

**Texas Department of Transportation  
Book 2 - Technical Provisions**

**IH 35E Managed Lanes Project**

**Attachment 12-1**

**Drainage Report for Major Stream Crossings  
Guidelines**

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

I. Cover Sheet

The cover sheet shall contain the following items:

- Highway and stream name
- Project CSJ
- County name
- TxDOT name and logo
- Consultant company name and firm number (if applicable)
- Responsible engineer's seal, signature and date

II. Table of Contents

The Table of Contents shall be:

- List of topics by page number
- List of tables
- List of figures
- List of Appendix items

III. Report Topics

A. Purpose

- Describe the site location
- Describe the type of roadway facility
- Provide an explanation in general terms of what improvements are proposed for the project, why a hydraulic study is being performed, and describe what is happening to the existing structure (rehabilitation or replacement).
- Describe the design frequency being used for the proposed structure. If the design frequency is different from what is recommended in the Hydraulic Manual (i.e., a city requests a higher frequency design and is providing additional funding for the structure), then it must be discussed in this section of the report.

B. Existing Conditions

The following discussion items must be included about the structure(s) to be replaced, if applicable:

- Existing structure type - bridge (concrete beam spans, steel truss, etc.), multiple box culvert, etc.
- Existing structure width, number of lanes, shoulder widths, etc.
- The current and projected future average daily traffic (ADT)
- Existing structure span lengths
- Skew of existing structure

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

- Existing type of rail
- Structural condition and sufficiency rating for the existing structure
- Low chord of existing structure (bridges)
- Headwater and tailwater elevations (culverts) for the design and 100-year discharge
- Discussion of existing hydraulic conditions (i.e., frequency of overtopping, field evidence of overtopping, debris blockage, etc.)
- FEMA – Whether in a Special Flood Hazard Area (SFHA) or not. If in an SFHA, the zone (A, AE, AO, AH, V, VE) and its implications
- Any discussions, information, or requests from the local Floodplain Administrator (FPA)

C. Discharges

For studied SFHAs:

- Describe the FIS data format and how the data was acquired
- Describe all assumptions, conversions, and corrections
- Describe any benchmark or datum used
- If the FEMA discharges need to be corrected, fully explain why
- If the FEMA discharges are not used, fully explain why not

For non-studied drainage basins, provide the following:

- Drainage area size (square miles or acres)
- Describe the type of watershed in the report (uncontrolled or controlled by reservoirs/dams, etc.). If a dam is located upstream, provide documentation concerning data provided by the owner.
- Description of land use (agricultural, pasture, single family subdivisions, commercial, etc.) and type of terrain
- Soil types within the watershed
- Stream gauge information, if applicable (very rare for most projects)
- Discharges from previous studies, if available
- Runoff method used for design and comparison (regression equations, NRCS, etc.). The regression equations are good to use as a check for other methods.
- Computer model used for runoff calculations (spreadsheet, HEC-HMS, Win TR-55, etc.)
- Parameters used for the model (time of concentration, runoff curve numbers, etc.)
- Tabulation of the results of the calculations for each method (minimum of two methods for comparison)
- State the basis for the method selected for design frequency or AEP

Water Surface Profiles and Velocity Data

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

- Describe the computer software, including the version number, used for the analysis (HEC-RAS, HY-8, etc.). HEC-RAS should be must for crossings that involve FEMA detailed studies and for culverts with high flow over the road. FEMA considers HY-8 and other culvert programs to be approximate methods.
- Document the basis of the starting water surface profile or boundary conditions (i.e., the slope/area method was used assuming normal depth, etc.).
- Provide the vertical datum that is used for project elevations.
- Document any weir flow over the roadway (if applicable), for existing and proposed conditions.
- Document assumptions concerning Manning's n value for the channel and overbanks.
- The cross sections must be located far enough upstream and downstream from the site to show that water surface profiles for proposed conditions will match (or come close to matching) the existing profile.
- For SFHA's, document the use of the official FEMA model. Discuss any necessity for a corrected model. Provide a table of corrected water surface elevations (WSELs) compared to the current effective WSELs, as well as published FIS WSELs (if different from current effective),
- If the FEMA discharges were corrected, include a table comparing the WSELs using both the FIS and the corrected discharges.

**D. Proposed Conditions**

The discussion about the proposed structure must include the following items:

- Proposed structure type (TX prestressed concrete girders, box beams, slab-spans, multiple box culvert, etc.)
- Proposed structure width, number of lanes, offset to rail, etc.
- Proposed structure span length configuration
- Proposed skew of abutments and bents, or skew of culvert
- Proposed rail type
- Proposed low chord (bridges)
- Type of proposed wingwall (culverts)
- Freeboard based on the design storm (bridges) and why it should be necessary
- Basis for the allowable headwater and through-bridge velocity
- Proposed velocity/scour control measures (i.e., concrete riprap, etc.)
- Proposed upstream or downstream channel grading, if applicable

**Water Surface Profiles and Velocity Data**

- Include a table comparing existing and proposed (or corrected existing and proposed) WSELs and channel velocities for the channel cross sections used in the analysis.
- For studied zones with a floodway, include a table comparing existing and proposed floodway WSELs. Also include floodway widths.

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

- Provide a discussion of the tabulated results and describe if there are any adverse impacts to properties upstream or downstream of the site due to proposed construction.

E. Corridor Development Certificate (CDC) (if applicable)

The CDC permit applies to bridge construction on the West Fork, Elm Fork, or Main Stem of the Trinity River, as well as tributaries that experience backwater effects from these rivers. Refer to the current CDC manual and certificate form for details and requirements. This information is available on NCTCOG's web page at the following location:

<http://www.nctcog.org/envir/SEEsafe/fpm/cdc/index.asp>

- Tabulate current effective CDC model results (existing conditions) for 100-year flow and Standard Project Flood (SPF). If the current effective CDC model does not accurately depict actual existing conditions at your site (based on survey), then you will need to create a corrected effective CDC model with updated cross sections.
- Tabulate the CDC model results with proposed bridge and cross sections for 100-year flow and SPF.
- Tabulate the results of the valley storage analysis and determine if valley storage mitigation is required based on CDC requirements.
- Provide a discussion of the CDC analysis (i.e., was CDC criteria met?).

F. Scour Analysis and Stream Stability (if applicable)

This must be done in accordance with Bridge Division, Geotechnical Section guidance.

G. Coordination with Local Floodplain Administrator

- Document phone conversations, emails, or written correspondence with the local floodplain administrator concerning the proposed bridge or culvert. Include the date that the report and hydraulic data sheets were submitted to the local FPA in the report and on a note on the hydraulic data sheets.

J. Conclusion

- Include a discussion about how the proposed structure will meet the design requirements and why the chosen structure is the best alternative.

IV. Figures

The following items should be included in the list of Figures:

- Project location map (to scale with a north arrow)

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

- Drainage area map (to scale with a north arrow)
- Soils map(s) for the drainage basin
- A copy of the current FEMA FIRM for the site (if applicable)
- Proposed structure layout(s) and core boring sheets
- Proposed typical sections
- Roadway plan & profile sheets at the stream crossing
- A copy of the hydraulic data sheets to be submitted with the PS&E. One of these sheets should be a plan view drawing (to scale) showing location of channel cross sections used in the analysis. Preferably, this drawing should show topography and ground contours in the background.

V. Appendix

- Site photographs (in color)
- Runoff calculations (spread sheets, TR-55 output, HEC-HMS output, etc.)
- A copy of the current FIS for the stream reach (if applicable).
- Hydraulic calculation input and output (HECRAS, HEC-2, etc.) for existing and proposed conditions (include FEMA data, if applicable). Include the list of error messages generated by the software.
- Channel cross section plots
- Water surface profile plots
- HEC-RAS scour output and scour envelope plots (or spreadsheet calculations)
- CDC hydraulic calculations, valley storage calculations and completed CDC permit form (if applicable)
- Any other miscellaneous supporting data

VI. Submittals

- The number of hard copies will depend on District preference. Electronic copies shall contain the hydraulic report document (in Word or PDF format) as well as all appendices and hydrologic and hydraulic computer models for the project.

Notes:

1. Any drawing included as a figure or in the Appendix should be easy to read and preferably drawn to scale, with a north arrow when applicable. If USGS maps are used in the background of drainage area maps, the contours should be legible.
2. The latest version of software (HEC-HMS, TR-55, HEC-RAS, etc.) that is available at the time of preparing the report should be used. Beta versions of software shall not be used for TxDOT projects.
3. Many of the FEMA FIS computer models extend for miles upstream and downstream from the site. In that case, the Designer only needs to use the relevant portion of the model required for the design, based on engineering

**ATTACHMENT 12-1**  
**Drainage Report for Major Stream Crossings Guidelines**

judgment, which will reduce the size of the files the designer is working with, along with the paper output.

4. If hard copy reports are prepared, they should be bound using a three-ring or spiral binder, with labeled tabs used for Appendix dividers.
5. In general, the guidelines listed above are intended to apply to new location bridge class structures, replacement of existing bridge class structures, or modifications to existing structures that could potentially impact the design and 1% AEP (100-year) water surface profiles at stream crossings. Engineering judgment should be applied in each case.