

GIS SUBMITTAL FORMAT FOR FLOOD HAZARD STUDIES

The following document provides guidance on creating data for submittal to WDNR for flood hazard mapping. Flood lines (s_fld_haz_ln), flood polygons (s_fld_haz_ar), stream centerlines (s_wtr_ln), cross sections (s_xs), cross-section elevation table (l_xs_elev), Base Flood Elevation (BFE) lines (s_bfe) and the station starting locations table (s_stn_start) shall be submitted. The final products should be submitted in geodatabase or shapefile format using the samples provided by the WDNR. These guidelines have been taken from Appendix L [2011] of FEMA's *Guidelines and Standards for Flood Hazard Mapping Partners*.

These guidelines will be accompanied by a sample geodatabase containing the seven required layers. Fields that contain multiple accepted values are linked to domain tables contained within the geodatabase—only those values should be used. The list of required domain tables is contained in Appendix A of this document.

The information below contains specific guidelines on creating and filling in the attribute tables associated with each shapefile. Each required field is listed and for those fields with multiple possible entries, the applicable values for this project are listed.

Layer: S_Fld_Haz_Ar (Flood Polygons)

The S_Fld_Haz_Ar attribute table contains information about the flood hazards within the study area. These zones are used by the Federal Emergency Management Agency (FEMA) to designate the Special Flood Hazard Area (SFHA) and for insurance rating purposes. These data are the regulatory flood hazard areas that are or will be depicted on the Flood Insurance Rate Map (FIRM).

The spatial elements representing the flood zones are polygons. The entire area of the jurisdiction(s) mapped by the FIRM should have a corresponding flood zone polygon. There is one polygon for each contiguous flood zone designated.

The S_Fld_Haz_Ar table contains the following elements:

FLD_AR_ID	Primary key for table lookup. Assigned by table creator.
STUDY_TYP	Study Type. This describes the type of flood risk project performed for flood hazard identification. Acceptable values for this field are listed in the D_Study_Typ table.
FLD_ZONE	Flood Zone. This is a flood zone designation. These zones are used by FEMA to designate the SFHAs and for insurance rating purposes. NOTE: The symbol '%' is a reserved symbol in most software packages, so the word 'percent' was abbreviated to 'PCT.' Acceptable values for this field are listed in the D_Zone table.

ZONE_SUBTY	Flood Zone Subtype. This field captures additional information about the flood zones not related to insurance rating purposes. For example, insurance rate zone Shaded X could have “PROTECTED BY LEVEE” or “0.2 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE.” Types of floodways are also stored in this field. Floodways are designated by FEMA and adopted by communities to provide an area that will remain free of development to moderate increases in flood heights due to encroachment on the floodplain. Normal floodways are specified as ‘FLOODWAY.’ Special cases will have a more specific term for the designation (such as COLORADO RIVER) and will appear as a note on the hardcopy FIRM. See <i>Appendix K</i> of the <i>Guidelines and Standards</i> for available floodway notes. Acceptable values for this field are listed in the D_Zone_Subtype table.
SFHA_TF	Special Flood Hazard Area. If the area is within a SFHA this field would be true. This field will be true for any area coded as an A or V flood zone area. It should be false for any X or D flood areas. Acceptable values for this field are listed in the D_TrueFalse table.
STATIC_BFE	Static Base Flood Elevation. This field will be populated for areas that have been determined to have a constant Base Flood Elevation (BFE) over a flood zone. The BFE value will be shown beneath the zone label. In this situation the same BFE applies to the entire polygon. This normally occurs in lakes or coastal zones.
DEPTH	Depth This is the depth for Zone AO areas. This value is shown beneath the zone label on the FIRM. This field is only populated if a depth is shown on the FIRM.
LEN_UNIT	Length Units. This unit indicates the measurement system used for the BFEs and/or depths. Normally this would be feet. This field is only populated if the STATIC_BFE or DEPTH field is populated. Acceptable values for this field are listed in the D_Length_Units table.

Layer: S_Fld_Haz_Ln (Flood Lines)

The S_Fld_Haz_Ln attribute table contains information about the flood hazard line features for the study area. The spatial elements representing the boundaries of the flood hazard areas depicted on the Flood Insurance Rate Map (FIRM) are lines.

The S_Fld_Haz_Ln attribute table contains the following elements.

FLD_LN_ID	Primary key for table lookup. Assigned by table creator.
LN_TYP	Line Type. These line types describe the flood boundary and may be used to indicate how the feature must be depicted on the hardcopy FIRM. Acceptable values for this field are listed in D_Ln_Typ table.

Layer: S_Wtr_Ln

The S_Wtr_Ln attribute table contains information about surface water linear features. This layer should only include profile baselines for new studies. This is a Standard DFIRM Database table.

The S_Wtr_Ln table contains the following elements:

WTR_LN_ID	Primary key for table lookup. Assigned by table creator.
WATER_TYP	Surface Water Feature Type. The type value describes the kind of watercourse represented. Valid entries include items such as STREAM CENTERLINE, OPEN WATER AREA, WETLANDS, and MANMADE WATER FEATURE. Acceptable values for this field are listed in the D_Water_Typ table.
WTR_NM	Surface Water Feature Name. This is the formal name of the surface water feature, as it will appear on the hardcopy FIRM.

Layer: S_XS (Cross sections)

The S_XS attribute table contains information about cross section lines. These lines represent the locations of channel surveys performed for input into the hydraulic model used to calculate flood elevations. These locations are also shown on the Flood Profiles in the Flood Insurance Study (FIS) report and can be used to cross reference the Flood Profiles to the planimetric depiction of the flood hazards. All cross sections for which a spatial location is available should be included in this table.

The spatial elements representing cross sections are lines generally extending from outside the floodplain, across the entire floodplain and out the other side. Each cross section should be represented by a single line feature without the hexagons shown on each end on the hardcopy map. The location and shape of the lines should depict as accurately as possible the position of the cross section used.

The S_XS table contains the following elements:

XS_LN_ID	Primary key for table lookup. Assigned by table creator.
WTR_NM	Surface Water Feature Name. This is the name of the stream or water body.
STREAM_STN	Stream Station. This is the measurement along the profile baseline to the cross section location. This value is used in the FDTs and profiles.
START_ID	Station Start Identification. This is the foreign key to the S_Stn_Start layer. The station start describes the origin for the measurements in the STREAM_STN field. This value is used in the FDTs and profiles
XS_LTR	Cross Section Letter. This is the letter or number that is assigned to the cross section on the hardcopy FIRM and in the FIS report. This field is populated when the cross section is lettered.
XS_LN_TYP	Cross-Section Line Type. This attribute should contain 'LETTERED, MAPPED' for cross sections that are shown on the hardcopy FIRM and are given a letter. If the cross section will be shown on the FIRM but not lettered, the attribute should contain 'NOT LETTERED, MAPPED' to indicate that it is a cross section placed to meet the 1-foot vertical rise rule mentioned above. If the cross section will not be shown on the hardcopy FIRM, this attribute should contain 'NOT LETTERED, NOT MAPPED' to indicate that the cross section is part of the backup data for the flood risk project, but is not shown on the FIRM. All cross sections used in the development of effective hydraulic models shall be stored in this table, regardless of the flood hazard zone depicted on the effective panels. Acceptable values for this field are listed in the D_XS_LN_TYP table.

WSEL_REG	Modeled Water Surface Elevation for the 1-Percent-Annual-Chance Flood Event. This the modeled water-surface elevation for the 1-percent-annual-chance flood event in the stream channel at this cross section. In the case of levee(s) associated with a cross section, it is assumed that the levee(s) holds. This field is stored here and in L_XS_Elev to simplify annotation of the FIRM panel water-surface elevation at this cross section. This value and the corresponding value in L_XS_Elev must match.
STRMBED_EL	Streambed Elevation. This is the water-surface elevation for the thalweg or the lowest point in the main channel. This value is used in the profiles.
LEN_UNIT	Water-Surface and Streambed Elevation Units. This unit indicates the measurement system used for the water-surface and streambed elevations. Normally, this would be feet. Acceptable values for this field are listed in the D_Length_Units table.
MODEL_ID	Model Identifier. This field stores the feature's identifier that was used during hydrologic and hydraulic modeling. This field provides a link between the hydrologic or hydraulic modeling and this spatial file.

Table: L_XS_Elev

The L_XS_Elev table is required for hydraulic models that utilize cross sections and when the cross section is included in the Floodway Data Tables in the FIS report, or is shown on the FIRM, or is used for plotting the profile. This table contains information for those cross sections that will be included in the Floodway Data Table in the FIS report or are shown on the FIRM or are used for plotting the profile. Both lettered and non-lettered cross sections may be included in this table. This table includes cross-section information for all event types, and for levee and future conditions scenarios. For studies of high-risk stream reaches such as Zone AE areas, cross sections are required to be shown on the FIRM and flood profile at significant profile inflection points (breaks in the profiles) or as close to the inflection points as possible. The contractor responsible for the hydraulic analysis should select cross sections so that linear interpolation between two cross sections is minimally different than the base flood profile (no more than a 0.5 foot difference). In areas where the profile is flat, the contractor should choose at least two cross sections per FIRM panel. This table stores the hydraulic information, including water-surface elevations, velocity, and floodway width, associated with the cross section.

XS_ELEV_ID	Primary key for table lookup. Assigned by table creator.
XS_LN_ID	Foreign key to S_XS table. This field captures the cross section line identification number that corresponds to this record. This is used in order to link a cross section to multiple elevation records.
FW_WIDTH	Floodway Width. Width of the floodway at this cross section as shown in the Floodway Data table. This field is populated when a floodway is defined. This value is used in the FDTs.
NE_WIDTH_L	Non-Encroachment Zone Width, Left Side. This is the width of the non-encroachment zone at this cross section as shown in the Non -Encroachment Zone Data table. This field is populated when a non-encroachment zone is defined.
NE_WIDTH_R	Non-Encroachment Zone Width, Right Side. This is the width of the non-encroachment zone at this cross section as shown in the Non -Encroachment Zone Data table. This field is populated when a non-encroachment zone is defined.
WSEL_FLDWY	Base Flood Water-Surface Elevation With Floodway. This is the water-surface elevation of the base flood with the floodway calculated at this cross section. This number is determined during the engineering analysis for the flood risk project. This value should match the “with floodway” column in the Floodway Data table in the FIS report. This field is populated when a floodway is defined, usually only for the 1-percent-annual-chance flood event. This value is used in the FDTs.

XS_AREA	Cross Section Area. Area of the cross section underwater for the width of the floodway as shown in the Floodway Data table. This field is populated when a floodway is defined. This value is used in the FDTs.
VELOCITY	Mean Velocity. The mean velocity of the floodway at this cross section as shown in the Floodway Data table. This field is populated when a floodway is defined. This value is used in the FDTs.
EVENT_TYP	Flood Event. Identifies the annual percent chance of exceedance for a flooding event such as 0.2-, 1-, 2-, 4-, and 10-percent. Acceptable values for this field are listed in the D_Event table.
WSEL	Water-Surface Elevation. This is the water-surface elevation for the flood event specified in the EVENT field at the cross section. This value is used in the FDTs for the 1-percent-annual-chance and 1-percent-annual-chance future event types. This elevation exactly matches the elevation of the flood event in the Flood Profiles and the Floodway Data table in the FIS report. This value should include backwater but if it does not, the CALC_WO_BW field must be coded "T."
WSEL_WOFWY	Base Flood Water-Surface Elevation Without Floodway. This is the water-surface elevation of the base flood without the floodway calculated at this cross section. This number is determined during the engineering analysis for the flood risk project. This value should match the "without floodway" column in the Floodway Data table in the FIS report. This field is populated when a floodway is defined, usually only for the 1-percent-annual-chance event. This value is used in the FDTs.
WSEL_FLDWY	Base Flood Water-Surface Elevation With Floodway. This is the water-surface elevation of the base flood with the floodway calculated at this cross section. This number is determined during the engineering analysis for the flood risk project. This value should match the "with floodway" column in the Floodway Data table in the FIS report. This field is populated when a floodway is defined, usually only for the 1-percent-annual-chance flood event. This value is used in the FDTs.
WSEL_INCRS	Increase between Base Flood Water-Surface Elevation Without Floodway and With Floodway. This is difference between the calculated water-surface elevations for the 1-percent-annual-chance flood event with and without the floodway. This value may be calculated by subtracting the WSEL_WOFWY value from the WSEL_FLDWY value. If the Floodway Data table is published, this value should match the increase column in the Floodway Data table in the FIS report. This field is populated when a floodway is defined, usually only for the 1-percent-annual-chance flood event. This value is used in the FDTs.

Layer: S_BFE (Base Flood Elevation Lines)

The Base Flood Elevation (BFE) table is required for any digital data where BFE lines will be shown on the corresponding FIRM, with the exception of areas where a profile exists. New for this revision, for areas where a profile exists, the water-surface elevation (BFE value) will be labeled on the cross sections as stored in the FIRM Database S_XS feature class. The use of BFE lines is now only required in special cases. BFE lines must be placed in the S_BFE feature class for any area where cross section maximum vertical rise requirement is not met. As mentioned in the description for S_XS, if there is not at least one mapped cross section in S_XS for every 1-foot vertical rise in the 1-percent-annual-chance flood elevation, intervening BFE lines must be placed at whole-foot intervals. Other examples include; a riverine AE zone without a flood profile in the FIS report, areas studied with two-dimensional modeling, certain ponding areas, and backwater areas off to the side of streams with flood profiles. Any exceptions to these guidelines should be documented in the metadata.

There are cases when S_BFE may be required in the FIRM Database, even if it is not required by the data submittal requirements in Appendix M of FEMA's *Guidelines*. BFE line data can be added to the FIRM Database to meet the 1-foot vertical rise requirement. Table 1 provides an overview of S_BFE requirements at different mapping stages.

Table 1. S_BFE Requirements

Study Scenarios	S_BFE Required by Appendix M?	S_BFE Required in FIRM Database?	BFE Lines Shown on FIRM?
Profiles available for all studied streams and 1-ft vertical rise requirement met for all cross sections	No	No	No
Profiles available for all studied streams and 1-ft vertical rise requirement not met for all cross sections	No	Yes	Yes
Profiles available for some studied streams	Yes	Yes	Yes
Study has two dimensional modeling	Yes	Yes	Yes
Study contains ponding areas or backwater areas	Yes	Yes	Yes

The S_BFE table contains the following elements:

BFE_LN_ID	Primary key for table lookup. Assigned by table creator.
ELEV	The rounded, whole-foot elevation of the 1-percent-annual-chance flood. This is the value of the BFE that is printed next to the BFE line on the FIRM.
LEN_UNIT	BFE Units. This unit indicates the measurement system used for the BFEs. Normally this would be feet. Acceptable values for this field are listed in the D_Length_Units table.

Table: L_Stn_Start

This table is used to populate the Floodway Data Tables and Flood Profiles, as well as the Flood Hazard and Non-Encroachment Data for Selected Streams table in the FIS report.

The S_Stn_Start table contains information about station starting locations. These locations indicate the reference point that was used as the origin for distance measurements along streams and rivers. The location of the stationing start for a group of cross sections is normally referenced as a note on the Floodway Data Table and on the Flood Profiles. Generally, all of the cross sections for a particular reach are referenced to the same starting point. If multiple reaches are measured from the same point, they may share the same record in S_Stn_Start.

The L_Stn_Start table contains the following elements:

START_ID	Primary key for table lookup. Assigned by table creator. This field is the link that is used to reference station start descriptions in the FDTs and profiles, the appropriate stationing starting point.
START_DESC	Start Description. The description of the location of the station starting point. This should include the measurement units. For example, "Distances are measured in feet upstream from the confluence with the Main Channel of the Big River."
LOC_ACC	Start Station Locational Accuracy. The spatial placement accuracy level of the Station Start point. For all new models with profile baselines, the exact location of the profile baseline station start should be placed and the locational accuracy be categorized as "HIGH." For old models where the profile baseline and station start are documented on work maps, the locational accuracy is "MEDIUM." For areas that only have a text description, the point shall be placed as best possible, and the locational accuracy will be attributed as "LOW." The acceptable values for this field can be found in the D_Loc_Accuracy table.

Appendix A

The following tables were taken from the Domain Tables Guide, a supplemental document containing allowable domain values referenced in the Appendix L [2011] of the *Guidelines and Standards for Flood Hazard Mapping Partners*.

1. Table D_Event

Add Description of Values
50 PERCENT CHANCE
10 PERCENT CHANCE
4 PERCENT CHANCE
2 PERCENT CHANCE
1 PERCENT CHANCE
0.2 PERCENT CHANCE
1 PERCENT CHANCE FUTURE

2. Table D_Length_Units

Type of Length Unit
CENTIMETERS
FEET
INCHES
KILOMETERS
METERS
MILES
MILLIMETERS

3. Table D_Ln_Typ

Type of Line
SFHA / FLOOD ZONE BOUNDARY
LIMIT OF DETAILED STUDY / LIMIT OF STUDY
OTHER BOUNDARY

SFHA / FLOOD ZONE BOUNDARY category includes any line that forms the boundary of a floodplain zone or floodway, not including Limit of Detailed Study / Limit of Study lines.

LIMIT OF DETAILED STUDY / LIMIT OF STUDY category includes lines that form the limit of a detailed study, but not the edge of a floodplain.

OTHER BOUNDARY category includes any line types that do not form the edge of a floodplain, floodway, limit of detailed study or limit of study. These other boundaries do not get shown on the map. Examples include the end of spatial extent, apparent limit, and source boundary.

4. Table D_Loc_Accuracy

Locational Accuracy
HIGH
MEDIUM
LOW

HIGH locational accuracy includes any station start point that can be placed with a high degree of spatial accuracy, and usually applies to all new models.

MEDIUM locational accuracy includes any station start point that can be obtained from old work maps with profile baselines or other source data which can be georeferenced to the new FIRM base map with a reasonable level of accuracy. This category usually applies to old models with good quality back-up data available at the FEMA Engineering Library.

LOW locational accuracy includes any station start point that cannot be placed accurately and for which only a text description exists, such as a note on the FDT or profile in the effective FIS. This category applies to old models with no or poor quality back-up data at the FEMA Engineering Library.

5. Table D_Study_Typ

Type of Study	Description
SFHAs WITH LOW FLOOD RISK	Such as A zones without published water surface elevations
SFHAs WITH MEDIUM FLOOD RISK	Such as A zones with water surface elevations published only in FIS Report
SFHAs WITH HIGH FLOOD RISK	Such as AE zones with regulatory water surface elevations and/or a regulatory floodway
REDELINEATION	Existing studies remapped on new topographic data
DIGITAL CONVERSION	Existing studies digitized from existing scanned panels

6. Table D_TrueFalse

True, False, Unknown
T
F
U

7. Table D_Water_Typ

Type of Water Feature
AREA OF COMPLEX CHANNELS / OVERFLOWS
STREAM CENTERLINE
OPEN WATER AREA
WETLANDS
MANMADE WATER FEATURE
GLACIAL FEATURE
COASTLINE / ISLAND SHORELINE
INTERMITTENT RIVER / STREAM / WASH
HYDRAULIC LINK
PROFILE BASELINE
PROFILE BASELINE AND STREAM CENTERLINE

8. Table D_XS_Ln_Typ

Type of Cross Section
LETTERED
NOT LETTERED, NOT MAPPED
NOT LETTERED, MAPPED

9. Table D_Zone

Type of Flood Zone
A
AE
AH
AO
1 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN CHANNEL
A99
V

VE
0.2 PCT ANNUAL CHANCE FLOOD HAZARD
0.2 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN CHANNEL
AREA NOT INCLUDED
D
X
X AREA OF SPECIAL CONSIDERATION
OPEN WATER

10. Table D_Zone_Subtype

Sub-Types of Flood Zones
0.2 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE
1 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE
1 PCT DEPTH LESS THAN 1 FOOT
1 PCT DRAINAGE AREA LESS THAN 1 SQUARE MILE
1 PCT FUTURE CONDITIONS
1 PCT FUTURE CONDITIONS CONTAINED IN STRUCTURE
ADMINISTRATIVE FLOODWAY
AREA OF SPECIAL CONSIDERATION
AREAS DETERMINED TO BE OUTSIDE THE 0.2 PCT ANNUAL CHANCE FLOODPLAIN
COASTAL
COLORADO RIVER FLOODWAY
COMMUNITY ENCROACHMENT AREA
DENSITY FRINGE AREA
FLOODWAY
FLOODWAY CONTAINED IN STRUCTURE
FLOWAGE EASEMENT AREA
NARROW FLOODWAY
PROTECTED BY LEVEE
RIVERINE
RIVERINE FLOODWAY SHOWN IN COASTAL ZONE
STATE ENCROACHMENT AREA