Guidance for Flood Risk Analysis and Mapping

Flood Insurance Rate Map (FIRM) Database

November 2022

FEMA

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Requirements for the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) Program are specified separately by statute, regulation, or FEMA policy (primarily the Standards for Flood Risk Analysis and Mapping). This document provides guidance to support the requirements and recommends approaches for effective and efficient implementation. Alternate approaches that comply with all requirements are acceptable.

For more information, please visit the FEMA Guidelines and Standards for Flood Risk Analysis and Mapping webpage (www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping). Copies of the Standards for Flood Risk Analysis and Mapping policy, related guidance, technical references, and other information about the guidelines and standards development process are all available here. You can also search directly by document title at https://www.fema.gov/library.

Table of Revisions

The following summary of changes details revisions to this document subsequent to its most recent version in December 2020.

Affected Section or Subsection	***Date***	***Description***
7.2, 7.3.2, 10.0, 12.7.1, 12.8, 12.12, 12.15, and 12.39	November 2022	Added information about the latest NFHL conversion. Included clarification about profile baselines that should fall within political boundary. Removed incorrect statement about zone subtype not being used for insurance rating purposes. Added information about flowage easement lines. Included LiMWA clarification. Political jurisdiction clarification included. Included clarification on floodway data table information to be included for lettered cross-sections.

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1. Automated Map Production (AMP)

To support greater automation within the Risk MAP Program, FEMA is developing a tool within the Mapping Information Platform (MIP) called Automated Map Production (AMP). AMP will automate FIRM panel creation, replacing previous practices of manual cartography. The goal of AMP is to eliminate the need for manual edits or adjustments to labels on the FIRM panels and FIRM index.

AMP will read the data in a submitted FIRM database and use a series of cartographic algorithms, with established rules of hierarchy, to autogenerate FIRM panels and indexes that comply with FEMA requirements through all study stages (e.g., draft, preliminary, and final). However, AMP will not change the engineering analysis or alter the FIRM database (i.e., geodatabase; shapefiles). AMP will not fix errors in the submitted FIRM database (e.g., topology). It will continue to be the responsibility of the FIRM database producer to perform quality assurance / quality control (QA/QC) to make sure the submitted data meets all Risk MAP standards. Producers will also be expected to visually review the auto generated AMP panels to determine if they meet expectations or require changes. If updates are needed, the producer will edit the FIRM database and then resubmit to the MIP as usual to begin the process over, to include required DVT submittals.

As AMP is introduced into the Risk MAP study lifecycle, producers need to understand how it will impact the information in this document. While the mission of AMP is to replicate the FIRM panel and FIRM index requirements as known today, there will be changes to the output panels that do not directly align with the guidance and direction in this and other Risk MAP documents. AMP panels will have slight variations from what producers and users have seen since the beginning of Risk MAP. FEMA will develop a best practice document to summarize these changes. Because AMP will be enhanced through future agile development cycles, changes will likely occur more frequently than the annual Guidelines and Standards (G&S) cycle. Therefore, the best practice model will be the most efficient way to provide up-to-date information on changes. Future edits to this document will be made to align the information between this and the AMP best practice document.

2. FIRM Database Overview

This document contains guidance for the development and submission of Flood Insurance Rate Map (FIRM) Databases. A full description of the standards and schema for the content of the FIRM Database can be found in the FIRM Database Technical Reference.

The following documents are also referenced in this guidance document:

- FIRM Database Verification Tool (DVT) – Topology Verification Guidelines
- FIRM Panel Technical Reference
- Flood Insurance Study (FIS) Report Technical Reference
- Domain Tables Technical Reference

- Metadata Profiles Technical Reference
- Vertical Datum Conversion Guidance
- FIS Report Guidance
- Metadata Guidance
- Physical Map Revision (PMR) Guidance
- Contiguous Community Matching Guidance

3. FIRM Database Data Resources

The assigned Mapping Partner should identify and use existing digital data whenever possible, while still meeting the required standards and quality of work. Initial research should be performed, typically during the Discovery process, to identify sources of applicable digital data so as to avoid the duplication of effort during a flood risk project. The assigned Mapping Partner should verify that any existing digital data chosen for use in a Flood Risk Project meets or exceeds FEMA's base map and Flood Insurance Study (FIS) report information standards.

The position of horizontal control features of the FIRM products should be based on published standards. The assigned Mapping Partner should not re-digitize these control features but should use the exact coordinates in the published standards. Horizontal control features relevant to the FIRM panels and FIRM Database include the U.S. Geological Survey 7.5-minute series quadrangle map corner coordinates shown at the corners of each FIRM panel and used as the basis for the FIRM panel grid in S_FIRM_Pan, Universal Transverse Mercator (UTM) and State Plane coordinate grids shown on the FIRM panels, and U.S. Public Land Survey System (PLSS) data shown on the FIRM panels and included in S_PLSS_Ar (in areas of the United States (US) where they apply).

In general, the most accurate data source should be relied upon to reference other features compiled onto the FIRM panel. If this policy creates significant visual problems with the floodplain boundary delineations on the base map selected, the Mapping Partner should resolve the issue with the FEMA Project Officer.

Any new digitizing performed as the Flood Risk Project is developed should be done carefully and in conformance with FEMA's accuracy standards. Digitized line work should be collected at a reasonably fine line weight, only simple line strings or simple linear elements should be used for all line work, and line features should be continuous (with no dashes, dots, patterns, or hatching).

4. FIRM Database Structure

All the FIRM Database spatial and non-spatial tables that are described in the FIRM Database Technical Reference are required to be populated and submitted if they apply to the FIRM or FIS

Report being created. Spatial and non-spatial tables for which no data are available do not need to be created or submitted. For example, if the Flood Risk Project is not in a coastal area, tables with coastal content such as S_Cst_Gage, S_Cst_Tsct_Ln, S_LiMWA, S_PFD_Ln, S_Tsct_Basln, L_Cst_Model, and L_Cst_Struct would not be applicable and would not need to be populated or submitted for that Flood Risk Project. Similarly, if a Flood Risk Project area did not include any levee systems, the S_Levee table would not be applicable and would not need to be populated or submitted for that Flood Risk Project.

If the FIS Report that accompanies the FIRM Database is not updated to the newer FIS format (e.g., the newer format outlined in the 2013 or newer FIS Report Technical Reference), certain FIRM Database tables that are designed to support the FIS Report may not need to be populated or submitted. However, if the table supports submitted hydrologic, hydraulic, or coastal modeling that is included in the Flood Risk Project, then the tables do need to be populated. Several examples are provided below.

- If the Flood Risk Project includes newly studied streams with new hydrology and hydrologic modeling but an old-format FIS Report, then the FIRM Database tables, such as L_ManningsN, L_Summary_Discharges and L_Summary_Elevations, should be populated for the newly studied streams, because these tables support the hydrologic and hydraulic analyses as well as the FIS Report.

- If the Flood Risk Project is for redelineation only and an old-format FIS, then L_ManningsN, L_Summary_Discharges and L_Summary_Elevations would not be required to be back-populated with historic data. The same holds true for non-restudied streams within a PMR footprint—these tables would only be required to be filled out for the restudied streams if the FIS Report is in the old format.

- While L_XS_Elev is required for all FIRM Databases that include cross sections, only the 1% annual-chance water surface elevation values are required for Letters of Map Revision (LOMRs) and non-restudied streams within a PMR footprint.

- Note that L_Profil_Bkwtr_El, L_Profil_Label, L_Profil_Panel, L_XS_Struct are only required if RASPLOT v.3 or higher was used to generate the FIS profiles.

Refer to Table 2 in the FIRM Database Technical Reference for more information about which tables support components of the FIS and to which Data Capture tasks each table applies.

Refer to the PMR Guidance document for additional information about populating FIRM Database tables and fields for a PMR.

FIRM Databases created and submitted by Mapping Partners at the Floodplain Mapping, Draft FIRM Database, Produce Preliminary Products, and Develop Final Mapping Products Data Capture tasks should be consistent in file structure and content.

Domain values, documented in the Domain Tables Technical Reference, are provided for certain fields contained within the FIRM Database and/or the Flood Risk Database (FRD). If additional domain values are needed for use in a Flood Risk Project, approval must be obtained from the FEMA Regulatory Products Team and documented before submitting a FIRM Database that references a non-standard domain value. The non-standard domain value should also be documented in the metadata file that accompanies the FIRM Database and/or the FRD.

5. FIRM Database File Formats

The FIRM Database Technical Reference makes a distinction between production FIRM Databases and FIRM Database Submittals, noting that FIRM Database submittals are delivered in Environmental Systems Research Institute (Esri) Shapefile (SHP), and production FIRM Databases are geodatabases. Field definitions are provided in the FIRM Database Technical Reference for both SHP and geodatabase formats. Topology rules are defined for use in geodatabases since SHP files do not support topology rules.

It is envisioned that Mapping Partners will prepare their FIRM Databases and generate their FIRM panels and FIS Reports from these “production” or “working” FIRM Databases that use one of the available geodatabase formats (e.g., file Geodatabase, personal geodatabase, Spatial Database Engine (SDE) geodatabase). A FIRM Database schema Extensible Markup Language (XML) that conforms to the FIRM Database Technical Reference and the Domain Tables Technical Reference is provided by FEMA as a template with this production environment in mind. The FIRM Database schema XML template can be found at the FEMA Library.

This geodatabase schema takes advantage of coded domains that limit the values, which can be entered into certain fields in the FIRM Database, thereby enabling a certain amount of quality assurance during data entry. The geodatabase schema also includes relationship classes that are established to define the relationships between tables within the FIRM Database. This again provides a means for Mapping Partners to implement quality assurance during their data preparation.

The FIRM Databases that are submitted to the Mapping Information Platform (MIP) are submitted in SHP file format. The submitted SHP files do not use coded domain values, but rather use the domain description as the value in the applicable FIRM Database field. These domain description values need to be exported into the SHP files before the FIRM Database is submitted to the MIP. The SHP files also do not contain topology rules, so any topology checks that are applied to the submitted FIRM Database will need to be run before the SHP files are exported from the geodatabase, or else the SHP files will need to be imported into a geodatabase so that topology rules can be run. The topology rules that are documented in the FIRM Database Technical Reference will be applied to the submitted FIRM Database SHP files as the FIRM Database Verification Tool (DVT) checks are run, and the study will not pass DVT until its topology is correct. Additional information on DVT can be found in the DVT Guidance document.

6. FIRM Database Deliverables by MIP Data Capture Task

The FIRM Database structure was established to include all the main spatial and non-spatial entities that would be needed for the entire Flood Risk Project life cycle from Base Map Data Capture through Hydrology and Hydraulics Data Capture, to Develop Final Mapping Products Data Capture. Table 2, FIRM Database Submittal Table, in the FIRM Database Technical Reference provides a summary of which spatial and non-spatial tables are applicable to each of these Data Capture tasks.

The FIRM Database is designed to be incrementally built and expanded as the Flood Risk Project progresses. To that end, the S_Submittal_Info table is intended to keep track of which data were developed and submitted at different points along the Data Capture workflow. More information about how Flood Risk Project data should be entered and tracked within the S_Submittal_Info table can be found in section 11.2.

7. Spatial Reference

This section provides information about the spatial reference of the FIRM Database, including precision, cluster tolerance and spatial resolution, projections and datums, and topology. Additional information on these topics can be found in the FIRM Database Technical Reference and the Projections and Coordinate Systems Guidance document. Technical information on these topics is also available from other sources, such as Esri's ArcGIS Help and various on-line Geographic Information System (GIS) knowledge-sharing communities.

7.1. Precision

Precision is often understood to mean the number of significant digits used to store numbers, particularly coordinate values. Precision is important for accurate feature representation, analysis, and mapping. Datasets can be stored in either single or double (high) precision.

Double-precision geometries store up to 15 significant digits per coordinate (typically 13 to 14 significant digits), retaining the accuracy of much less than 1 meter at a global extent. Single-precision numbers can only store up to seven significant digits for each coordinate, retaining a precision of plus or minus 5 meters in an extent of 1,000,000 meters.

Because the FIRM Databases are submitted to the MIP and stored in the National Flood Hazard Layer (NFHL) in the Geographic Coordinate System (GCS) with coordinates stored in decimal degrees, it is important that the FIRM Databases be developed in an environment that can retain the required number of decimal places to accurately represent the spatial geometry of the features.

Precision is also applicable to the elevation values that are stored in the FIRM Database. Typically, all regulatory water surface elevations should be stored in the FIRM Database with values to the tenth of a foot (i.e., one decimal place) as shown in the FIS Report tables and as

shown at the cross section lines on the FIRM panels. The FIRM Database is capable of storing additional decimal places, but regulatory water surface elevation values should be rounded to the tenth of a foot.

7.2. Cluster Tolerance and Spatial Resolution

In ArcGIS, XY tolerance is the minimum distance allowed between XY coordinates before they are considered equal. It is used during clustering operations such as topology validation, buffer generation, polygon overlay, and some editing operations. Vertices that fall within the cluster tolerance are snapped together during topology validation. The cluster tolerance of a topology rule defaults to the XY tolerance of the feature dataset in which the topology is created. You can specify a cluster tolerance for a topology rule that is larger than the XY tolerance, but not one that is smaller. Note that the XY tolerance of any feature class or feature dataset cannot be changed after it has been created. M and Z values also have tolerance and resolution properties. If not otherwise specified, the default M tolerance is 0.001 units, and the default Z tolerance is the equivalent of 1mm in the linear units of the vertical coordinate system used by the data. Areas outside of Puerto Rico should use a Z tolerance of 0.1 feet.

The spatial resolution of a dataset is the smallest allowable separation, in map units, between unique X-values and unique Y-values in a feature class. This can include X, Y, Z, and M values. For example, if the XY resolution is set to 0.01, then X-coordinates 1.22 and 1.23 can be stored as separate coordinate values, but X-coordinates 1.222 and 1.223 would both be stored as 1.22, because the change in value is less than the XY resolution.

The cluster tolerance and spatial resolution documented in the FIRM Database Technical Reference were established based on conversion to decimal degrees at the approximate center of the U.S. (Meade's Ranch, Kansas). This specified cluster tolerance and spatial resolution applies to any "production" or "working" geodatabases as well as the FIRM Database SHP files that are submitted to the MIP. Table 1 shows the FIRM Database cluster tolerance equivalents in feet, meters, and decimal degrees.

Table 1: FIRM Database Cluster Tolerance Equivalents

Units	Cluster Tolerance	Spatial Resolution
Feet	0.25	0.025
Meters	0.0762	0.00762
Decimal Degrees	0.000000784415	0.0000000784415

Because one degree of longitude or latitude can vary in distance as measurements are taken nearer or farther from the equator, a sensitivity analysis was conducted on the conversion of a 25-foot

square from feet to decimal degrees in Kansas and the geographic extremes of the U.S. in Alaska, Hawaii, and Maine. When converted back to feet, the values shown in Table 2 were obtained.

Table 2: FIRM Database Cluster Tolerance Conversion

	Cluster Tolerance (ft)		XY Resolution (ft)	
	X (Longitude)	Y (Latitude)	X (Longitude)	Y (Latitude)
Kansas	0.25	0.25	0.025	0.025
Alaska	0.1773	0.2863	0.01773	0.02863
Hawaii	0.2660	0.2850	0.02660	0.02850
Maine	0.1983	0.2860	0.01983	0.02860

When applied to spatial resolution, this indicates that the distance between two vertices on FIRM Database features could range from 0.01773' to 0.02863' instead of 0.025', depending on where the feature is located. This was deemed to be consistent with the range of expected engineering accuracy of those features and to not diminish the usability of the FIRM Database data. Stakeholders would most likely project the data stored in the FIRM Database to a local coordinate system for convenience in making measurements, overlaying with existing datasets, etc. The accuracy of the underlying data would be preserved.

It should be noted that the previous version of the NFHL data did not conform to the cluster tolerance and spatial resolution documented in the FIRM Database Technical Reference due to the legacy data that currently remain in the NFHL. Older data may have been created using different cluster tolerances and spatial resolution. Additionally, older data that were projected to GCS and stitched into the NFHL may have lost vertices during that process. Any topology errors created from the differences in the cluster tolerance and spatial resolution should be corrected to pass DVT.

7.3. Projection and Datum

This section provides information about projection and datum (horizontal and vertical) as they apply to the FIRM Database.

7.3.1. PROJECTION

Even though the FIRM Database will ultimately be delivered to the MIP and incorporated into the NFHL in geographic coordinates, the initial data development, including much of the engineering work (i.e., the hydrologic and hydraulic modeling) will be performed using a local projection (e.g., UTM or State Plane). The FIRM panels should also be prepared using a local projection. The projection used for preparation of the FIRM panels is shown on the FIRM panels as the primary

horizontal reference grid and is recorded on the map collar and in the Study_Info PROJECTION field. The coordinate system used in the submitted FIRM Database (i.e., GCS) should be recorded in the accompanying metadata file.

It is up to the discretion of the Mapping Partner as to when the conversion from local projection to GCS takes place in their individual workflow process. However, topology verification will need to be performed on the FIRM Database data in GCS before the data are submitted to the MIP in order for the data to pass the DVT topology checks. Simply projecting and exporting the data from a geodatabase to SHP files will not maintain the required FIRM Database topology.

See section 6.4 below for additional information about FIRM Database topology. See also the DVT Guidance document for additional information on ways to correct topology errors that may be identified during DVT checks.

In addition to maintenance of FIRM Database topology, it is important to remember that a simple projection is not always sufficient to perform the necessary coordinate conversion between local projections or from a local projection to GCS. There are multiple mathematical calculations that can be used to define how the coordinates will be converted to GCS. The geographic transformation defines the mathematical calculation that will be used for this process. A geographic transformation is always required when the conversion involves a datum conversion such as from High Accuracy Reference Network (HARN) State Plane to GCS or from North American Datum (NAD) 1983 to NAD 1983 (National Spatial Reference System [NSRS] 2007).

If a given county or jurisdiction falls within more than one projection and coordinate system zone, the Mapping Partner should ensure that all FIRM panels should be referenced to the single zone that contains the largest portion of the jurisdiction. The Mapping Partner should not use multiple UTM or State Plane zones within a single jurisdiction for FIRM panel production.

7.3.2. VERTICAL DATUM

Except for some possible exceptions outside of the contiguous United States (CONUS), all vertical coordinates stored in the FIRM Database must be referenced to the North American Vertical Datum of 1988 (NAVD88) in U.S. survey feet. Outside of the CONUS, there are some limitations to NAVD88, and research into the local datum and available geodetic control may be needed in order to make project specific decisions about what datum to publish the maps in and how to complete any necessary conversions between datums. As noted in the FIRM Database Technical Reference, the use of other datums or vertical units (e.g., the use of meters in areas such as Puerto Rico where Base Flood Elevations [BFEs] are expressed in meters) requires approval of the FEMA Project Officer.

Refer to the Vertical Datum Conversion Guidance document for more information about how to convert between vertical datums, including available software for performing conversions, information about the applicability and use of a countywide conversion factor versus stream-based conversion, and considerations for vertical datum conversion in coastal areas where static BFEs are used.

7.4. Topology

7.4.1. PRESERVING TOPOLOGY WHEN PROJECTING FROM UTM OR STATE PLANE TO GCS

As noted above, topology errors may be introduced during the projection and transformation of data from State Plane or UTM to GCS. Even data that are topologically clean before projection may have topology errors after this process. This may be due to the fact that one degree of longitude or latitude can vary in distance depending on how close to the equator the measurement is taken. Thus, the conversion from feet or meters to decimal degrees may introduce new topology errors. Therefore, topology should always be run on data that are in GCS before being submitted for DVT checks.

The most common topology problem identified is self-intersecting polygons. These may require an iterative process to correct. Sometimes, very large Zone X polygons will need to be split into smaller polygons to isolate the problem(s). In some cases, the problem may require a fix to the FIRM Database geodatabase as well as the SHP file(s), although this is not a desirable workflow as it requires double work.

Refer to the DVT Guidance document for additional information on ways to correct topology errors that may be identified during DVT checks.

7.4.2. COINCIDENT FEATURES

Several layers in the FIRM Database have a spatial relationship to one or more other layers. The primary example of this spatial relationship is the S_Fld_Haz_Ar and S_Fld_Haz_Ln layers, which must be identical. All elements within the S_Fld_Haz_Ln layer must match the boundaries of the elements in the S_Fld_Haz_Ar layer within the specified database tolerance. This spatial relationship is checked by DVT.

Other FIRM Database layers that should have a spatial relationship include the following:

- S_Alluvial_Fan polygons should correspond with ZONE AO areas in S_Fld_Haz_Ar.
- S_BFE lines should fully cross but not extend beyond Special Flood Hazard Areas (SFHAs). This spatial relationship is checked by DVT at a tolerance of 25 feet.
- S_Cst_Tsct_Ln should intersect S_Tsct_Basln indicating that the coastal transects begin at the 0.0’ contour line. This spatial relationship is checked by DVT.
- S_Cst_Tsct_Ln XCOORD and YCOORD points should fall on S_Tsct_Basln.
- S_Datum_Conv_Pt points should fall on United States Geological Survey (USGS) quadrangle corners if WTR_NM = “COUNTYWIDE/COMMUNITY-BASED” indicating that the points represent quadrangle corners.
- S_FIRM_Pan should encompass all features within the following layers (if submitted): S_Alluvial_Fan, S_BFE, S_Cst_Gage, S_Cst_Tsct_Ln, S_Fld_Haz_Ar, S_Fld_Haz_Ln,

S_Gen_Struct, S_Levee, S_LiMWA, S_PFD_Ln, S_PLSS, S_Pol_Ar, S_Trnsport_Ln, S_Wtr_Ar, S_Wtr_Ln, and S_XS. This spatial relationship is checked by DVT.

- S_Fld_Haz_Ar areas and S_Fld_Haz_Ln lines must be covered by S_Pol_Ar polygons indicating that the flood hazard features fall within the subject county or jurisdiction. This spatial relationship is checked by DVT. Exceptions to this rule may occur if countywide political boundary updates are provided and submitted, but updates to the flood hazard features apply to a smaller area (e.g., a PMR). A manual bypass for the DVT check may be required when this occurs.

- S_Nodes should fall on S_Profil_Basln or S_Hydro_Reach lines. Exceptions may occur.

- S_Pol_Ar should encompass all features within the following layers (if submitted): S_Alluvial_Fan, S_BFE, S_Cst_Tsct_Ln, S_Fld_Haz_Ar, S_Fld_Haz_Ln, S_Gen_Struct, S_Levee, S_LiMWA, S_PFD_Ln, S_PLSS_Ar, S_Profil_Basln (if SHOWN_FIRM is True), S_Riv_Mrk, S_Trnsport_Ln, S_Tsct_Basln, S_Wtr_Ar, S_Wtr_Ln, and S_XS.

- S_Stn_Start points must fall on S_Profil_Basln lines if S_Stn_Start LOC_ACC = “HIGH” indicating that the location accuracy of the station start points is considered to be high. This spatial relationship is checked by DVT.

See the FIRM Database Verification Tool (DVT) – Topology Verification Guidelines for a more detailed description of the DVT topology checks.

Note that there are several FIRM Database layers that may include features that fall outside the S_Pol_Ar and/or S_FIRM_Pan layers for the Flood Risk Project area. These include features such as datum conversion points, gages, nodes, high water marks, hydro reaches, station start locations, and subbasins. If this occurs, the study metadata bounding coordinates may need to be enlarged to encompass the largest extent in the database. Figure 1 shows an example of subbasins, nodes, gages, hydro reaches, and S_Submittal_Info features extending beyond the S_Pol_Ar and S_FIRM_Pan layers.

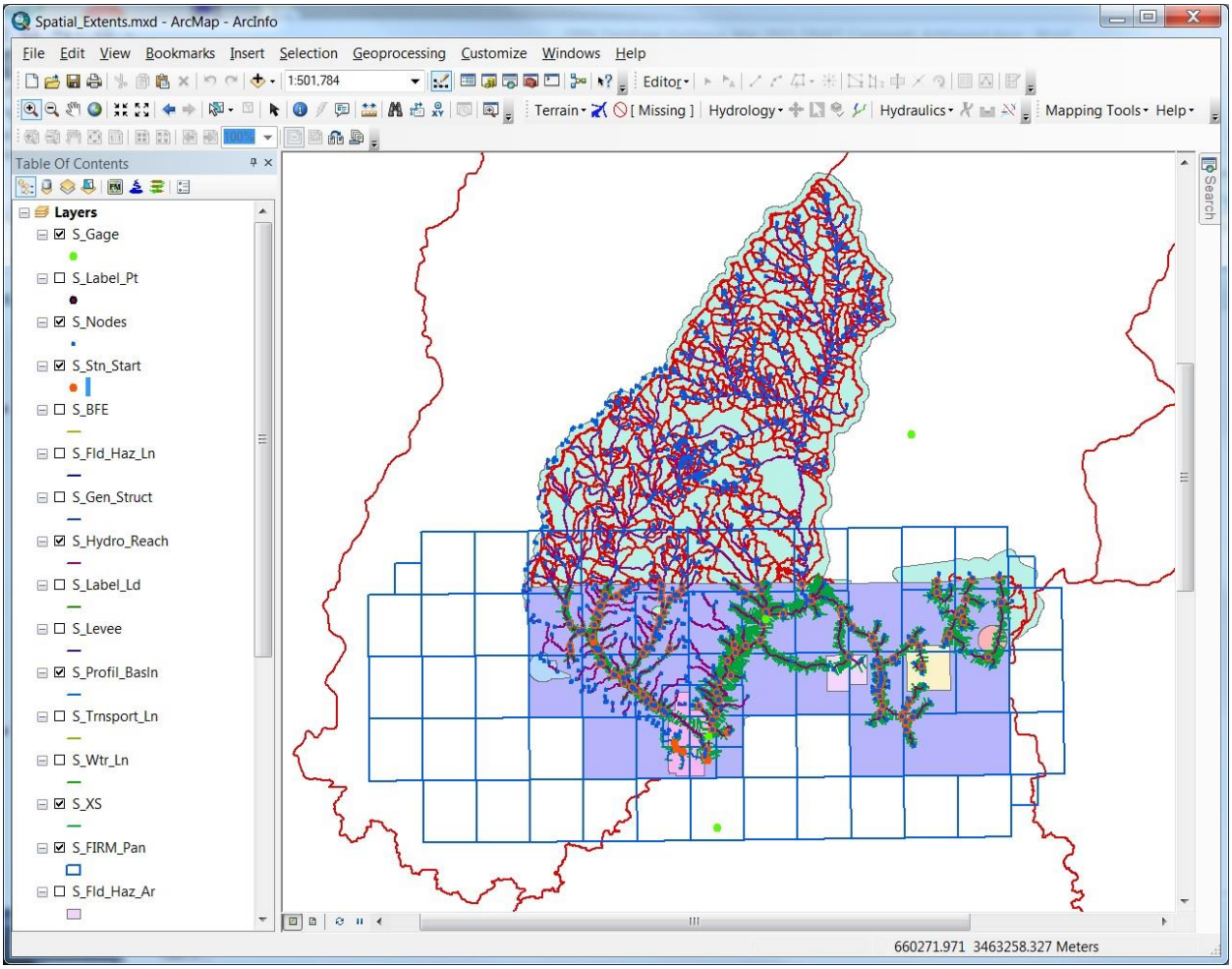

Figure 1: FIRM Database Spatial Extents

7.4.3. SHP FILE APPLICABILITY

Submitted FIRM Database SHP files must comply with the same topology rules that are listed in the FIRM Database Technical Reference. The submitted FIRM Database SHP files will be evaluated for conformance with these topology rules through the use of the DVT tool.

7.4.4. MINIMUM AREA REQUIREMENTS

To the extent possible, Mapping Partners should limit the use of very small polygon features. Despite the desire to maintain data at the highest possible accuracy and recognizing that newly collected terrain data may allow the delineation of flood hazard areas that are extremely small, the usefulness of very small flood hazard areas in the context of flood insurance and flood hazard mitigation is questionable.

DVT returns a warning for any polygons that are smaller than 40 square units in size when run on FIRM Databases that are submitted in State Plane or UTM (i.e., 2003 or 2011 schema FIRM

Databases). Because 40 square feet or meters converts to 0.0 in GCS, this check is not performed on data submitted in the 2013 or later FIRM Database schema.

8. Metadata and Sources

Each of the spatial layers in the FIRM Database includes the field SOURCE_CIT. SOURCE_CIT is the foreign key to the L_Source_Cit table and provides the ability to document data sources at the feature level. The L_Source_Cit table is used to document the sources of the data contained in each spatial layer. This information can then be used to populate the Lineage sections of the required FEMA Metadata Profiles.

As noted in the FIRM Database Technical Reference, each source citation abbreviation referenced in the FIRM Database is numbered to create a unique data source (e.g., BASE1, BASE2, and BASE3). Each unique SOURCE_CIT value must be documented with a source description in the corresponding metadata files.

For a first time countywide FIRM Database, numbering the unique SOURCE_CIT values should be quite straightforward. Each source type can be numbered sequentially.

For PMRs or LOMRs in areas where digital data already exist, numbering the SOURCE_CIT values so as to keep track of new and revised data is somewhat more complicated.

New source citations should start with the next available number. For example, a FIRM Database with STUDY1 as the highest numbered Flood Risk Project record would get a new record coded “STUDY2”. Unmodified areas would remain coded as STUDY1. The boundary between areas coded as STUDY1 and STUDY2 should be coded in S_Fld_Haz_Ln with the line type “OTHER BOUNDARY” from the D_Ln_Typ table.

If flood hazard information is updated from multiple studies or flooding sources simultaneously, each study should be assigned a unique source citation. When a combined rate of occurrence analysis is performed in conjunction with a coastal or riverine study, a distinct source citation should be used for the spatial features related to the combined coastal and riverine flooding. For example, a FIRM Database with STUDY1 as the highest numbered flood risk project record would get a new record coded “STUDY2” for the coastal floodplain and “STUDY3” for the combined coastal and riverine flooding floodplain.

In some cases, new SOURCE_CITs and associated source documentation will be needed for entire new datasets (e.g., new countywide orthoimages or road centerlines). In other cases, new documented sources will need to be added that generally follow the S_Submittal_Info polygons. In either case, the new source citations should build upon the previously provided source documentation. Several additional examples are provided for clarification:

As new base data sources are provided (e.g., updates to orthoimagery, road centerlines, or political boundaries), new BASE# SOURCE_CITs should be added. Each new SOURCE_CIT value should

increment up by one, starting with the highest existing number already used. For example, if BASE8 is the highest existing BASE# value used in a given county for the initial countywide mapping, then BASE9 might be used for new countywide road centerlines and BASE10 for new countywide political boundaries provided for the restudy.

As new restudy data sources are added due to LOMRs or PMRs, new LOMC# or STUDY# source citations should be added. All features that are revised due to the LOMR or restudy should reflect the new SOURCE_CIT value. Unrevised areas should reflect the original source citation. For example, if a LOMR revises BFEs, cross sections, flood hazard boundaries, flood hazard areas, and adds one new road centerline, each of those affected features should get the same LOMC# SOURCE_CIT value that references the LOMR case number and effective date in L_Source_Cit. Similarly, all features associated with a restudy should have new source citation abbreviations that increment up from any that were previously used in the county.

As noted in Table 2 of the FIRM Database Technical Reference, if a LOMR removes all 1% and 0.2% annual-chance flood hazard areas, an incremented SOURCE_CIT should be added to a polygon in S_Fld_Haz_Ar that is bounded by the LOMR area of revision outline.

Information on documenting SOURCE_CIT values in the Lineage section of the FIRM Database metadata can be found in the Metadata Profiles Technical Reference.

9. Edgematching

Edgematching is the process of ensuring agreement between features contained with the same and/or adjacent FIRM Databases. It is critically important that flood hazard features are seamless, so that the flood hazard information provided to users is unambiguous. This section provides information about required edgematching between adjacent FIRM Databases, including the fitting of features between layers; edgematching between FIRM panels or communities within a county; and how to address overlaps and gaps. The Contiguous Community Matching Guidance document provides additional information about edgematching data between communities to include ensuring agreement between engineering data.

Edgematching involves the matching of features on both sides of the “edge” of a hardcopy map or tile of digital data. Proper edgematching will ensure that the digital data form a seamless data layer in a GIS application. As edges are digitized, features that cross the edge should snap together to form a seamless feature.

The following are edgematching problems that should be avoided:

- **Disconnects:** Disconnects occur when the line work for features does not connect, being either too short or too long at the source maps’ edge.
- **Jogs:** Jogs occur when a common feature on adjoining maps does not line up seamlessly.

- **Missing Features:** Missing features are those that appear on one source map, but not on the adjacent map. The features may be missing for a variety of reasons, such as (1) different dates of the two maps; (2) an error in one map; (3) a difference in interpretation by the cartographers of the two maps; (4) differing scales of the two source maps, or (5) adjacent data not available.

- **Different Representation of Features:** This occurs when features are represented differently on the source maps. For example, a stream is a double line on one, and a single line on the other.

Standards #65, #71, #126, #189, #306, #363, #370, and #390 are relevant to the ensuing discussion of edgematching. These standards address the requirements for BFEs, flood depths, floodplains, floodways, and flood zones to be in agreement between studies, communities, and counties.

As Discovery is performed and sources of spatial data are sought, it is important to understand and document the timeline of effective dates and spatial accuracy of each data source. Obtaining and preserving metadata from the data provider is the best way to understand and document this information. However, if metadata is not available from the data provider, other means of obtaining and recording this information may be needed. Informed edgematching decisions will rely on knowing which data are most current and/or most accurate.

9.1. Agreement Between Layers

As noted previously, the most accurate data source should be used to reference other features compiled onto the FIRM panel. The following layers may need to be reviewed to determine if they are compatible. If significant disagreements are found, an alternate source of base map data may need to be found, or modifications may need to be made to individual features to effect alignment.

- The topographic data and the base map data used in preparing the FIRM need to be compatible; that is, like features in both data sources need to align.

- If displayed on the FIRM, vector water areas and/or water lines may need to be reviewed to ensure that they follow the corresponding features on any orthoimagery that is used as the FIRM base map.

- Political boundaries may need to be reviewed to ensure that they follow relevant base map features, such as roadways or river centerlines/riverbanks.

- PLSS features may also need to be reviewed to ensure that they follow relevant base map features, such as roadways or river centerlines/riverbanks.

- Vector transportation lines that are used as the source for road names displayed on an orthoimagery-based FIRM may need to be reviewed to ensure that road names will be reasonably well aligned to the corresponding features on the orthoimagery.

If significant problems are found with the floodplain boundary delineations on the base map selected, the Mapping Partner should resolve the issue with the FEMA Project Officer.

9.2. Agreement between Effective and Revised Data

As noted in a number of the standards cited at the beginning of this section, revised flood hazard data must be tied into existing effective data. This applies both horizontally and vertically.

Horizontal tie-ins need to be seamless and vertical (elevation) tie-ins need to be within 0.5' foot. If this is not possible, the discontinuity needs to be accepted by the FEMA Project Officer and documented in the Coordinated Need Management Strategy (CNMS).

Resolution of tie-ins between newer and older flood hazard data may require extending models to a point farther upstream or downstream of the proposed limit of study to a point where agreement can be achieved. Additional information about resolving engineering tie-in issues will be provided in future guidance documents.

9.3. Agreement between Panels or Communities within County

Edgematching in order to achieve agreement between panels and/or communities within a countywide FIRM Database should be performed by the Mapping Partner as part of the study or restudy. For a first time countywide study, this may involve significant research to resolve mismatches between communities that were mapped at different times, at different scales, with different modeling techniques, and with different base maps.

As noted previously, knowledge of the provenance of any features that do not match will be invaluable in resolving how to address the mismatch. Options may include (1) holding a feature that is determined to be more current or more accurate in place and forcing another feature determined to be older or less accurate to fit to it; (2) splitting the difference between two features of similar age or accuracy; or (3) if applicable, extending a model to achieve a match.

Another scenario to consider is when detailed modeling is currently available for a community on one side of a river and the community on the other side was either previously not modeled or was modeled by approximate methods. Using the available modeling, updates, or additions to the flood hazard data on the other side of the river may be able to be made.

However, coordination with the community and the FEMA Project Officer is necessary if the addition of a floodway or changes to an effective floodway are involved, as floodways require community adoption. Additional guidance regarding floodways will be provided in future guidance documents.

If a PMR covers only a portion of a community and a new political boundary is provided that covers the entire community, the entire community boundary should be updated and provided in the S_Pol_Ar layer. This may result in the PMR's S_Pol_Ar extents being larger than the S_Fld_Haz_Ar extents, thus requiring a manual bypass in order to pass DVT.

9.4. Agreement with Surrounding Areas

As noted in several of the standards cited above, Mapping Partners need to ensure that all submitted digital data are edgematched to any existing (NFHL) digital data files for a seamless transition. The Contiguous Community Matching Guidance document provides additional information about edgematching data to the NFHL

9.5. Resolving Overlaps and Gaps

During the process of edgematching between panels or communities, either within the same county or between counties, overlapping data or gaps where data are missing may be discovered. These may be very small, or they may be large enough to be noticeable at FIRM scale. Overlapping flood hazard data can cause users to get two different answers when trying to identify the flood zone, BFE, or political jurisdiction of a particular location. Gaps in data provide the user with no information about the location in question. Both scenarios are problematic and should be addressed and eliminated.

Once again, knowledge of the provenance of any features that do not match will be invaluable in resolving how to address the mismatch.

9.6. Allowable Data Overlaps

Certain layers of data may overlap between counties due to allowable causes. For instance, gages that are relevant to a flooding source within a county may actually fall in an adjacent county. Similarly, sub-basins and their nodes may extend outside the county boundary. And a confluence, from which the stream stationing along the profile baseline is measured, may actually fall outside the county boundary. These are all examples of data overlaps that are allowable and may even be desirable. Overlaps of BFEs, flood depths, flood hazard areas, floodways, or political areas are not allowable and should be addressed and eliminated.

10. rFHL/NFHL Submittals

There are several schema differences between the FIRM Database and the regional Flood Hazard Layer (rFHL)/NFHL. Most notably, all _ID field widths are wider in the NFHL (text, 32) as compared to the FIRM Database (text, 25) in order to allow for the DFIRM_ID to be appended to the _ID fields for national uniqueness.

FIRM Databases may be submitted to the MIP and the rFHL teams in the schema under which the Flood Risk Project was contracted. This may mean that the data may be in the 2003, 2011, 2013, or newer FIRM Database schema, depending on the age of the study. However, all rFHL data submitted to the NFHL Data Management team for inclusion in the NFHL must match the 2021 FIRM Database schema. The NFHL Guidance document provides guidance on manual conversion that will need to be performed by the rFHL teams prior to submitting data to the NFHL Data Management team. Guidance is provided on this process for 2003 to 2013 schema conversion, 2011 to 2013 schema conversion, as well as 2013 to 2021 schema conversions.

11. Version Numbering

A field named VERSION_ID has been included in each table in the FIRM Database to store a 4-digit version identifier. The version identifier can be incremented at the feature level, and it allows any given feature to be related to the Guidelines and Standards that were in place when the feature was created. In the future, the version identifier will be used to establish "if-then" rules for data validation.

Each digit of the version identifier signifies an aspect of the Guidelines and Standards. The first digit identifies the Program (Map Modernization or Risk MAP), the second digit identifies the FIRM Database schema, the third digit identifies the engineering standards, and the fourth digit identifies the non-regulatory standards.

During the migration of the NFHL data from the 2003 FIRM Database schema to the 2013 FIRM Database schema, all features were assigned a VERSION_ID of 1.1.1.0 to signify that the data may have been created under the first edition of the Guidelines and Standards. VERSION_ID 1.1.1.0 is also applied to any FIRM Databases that are submitted to the MIP in the 2003 FIRM Database schema and converted to the 2013 schema during insertion into the rFHL/NFHL. As Flood Risk Projects update NFHL data, it is expected that individual features will be updated with newer version identifiers that reflect the Guidelines and Standards in place at the time of their creation.

Additional information about the FIRM Database version identifiers can be found at FEMA Guidelines and Standards for Flood Risk Analysis and Mapping webpage.

12. FIRM Database Tables

This section provides guidance that is specific to individual FIRM Database layers and tables. The definition and requirements of each of the FIRM Database layers and tables is provided in the FIRM Database Technical Reference. This information is intended to supplement those requirements.

12.1. S_Alluvial_Fan

The S_Alluvial_Fan layer is designed to provide additional information about the methodology used to identify and map alluvial fans. This information is used to summarize the alluvial fan analyses and results in the FIS Report. Additionally, the S_Alluvial_Fan layer provides users with spatial information about the spatial extents of alluvial fans along with their discharge, minimum and maximum velocity, depth of flooding, and flood hazard zone. Because of the significant risk to communities posed by the uncertain flow paths and the potential for mud and debris flows associated with alluvial fans, this additional spatial information can better inform floodplain management decisions.

Any alluvial fan polygons that are included in the S_Fld_Haz_Ar layer should have a corresponding polygon in the S_Alluvial_Fan layer. Alluvial fans may be mapped as Zone AO areas with depths and velocities; Zone AO areas with just depths; or Zone A, AE, or X. Therefore, the populated attributes for

S_Alluvial_Fan will depend on the flooding type. Zone AO areas will include DEPTH and DEPTH_UNIT and may have FAN_VEL_MN, FAN_VEL_MX, and VEL_UNIT populated. This information will be obtained from the hydraulic analysis (FAN program). Zone A, AE, or X areas will not have the FAN_VEL_MN, FAN_VEL_MX, VEL_UNIT, DEPTH, or DEPTH_UNIT fields populated. The ACTIVE_FAN field will be populated based on the results of the alluvial fan analysis. Zone AO areas with depths and velocities are associated with active alluvial fan flooding, while Zone AE and Shaded Zone X areas are associated with inactive flooding. Other Zone AO and Zone A areas may be considered active or inactive depending on the characteristics of the area and the alluvial fan. Generally, studies do not continue past areas of minimal hazard where flood depths are less than 0.5 ft. The minimal hazard areas are designated as shaded Zone X areas (pink/purple area in Figure 2).

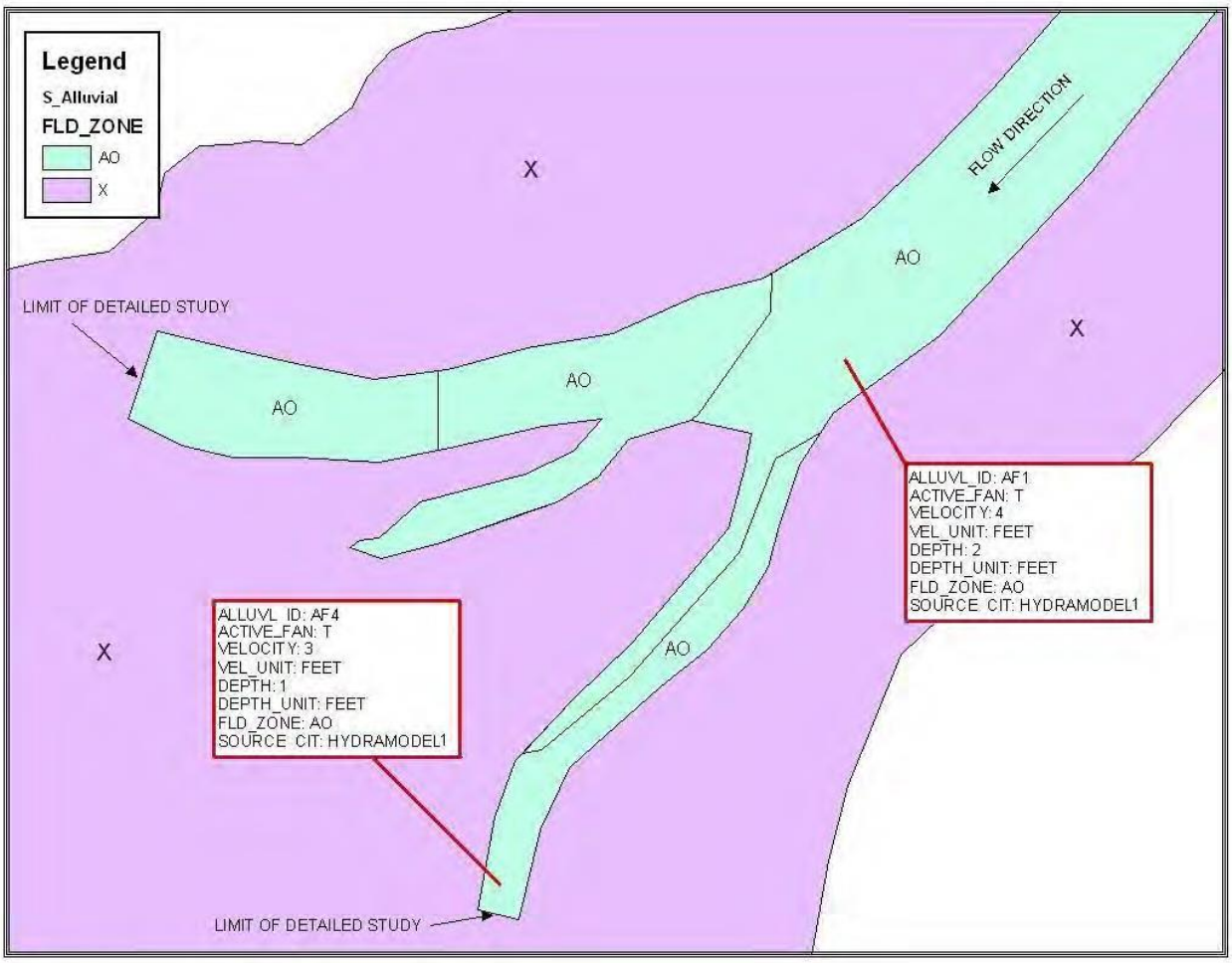

Figure 2: S_Alluvial_Fan

12.2. S_BFE

The S_BFE layer stores information about the “wavy line” BFEs that are shown on the FIRM panels. Note that the term BFE is sometimes used to refer to the 1% annual-chance water surface elevations

that are shown on the FIRM at cross section locations; but the S_BFE layer only depicts the "wavy line" BFEs.

The requirements for showing these "wavy" lines on the FIRMs has evolved over time, so there may be some variation in how these lines are depicted on different FIRM panels or even within the same panel depending on the age of the flood hazard data for different streams. Furthermore, the appearance of the BFE lines may vary if based on the results of a 1D or 2D model. Some BFEs may be shown with whole foot rounded elevation values, and some may be shown with elevation values to the 1/10th of a foot. The elevation values stored in the S_BFE ELEV field should reflect the values shown on the FIRM panel to the applicable decimal place.

Refer to the Mapping Base Flood Elevations on Flood Insurance Rate Maps Guidance document for additional information about BFE placement and elevation values.

12.3. S_Cst_Gage

The S_Cst_Gage layer stores information about coastal tide, wind, or buoy gages used during the coastal analyses or their calibration for a Flood Risk Project. S_Cst_Gage information includes gage specific data such as the start and end period of the gage records, gage type, and information about the type of data recorded by the gage such as wave direction, wave spectra, wind speed, and wind direction. The actual gage records are not stored in this table.

Coastal gages may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents.

12.4. S_Cst_Tsct_Ln

The S_Cst_Tsct_Ln layer stores information about coastal transects used in the coastal modeling. The transect lines indicate the location that was used to provide representative topographic information for the coastal flood models used. Hydraulic analyses of coastal flood effects are executed along transects, which are cross sections taken perpendicular to the shoreline, representing a segment of coast with similar characteristics. Transect elevations are interpolated to delineate the coastal flood zones.

Each transect should be represented by a single line feature without the circles on each end shown on the hard copy map. The location and shape of the lines should depict the position of the transect as accurately as possible. Off-shore profiles used for coastal analysis and modeling are generally not included in the S_Cst_Tsct_Ln layer but should be submitted to the MIP with the Coastal Data Capture task submittals.

12.5. S_Datum_Conv_Pt

When a conversion between vertical datums is necessary, the S_Datum_Conv_Pt layer stores the points used to calculate either countywide/community-based or flooding source-based vertical datum conversion factors. Refer to the Vertical Datum Conversion Guidance document for a more

detailed description of the vertical datum conversion process and the criteria for selecting the appropriate vertical datum conversion methodology.

If countywide/community-based vertical datum conversion was performed, the points included in S_Datum_Conv_Pt will fall at USGS Quadrangle corners. The averaged countywide/community-based vertical datum conversion factor is entered in the Study_Info table. If flooding source-based vertical datum conversion was performed, the points included in S_Datum_Conv_Pt will fall on S_Profil_Basln features. Flooding source-based conversion factors are entered into S_Profil_Basln for each profile baseline feature in question.

Datum conversion points may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents.

12.6. S_FIRM_Pan

The S_FIRM_Pan layer stores information about the spatial extents and characteristics of the FIRM panels. Panel boundaries are generally derived from USGS digital orthophoto quarter quadrangle (DOQQ) boundaries or subdivisions thereof. As a result, the panels are generally rectangular. Exceptions to the panel boundaries following DOQQ boundaries may occur in areas with non-contiguous land coverage, such as on some of the Pacific islands, in areas that use metric units, or in areas with unique FIRM paneling schemes such as North Carolina.

FIRM panel numbers are 11-digit numbers that are made up of the 2-digit State FIPS code, a 4-digit community identification number, a 4-digit panel number that is unique to the mapped jurisdiction, and an alphabetic panel suffix that denotes the map version or edition. The FIRM panel number is shown in the title block of the FIRM panel and is also shown on the FIRM Index.

The FIRM panel suffix is incremented when the map panel is updated along with giving the map panel a new effective date. Usually, the suffix advances by one letter for each map update. But in the case of a first-time countywide conversion, the suffix used for the new countywide map advances to one letter beyond the highest existing suffix of any community within the county, thus potentially skipping suffix letters for some community areas. With the exception of the first-time countywide conversion, FIRM panels within a jurisdiction can be updated independently, and some panels may be updated more frequently than others. This may mean that FIRM panels within a given jurisdiction have different map suffixes. The panels with the higher letter suffix would indicate that those panels had been updated more frequently. But the highest suffix may not correspond with the most recent effective date. The suffix and the effective date should both be considered when determining the most recent version of any given map panel.

The S_FIRM_Pan layer should be fully populated with each submittal to the MIP, this should be submitted in its entirety for a countywide database but can be clipped to a PMR if not countywide.

12.7. S_Fld_Haz_Ar

The S_Fld_Haz_Ar layer stores information about the FEMA designated flood zone for all mapped areas of the jurisdiction. All areas within the jurisdiction should be covered by one and only one non-overlapping S_Fld_Haz_Ar polygon. Each polygon should be assigned a flood hazard zone (FLD_ZONE) and a flood hazard zone subtype (ZONE_SUBTY).

12.7.1. FLOOD ZONE AND ZONE SUBTYPE

FEMA uses the flood zone to designate the SFHAs. Acceptable values for this field are listed in the D_Zone table.

The zone subtype further describes the flood zone. For example, a Zone X can be either an area of minimal flood hazard (unshaded Zone X) or an area subject to 0.2% annual-chance flooding, 1% annual-chance flooding with average depths less than one foot, or 1% annual-chance flooding with drainage areas less than one square mile (shaded Zone X). Additionally, some areas behind levee systems are designated as Zone X, as are some areas of future conditions 1% annual-chance flooding. In each of these cases, the FLD_ZONE would be "X." The ZONE_SUBTY would then clarify which of these designations applies. The ZONE_SUBTY field also is used to describe which of the different types of floodways might apply to a Zone AE area.

The ZONE_SUBTY field is also used to spatially distinguish between coastal and riverine floodplains, as well as the transition zone or area of floodplain determined by combined rate of occurrence methods (versus adjacent areas that are predominantly riverine or coastal floodplains for the base flood). The zone subtypes that are available for this should only be used in coastal areas and should not be used inland.

The FIRM Database Technical Reference Table 14: Flood Zone and Zone Subtype Cross-Walk provides a listing of the valid ZONE_SUBTY values that can be used with any given FLD_ZONE value.

Occasionally, an area of a jurisdiction cannot be assigned a flood hazard zone. There are several FLD_ZONE values that can be used in these instances.

- FLD_ZONE "ANI" can be used for an "Area Not Included" where the area is actually mapped, but on a separate FIRM panel(s) and FIRM Database.
- FLD_ZONE "OW" can be used for areas of "Open Water" where a water body of significant size covers a portion of the jurisdiction and for which no flood hazard zone is defined.
- FLD_ZONE "NP" can be used for an area that is designated as "Area not Mapped". This designation would apply to an area of mismatch that is identified during the levee seclusion mapping process. It should only be used when justification to use Seclusion mapping on the FIRM panel is approved by the FEMA Region and FEMA Headquarters.

12.7.2. ZONE AR

When the FLD_ZONE is Zone AR, several additional fields within S_Fld_Haz_Ar need to be populated. Zone ARs are shown on FIRM panels when:

a. A community has a flood hazard reduction system that was recognized as providing 1% annual-chance flood hazard reduction on an effective FIRM or FIRM Database; and

b. This flood hazard reduction system is subsequently decertified by a federal agency responsible for flood hazard reduction design and construction; and

c. The community is in the process of restoring the flood hazard reduction system; and

d. The community requests a Zone AR from the FEMA Region; and

e. FEMA approves the request.

Zone ARs may be shown on the FIRM as a Zone AR or as a dual zone, with or without static BFEs. When dual zones and/or dual static BFEs are shown, the second zone and/or BFE is the zone the Zone AR will revert to once the flood hazard reduction system is restored. Examples are shown below.

- ZONE AR/A
  (EL 12 /)
- ZONE AR/AE
  (EL 11) (EL 7)
- ZONE AR/AH
  (EL 425)

Areas labeled as Zone AR without a dual zone revert to either unshaded or shaded Zone X.

The S_Fld_Haz_Ar fields AR_REVERT, AR_SUBTRV, BFE_REVERT, and DEP_REVERT are used to store the information about the zone, zone subtype, BFE, and depth that the Zone AR would revert to once the flood hazard reduction system is restored. The DUAL_ZONE field notes as T or F whether a dual zone is labeled on the FIRM panel.

12.7.3. BOUNDARY SMOOTHING

Flood hazard boundaries should be generalized to not misrepresent the accuracy of the flood hazard data. The flood hazard boundaries should be reviewed to find a balance between the topographic data and the representation of the data on the map. Refer to the FEMA Best Practice: Floodplain Boundary Processing for common GIS methodologies and strategies for smoothing floodplain boundaries. These methodologies may include but are not limited to: smoothing boundaries to reduce line complexity, simplifying and generalizing boundaries to reduce boundary vertex count, or

other strategies using commonly available simplification algorithms in GIS software. The Floodplain Boundary Processing Best Practice is accessible through the FEMA Guidelines and Standards for Flood Risk Analysis and Mapping webpage.

Any boundaries that are smoothed, generalized, or otherwise post-processed must still meet Floodplain Boundary Standards. Refer to Guidance Document No. 49, Floodplain Boundary Standards (FBS) Guidance for full details on FBS requirements. Guidance Document No. 49 is accessible through the FEMA Guidelines and Standards for Flood Risk Analysis and Mapping webpage.

12.8. S_Fld_Haz_Ln

The S_Fld_Haz_Ln layer stores information about the flood hazard zone boundaries. It must be spatially coincident with the S_Fld_Haz_Ar layer and cover the footprint of the S_Pol_Ar layer. Smoothing practices applied to the S_Fld_Haz_Ar apply to the S_Fld_Haz_Ln as well. It is recommended that the smoothing practices for S_Fld_Haz_Ar should be completed before creating the coincident S_Fld_Haz_Ln file.

Four types of flood hazard lines are included in the FIRM Database:

- SFHA/FLOOD ZONE BOUNDARY – This category includes all 1% annual-chance and 0.2% annual-chance flood hazard boundaries; 1% future conditions boundaries; Zone D boundaries; “gutter” lines that divide SFHA areas with different zones, elevations, or depths; floodway boundaries; flowage easement boundaries; Limit of Floodway not at SFHA terminus; Limit of Detailed Study not at SFHA terminus; and state or community encroachment lines. These lines are plotted as white lines on orthoimagery-based FIRMs and as light grey lines on vector-based FIRMs.

- LIMIT LINES – This category includes lines formerly coded and labeled as Limit of Detailed Study at SFHA terminus or Limit of Study. These lines are shown on the FIRM as red and white line.

- OTHER BOUNDARY – This category includes lines formerly coded as SOURCE BOUNDARY, APPARENT LIMIT, END OF SPATIAL EXTENT, and any other flood hazard boundary line type that is not printed on the FIRM panel. These lines are not shown on the FIRM panel.

- FLOWAGE EASEMENT – This category includes lines that form the edge of a flowage easement polygon.

Note that no SFHA/FLOOD ZONE BOUNDARY line is needed between 0.2% flood hazard areas that were studied by different methods unless they have a different ZONE_SUBTY, in which case they would be separated by an SFHA/FLOOD ZONE BOUNDARY.

12.9. S_HWM

The S_HWM layer stores information about high water marks when they are provided by the community and/or are shown on the flood profile. High water marks may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents.

If historic high water mark data is derived from a previously published FIS Report and the exact location of the high water mark is not provided, the S_HWM point should be placed at an approximate location as derived from the location description (e.g., along South Fork Inundation River approximately 700 feet upstream of Fulton Road, or at the location of the USGS gage on Inundation River).

12.10. S_Hydro_Reach

The S_Hydro_Reach layer stores information about the hydrologic reaches used in the hydrologic model. The hydrologic reach represents the connectivity between the sub-basins and the flow direction between nodes. Hydrologic reaches may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents.

12.11. S_Levee

The S_Levee layer stores information about levee systems, floodwalls, or dikes that have been designed for flood control, including those portions that are closure structures, whether or not they have been demonstrated to meet the NFIP requirements in 44 CFR 65.10. The spatial line features that represent the levee system structures should be drawn at the centerline of the feature. Note that certain coastal levee systems may be documented in L_Cst_Struct.

For more information on how to apply the non-accredited levee system status domains please refer to the flood hazard mapping section of the Levee Guidance document.

12.12. S_LiMWA

The S_LiMWA layer stores information about the Limit of Moderate Wave Action (LiMWA), which is defined as the extent of the coastal Zone AE area affected by wave heights greater than 1.5 feet. Damages to structures from wave heights between 1.5 and 3 feet are similar to, but less severe than, those in areas where wave heights are greater than 3 feet, typically designated as Zone VE on the FIRM.

The LiMWA is shown as an informational layer in the FIRM Database and on the FIRM panel. There are no special minimum NFIP floodplain management requirements within the LiMWA. Communities are encouraged but not required to adopt higher standards than the minimum NFIP requirements in these areas. The LiMWA is included on the Preliminary FIRMs; however, a community my request that the LiMWA not be delineated on its Final FIRMs. A community's NFIP eligibility is not affected if it opts not to include the LiMWA on its Final FIRMs. However, the LiMWA is included in the FIRM Database regardless of whether it is shown on the printed FIRM. A LiMWA line that is coded as

SHOWN_FIRM = “F” will not be printed on the FIRM panel and will not be displayed in the NFHL Web viewer.

12.13. S_Nodes

The S_Nodes layer stores information about nodes used in the Flood Risk Project. Nodes are point features that usually lie on the profile baseline (S_Profil_Basln) or the hydro reach line (S_Hydro_Reach). They often also lie at S_Subbasins pour points. The L_Summary_Discharges table is linked to S_Nodes by the NODE_ID. L_Summary_Discharges stores information about each node’s drainage area, discharges, and if applicable, water surface elevations for the modeled flood frequencies. Not all nodes in S_Nodes are required to be included in L_Summary_Discharges.

Nodes can represent sub-basin outlets, junctions, reservoirs, structures, or diversions and are required at all hydraulically modeled flow change locations. For hydraulic models that use nodes, such as Storm Water Management Model (SWMM) or Interconnected Pond Routing (ICPR), the nodes can be used to represent structures or hydraulic elements. In these cases, the nodes and the profile baseline layer are used to represent the hydraulic connectivity of the network. Nodes can also represent more detailed inventory, such as manholes or curb inlets. For situations where cross sections are not integral to modeling, the cross section spatial file should not be submitted, and the water-surface elevations need to be reported in the L_Summary_Elevations file at the corresponding node.

Figure 3 shows the relationship of sub-basin outlet nodes, junction nodes, hydro reaches, and sub-basins. Note that sub-basin outlet nodes should fall on sub-basin pour points and junction nodes should fall at the junction of two hydro reaches.

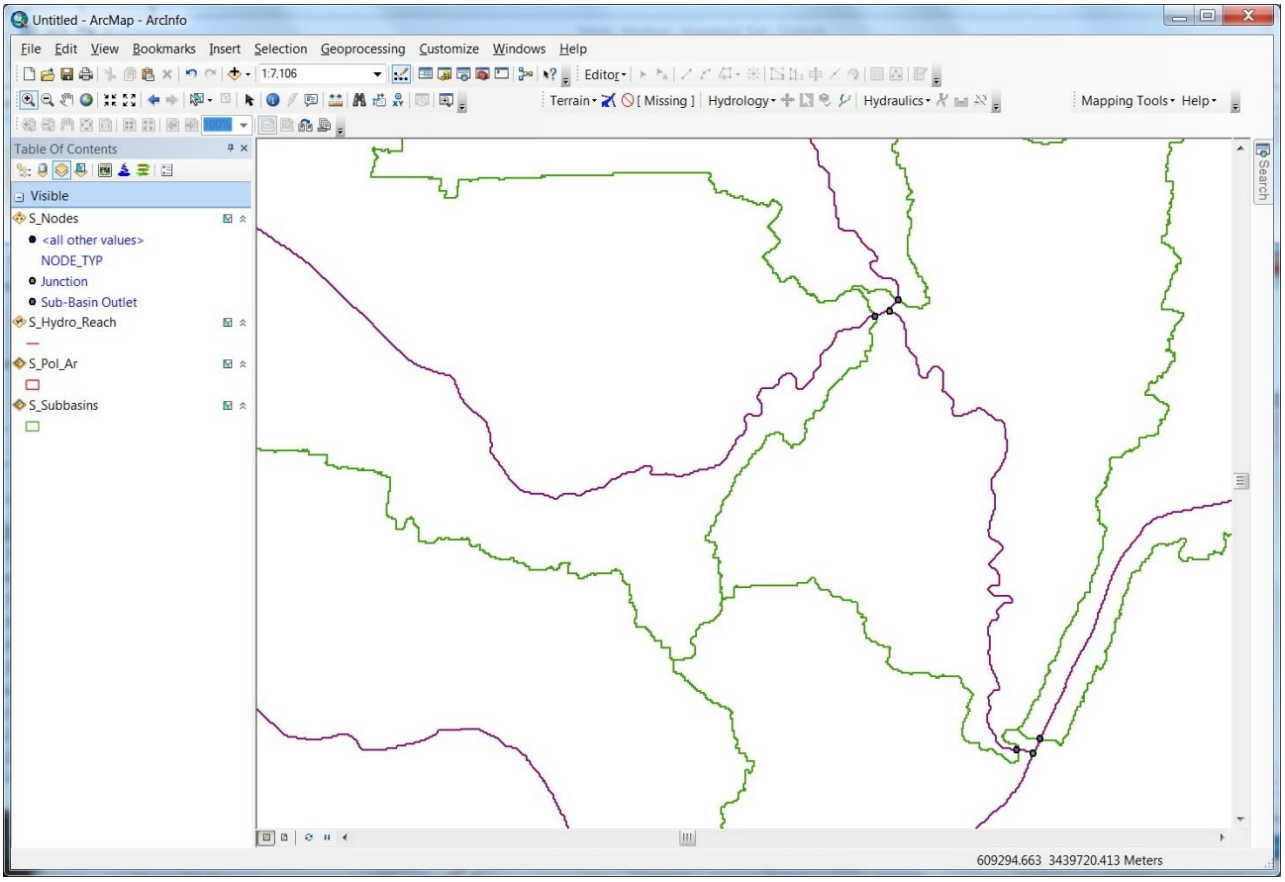

Figure 3: Nodes, Subbasins, and Hydro Reaches

Nodes may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents.

12.14. S_PLSS_Ar

The S_PLSS_Ar layer stores information about U.S. Public Land Survey System (PLSS) areas that are shown on the FIRM. Where available, the PLSS grid serves as the primary horizontal control grid shown on the FIRM. Pertinent attributes include the range and township number, and section number or if applicable, land grant name. PLSS range, township, and section lines should be terminated at the S_Pol_Ar spatial extents.

The PLSS typically divides land into 6-mile-square townships. Townships are subdivided into 36 one-mile-square sections. Sections can be further subdivided into quarter sections, quarter-quarter sections, or irregular government lots. Each township is identified with a township and range designation. Township designations indicate the location north or south of a baseline, and range designations indicate the location east or west of the Principal Meridian.

In most areas of the country the section grids are fairly regular. Often, however, the grids are interrupted by natural features such as rivers. In some cases, additional sections, numbered above 36 are inserted. In some sections of the country, the section grid is interrupted by named land grant

areas. Where land grant names are available instead of section numbers, these should be included in the S_PLSS_Ar layer and labeled on the FIRM panel. Figure 4, from the National Map, provides an illustration of the PLSS grid system.

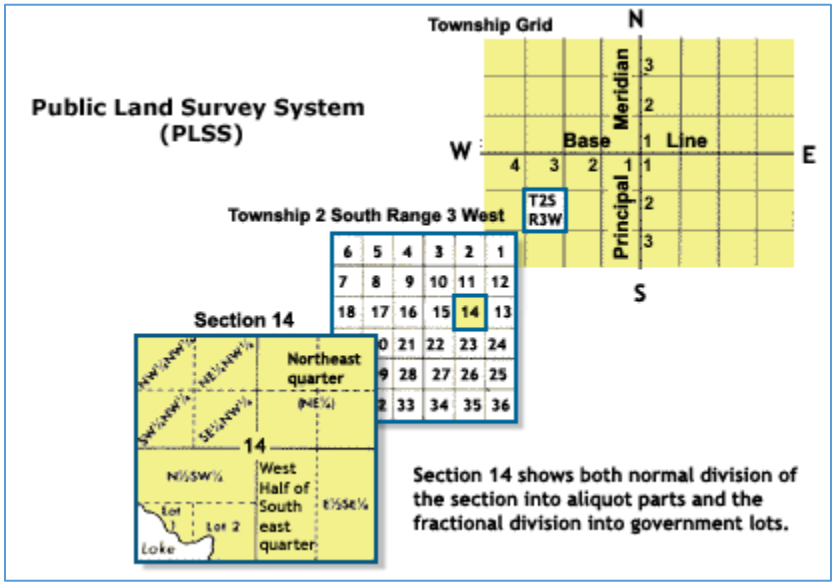

Figure 4: PLSS Grid System

12.15. S_Pol_Ar

The S_Pol_Ar layer stores information about all the political jurisdictions included within the Flood Risk Project area. Pertinent information about the communities included in S_Pol_Ar includes the community name, its FEMA Community Identification number (CID), its county and state Federal Information Processing Standards (FIPS) codes, and whether the community is included in the Flood Risk Project.

All jurisdictions that spatially fall within the Flood Risk Project area should be included in S_Pol_Ar, regardless of whether they are participating in the NFIP or whether they are flood prone or not. Additional jurisdiction-specific information about each of the jurisdictions that are participating in the NFIP is stored in the L_Comm_Info table.

For the NFIP, it is important to know the jurisdiction that has land-use authority over an area. Political jurisdictions individually agree to participate in the NFIP and the availability of insurance and floodplain regulations may vary by political jurisdiction. The political jurisdiction assigned to each S_Pol_Ar polygon should correspond to the jurisdiction responsible for NFIP and floodplain management for that area. If a community has floodplain management responsibilities for park or forest lands, these areas should be attributed with the community's CID.

12.15.1. POLITICAL AREA NAMES

The primary name of the political area should be stored in the POL_NAME1 field in S_Pol_Ar. When Unincorporated Areas are included within the Flood Risk Project area, the county name should be stored in the POL_NAME1 field and "Unincorporated Areas" should be stored in the POL_NAME2 field. When Extraterritorial Jurisdictional (ETJ) areas are included within the Flood Risk Project area, the jurisdiction name should be stored in the POL_NAME1 field and "Extraterritorial Jurisdiction" should be stored in the POL_NAME2 field. These identifiers will be printed underneath the jurisdiction name (stored in POL_NAME1) on the FIRM panel. See the Extraterritorial Jurisdiction Mapping and Distribution Guidance document for additional information about mapping ETJs.

If the S_Pol_Ar layer includes national parks or forests, military areas, or other special areas are included, the POL_NAME3 field may be used to store these area names. These identifiers will be printed underneath the jurisdiction name(s) (stored in POL_NAME1 and POL_NAME2) on the FIRM panel. Note that POL_NAME3 should only be used if POL_NAME1 and POL_NAME2 are populated (i.e., do not skip over POL_NAME2).

12.15.2. AREAS NOT INCLUDED (ANIS)

Areas Not Included are political jurisdiction that fall within the extent of the Flood Risk Project, but no flood risk information is shown. This is typically either because the area is mapped on another FIRM or because the area is not mapped at all by FEMA. All S_Pol_Ar attributes should be filled out for ANIs, and the ANI_TF field will indicate if the area is an ANI. If the jurisdiction is an ANI and is included in a different FIRM Database, the ANI_FIRM field should list the DFIRM_ID of the FIRM Database in which the ANI is included. If submitting the entire political area for a PMR, the ANI_FIRM field should be populated for areas outside the PMR footprint.

The L_Comm_Info table will not include information about ANIs. If the jurisdiction is considered an ANI because it is included in a different FIRM Database, its L_Comm_Info information should be included in the FIRM Database with which the jurisdiction is included.

12.15.3. MULTI-COUNTY COMMUNITIES

A multi-county community may be mapped in one of several ways. It may be mapped completely separately as a single-jurisdiction FIRM (Option 1). It may be mapped with one of the countywide FIRMs on which it falls, typically the one with the largest land area of the community (Option 2). Or it may be split between the countywide FIRMs on which it falls, as long as the community does not object to adopting multiple FIRMs (Option 3). See the FIRM Panel Technical Reference for information on choosing the most appropriate processing option for a multi-county community.

If Option 1 is chosen, the community will be listed as an ANI in any other FIRM Databases within which it falls. If Option 2 is chosen, the community's information will be listed in S_Pol_Ar and L_Comm_Info in the FIRM Database within which it is included, and it will be listed as an ANI in any other FIRM Databases within which it falls. If Option 3 is chosen, the community's information will be listed in S_Pol_Ar and L_Comm_Info in all the FIRM Databases within which it is included

12.15.4. COMMUNITIES WITH NO IDENTIFIED SFHAS

If a community falls within the Flood Risk Project area but was determined to have no identified SFHAs (i.e., the community is all within Zone X), it should be included in S_Pol_Ar and L_Comm_Info. The L_Comm_Info FLOODPRONE field should be "F." The L_COMM_INFO table should be populated even if the community has no identified SFHAs. The information in this table should match the date information in the FIS Report. See the *FIS Report Guidance* document for information on how to research and capture community date information.

Communities without identified SFHAs should be listed in Table 31 of the FIS Report, but footnoted as having No Special Flood Hazard Area (NSFHA). The L_Comm_Info FLOODPRONE = "F" attribute can be used to determine which records would need this footnote. See the FIS Report Technical Reference and the FIS Report Guidance document for additional information on populating the FIS Report tables from the FIRM Database.

12.15.5. POLITICAL BOUNDARY UPDATES OUTSIDE FLOOD RISK PROJECT AREA

Per Standard #378, for PMRs where updated political boundaries are available for the entire extent of the FIRM database, the S_Pol_Ar feature class shall be incorporated into the rFHL and shown on the FIRM Index. Only the S_Pol_Ar layer would need to be updated outside the extents of the PMR. Other FIRM Database tables that store community information would be unaffected. The L_Comm_Info, L_Comm_Revis, and L_Pan_Revis tables list the most recent FIRM panel date. They would only be updated when a FIRM panel is reissued, not for an S_Pol_Ar update on an unrevised FIRM panel.

When a countywide S_Pol_Ar layer is submitted for a PMR whose S_Fld_Haz_Ar extents are clipped to the PMR footprint, the study will require a manual bypass in order to pass DVT.

12.16. S_Profil_Basln

The S_Profil_Basln layer stores information about the profile baseline or stream line used in the hydraulic model. This includes information about the name of the flooding source, its study type, station start ID, a description of its start and end points, the vertical datum conversion factor for it if flooding source-based vertical datum conversion was performed, any flooding problems associated with it, and any special modeling considerations associated with it. The profile baseline layer must be defined as a Z- and M-aware layer.

The profile baseline shows the path of flood flows on the FIRM and should be an accurate representation of the distance between cross sections, structures, nodes, or grids in the hydraulic model. The profile baseline is used for replicating the stationing and water-surface elevations found in the FIS Report profiles but in GIS format.

12.16.1. 3D PROFILE BASELINE Z- AND M-VALUES

Profile baselines are stored as ArcGIS Polyline ZM features. The stream stationing values are stored as M-values, and 1% annual-chance water surface elevations are stored as Z-values. These Z- and M-

values should be calculated at cross sections, structures, and other modeled inflection points along the profile baseline. The S_Profil_Basln Z- and M-values should agree with the S_XS stream station and regulatory WSEL values at those intersect locations. Vertices between these modeled locations along the profile baseline should be calibrated using linear referencing/dynamic segmentation tools in GIS. The first vertex of each profile baseline should be the downstream most point on the profile, which should correspond to the S_Stn_Start point.

This means that the distance along the profile baseline between cross sections will be divided up based on the stream stationing at the cross section intersections, not based on the digitized length of the line. Similarly, the elevation difference between cross sections will be apportioned along the profile baseline. Figure 5 shows an example of how stream station and water surface elevations are intersected with profile baselines to calculate the Z- and M-values.

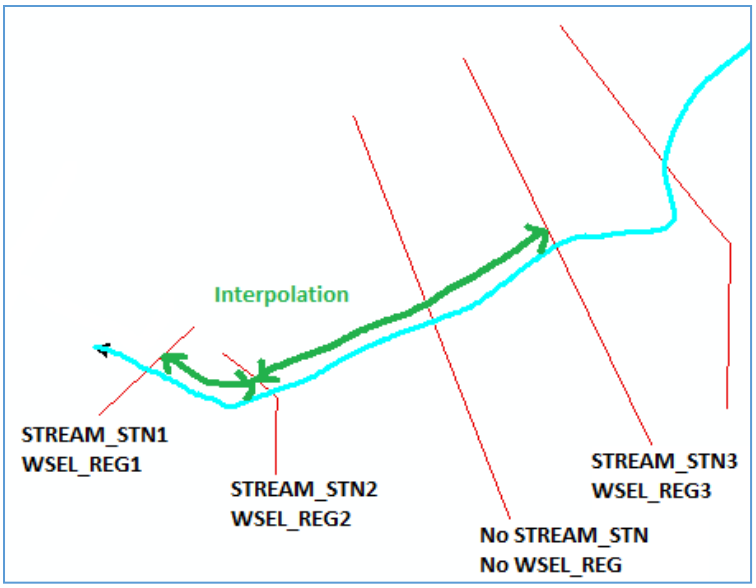

Figure 5: Profile Baseline Polyline ZM

To view or edit the profile baseline Z- and M-values, the ArcGIS 3D Analyst Profile Graph tool can be used as shown in Figure 6.

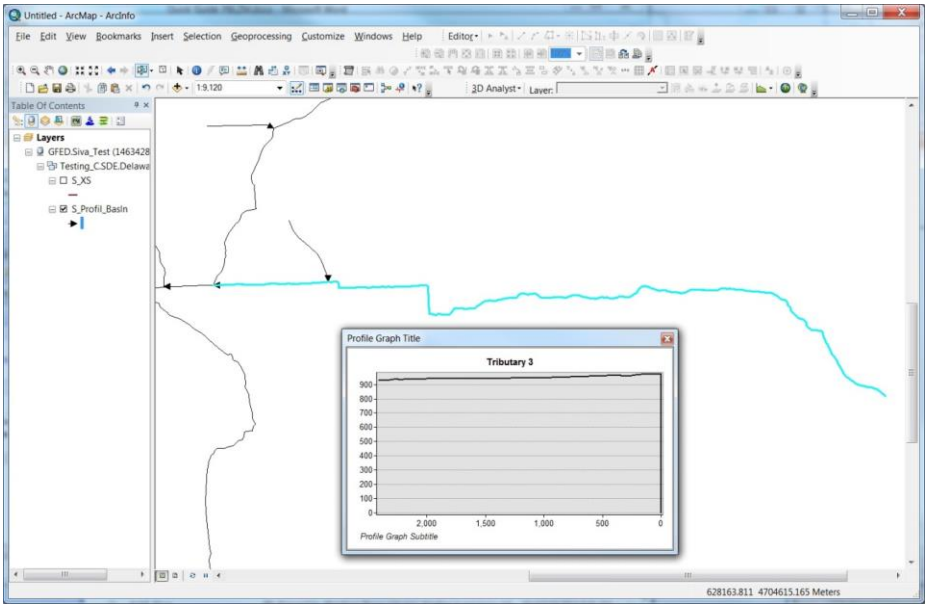

Figure 6: Viewing Profile Baseline Elevations

12.16.2. PRINCIPAL FLOOD PROBLEMS AND SPECIAL CONSIDERATIONS

The S_Profil_BasIn layer also stores Principal Flood Problem and Special Consideration data for use in the FIS text. Due to the limitations in the Esri SHP file DBF format, text fields are limited to 254 characters in length. Several fields have been provided in the S_Profil_BasIn table to hold this information, but in the event, that the description of principal flood problems or special considerations exceeds the number of characters provided, a tab separated value text file may be submitted instead. The first row of the text file must include a header as follows:

WTR_NM <TAB> FLD_PROB <TAB> SPEC_CON <CR>

Each row after the header should have the name of the studied reach/stream followed by a tab, the principal flood problem text followed by a tab and special considerations for that reach, followed by a carriage return.

When required, principal flood problem and special consideration files should be named using the following convention: <DFIRM_ID>*_FIS_Fld_Problems_Spec_Considerations.txt*

12.16.3. RELATIONSHIP TO S_WTR_LN AND S_WTR_AR

Water lines are shown on vector-based FIRMs to represent stream or lake banks and other hydrography features that are shown on the FIRM but not represented by the profile baseline. At the discretion of the FEMA Project Officer water lines may also be shown on orthoimagery-based FIRMs. The main purpose of the S_Wtr_Ar table and the S_Wtr_Ln table is to provide a cartographic depiction of the surface water features for visual interpretation of the flood hazard data.

Examples of when it may be desirable to show S_Wtr_Ln and/or S_Wtr_Ar features in addition to profile baselines are very wide river channels where it would be helpful to show the river banks in addition to the profile baseline down the center of the channel, lakes where it would be helpful to show the lake extents in addition to the profile baseline down the center of the lake, or areas of split flow where it may be helpful to show an alternate flow path to the one that was modeled.

When a profile baseline and water lines are available for the same stream reach, only the profile baseline is shown on the FIRM in order to eliminate overlaps and confusion. In this case, the water lines may be retained in the FIRM Database but are coded as SHOWN_FIRM = “F.”

12.16.4. MODEL-BACKED ZONE AS

Profile baselines are required in new riverine Zone A areas with model backup. Unmapped cross sections should be included in the FIRM Database for these model-backed Zone A areas. Cross section elevation information should also be included in the FIRM Database for unmapped cross sections in model-backed Zone A areas for all modeled frequencies. No flood profiles would be published in the FIS Report.

12.16.5. BACKWATER TRIBUTARIES

Profile baselines are only required for backwater tributaries if they were modeled separately. If unmapped cross sections were used to develop the backwater elevations, these cross sections should be included in the FIRM Database even if no flood profiles were developed or published for the tributary. A profile baseline would not be required in this instance.

12.17. S_Stn_Start

The S_Stn_Start layer stores information about the location of stream stationing origin points for flooding sources with profile baselines and cross sections as well as rivers with river mile marker locations. Pertinent attributes include the description of the location of the station starting point and the accuracy of the location of the station start point. Generally, all 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 location description should correspond to the description used on the flood profile and the Floodway Data Table in the FIS Report. It should include measurement units, but does not need to be a full sentence, for example, “Feet upstream from confluence with Main Channel of Big River”.

During the migration of NFHL data from the 2003 FIRM Database schema to the 2013 FIRM Database schema, S_Stn_Start points without location accuracy information were coded as LOC_ACC = “Low”, and a point was added at the centroid of the study area. As Flood Risk Projects are performed in areas where the S_Stn_Start points are not accurately located, they should be moved to the correct downstream station start point along the profile baseline.

Station start points may extend beyond the jurisdiction’s S_Pol_Ar and/or S_FIRM_Pan extents.

12.18. S_Subbasins

The S_Subbasins layer stores information about the watershed sub-basins used for the hydrologic analysis of the Flood Risk Project. It may also correspond to the drainage area used in a regression analysis or to the drainage area for a stream gage. At a minimum, S_Subbasins should include all the Hydrologic Unit Code 8 (HUC8) polygons that cover the jurisdiction for use in displaying the HUC8 boundaries on the FIRM Index. It may also include sub-basins smaller than the HUC8 sub-basins if they were used in the hydrologic analysis. Figure 8 below shows an example of sub-basins, nodes, and hydro reaches. Note the smaller sub-basins within the study area and the larger HUC8 watersheds beyond.

The NODE_ID field in S_Subbasins is a foreign key that links the information in the record to the corresponding information found in the S_Nodes_Table.

Sub-basins may extend beyond the jurisdiction's S_Pol_Ar and/or S_FIRM_Pan extents as shown in Figure 7.

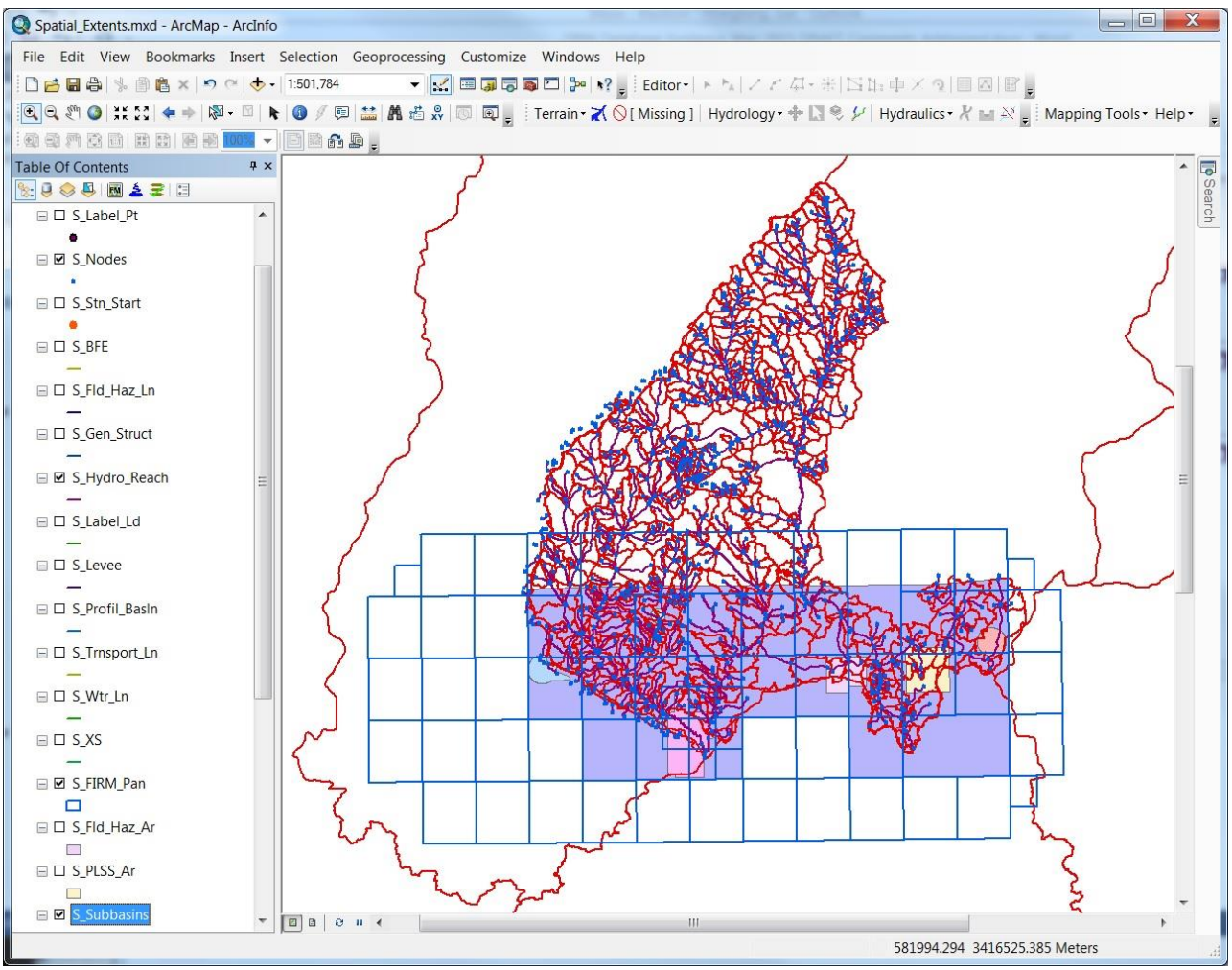

Figure 7: Subbasins, Nodes, and Hydro Reaches

S_Subbasin polygons may overlap, for example, cumulative sub-basin areas used for a regression analysis. S_Subbasin polygons will typically extend beyond the jurisdiction's S_Pol_Ar extents, since the HUC8 polygons are based on terrain, not political jurisdictions. The contributing area of a studied stream may begin at its headwaters, which may fall outside the jurisdiction.

12.19. S_Submittal_Info

The S_Submittal_Info layer stores information about the spatial extents of the various Data Capture tasks associated with the Flood Risk Project. This includes information about the Flood Risk Project case number, Mapping Partner, study type, its completion date, the model(s) used—hydrologic, hydraulic, and coastal, information about the underlying terrain data used for the mapping, and the effective date of the study. Note that the S_Submittal_Info layer is only intended to document the information associated with the current Flood Risk Project. It does not need to be back-populated with historic study information.

During each Data Capture task, this table should be populated and submitted by the Mapping Partner as part of the Data Capture submission. The Mapping Partner responsible for the FIRM Database should compile the features from the individual Data Capture submissions into a single layer in the FIRM Database. Only those areas that were revised and were part of the Data Capture submission associated with the current Flood Risk Project should be represented in the table; in the FIRM Database creation process, the Mapping Partner is not responsible for creating features that were not submitted with the various Data Capture submissions. The features will help users identify the FEMA case number for the various studies so that the engineering data may be easily located on the MIP.

There can be one or multiple irregular polygons that capture the extent of the Flood Risk Project Data Capture task area(s). If multiple polygons are required, the attributes of each polygon should be set appropriately for the area covered, and all polygons for that project should contain the same FEMA case number. Multiple polygons may be needed to represent a single Data Capture task. For instance, when a Mapping Partner performs hydraulic analyses for two streams, each may have a different type of hydraulic model. In this case, a single polygon should be created for each of the streams and the attribute values should reflect the different model information. The two polygons for the two streams should enclose the full extents of the modeling but should not overlap.

In most cases, there will be multiple S_Submittal_Info polygons for the same Flood Risk Project area that represent multiple Data Capture task areas. For example, there may be overlapping polygons for LOMRs, Terrain Data Capture, Survey Data Capture, Coastal Data Capture, Hydrology Data Capture, and Hydraulics Data Capture. The shapes of each of these polygons will be different based on the different extents of each Data Capture task. In cases where the flood hazards for the entire jurisdiction included in the FIRM Database have been redelineated and no new/updated Flood Risk Project information was created, a single polygon that matches the extent of the S_Pol_Ar polygon should be created. For the Floodplain Mapping Data Capture task in the case where the flood hazards for a given FIRM are from both new or updated Flood Risk Project data and redelineated areas, the polygon(s) for the redelineated areas should not overlap the polygons for the new Flood

Risk Project areas and the outer edges of the redelineated area polygons should generally not extend beyond the S_Pol_Ar polygon for the FIRM.

Separate S_Submittal_Info polygons will be submitted for each original topographic data source and each processed terrain data source used for modeling within the Flood Risk Study area. The result will be that for each unique topographic data source used on the project, there will be two S_Submittal_Info polygons – one for the footprint of the original source topographic data and one for the footprint of the processed terrain data used in the final modeling. The S_Submittal_Info TASK_TYP field will be used to document the Data Capture task type (i.e., New Topographic Data Capture, Existing Topographic Data Capture, or Terrain Data Capture).

S_Submittal_Info polygons may extend past the S_Pol_Ar extents of the Flood Risk Project when necessary to encompass the extents of the Data Capture task. For instance, the Hydrology Data Capture task area(s) should fully cover the gages, sub-basins, hydro reaches, and nodes that are included in the hydrologic modeling for the Flood Risk Project. The Hydraulics Data Capture task area(s) should fully cover the station start points and profile baselines that are included in the hydraulic modeling for the Flood Risk Project. The Coastal Data Capture task area(s) should fully cover the coastal gages, coastal transects, primary frontal dunes, and coastal baselines that are included in the coastal modeling for the Flood Risk Project.

S_Submittal_Info polygons can overlap between different Data Capture tasks as described above and shown in Figure 9 below. However, in general, S_Submittal_Info polygons should not overlap within the same Data Capture task. For example, the S_Submittal_Info polygons for the Hydraulics Data Capture task for two streams modeled using different hydraulic models should not overlap. If including the S_Stn_Start points in the S_Submittal_Info polygon would cause overlaps with another S_Submittal_Info polygon for the same Data Capture task, the S_Submittal_Info polygon can be clipped to avoid overlaps. The same would hold true for other features such as gages or high water marks that may fall well away from the main study area. S_Submittal_Info polygons for the finished terrain surface used for modeling should not overlap other polygons corresponding to the finished terrain surface. In other words, for any given location there should be only one polygon representing the source for the finished terrain surface. However, S_Submittal_Info polygons for original source topographic data may overlap each other.

Figure 8 shows an example of the varying spatial extents of the different Data Capture task submittal areas for a Flood Risk Project. The Terrain Data Capture submittal area (green speckles) fully covers the Flood Risk Project sub-basins, the Base Map Data Capture and FIRM Database submittal areas (blue cross hatch) cover the PMR footprint, and the Survey, Hydraulics, and Floodplain Mapping Data Capture submittal areas (solid pink and green) cover the studied stream corridors.

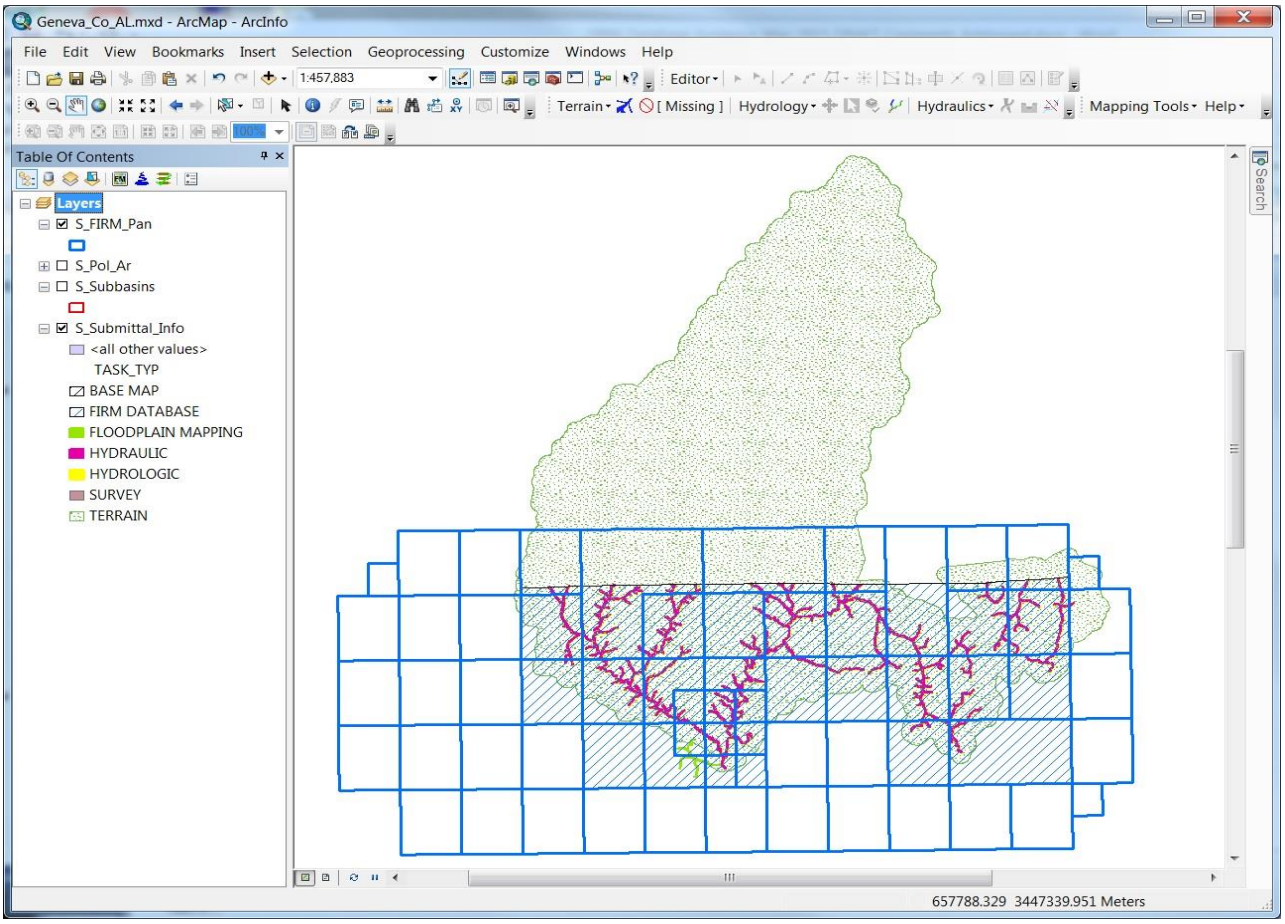

Figure 8: S_Submittal_Info

Also, note that when documenting the models used for the Flood Risk Project, if the hydrology was performed using gage analysis, use “Other” in HYDRO_MDL.

S_Submittal_Info includes several fields that are used to document the source, vertical accuracy, and horizontal accuracy of the terrain data used for the Flood Risk Project. The vertical accuracy reported should be that of the topographic data used in each specific submittal. The terrain data for most newer projects will be LiDAR. The vertical accuracy for LiDAR data should be expressed in cm $RMSE_z$ (Root Mean Square Error). Please provide the actual values from the LiDAR QA Report or metadata if available and note if the accuracy values represent tested data. Testing refers to the process whereby the vertical accuracy of a LiDAR dataset is calculated by comparing LiDAR points to ground surveyed points in areas of different vegetation classification. If the terrain data used were not LiDAR data, then use the information provided in the metadata that accompany the topographic data to derive the vertical accuracy information.

The horizontal accuracy reported should be that of the topographic data used in each specific submittal. The horizontal accuracy may be expressed in meters with a confidence level (i.e., 1 meter at 95% confidence level), as $RMSE_x$ and $RMSE_y$, or as a combined $RMSE_{XY}$. If the horizontal accuracy has been tested, please indicate as such. If the horizontal accuracy was not tested, but the data

were produced to meet specific accuracy requirements, please include that information as well. If horizontal accuracy information is not provided, or you are not able to determine an equivalent accuracy, enter "Not Provided." Otherwise, use the actual value(s) from the LiDAR QA Report or topographic metadata.

For older topographic datasets where horizontal accuracy may not have been reported in the metadata, an equivalent scale and contour interval horizontal accuracy may be able to be approximated. The horizontal accuracy of the LiDAR data can be translated from an equivalent scale and reported in the TOPO_H_ACC field. Similarly, the vertical accuracy of the LiDAR data can be estimated from an equivalent contour interval and reported in the TOPO_V_ACC field.

Table 3 provides an approximate horizontal accuracy from the “equivalent scale” for various map scales. Note that the confidence interval of the accuracy report is required for tasks that incorporate the use of topographic data.

Table 3: Equivalent Horizontal Accuracy from Map Scales

Horizontal Accuracy	Equivalent Scale
+/- 3 ft at 90 % confidence	1:1,200
+/- 7 ft at 90 % confidence	1:2,400
+/- 33 ft at 90 % confidence	1:12,000
+/- 40 ft at 90 % confidence	1:24,000
+/- 170 ft at 90 % confidence	1:100,000
+/- 420 ft at 90 % confidence	1:250,000

Table 4, taken from Procedure Memorandum 61, provides an approximate vertical accuracy from the “equivalent contour accuracy” for various standard contour intervals, referenced also in terms of vertical root mean square error ($RMSE_z$), National Standard for Spatial Data Accuracy (NSSDA) $Accuracy_z$, Supplemental Vertical Accuracy (SVA), and Consolidated Vertical Accuracy (CVA).

Table 4: Equivalent Vertical Accuracy from Contour Intervals

Equivalent Contour Accuracy	RMSE	NSSDA $Accuracy_z$ 95 % Confidence Level	SVA (Target)	CVA (Mandatory)
1 ft	0.30 ft or 9.25 cm	0.60 ft or 18.2 cm	0.60 ft or 18.2 cm	0.60 ft or 18.2 cm
2 ft	0.61 ft or 18.5 cm	1.19 ft or 36.3 cm	1.19 ft or 36.3 cm	1.19 ft or 36.3 cm

Equivalent Contour Accuracy	RMSE	NSSDA Accuracy$_z$ 95 % Confidence Level	SVA (Target)	CVA (Mandatory)
4 ft	1.22 ft or 37.1 cm	2.38 ft or 72.6 cm	2.38 ft or 72.6 cm	2.38 ft or 72.6 cm
5 ft	1.52 ft or 46.3 cm	2.98 ft or 90.8 cm	2.98 ft or 90.8 cm	2.98 ft or 90.8 cm
8 ft	2.43 ft or 73.9 cm	4.77 ft or 1.45 m	4.77 ft or 1.45 m	4.77 ft or 1.45 m
10 ft	3.04 ft or 92.7 cm	5.96 ft or 1.82 m	5.96 ft or 1.82 m	5.96 ft or 1.82 m
12 ft	3.65 ft or 1.11 m	7.15 ft or 2.18 m	7.15 ft or 2.18 m	7.15 ft or 2.18 m

12.20. S_Topo_Confidence

The S_Topo_Confidence layer stores information about areas of terrain data collection where conditions were such that the data may not meet the vertical data accuracy requirements. This may be due to heavy vegetation or other uncontrollable ground conditions.

Regardless of the technology used to collect digital terrain data, low confidence areas should be delineated by the data provider to indicate areas where the confidence in the vertical accuracy of the data may not meet the data accuracy requirements even though the specified nominal pulse spacing was met or exceeded in those areas. The Terrain metadata should include an explanation of steps taken to minimize the areas delineated as low confidence areas. Accuracy test points should normally be retained within such areas and should not be discarded. The data provider should take reasonable steps to minimize areas delineated as low confidence areas, taking into consideration the density of the vegetation in the floodplain being mapped and other factors.

The S_Topo_Confidence layer should cover the spatial extents of the Terrain S_Submittal_Info polygon. Areas outside of the areas of low confidence should be coded as “Acceptable Confidence Area”.

12.21. S_Tsct_Basln

The S_Tsct_Basln layer stores information about the transect baseline used in the coastal model. The transect baseline is the coastal equivalent of the riverine profile baseline. Typically, the S_Tsct_Basln represents the 0.0-foot elevation contour, the starting point for the transect line and the measuring point for the coastal mapping. When a coastal transect baseline and water lines are available for the same study reach, only the transect baseline should be shown on the FIRM to eliminate overlaps and confusion.

S_Tsct_BasIn features should be continuous for an entire reach for which the attributes are the same. They should not be broken into segments at the intersection with each transect unless there are attribute differences that would warrant the creation of separate features.

12.22. S_Wtr_Ar and S_Wtr_Ln

The S_Wtr_Ar and S_Wtr_Ln layers store information about vector surface water features that are shown on the FIRM. Vector streams are always shown on vector-based FIRMs. They may also be shown on orthoimagery-based FIRMs at the discretion of the FEMA Project Officer. S_Wtr_Ar and S_Wtr_Ln are not needed if the FIRM is orthoimagery-based or all streams on the FIRMs have profile baselines.

The main purpose of the S_Wtr_Ar and S_Wtr_Ln layers is to provide a cartographic depiction of the surface water features for visual interpretation of the flood hazard mapping data. As a result, the method for structuring surface water features as lines or polygons is very flexible. Lake shorelines and stream channel banks used to show wide rivers may be represented as polygons. However, they may be represented as lines based on the structure of the data received and the Mapping Partner's discretion. Surface water features may appear in either the S_Wtr_Ar table or the S_Wtr_Ln layer or both. However, features that appear in both layers must match exactly.

If stream centerlines are included in S_Wtr_Ln for streams that have a profile baseline, only the S_Profil_BasIn features should be shown on the FIRM panel and the S_Wtr_Ln features should be coded as SHOWN_FIRM = "F" to eliminate overlaps and confusion.

12.23. S_XS

The S_XS layer stores information about 1D model cross section lines and 2D model evaluation lines to include information about the cross section or evaluation line type, its letter (or number), stream station, 1% annual-chance water surface elevation, and stream bed elevation. Both mapped and unmapped cross sections and evaluation lines are stored in the S_XS layer. These lines usually represent the locations of channel surveys performed for input into the hydraulic model used to calculate flood elevations. Evaluation lines represent locations where results of a floodway generated from a 2D, or hybrid 1D-2D models are evaluated, and in the case of lettered evaluation lines, represent locations reported in the Floodway Data Tables. Sometimes cross sections are interpolated between surveyed cross sections using high accuracy elevation data. Depending on the zone designation (Zone AE, Zone A, etc.), these locations may be shown on Flood Profiles in the FIS Report and can be used to cross reference the Flood Profiles to the planimetric depiction of the flood hazards.

The cross section's or evaluation line's 1% annual-chance water surface elevation is shown on the FIRM panel for all mapped locations. BFE lines may be shown to augment the cross section and/or evaluation line elevations where needed for interpretation of the flood profile information. Refer to the Mapping Base Flood Elevations on Flood Insurance Rate Maps Guidance document for additional information about BFE, cross section, and evaluation line placement and elevation values.

Note that the SEQ field is included in S_XS to support exchange of information with RASPLOT. This field is defined as a short integer in the FIRM Database schema. The default width for a short integer in a SHP file is 4; however, this field is defined with a width of 6 in the NFHL. The wider field width is required in order to store the "-9999" value that is used if data are not applicable for this field. SHP files may be submitted using the wider field width of 6.

12.24. Study_Info

The Study_Info table stores project wide information about the data contained in the FIRM Database such as the jurisdiction name, datum, and projection needed for the FIRM panel title blocks, FIRM legend and notes to user, FIS Report cover, and FIRM Index. Also, included in Study_Info is the field AVG_CFACTR, which stores "COUNTYWIDE/COMMUNITY-BASED" datum conversion factors that meet the <0.25 foot variance requirements. If the flooding source-based method is required, the stream reach's datum conversion factor would be entered in the S_Profil_BasIn feature associated with that stream reach instead of in Study_Info.

Note that the projection information included in Study_Info should reflect the projection used for hardcopy FIRM production, not GCS used for the submitted FIRM Database. Both primary and secondary map projection information can be stored in Study_Info. If the primary map projection is State Plane, then secondary UTM map projection information is required. If the primary map projection is UTM, populating the secondary map projection information is at the discretion of the Mapping Partner.

The DBREV_DT field stores the date on which the FIRM Database was last updated. In the NFHL, this date will be either the effective date of the most recent LOMR or the effective study date, whichever is newer. For Flood Risk Projects, this is the effective date of the PMR or countywide study.

12.25. L_Comm_Info

The L_Comm_Info table stores information about each jurisdiction's map repository address, pertinent NFIP dates, floodprone status, and FIS date. Each record in L_Comm_Info is linked to a jurisdiction that is spatially represented in S_Pol_Ar.

Table 5 provides information about the definition of the dates that are included in L_Comm_Info.

Table 5: NFIP Dates

Date	Definition
Initial ID Date	Date of first FIRM/Flood Hazard Boundary Map (FHBM) showing the community with a SF H A
Initial NFIP Date	Date of the first NFIP map (FHBM or FIRM) published by FEMA for the community land (may be for an adjacent community or the county)
Initial FHBM Date	Date of first FHBM mapping the community land (may be for an adjacent community or the county)
Initial FIRM Date	Date of FIRM mapping the community land (may be for an adjacent community or the county)
First Countywide Effective Date	This is the effective date of the first countywide FIRM for this community. This date will be displayed on the FIRM panel under the heading EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP.
First Countywide FIS Date	This is the effective date of the first countywide Flood Insurance Study (FIS) for this community. This date will generally be the same as the first countywide FIRM for this community, except where an FIS was not published with the first countywide FIRM.
Most Recent Panel Date	Date of the most recent printed panel for the community (countywide and post-countywide mapping)

As noted previously, the L_Comm_Info table will not include information about ANIs. If the jurisdiction is considered an ANI because it is included in a different FIRM Database, its L_Comm_Info information should be included in the FIRM Database with which the jurisdiction is included. Communities without identified SFHAs are included in L_Comm_Info but noted as FLOODPRONE = "F." The L_Comm_Info table should be populated even if the community has no identified SFHAs. The information in this table should match the date information in the FIS Report. See the FIS Report Guidance document for information on how to research and capture community date information.

Historic community dates may need to be obtained from a number of different sources. These may include the following:

- For updates to existing countywide studies, community dates should be obtained from the effective Listing of Communities table on the FIRM Index and/or the Community Map History table in the FIS Report.

- For a first-time countywide study, the dates may be obtained from the current effective FIRMs or FHBMs under the Legend header. Be sure to check all panels in the effective map set since some may contain different revision dates.

- If the community's first FIRM will be the new countywide FIRM, the new countywide effective date will become the community's first dates.

Refer to the FIS Report Guidance document for additional information about community dates and their sources. Community dates can also be forwarded to the Flood Map Service Center for review and validation.

12.26. L_Comm_Revis

The L_Comm_Revis table stores information about historic effective and map revision dates for each jurisdiction included in the FIRM Database. If the L_Comm_Info table has "T" in the REVISIONS field, the L_Comm_Revis table should be populated. Each record in L_Comm_Revis is linked to a jurisdiction that is spatially represented in S_Pol_Ar. For each historic FIRM date listed in the FIS Community Map History table, there should be one record in L_Comm_Revis.

The listing above for L_Comm_Info regarding sources of community dates applies to L_Comm_Revis as well.

12.27. L_ManningsN

The L_ManningsN table stores information about Manning's "N" or "K" roughness coefficient values used in the hydraulic analysis for the Flood Risk Project.

Manning's "N" values are required for all newly studied riverine areas including new Zone A areas with model backup. If the FIS Report is converted to the new format, this table should be back-populated using the information contained in the effective FIS Report.

For model-backed Zone A areas, there can be one entry per studied stream or streams can be grouped together if applicable to the data. This table does not have a link back to any spatial features, so streams can be grouped as needed to support Table 14: Roughness Coefficients in the FIS Report.

12.28. L_Meetings

The L_Meetings table stores information about community meetings that are held throughout the duration of the Flood Risk Project. At a minimum, it should include meetings held for the current Flood Risk Project. If a PMR only updates data within a few communities within a county, then the meetings previously held for the unrevised communities should also be listed. Pertinent meeting information includes date, location, meeting type, and purpose. Attendees of the various meetings are recorded in the L_Mtg_POC table. The MTG_ID field for this table can be duplicated unlike other feature ID fields. There should be one ID per meeting that is then duplicated for each community.

12.29. L_MT2_LOMR

The L_MT2_LOMR table stores information about previously issued LOMRs that have been incorporated into the FIRM Database or superseded by the revised information from the new Flood Risk Project. Note that only the LOMRs being incorporated into the current Flood Risk Project or superseded by it need to be included in the L_MT2_LOMR table. It does not need to be back-populated with historic LOMR cases. Pertinent information includes the LOMR case number, effective date, flooding source, and status as well as the panel number(s) and scale of the panel(s) on which the LOMR falls.

The L_MT2_LOMR table should contain at least one record for each LOMR on the Preliminary and Final Summary of Map Amendments (SOMAs). There will be multiple records for any LOMR that spans multiple FIRM panels—one record for each FIRM panel on which the LOMR falls. These records should include all LOMRs that are incorporated or superseded in the SOMAs. Effective LOMRs outside of the PMR footprint should not be reported in this table. These are captured in the S_LOMR table in the National Flood Hazard Layer only.

Refer to the FIS Report Technical Reference and the Physical Map Revision Guidance document for information about specific issues where LOMRs are split across a PMR footprint and only a portion of the LOMR is able to be incorporated into the PMR.

12.30. L_Pan_Revis

The L_Pan_Revis table stores information about the revision history for FIRM panels included in the FIRM Database. If the FIRM panel title block has “MAP REVISED” instead of “EFFECTIVE DATE”, the L_Pan_Revis table should be populated. Note that this table is the only location where this panel-specific revision information is stored. These notes are no longer printed on each FIRM panel. The NFHL contains all revisions for a county and this table may contain revision information for panels that have since been superseded.

Only revisions for the current study should be submitted. The historic revision records will be maintained in the NFHL through the NFHL team processing. The revision date listed in L_Pan_Revis should be accompanied by one or more reasons indicating the purpose for the panel’s reissuance. Multiple reasons may apply to a given panel; these should be given individual records.

See Table 6 for some of the most common revision reasons. This list may be expanded as necessary to explain the reason the panel was revised.

Table 6: Map Revision Reasons

Map Revision Reason	Description
To update corporate limits	This note is used any time a revised FIRM shows a new corporate limit configuration. If an Area Not Included boundary is revised on the FIRM for the unincorporated areas of a county, this note specifically references the community (i.e., to update Town of Atlantic Beach corporate limits).
To decrease Base Flood Elevations	This note is used any time existing BFEs have only been decreased.
To increase Base Flood Elevations	This note is used any time existing BFEs have only been increased.
To change Base Flood Elevations	This note is used when BFEs are both increasing and decreasing.
To add Base Flood Elevations	This note is used when BFEs are added to a new detailed A or V zone for an area previously unstudied or previously studied by approximate methods.
To add Special Flood Hazard Areas	This note is used when new detailed or approximate 1% annual-chance flooding is added to an area previously unstudied.
To change Special Flood Hazard Areas	This note is used when the configuration of an existing SFHA is modified.
To delete Special Flood Hazard Areas	This note is used when an SFHA is entirely removed from the FIRM.
To change zone designations	This note is used when X (0.2% annual-chance) zones are changed to X (no flooding) zones, or vice versa; when A zones are changed to X (0.2% annual-chance) zones; and when A or V zones are changed to detailed zones (AE or VE zones).
To update map format	This note is used when an 11" x 17" FIRM is remapped into a z-fold, when a FIRM and FBFM are combined into a FIRM (Map Initiatives or Partial Map Initiatives), or when the FIRM is being prepared using digital methods for the first time.
To update map due to new panel layout	This note is used when a FIRM is revised due to new panel layout by adding additional panels to any existing digital layout.
To add roads and road names	This note is used when new roads and road names are added to the FIRM. "Update" instead of "add" is used when roads are moved or deleted, or when the names of roads change.

Map Revision Reason	Description
To include the effects of wave action	This note is used when a coastal wave height analysis has been added for the first time to an existing "non-wave height" FIS. Please note that revision notes covering BFE and SFHA additions, deletions, changes, or modifications are not necessary when this note is used to describe changes to the FIRM resulting from the addition of a wave height analysis.
To update the effects of wave action	This note is used when a coastal wave height analysis has been revised.
To incorporate Primary Frontal Dune analysis	This note is used when a FIS is revised to reflect the inland limit of the Primary Frontal Dune.
To reflect revised shoreline	This note is used when all or part of the shoreline on a coastal FIRM has been revised.
To reflect the effects of coastal erosion	This note is used when coastal erosion has been taken into account in the analysis.
To add Special Flood Hazard Areas previously shown on (community name), (state) Flood Insurance Rate Map dated (date), (year)	This note is used when a FIRM revision incorporates the annexation of an area with special flood hazards that was previously shown on another community's FIRM.
To incorporate previously issued Letters of Map Revision	This note is used when determinations made by Letter of Map Revision are incorporated into the revised FIRM.
To reflect updated topographic information	This note is used when the FIRM revision is based, at least in part, on new topographic information.
To incorporate previously issued Letters of Map Amendment	This note is used when determinations made by Letters of Map Amendment are incorporated into the revised FIRM.
To add floodway	This note is used when floodway delineation has been added. This note is used only on Map Initiatives format FIRMs.
To change floodway	This note is used when a floodway delineation change is the basis of the revision. This note is used only on Map Initiatives format FIRMs.
To advance suffix	This note is used when the only change to the FIRM is to change the map number suffix. This note is used only with the approval of a FEMA Project Officer.

12.31. L_Pol_FHBM

The L_Pol_FHBM table stores information about historic FHBM revisions and their effective date(s). Each record in L_Pol_FHBM is linked to a jurisdiction that is spatially represented in S_Pol_Ar. Pertinent information contained in the table includes the FHBM effective date and a revision note indicating the reason for the FHBM's reissuance. There may be multiple revision dates per jurisdiction. Each revision date listed in L_Pol_FHBM should be accompanied by one or more reasons.

See Table 6 above for some of the most common revision reasons. This list may be expanded as necessary to explain the reason the FHBM was revised.

12.32. L_Profil_Bkwtr_El

The L_Profil_Bkwtr_El table stores information about the backwater elevations needed to plot the backwater elevation lines on the stream profile sheets. The backwater elevations stored in this table are intersected with the modeled water surface elevations when the profiles are plotted.

This table enables the exchange of information between the FIRM Database and RASPLOT, facilitating both the import of data from the FIRM Database into RASPLOT and the ability to store RASPLOT data in the FIRM Database for future reuse within RASPLOT. The data in this table corresponds with the RASPLOT "Profiles" table shown in Figure 9.

profileName	frequency	backwaterElev	backwaterText	ID *
F100YR	1%-annual-chance	920.1	1% ANNUAL CHANCE BACKWATER EFFECTS FROM MAQUOKETA RIVER	163
100FW				164
F10YR	10%-annual-chance	914.5		165
F25YR	4%-annual-chance	916.4		166
F50YR	2%-annual-chance	917.2		167
F500YR	0.2%-annual-chance	921.0		168

Figure 9: RASPLOT "Profiles" Table

Note that the Backwater Text used in RASPLOT is not currently stored in the FIRM Database and may have to be re-entered in RASPLOT when plotting the profiles.

12.33. L_Profil_Label

The L_Profil_Label table stores information about the horizontal or vertical notes that may be added to stream profile sheets. Note that the labels shown at cross sections and the backwater notes are not stored in this table.

This table enables the exchange of information between the FIRM Database and RASPLOT, facilitating both the import of data from the FIRM Database into RASPLOT and the ability to store RASPLOT data in the FIRM Database for future reuse within RASPLOT. The data in this table corresponds with the RASPLOT "Landmark" table shown in Figure 10.

CumulativeDistance	Elevation	Text	Orientation	adjusted	underline	ID *
1000	34.4	LAKE BUENA VISTA	H	C	Y	207

Figure 10: RASPLOT "Landmark" Table

Note that RASPLOT exports values in the L_Profil_Label ORIENT field that are truncated (i.e., "HORIZO" and "VERTIC") and may need to be adjusted to the full value (i.e., "HORIZONTAL" and "VERTICAL") after export.

12.34. L_Profil_Panel

The L_Profil_Label table stores information about the definition of the location and scale of each of the stream profile sheets. Note that the origin information stored in this table is relative to the lower left corner of the profile grid.

This table enables the exchange of information between the FIRM Database and RASPLOT, facilitating both the import of data from the FIRM Database into RASPLOT and the ability to store RASPLOT data in the FIRM Database for future reuse within RASPLOT. The data in this table corresponds with the RASPLOT "Panel" table shown in Figure 11.

Panel	StartingStation	EndingStation	StartingElevation	EndingElevation	OrginX	OrginY	HScale	VScale	ID *
1	0	6500	0	90	0	0	500	10	65
2	6500	13000	0	90	6500	0	500	10	66
3	13000	19500	10	100	13000	10	500	10	67
4	19500	26000	0	90	19500	0	500	10	68
5	26000	32500	0	90	26000	0	500	10	69
6	32500	39000	0	90	32500	0	500	10	70
7	39000	45500	0	90	39000	0	500	10	71
8	45500	52000	10	100	45500	10	500	10	72
9	52000	58500	0	90	52000	0	500	10	73
10	58500	65000	0	90	58500	0	500	10	74
11	65000	71500	0	90	65000	0	500	10	75
12	71500	78000	10	100	71500	10	500	10	76
13	78000	84500	10	100	78000	10	500	10	77

Figure 11: RASPLOT "Panel" Table

12.35. L_Source_Cit

The L_Source_Cit table stores information about the sources of the data used in the Flood Risk Project. The SOURCE_CIT field in L_Source_Cit is found in each spatial layer in the FIRM Database and serves to link each spatial feature with a source description. L_Source_Cit can serve as input that can be used for generating FEMA metadata. In addition, this table contains all bibliography entries intended for use in the Bibliography and References table in the FIS Report text.

The content of the L_Source_Cit table largely corresponds to the required content of the Lineage subsection of a Federal Geographic Data Committee (FGDC) metadata file. The Lineage subsection provides information about the events, parameters, and source data which constructed the data set,

and information about the responsible parties. See the Metadata Profiles Technical Reference and the Metadata Guidance document for more information about metadata content and requirements.

The content of one metadata lineage record for one source is shown below:

2.5.1 Source Information -- list of sources and a short discussion of the information contributed by each.

2.5.1.1 Source Citation -- reference for a source data set.

2.5.1.2 Source Scale Denominator -- the denominator of the representative fraction on a map (for example, on a 1:24,000-scale map, the Source Scale Denominator is 24000).

2.5.1.3 Type of Source Media -- the medium of the source data set.

2.5.1.4 Source Time Period of Content -- time period(s) for which the source data set corresponds to the ground.

2.5.1.4.1 Source Currentness Reference -- the basis on which the source time period of content information of the source data set is determined.

2.5.1.5 Source Citation Abbreviation -- short-form alias for the source citation.

2.5.1.6 Source Contribution -- brief statement identifying the information contributed by the source to the data set.

12.36. L_Summary_Discharges

The L_Summary_Discharges table stores the hydrologic information, including drainage area and peak discharges, associated with nodes. All nodes used for hydrologic modeling should be included in the L_Summary_Discharges table; the SHOWN_FIS field can be used to indicate which values are included in Table 10: Summary of Discharges in the FIS report.

At a minimum, the nodes to be included in the L_Summary_Discharges table should be at or near major road or street crossings, upstream and downstream of major tributaries (where base flood discharge changes by at least 25%), at diversions of flow from the channel, at or near gaging stations, at corporate or county boundaries and at major flood control structures. In the absence of these locations, nodes should be included in the L_Summary_Discharges table when there is an approximately 25% change in the base flood discharge.

The SHOWN_FIS field is used to indicate nodes whose discharge data are not to be included in the FIS Summary of Discharges table when SHOWN_FIS = “F.”

If discharge information is available for model-backed Zone A areas, it should be included in L_Summary_Discharges. Model-backed Zone A discharges would not need to be listed in the FIS Report.

12.37. L_Summary_Elevations

The L_Summary_Elevations table stores information about non-coastal stillwater elevations, node-based hydraulic elevations, and non-transect based coastal stillwater elevations. Coastal stillwater elevations are stored in L_Cst_Tsct_Elev unless there are no corresponding coastal transects in S_Cst_Tsct_Ln. Records in this table are linked to S_Nodes point features. If there are no corresponding spatial node features, but stillwater elevations are needed for Table 11: Summary of Non-Coastal Stillwater Elevations in the FIS Report, "NP" can be entered into the NODE_ID field.

This table stores the STATIC_BFE information contained in S_Fld_Haz_Ar for water bodies including lakes, reservoirs, and ponds; rivers that were studied with hydraulic models, including 1D models, whose results are provided at nodes; and coastal flooding sources. There will not necessarily be a 1:1 relationship between records in the L_Summary_Elevations table and the S_Fld_Haz_Ar features with STATIC_BFE values. This table also includes elevations for additional modeled flood frequencies not contained in the S_Fld_Haz_Ar table.

The L_Summary_Elevations table includes a SHOWN_FIS field, which identifies whether the elevation is to be included in the FIS Summary of Non-Coastal Stillwater Elevations table. Coastal stillwater elevations are not shown in the FIS Summary of Non-Coastal Stillwater Elevations table and are shown as "F" in this field.

12.38. L_Survey_Pt

The L_Survey_Pt table stores information about field survey data generated as part of the Flood Risk Project. Pertinent information contained in the table includes the survey point locations, elevations, and survey codes indicating what type of feature was surveyed. Default survey codes and descriptions are provided as best practice information in the Data Capture Technical Reference.

Typically, surveyors provide their field survey information as comma separated values (.csv) files or Microsoft Excel (.xls, .xlsx) files. Both of these file types can be imported into L_Survey_Pt. L_Survey_Pt should contain all survey points for all reaches surveyed as part of the Flood Risk Project.

12.39. L_XS_Elev

The L_XS_Elev table stores information about the water surface elevations for each of the modeled flood frequencies at each 1D model cross section or 2D model evaluation line. This information is intended to correspond with the information shown in the Floodway Data Tables and on the flood profiles contained in the FIS Report. This table also includes cross section or evaluation line elevation information for levee systems, future conditions, and 1% plus scenarios. In addition to water surface elevations, this table stores the velocity and floodway width associated with each cross section or evaluation line. The 1% annual-chance water surface elevations contained in the L_XS_Elev table should match exactly the corresponding WSEL_REG elevations stored in the S_XS layer.

Note that the CALC_WO_BW field in L_XS_Elev is intended to be used to add a footnote in the WSEL_WOFWY field for the FDT in the FIS Report. When backwater has been applied to the regulatory 1% annual-chance WSEL at a cross section, the WSEL_WOFWY field will store the modeled (without backwater) WSEL for that cross section and EVENT_TYP and the CALC_WO_BW field should be set to "T."

Evaluation lines should have records within L_XS_Elev for EVAL_LN set to T for all records this will be used to differentiate 2D modeling from 1D modeling and will also populate footnotes within the FIS for records that have Floodway Data Table information.

For cross sections or evaluation lines along levee systems, there may be up to three records per cross section per event type to reflect the following modeling scenarios: landward of right levee, landward of left levee and with both levees. In these situations, for each scenario, the WTR_NM field should also reflect that scenario as it would be shown in the profile title block (e.g., "Big River Landward of Right Levee").

During migration of the NFHL from the 2003 to the 2013 FIRM Database schema, the L_XS_Elev table was populated with the 1% annual-chance water surface elevations from the S_XS layer. All subsequent Flood Risk Projects that involve newly studied streams should result in updates to the L_XS_Elev table to reflect the full range of flood frequencies and elevations that were modeled. This includes streams with model-backed Zone A areas. The exceptions to this would be LOMRs, and non-restudied streams within the PMR footprint. However, the 1% annual-chance water surface elevations must still match between S_XS and L_XS_Elev for any cross sections or evaluation lines within the LOMR or PMR footprint. All lettered cross-sections should be populated with all floodway data table information in L_XS_Elev and the FIRM database and FIS should have a one-to-one consistency between them. Floodway data table attributes include floodway width, section area, mean velocity, 1% annual-chance flood water surface regulatory elevation, without floodway elevation, with floodway elevation, and elevation increase.

RASPLOT version 3.0 can be used to extract the water surface elevations needed for the flood profiles and the L_XS_Elev table from the models. RASPLOT includes an export function that can format the required L_XS_Elev data.

Note that the fields NE_WIDTH_L and NE_WIDTH_R are only applicable to streams with encroachment zones instead of floodways. These fields support FIS Report Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams.

12.40. L_XS_Struct

The L_XS_Struct table stores information about the location of structures shown on stream profile sheets. Information is stored about the stream stationing, face, and elevation of the structure that can be used to plot it on the profile. Structures may be plotted as single lines with low and high chord ticks, or as polygons that represent the two faces of the structure with the stream station and low and high chords at each face.

This table enables the exchange of information between the FIRM Database and RASPLOT, facilitating both the import of data from the FIRM Database into RASPLOT and the ability to store RASPLOT data in the FIRM Database for future reuse within RASPLOT. The data in this table corresponds with the RASPLOT "Working" table for records containing structure information. An example of a RASPLOT "Working" table is shown in Figure 12.

river	reach	rs	struc	lengthchnl	cumdist	minchel	lowchord	highchord	labelletter	labeltext	Prof1	Prof2	Prof3	Prof4	ID *
Fish River	3696	3351.12		0	0	33.47					60.35	54.2	58.6	67.2	1
Fish River	3696	4403.88		1052.76	1052.76	36.8					61.10414	55.47741	59.39011	67.52064	2
Fish River	3696	6122.83		1718.95	2771.71	40.01					62.09913	58.57495	60.70693	67.7843	3
Fish River	3696	8107.96		1985.13	4756.84	43.45					65.13154	61.26288	63.85924	68.95363	4
Fish River	3696	10673.2		2565.24	7322.08	47.85					67.56049	64.83359	66.55138	70.24259	5
Fish River	3696	11708.96		1035.76	8357.84	49.71					68.73138	66.04555	67.78497	70.83504	6
Fish River	3696	11771.9	Bridge-DN	44.94	8402.78	49.71	69.41227	73.91227			70.8406	66.04555	70.31366	71.116	7
Fish River	3696	11771.9	Bridge-UP	36	8438.78	49.87	69.41919	73.91919			70.8406	69.43954	70.31366	74.55503	8
Fish River	3696	11839.4		49.5	8488.28	49.87					70.8406	69.70787	70.31366	76.08309	9
Fish River	3696	12093.97		254.57	8742.851	50.17					73.31065	70.65965	72.2936	76.40639	10
Fish River	3696	13914.27		1820.3	10563.15	53.5					75.6979	72.39036	74.54512	78.20354	11
Fish River	3696	16914		2999.73	13562.88	58.72					78.30398	74.67169	77.06715	80.58855	12
Fish River	3696	19420.59		2506.59	16069.47	62.31					79.99118	76.48778	78.76501	82.13749	13
Fish River	3696	21480.16		2059.57	18129.04	64.81					81.78167	78.31732	80.54501	83.9198	14
Fish River	3696	22605.02		1124.86	19253.9	67.03					82.57041	79.25069	81.36092	84.65229	15
Fish River	3696	25038.39		2433.37	21687.27	71.19					86.5515	83.48773	85.42764	88.43024	16
Fish River	3696	26697.95		1659.56	23346.83	73.91					88.93282	85.89661	87.82442	90.76712	17
Fish River	3696	27582.74		884.79	24231.62	75.72					89.64056	86.72296	88.56004	91.43948	18
Fish River	3696	28759.26		1176.52	25408.14	77.64					90.71567	88.0677	89.73192	92.40427	19
Fish River	3696	31889.43		3130.17	28538.31	79.9					94.21846	91.71001	93.3559	95.67513	20

Figure 12: RASPLOT "Working" Table