Texas Water Development Board

Guidance for the Preparation of Flood Mitigation Project Engineering Feasibility Reports

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Guidance for the Preparation of Flood Mitigation Project Engineering Feasibility Reports

Overview

This document provides guidance to assist Applicants providing engineering data needed in support of the engineering review for flood mitigation projects funded through the Texas Water Development Board (TWDB) Flood Infrastructure Fund (FIF) programs.

Applicants pursuing construction-oriented projects are required to submit a Preliminary Engineering Feasibility Report (PEFR) as described in Part D of the Application and this document. During the planning phase of the project Applicants must provide updates to the material in the PEFR document or a report that contains similar details. Note: Applicants that have already completed detailed planning may submit a complete Engineering Feasibility Report (EFR) with the application in lieu of PEFR.

For co-funded projects, if Applicants are required to complete a similar EFR for another Federal or other State funding source, they may submit the prepared report in lieu of developing a substantially similar FIF EFR. However, any information specified by this guidance which is not present in the initial report must be included as an attached technical memorandum.

An accepted EFR will be presented for one (1) month of public comment. The Applicant will host an electronic version and physical copy of the EFR, both of which will be free to view. At the close of the public comment period the TWDB Project Manager/Reviewer will review and identify comments to be addressed by the Applicant's project engineer, prior to approval of the EFR. The public comment period for an accepted EFR may be concurrent with the environmental findings public comment, if one is required.

This guidance is consistent with the Texas Water Code (TWC) and the following Texas Administrative Code (TAC) rules:

1. 30 TAC Chapter 213 – Edwards Aquifer
2. 30 TAC Chapter 216 – Water Quality Performance Standards for Urban Development
3. 30 TAC Chapter 297 – Water Rights, Substantive
4. 30 TAC Chapter 298 – Environmental Flow Standards for Surface Water
5. 30 TAC Chapter 299 – Dams and Reservoirs
6. 30 TAC Chapter 301 – Levee improvement Districts, District Plans of Reclamation, and Levees and Other Improvements
7. 30 TAC Chapter 307 – Texas Surface Water Quality Standards
8. 30 TAC Chapter 308 – Criteria and Standards for the National Pollutant Discharge Elimination System
9. 30 TAC Chapter 311 – Watershed Protection
10. 30 TAC Chapter 331 – Underground Injection Control
11. 31 TAC Chapter 363 – Financial Assistance Programs

To obtain information on these or any other rules see the TAC rules on line at:
http://www.sos.state.tx.us/tac/index.shtml
Open the link, select “View the current Texas Administrative Code”.

To obtain information on state statute see TWC rules on line at:
https://statutes.capitol.texas.gov/?link=WA

Definitions

2-D	Two Dimensional
BFE	Base Flood Elevation
CFR	Code of Federal Regulations
CLOMR	Conditional Letter of Map Revision
EAP	Emergency Action Plan
EFR	Engineering Feasibility Report
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIF	Flood Infrastructure Fund
FIRM	Flood Insurance Rate Map
H&H	Hydrologic and Hydraulic
HEC-HMS	Hydrologic Engineering Center's Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HUC	Hydrologic Unit Code
ICPR	Interconnected Channel and Pond Routing
IUP	Intended Use Plan
LOMR	Letter of Map Revision
MOU	Memorandum of Understanding
NOAA	National Oceanic and Atmospheric Administration
OM&R	Operation, Maintenance, and Repair
PDF	Portable Digital Format
PEFD	Preliminary Engineering Feasibility Data
SFHA	Special Flood Hazard Area
SWMM	Storm Water Management Model
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TWC	Texas Water Code
TWDB	Texas Water Development Board
USACE	United States Army Corps of Engineers
ZIP	Compressed Electronic File Format

Introduction

The use of this guidance will assist Applicants to address identified relevant issues concerning the planning of flood mitigation projects. However, TWDB approval does not negate the need for permits required by the Texas Commission on Environmental Quality (TCEQ) or any other agencies.

The Engineering Feasibility Report (EFR) should form the conceptual basis for the flood mitigation strategy proposed. Applicants proposing substantial modification to a watershed, floodplain, or other hydrologic system (system) of reasonable complexity should address the following guidance, as applicable. Applicants impacting a minor portion of the system or impacting a reasonably non-complex system should provide enough information to give a sufficient description of the need and proposed solution within the context of the defined watershed's upstream and downstream system. The EFR shall bear the signed and dated seal of the professional engineer, registered in the State of Texas, responsible for the report. The EFR shall also include the firm's Registration Number.

Applicants who are required to complete a complementary EFR for co-funding through Federal or other State funding sources may submit the complementary EFR in lieu of developing a substantially similar FIF EFR. However, any information specified by this guidance which is not present in the complementary EFR must be included as an attached technical memorandum to the complementary EFR.

A PEFR submitted with the application should, at a minimum, cover the information within the General Description section of this guidance and a description of alternatives considered, which conform to 31 TAC §363.13 – Preliminary Engineering Feasibility Data.

Please submit one physical copy (bound) of the EFR and one electronic copy, with the EFR in compressed portable digital format (PDF) with searchable text and the supporting modeling and mapping data electronically compressed in a ZIP file format.

General Description

1. List the project's sponsoring political subdivision, address, telephone number, and legal owner.

2. List the project engineer's name, address, email address, and telephone number.

3. Identify the program(s) from which financial assistance is sought and/or granted.

4. Identify and denote on a map the watershed(s) affected by the proposed project, consistent with 31 TAC §363.13 – Preliminary Engineering Feasibility Data and 363.408(b)(4) – Description of the Project Watershed.

5. Identify the political subdivision(s) as defined in Section 15.531(1) of the Water Code within the affected watershed area, if any, and provide as an attachment a copy of the Memorandum of Understanding (MOU) with the identified political subdivision(s).

6. Provide a general description of the existing flood control and/or stormwater system within the affected watershed area.

7. Provide a complete statement explaining the flood mitigation problems and needs within the planning area, including the following:

   A. The future land use of the area to be served by the proposed project (present through 30-year projection) and the land use for which the project is designed. We recommend the proposed project account for the 30-year needs and build for at least the 10-year needs or the term of the funding loan, whichever is greater.
   B. A discussion of any known flooding or drainage problems — such as flooded structures, drivers entering flooded roadways, erosion, etc. — both within the immediate planning area and the affected watershed area.
   C. A discussion of any stormwater related enforcement actions within the proposed project area and the NFIP status of the Applicant.
   D. A discussion of joint watershed management strategies and relationship between this document and identified regional flood mitigation strategies.
   E. A discussion of drainage improvement projects currently underway or approved for construction in the affected watersheds and how these impact the proposed project.

8. Provide a description of the proposed project including an explanation of any phased implementation. Also, provide maps and drawings as applicable to locate and describe the proposed project service area, such as:

   A. Geographic and hydrologic limits.
   B. The 10-digit hydrologic unit code (HUC-10) for the affected watershed(s).
   C. The most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map(s) (FIRM) of the planning area and affected watershed(s), including Letters of Map Revision (LOMRs), if available, and any other best available flood mapping.
   D. General location of proposed improvements.
   E. Publicly identified critical and at-risk infrastructure locations.
   F. Existing base mapping and drainage features, as well as proposed improvements.
   G. Drainage area should be clearly defined by contour map at intervals of not more than ten (10) feet.

9. Provide sufficient detail to document how the project will reduce the risks that were evaluated for rating on the Flood Intended Use Plan (IUP), as applicable.

10. Identify local, regional, or other modeling and design standards and guidance used within this project and report. A two-dimensional (2-D) hydrologic and hydraulic (H&H) model of the affected watershed is anticipated for construction-oriented projects. If a 2-D H&H model is not proposed, provide a description why a one-dimensional (1-D) or other alternative model is more appropriate in this case.

Hydrologic and Hydraulic Modeling

Watershed hydrology and open channel hydraulic modeling have increased in complexity as once rural areas have become urbanized and urban areas have become more interconnected. The marked increase in urbanization and the resulting increase in interconnected impervious cover, among several other factors, have altered drainage patterns and increased stormwater runoff intensities. To assess the changes in stormwater patterns, a more rigorous modeling analysis is required within the Flood EFR.

Modeling Standards

1. Provide a two-dimensional (2-D) hydrologic and hydraulic (H&H) model of the affected watershed, as applicable, which accounts for:
   A. Existing conditions and recommended alternative;
   B. The critical storm duration for the 50, 20, 10, 4, 2, 1, and 0.2-percent chance occurrence intervals (colloquially, the 2, 5, 10, 25, 50, 100, and 500-year return periods) and identification of the design rainfall event; and
   C. Utilizes the best available rainfall values, defined as values sourced from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 11 *Precipitation-Frequency Atlas of the United States, Texas* or more recently published study. If a more recent study is utilized, provide the basis and justification for its use.
   D. If a 2-D H&H model was not used, provide:
      - Supporting documentation within the EFR detailing why a 2-D model was not applicable to model the affected watershed; and
      - A 1-D or alternative H&H model which generally conforms to the above Modeling Standards, with justification for choice in modeling method.

2. Provide the basis of the H&H model by:
   A. Identifying local, regional, or other modeling standards and guidance used;
   B. Identifying modeling methodology, assumptions, and calibration standards;
   C. Identifying the proposed level of protection (*e.g.* the 24-hour, 0.2-percent chance rainfall event); and
   D. Include hyperlink to, or attach copy of, identified standards and guidance.

The Hydrologic Modeling System (HEC-HMS) and River Analysis System (HEC-RAS), developed by the US Army Corps of Engineers (USACE) and freely distributed, are the minimum modeling standard and are used commonly in flood mitigation planning and design.

- HEC-HMS computes peak flows and associated hydrographs by performing rainfall runoff analysis and hydrograph routing. HEC-HMS natively utilizes 1-D models. However, HEC-HMS version 4.4.0 (v4.4) and later have expanded 2-D modeling capability. HEC-HMS v4.4 allows the user to create a basin model from a digital elevation model. After assigning a terrain data component to a basin model, the user can apply tools to remove sinks, compute flow direction and accumulation, identify streams by drainage area, define break points, and finally, delineate a watershed. Once the watershed has been delineated, the user also has tools to merge and split sub-basin and reach elements.
- HEC-RAS computes water surface profiles and floodways for steady, gradually varied flow in channels. This water surface profile is calculated using discharges from HEC-HMS. HEC-RAS version 5 (v5) and later natively utilize 2-D models.

By using these programs, the water surface elevations and the regulatory floodway may be calculated, if needed, as well as many other pertinent variables involved in the design and analysis of flood infrastructure. HEC-HMS v4.4 and HEC-RAS v5, or most current versions, are the preferred programs to be utilized for modeling and analysis. Other programs, such as XPSWMM available from Innovyze and approved for use by FEMA, PCSWMM available from CHI, Interconnected Channel and Pond Routing (ICPR4) model available from Streamline Technologies, or similar software programs, may be used for projects. If an alternate program is utilized, provide the basis for its use as the preferred tool over HEC-HMS v4.4 and HEC-RAS v5.

Resilience Alternatives Analysis

Flood mitigation strategies hold a series of possible solutions due to the complex nature of flooding. To address the variety of possible solutions, a rigorous alternative analysis is anticipated within the Flood EFR. Additionally, flood infrastructure has the probability and, given a long enough timeline, likelihood of having its design capacity exceeded by extreme storm events, as evidenced by the events of Hurricane Harvey and other recent storms. Addressing the possibility of exceedance broadens the analysis of alternatives to consider the *resilience* of each alternative. Resilience, as applied to flood infrastructure, captures the reaction of an alternative to flood events resulting in exceedance, failure, recovery, and reimplementation of the infrastructure.

At a minimum, the Resilience Alternatives Analysis shall consider three (3) alternatives for comparison in items 1 through 5 below:

A. A No-Action alternative;
B. An alternative with one or more green, nature-based, non-structural, or water supply benefit design elements; and,
C. At least, but not limited to, one other design alternative.

Provide descriptions of each alternative considered. For a complete Resilience Alternative Analysis, provide a comparative analysis of all alternatives considered through evaluation of the following criteria:

1. Life Cycle Cost
   A. At a minimum, a life cycle cost analysis will include:
      a. The capital cost of the proposed alternative including soft costs;
      b. The cost of operating and maintaining the proposed alternative over the alternative's life cycle; and
      c. The cost of replacing the alternative at the end of its life cycle.
   B. The Present Worth Method is a viable method to provide a life cycle cost analysis. The Present Worth is the sum, which if invested now at a given interest rate, would provide exactly the funds required to pay all present and future costs. Total project cost, used to compare alternatives, is the sum of the initial capital cost, plus the present worth of operation, maintenance, and repair (OM&R) costs, minus the present worth of the salvage value at the end of the life cycle period.

2. Risk Reduction
   A. Number of structures removed from the existing conditions floodplain for the design rainfall event.
   B. Value of structures removed from the existing conditions floodplain for the design rainfall event.
   C. Changes to the range of flood events modeled, if any, including the Base Flood Elevation (BFE).
   D. If considered alternative affects a roadway, number of roadways and corresponding vehicles per day removed from the design rainfall event existing conditions floodplain. If traffic data is not available for an identified roadway, provide an alternate metric to quantify risk reduction.

3. Exceedance Consequence
   A. Possible effects to life and property if capacity of considered alternative is exceeded by the next percent chance occurrence interval 'above' the design rainfall event interval. If the design interval is the 1-percent chance interval also consider the 0.2-percent (500-year) chance interval.
   B. Possible impacts to life and property if considered alternative experiences structural failure.
   C. Identify if the exceedance or failure of considered alternative would isolate a community from evacuation routes or emergency medical services.
   D. Estimated time and cost of recovery and reimplementation / reconstruction if considered alternative is exceeded and fails, if applicable.

4. Green Infrastructure
   A. Volume of flood water detained or retained for considered alternative.
   B. Percent and volume of stormwater infiltrated in the critical storm duration, 50-percent chance (2-year) rainfall event for considered alternative.
   C. Linear feet of erosion set-back or riparian buffer.
   D. Acres of land naturalized for flood mitigation.
   E. Other green, nature-based, or ecosystem benefits which result in flood mitigation.

5. Any other analysis criteria considered.

The outcome of the Resilience Alternatives Analysis should be a scored, rank ordering of alternatives. It is understood that the most current data may not be available for all items within the Resilience Alternatives Analysis. TWDB encourages the Engineer to identify and utilize the best available data. However, if no data is available for a particular item the Engineer is encouraged to approximate values based upon their professional experience and judgment and provide an explanation for each approximate value.

The recommended alternative shall be selected from the alternatives considered in the above analysis and should be the alternative with the most favorable scored outcome.

Provide the following information about the recommended alternative:

   A. Briefly summarize the advantages and disadvantages of the recommended alternative as compared to the other considered alternatives.

B. Provide tabularized data as applicable of the recommended alternative proposed changes, from existing conditions to proposed conditions, in runoff rates, depths, BFE, 1-percent floodplain area, and inundation areas for the rainfall events identified in the Modeling Standards section of this document.
C. Provide certification of no adverse impacts or rise in the BFE, conforming to the requirements of 44 C.F.R. Part 60.3 – Floodplain management criteria for flood-prone areas.
D. Identify all permitting and regulatory requirements for the recommended alternative and verify the project's ability to meet and obtain all identified requirements and permits.
E. Identify any land or easement acquisitions for the recommended alternative and verify the method and means of procurement.

Project Specific Requirements

1. Request for Additional Information

Conforming to 31 TAC §363 Subchapter A – General Provisions:

A. §363.13(b) – The executive administrator may request additional information or data as necessary to evaluate the project.
B. §363.52 – Any substantial alteration which involves a change in the basic purpose of a project, or which involves an increase in the loan commitment of the board for the project, must be approved and authorized by the board. All other changes must be approved by the executive administrator.
C. For additional information, please refer to the above rule, in its entirety.

2. Dams, Levees, and Reservoirs

The following information shall be provided as an attachment to the EFR if applicable to the project:

A. Conformance to:
    a. 30 TAC Chapter 299 – Dams and Reservoirs
    b. 30 TAC Chapter 301 – Levee Improvement Districts, District Plans of Reclamation, and Levees and Other Improvements
B. Draft Emergency Action Plan (EAP) generally conforming to 30 TAC § 299.61 – Emergency Action Plans. Draft EAPs will be mandatory for all dam, levee, and reservoir projects funded under this program.

3. Property Buy-outs

Property buy-outs funded under this program will conform to 44 C.F.R Part 80 requirements. Eminent Domain may not be used for acquisitions of property for buy-out projects. Provide a copy of the deed restriction language proposed to meet these requirements as an attachment to the Flood EFR. See FEMA Model Deed Restriction for pre-approved language.

4. Designed Infiltration

Flood mitigation projects where infiltration is an integral component will provide a soil percolation test report containing the results, analysis, and recommendations as an attachment to the Flood EFR. The percolation test report shall bear the signed and dated seal of the registered professional engineer

or geologist responsible for the report. Multiple percolation tests are expected over the project area to sufficiently account for variation in the substrata. Provide the factor of safety on the design infiltration rate to account for uncertainty and possible clogging over the life cycle of the project.

5. Changes to Established Floodplain & Floodways

If the recommended alternative would affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway, the effective Base Flood Elevations (BFEs), or the Special Flood Hazard Area (SFHA) then a Letter of Map Revision (LOMR) from FEMA will be required for the project. For projects requiring a LOMR, it is recommended a Conditional Letter of Map Revision (CLOMR) is issued first. Provide, as an attachment to the Flood EFR, the draft CLOMR and documentation required by FEMA for review and issuance, if developed.

American Iron & Steel or U.S. Iron & Steel Requirements

Projects co-funded with State Revolving Funds will have to comply with the American Iron & Steel requirements as described in TWDB-1106. State funded projects, with the exception of State Participation, will have to comply with the U.S. Iron & Steel requirements as described in TWDB-1105. Please provide a discussion of any known issues or special considerations that may affect the design or construction as a result of the applicable iron and steel requirements. Also, include a discussion of any potential waivers that are being considered.

Cost of the Project (31 TAC § 363.13)

Provide the total project cost for each recommended project or project phase within the Project Budget Form (TWDB-1201). Include budget items from other sources of funding in the "Other Funds" column of the Project Budget Form.

Project Schedule

Include a detailed project schedule with timelines for each phase of the recommended project (as applicable). The projected timeline should include, but are not limited to the following:

1. Requested loan closing date
2. Completion of planning activities (EFR approval)
3. Submit plans and specifications for TWDB approval
4. Advertise for bids on contract(s)
5. Open bids and contingently execute contract(s)
6. Preliminary construction timeline
7. Final project completion

As necessary, include time for unforeseen delays to obtain easements for utilities, land, buffer zones, or right-of-way easements.

Environmental Assessment

If the Applicant includes the Environmental Assessment within the EFR, provide the information required in the Environmental Data Form TWDB-0800 (sole State funded programs) and Environmental Information Document Form TWDB-0801 (co-funded with Federal programs).

References

Rules as listed on page three (3) of this guidance.
Guidelines for the Preparation of Environmental Assessments, TWDB-0800 & TWDB-0801.
Flood Infrastructure Fund Program Guidance Manual, TWDB-0104
Guidance for the Preparation of Flood Mitigation Project Design Documents, TWDB-0511