter/exit the neighborhood	$13,300,000
103000013	Spicewood Springs Road Low Water Crossing #1	LWC upgrade	Bridge to replace an undersized box culvert	$4,550,000
103000014	Arroyo Doble/Twin Creeks Drainage Phase 3-7 Drainage System	LWC upgrade	Construct subdivision drainage improvements as identified in the 2009 Drainage Basin Study, and make drainage improvements to the adjacent Bethel Church Road, Polk Road, and Wirth Road. Design funds approved in FY17 CO's	$5,626,000
103000015	Dalton Lane Crossing Improvements	LWC upgrade	This project will upgrade the two low water crossings to improve public safety and reduce road closures during small, frequent storm events.	$13,000,000
103000016	Highland Hills Crossing Improvements	LWC upgrade	This project will upgrade the low crossing to reduce the frequency and depth of inundation and improve public safety.	$1,000,000
103000017	Shoal Creek - Nueces St Flood Risk Reduction Project	LWC upgrade	The project includes the construction of approximately 15,980 linear feet of the upgraded storm drain pipe and numerous new storm drain inlets throughout the area	$43,000,000
103000018	Waller Creek - Guadalupe St Flood Risk Reduction	Storm Drain	The project intends to upgrade 28,000 linear feet of subsurface stormwater drains east of Guadalupe Street and west of Avenue G, between 33rd and 46th streets.	$85,000,000
103000019	Navidad River - Stem Branch Buyout	Property Acquisition	Navidad River property acquisition	$200,000
103000020	La Salle Buyout	Property Acquisition	There is a flood-prone property at Site 5 - LaSalle RC&D that acquisition can mitigate the problem of repetitive flooding.	$200,000
103000021	Goat Trail Buyout	Property Acquisition	A flood-prone property at Site 6 – Goat Trail and acquisition can mitigate the problem of repetitive flooding.	$200,000
103000022	County Road 106 Buyout	Property Acquisition	A flood-prone property acquisition can mitigate the problem of repetitive flooding.	$200,000
103000023	Sandy Creek/Pecan Park Areas Buyout	Property Acquisition	Acquisition of property located in the floodway on Sandy Creek and Pecan Park area	$200,000
103000024	Lake Travis/Cross Street Area Buyout	Property Acquisition	Acquisition of property located in the floodplain of Lake Travis and Cross St area	$200,000

FMP ID	FMP Name	FMP Type	FMP Description	Cost
103000025	Onion Creek Structure Elevation	Property Elevation	Elevations of 15 at-risk homes in the 1% ACE at Arroyo Doble & Onion Creek Meadows	$2,650,000
103000026	Bluff Springs Elevation	Property Elevation	Elevation of 36 homes in the 1% ACE	$6,600,000
103000027	Onion Creek Meadows Elevation	Property Elevation	Elevations of 6 at-risk homes in the 1% ACE	$845,000
103000028	Thoroughbred Farm Buyout	Property Acquisition	Buyouts of 20 at-risk homes in the 1% ACE	$3,800,000
103000029	Twin Creeks Buyout	Property Acquisition	Buyout of 1 at-risk home in the 1% ACE	$200,000
103000030	Hays County Buyout	Property Acquisition	Action to mitigate 38 identified properties	$15,000,000
103000031	South Austin Regional WWTP/Sand Hill Energy Center Flood Reduction	Flood Walls and Levees	Structural flood mitigation measures to protect WWTP	$115,000,000
103000032	Walnut Creek Wastewater Treatment Plant Flood Wall	Flood Walls and Levees	Structural flood mitigation measures to protect WWTP	$35,000,000
103000033	S Bowie Low Water Crossing - Flood Warning System	Preparedness	Install FEWS with automatic gates & flashers	$25,000
103000034	8 Low Water Crossings - Flood Warning System	Preparedness	Install flood warning signals at eight identified low water crossings that are frequently overtopped. Additional flow gauge installments.	$200,000
103000035	Creek St at Barons Creek - Flood Warning System	Preparedness	Install FEWS with automatic gates & flashers	$25,000
103000036	Highway St Improvements	Channel	Vegetated channel system with two 10' x 4' box culverts in storm drain system to Baron Creek	$250,000
103000037	Lady Bird Golf Course Low Water Crossing - Flood Warning System	Preparedness	Install FEWS with automatic gates & flashers	$25,000
103000038	W Travis Low Water Crossing - Flood Warning System	Preparedness	Install FEWS with automatic gates & flashers	$25,000
103000039	Windmill Oaks Subdivision - Flood Warning System	Preparedness	FNI proposes to install FEWS with automatic gates & flashers	$25,000
103000040	Red Bud Trail - Flood Warning System	Preparedness	Install automatic warning system for Ullrich Water Treatment Plant	$25,000
103000041	Davitt St Water Plant Backup Generator	Preparedness	Retrofit plant with the backup generator	$750,000
103000042	City of Burnet Veterans of Foreign Wars Backup Generator	Preparedness	Emergency generator for VFW	$80,000
103000043	Beasley City Fire Department Backup Generator	Preparedness	Emergency generator for Fire Department	$80,000
103000044	Emergency Management System Backup Generators	Preparedness	Purchase/install a 30 kW generator to maintain government	$80,000
103000045	City of Edna Safe Room Backup Generator	Preparedness	Purchase/install 100 kW generator to for Community Safe Room (triage center)	$80,000
103000046	City of Edna Sewer Lift Station Backup Generator	Preparedness	Purchase/install 30 kW generator to maintain WWTP	$80,000

FMP ID	FMP Name	FMP Type	FMP Description	Cost
103000047	City of Ganado Sewer Lift Station Backup Generator	Preparedness	Emergency generators for sewer lift stations	$80,000
103000048	Jackson County Courthouse Backup Generator	Preparedness	Purchase generator for courthouse	$80,000
103000049	City of Boerne Backup Generators	Preparedness	Purchase generators in courthouse and fire stations	$370,000
103000050	City of Edna Hospital Backup Generator	Preparedness	Purchase a permanent backup generator for the hospital	$450,000
103000051	Various Streets - Flood Warning System	Preparedness	Purchase flood early warning system	$250,000
103000052	Jonestown Flood Warning System	Preparedness	Floodplain early warning system and local response plan	$50,000
103000053	City of Briarcliff WWTP Backup Generator	Preparedness	Purchase stand-by generator for WWTP	$750,000
103000054	Portable Electronic Signs	Preparedness	Portable electronic signs	$50,000
			Total Cost of FMPs:	**$382,899,000**

Flood Management Strategies (FMSs) Recommendation Approach

The approach for recommending FMSs adheres to similar requirements as the FMP process except, due to the flexibility and varying nature of RFPG's potential utilization of FMSs, some of these requirements may not apply to certain types of FMSs. In general, the RFPG must be able to demonstrate that each recommended FMS meets the following TWDB requirements as applicable:

1. The primary purpose is mitigation (response and recovery projects are not eligible for inclusion in the Regional Flood Plan)
2. Supports at least one regional floodplain management and flood mitigation goal
3. Implementation of the FMS results in:
    a. Quantifiable flood risk reduction benefits
    b. No negative impacts to adjacent or downstream properties (a No Negative Impact certification is required)
    c. No negative impacts on an entity's water supply
    d. No overallocation of a water source based on the water availability allocations in the most recently adopted State Water Plan.

In addition, the TWDB recommends that, at a minimum, FMSs should mitigate flood events associated with the 1 percent annual chance (100-year) flood LOS. However, if a 1 percent annual chance (100-year) LOS is not feasible, the RFGP can document the reasons for its infeasibility and still recommend an FMS with a lower LOS.

Although each potentially feasible FMS must demonstrate that there would be no negative flood impacts on a neighboring area due to its implementation, there were no structural FMSs identified for this region. Therefore, no adverse impacts from flooding or water supply are anticipated.

Recommended Flood Management Strategies (FMSs)

The RFPG identified more than 270 potential strategies from stakeholders within the Lower Colorado-Lavaca Region. Many of the identified strategies were found in existing Hazard Mitigation Action Plans and noted a lot of similarity and overlap in the strategies. All the strategies can be consolidated into broad regional strategies and initiatives. For these reasons, the planning group decided to create five regional strategies. The main reasons for

this decision were to make each strategy inclusive of all communities within the region that choose to pursue them and to encourage collaboration between sponsors, particularly neighboring communities.

For example, many communities identified Flood Awareness and Preparation Education and Outreach strategies. Rather than developing individual programs or material, the RFPG encourages communities within media markets to develop joint programs to provide consistency and efficient use of resources. A one-page summary for each strategy is included in *Appendix X*.

Floodplain Management and Regulation

This strategy will consist of education, outreach, and direct technical assistance to cities and counties throughout the Lower Colorado-Lavaca Region, with a particular focus on providing targeted assistance to cities that are eligible but not currently participating in the NFIP; and other communities with the identification, evaluation, adoption, and implementation of enhanced floodplain management practices and regulations and land development, land use, and comprehensive drainage regulations.

Flood Awareness and Preparation Education and Outreach

This strategy includes the Lower Colorado-Lavaca RFPG continuing its public outreach and engagement efforts through ongoing TWBD funding. This would include periodic e-mail news blasts, additional public meetings to present the initial Regional Flood Plan, and continuing outreach to key stakeholders (e.g., state and local elected officials, floodplain administrators, and emergency coordinators).

Low Water Crossing Assessment, Prioritization, and Mitigation

There are an estimated 1,352 low-water roadway crossings within the Lower Colorado-Lavaca Region. Many of these crossings experience frequent flooding but may have relatively minor flood risk in terms of public safety and/or the integrity of the roadway. This strategy is for the Lower Colorado-Lavaca RFPG to provide technical assistance to communities assessing flood risk at low water crossings.

Stream Corridor Protection and Restoration

This strategy is focused on encouraging public/private partnerships to enhance the protection and restoration of sensitive stream corridors. The essence of this strategy is open space acquisition, either through fee simple purchases of property within sensitive stream corridors or through voluntary agreements (i.e., conservation easements) between governmental and/or non-governmental organizations and private landowners.

Watershed Modeling and Floodplain Mapping

This strategy is intended to address the need for immediate region-wide effort and funding to update watershed models, floodplain mapping, and associated geospatial products needed to understand flood risk and exposure; provide effective floodplain management; identify and evaluate flood risk reduction solutions and enhance flood emergency preparedness and response.

Public Comment and Response Period

All the Technical Committee meetings and full RFPG meetings were open to the public and opportunities for public input were posted. No comments were received. The actions, including the summary sheets, will be included in the Draft Regional Flood Plan in August 2022. The public will have a minimum 60-day window to provide comments to the RFPG for consideration.

Anticipated Work to Final Recommendations

This section will be amended as the plan progresses.

Tasks 11 - Continued Sponsor Discussions on Draft Recommendations

With the recommended draft actions approved by the RFPG, the sponsor engagement process will continue by formally presenting the draft Regional Flood Plan through regional public meetings and sending the draft plan directly to community sponsors for review and concurrence. Another targeted sponsor outreach effort will be conducted to accomplish this task, in which actions will be backchecked with sponsors and documented.

Task 12 - Additional Evaluations

Currently, there are potential FMPs that require verification and refinement of information, namely:

- Confirmation of no negative impacts
- Finalize/update estimated capital costs
- Perform benefit-cost analyses to estimate benefit-cost ratios
- Verify other constraints

This process requires further detailed modeling and analysis. The most beneficial FMEs will be selected and further studied with the goal of elevating them to FMPs. The Technical Consultant Team will facilitate the modeling process, refine the solutions, perform or facilitate the negative impact analyses, finalize capital costs, calculate benefit-cost ratios, and confirm and study other constraints.

As high-risk areas have been identified in Task 4A, solutions proposed for these areas will need to be addressed by continued entity outreach. Proposed potential FMPs, FMEs, and FMSs will be identified to reduce the risk for areas with the greatest risk of flooding and the need for mitigation activities. The consultants shall continue to identify and use significant analyses already completed in the past to support these newly proposed FMPs, FMEs, and FMSs.

Geospatial Data Processing

Per TWDB guidelines[4], all FMPs, FMEs, and FMSs, must be submitted with the geospatial database with all required attributes. To comply with the requirement, the Technical Consultant Team has drawn all FMPs, FMEs, and FMSs into the geodatabase with all applicable information from hazard mitigation plans, drainage masterplans, and stakeholder engagements. The Technical Consultant Team also populated the required attributes from Exhibit D with available information.

The locations and boundaries of FMPs, FMEs, and FMSs are determined from the best information available. Often in this region, a map figure for a potential FMPs, FMEs, and FMSs is lacking, and only a brief location description is available. In this case, engineering judgment is used to determine the most probable location of FMPs, FMEs, and FMSs. Occasionally, potential FMPs, FMEs, and FMSs contain a map figure, in which case the geographic extent of the project is directly used for the location and boundary (when applicable as below).

Determining the locations and boundaries of FMPs, FMEs, and FMSs varies depending on the type. For example, the location of a low water crossing improvement FMPs, FMEs, and FMSs are often determined by the creek's name and the crossing road. The boundary of such FMPs, FMEs, and FMSs is the contributing upstream portion of the HUC-12 watershed. In another scenario, an urban drainage FMPs, FMEs, and FMSs location is determined by the best information on the neighborhood. The boundary is the upstream drainage area that leads to the project

[4] Data Submittal Guidelines for Regional Flood Planning, 3.10 – 3.12

outlet. Lastly, some FMPs, FMEs, and FMSs are citywide or county-wide, where a city/county boundary is used as the FMPs, FMEs, and FMSs boundary.

After all the FMPs, FMEs, and FMSs have been drawn in, a spatial join process is performed to populate geospatial parameters that are required by *Exhibit D 3.10 – 3.12.* Features in other layers containing geospatial information (HUC-12, flood risk types, entities with oversight, etc.) that overlap with the FMPs, FMEs, and FMSs footprint are joined and populated in the FMPs, FMEs, and FMSs geospatial attributes.