



**Guidance for the Preparation of Flood
Mitigation Project Design Documents**

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Guidance for the Preparation of Flood Mitigation Project Design Documents

Overview

This guidance was prepared to assist applicants in providing design documents needed in support of the engineering review for flood mitigation projects funded through the Texas Water Development Board (TWDB) Flood Infrastructure Fund (FIF) program.

Applicants pursuing construction-oriented projects are required to submit an Engineering Feasibility Report (EFR) as described in the Guidance for the Preparation of Flood Mitigation Project Engineering Feasibility Reports (TWDB-0554). During the design phase of the project, applicants must provide updates relating to the recommended alternative within the project's EFR, in the form of a Design Report.

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
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 design of construction-oriented 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 state or federal agencies.

Three engineering design documents are the outcome of the design phase: The Design Report, the Plans, and the Specifications.

The Design Report (DR) should refine the flood mitigation strategy recommended within the project's related Engineering Feasibility Report (EFR). It is expected for the DR to reuse many of the assets and text presented within EFR. Changes in modeling or analysis metrics for the recommended strategy between the EFR and DR should be emphasized and elaborated upon. The DR shall bear the signed and dated seal of the professional engineer, registered in the State of Texas, responsible for the report. The DR shall also include the firm's Registration Number.

The Plans and Specifications (P&S) should present the whole of the design for the flood mitigation strategy recommended within the EFR and refined within the DR. The P&S should conform to Supplemental Contract Conditions for State Loan Projects ([TWDB-0552](#)) and the guidance within this document. The P&S shall bear the signed and dated seal of the registered professional engineer responsible for the report. The P&S shall also include the firm's Registration Number.

Please submit one physical copy (bound) and one electronic copy of the DR and P&S, with the DR and P&S in compressed portable digital format (PDF) with searchable text and the supporting modeling and design data electronically compressed in a ZIP file format, accompanied by the TWDB [P&S Submittal Form](#).

Design Report Guidance

The DR should contain the information from the following sections:

- General Description
- Modeling and Analysis
- Basis of Design
- Design Calculations
- Cost of the Project
- Project Schedule

Additionally, the DR should contain any project specific requirements identified within the EFR.

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 the EFR associated with this DR.
5. Identify any changes between the associated EFR and DR regarding:
 - A. The watershed(s) affected by the final design.
 - B. The political subdivision(s) within the affected watershed area; if changes to affected political subdivisions(s) are identified, either confirm the existing Memorandum of Understanding (MOU) is still applicable or provide an amended MOU.
 - C. Design considerations presented within the EFR.
6. Provide a description of the final design including an explanation of any phased implementation. Also, provide revisions, as applicable, to the maps and drawings presented within associated EFR.
7. If the project proposes work within the floodplain, provide a copy of the executed permit from the Flood Plain Administrator approving the proposed final design.
8. Provide sufficient detail to document how the final design will reduce the risks that were evaluated for rating on the Intended Use Plan (IUP).
9. Identify local, regional, or other modeling and design standards and guidance used within the DR.

Modeling and Analysis

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 DR.

Modeling and Analysis Standards

The modeling and analysis standards for the DR shall conform to the Modeling Standards and Resilience Alternative Analysis sections, respectively, in *TWDB Guidance for the Preparation of Flood Mitigation Project Engineering Feasibility Reports* (TWDB-0554).

Model Changes

Changes in modeling outcomes for the final design between the associated EFR and DR should be detailed within the DR. Changes should be presented in a tabularized and graphic format which is easily read and understood. Explanation of design changes resulting in modeling changes should be explained in detail. Changes deemed substantial by the Executive Administrator (EA) may be presented for an additional public comment period, as outlined in the Flood Infrastructure Fund Program Guidance Manual (TWDB-0104).

Resilience Analysis Changes

Changes in input values for the final design in the Resilience Alternatives Analysis between the associated EFR and DR should be detailed within the DR.

Changes should be presented in a tabularized and graphic format which is easily read and understood. Explanation of design changes resulting in analysis changes should be explained in detail. Changes deemed substantial by the Executive Administrator (EA) may be presented for an additional public comment period, as outlined in the Flood Infrastructure Fund Program Guidance Manual (TWDB-0104).

Design

In the context of flood project design, the design engineer should achieve three goals to address flood risk:

1. Identify the flood risk and consequence the design will seek to address.
2. Identify and seek to maximize the protection provided by the design, specified in terms of the critical storm duration and percent chance occurrence.
3. Identify and seek to minimize the upstream and downstream impacts of the design.

Three criteria will be utilized to review flood project design submitted to TWDB for conformity with the above stated goals. The criteria are the Basis of Design and Design Calculations, as presented in the DR, and the Selected Design, as presented in the Plans and Specifications.

Basis of Design

Provide the basis of the final design within the DR by:

1. Identifying local, regional, or other design standards and guidance used;
2. Identifying design software utilized;
3. Identifying the designed level of protection (*e.g.* the 24-hour, 0.2-percent chance rainfall event; and
4. Include hyperlink to, or attach copy of, identified standards, guidance, and software.

Design Calculations

Provide design assumptions, calculations and chosen method to support final design. Describe reasoning behind assumptions and method used. Presentation of design calculations within the DR should include, but is not limited to:

1. Provide selection of design parameters (*e.g.* run-off coefficients or intensity-duration-frequency figures).
2. Tabularized results and outputs from design software.
3. Manual calculations with base equations utilized.
4. Technical data sheets from a product supplier.
5. Other calculations made to support the final design.

Design Selection Guidance

The State of Texas does not currently maintain regulatory flood engineering design standards. As such, TWDB will rely upon design guidance published by state, federal, and local agencies coupled with a higher standard of practice as published by professional organizations. Flood engineering design should follow the general guidelines as published by, but not limited to:

- The United States Army Corps of Engineers [1110-2 series](#) of Engineer Manuals;
- The American Society of Engineers [Standard 24 Flood Resistant Design and Construction](#); and
- The Texas Department of Transportation [Hydraulic Design Manual](#).

The legal responsibility for selection and utilization of design standards remains with the design engineer. The presented design, green, and resilient flood infrastructure standards do not relieve the design engineer of the legal responsibility for the integrity of the project design.

Regional Design Guidance

The flood design challenges throughout the State are as varied as the topography. Due to the variety in both design challenges and topography, best practices in one region of the State may not be the best practices in another region. Below is a regional selection of flood and stormwater design standards identified as substantially comprehensive and robust. Selection of design standards and guidance is neither intended to be an exhaustive list, nor limited to the presented selection. However, the design standards and guidance utilized for TWDB funded projects and referenced within the DR should contain a similar level of comprehensive depth as the presented selection.

Amarillo, City of – [Storm Water Management Criteria Manual](#)

Austin, City of – [Drainage Criteria Manual](#)

Corpus Christi, City of – [Draft Drainage Design Manual](#)

Dallas, City of – [Drainage Design Manual](#)

El Paso, City of – [Drainage Design Manual](#)

Ft. Worth, City of – [Stormwater Criteria Manual](#)

Harris County Flood Control District – [Hydrology and Hydraulics Guidance Manual](#)

Lubbock, City of – [Drainage Criteria Manual](#)

San Angelo, City of – [Stormwater Design Manual](#)

San Antonio, City of – [Storm Water Design Criteria Manual](#)

Green Infrastructure Design

The desire for Green and Resilient flood infrastructure design alternatives has risen to prominence in recent years. Highlighting this desire, the United States Environmental Protection Agency (EPA) published two articles titled [Why You Should Consider Green Stormwater Infrastructure for Your Community](#) and [Manage Flood Risk](#). In general, green—or nature based—design alternatives use natural features, materials, and processes as a method for flood reduction in lieu of traditional infrastructure. Resilient design, as applied to flood infrastructure, captures the coupled interaction of the natural and built infrastructure systems during storm events resulting in exceedance or failure to reduce recovery time and reimplementation costs.

TWDB encourages the consideration of Green and Resilient design alternatives and the selection of said alternatives, if they are a proven benefit to the Applicant and environment. Below is a regional selection of Green and Resilient design guidance identified as substantially comprehensive and robust.

Selection of design guidance is neither intended to be an exhaustive list, nor limited to the presented selection. However, the design guidance utilized for TWDB funded projects and referenced within the DR should contain a similar level of comprehensive depth as the presented selection.

American Society of Engineers, The – [Climate-Resilient Infrastructure](#)

Arizona State University – [Green Infrastructure Handbook](#)

Houston-Galveston Area Council – [Designing for Impact](#)

National Oceanic and Atmospheric Administration – [Green Infrastructure Effectiveness Database](#)

Naturally Resilient Communities – [Additional Resources](#)

San Antonio River Authority – [Low Impact Development Technical Design Guidance](#)

USACE – [Engineering with Nature](#)

U.S. EPA – [Green Infrastructure Design and Implementation](#)

University of Texas at San Antonio – [Implementing Low Impact Development](#)

Plans and Specifications

Plans and specifications must conform with and contain all documents required in the Supplemental Contract Conditions and Instructions, mitigation measures identified in the environmental finding, and conditions identified in required permits. The conditions for FIF projects are contained in the Supplemental Contract Conditions for State Loan Projects ([TWDB-0552](#)). TWDB-0552 must be incorporated in its entirety into the General and Special Conditions section of the construction contract documents. For projects with multiple funding sources, the most stringent requirements must be followed.

Plans submitted to TWDB for review must be the final construction set and must include each of the following items, as applicable to the project:

1. All Stormwater and Flood Infrastructure Plans
 - a. If the project is within 100 feet of a FEMA identified Special Flood Hazard Area (SFHA) the plans must identify the limits of the SFHA including, as applicable:
 - i. The 1-percent floodplain, 0.2-percent floodplain, and regulatory floodway limits; and,
 - ii. The base flood elevations (BFE).
 - b. If the project impacts the floodplain, the plans must show changes to the floodplain that would occur following completion of the project.
 - c. The plans must identify any environmental, cultural, or historic areas specified in the environmental finding and special conditions associated with the project.
 - d. The plans must identify the design rainfall event for the infrastructure.
 - e. The plans must specify the location of all potable, reuse, or sewer lines that are 9.0 feet or closer to any portion of a stormwater system and indicate the actual separation distances.

- f. The plans must show all local, state, and federal set-back requirements.
- g. The plans must state any additional local, state, and federal permit requirements.

2. Conveyance System Plans

- a. The plans for a stormwater collection system must include plan and profile drawings for both channels and pipes. Typical cross-sections must be included for channels. The plans must specify the size, grade, channel surface material, and pipe material.
- b. The profile drawing for both channels and pipes must show the water surface elevations (WSEL) and hydraulic grade lines (HGL) for the design storm.
- c. The plans must specify the location of any structural features of a collection system, including but not limited to manholes, head and tail walls, weirs, inlet and outlet control boxes, riprap, and velocity dispersion barriers.
- d. The plans must specify the location and crown elevation of crossing pedestrian paths, roadways, and railways. If the crossing is considered a bridge, also include the elevation of the lowest structural member of the bridge.
- e. The plans must include dimensional section details of any structural features as listed above.

3. Detention and Retention Pond Plans

- a. The plans for stormwater detention and retention ponds must include plan, profile, and typical cross-section drawings. The profile must follow the flowline of the pond. The plans must specify the grade and surface material of the pond.
- b. The plans must show the high-water level (HWL) for stormwater storage capacity for both detention and retention ponds.
- c. Retention ponds and ponds with permanent ponding must show the normal WSEL of the permanent pond.
- d. The plans must specify the locations and inverts of all inlets and outlets to the pond.
- e. The plans must specify the location of any of the structural features listed in 2.c above, as directly associated with the pond, in addition to any spill gates, overflow channels, or mechanical features such as pumps and flood gates.
- f. The plans must include dimensional section details of any structural features as listed above.
- g. If the pond is designed for stormwater infiltration, the plans must specify the area of designed infiltration, the infiltration filter media utilized, and the maximum anticipated rate of infiltration.

4. Green and Resilient Infrastructure

- a. The plans which include green and resilient infrastructure must include plan view drawings of all design elements. If the infrastructure is intended to convey, detain, or infiltrate water, the plans must also include a profile view, which must follow the flowline of the water, and a typical cross-section.
- b. The plans must specify the grade and surface material of the green and resilient infrastructure.
- c. The plans must identify the location, size, and type of any existing or added trees, shrubberies, or other plants.
- d. The plans must identify the area and depth of engineered or non-native soils.

5. Special Projects
 - a. Dam and Reservoir projects must conform to the requirements of 30 TAC Chapter 299.
 - b. Levee projects must conform to the requirements of 30 TAC Chapter 301.
 - c. Special projects which differ substantially from the projects listed in this section of the guidance should coordinate with TWDB design review staff for design expectations.

The specifications for construction of stormwater and flood infrastructure must include technical descriptions of all design elements including:

1. General description;
2. Quantity and sizing;
3. Any applicable materials specifications;
4. Performance standards; and
5. Citations to industry, state, and national standards with which the project complies.

The plans and specifications submitted to TWDB for review must be sealed by a professional engineer registered in the state of Texas. The Applicant should submit one (1) physical copy (bound) or more, as requested by the TWDB project engineer, and one (1) portable digital format (PDF) copy, with searchable text, of the plans and specifications for initial review. The Applicant should immediately notify the TWDB Project Engineer/Reviewer and Environmental Reviewer if modifications have been made to the project scope in the final engineering report(s) and/or the plans and specifications. Amendments to the information provided in the EFR may require revisions to the environmental finding(s) and significant changes to the project scope that occur after loan commitment may require Board approval.

A plans and specifications review checklist is available through the TWDB [Financial Assistance website](#). Follow the items under the “State Funded Project” column.

Cost of the Project (31 TAC §363.13)

Provide **an updated** total project cost for each recommended project or project phase within the Project Budget Form ([TWDB-1201](#)) to be included within the DR. Include budget items from other sources of funding in the “Other Funds” column of the Project Budget Form.

Project Schedule

Include **an updated** project schedule with timelines for each phase of the recommended project (as applicable). The timeline should include, at a minimum, the items identified within the associated EFR timeline.

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
Supplemental Contract Conditions for State loan Projects, TWDB-0552
Guidance for the Preparation of Flood Mitigation Project Engineering Feasibility Reports, TWDB-0554