Guidance for Flood Risk Analysis and Mapping

Database Verification Tool (DVT)

February 2019

FEMA

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. The guidance, context, and other information in this document is not required unless it is codified separately in the aforementioned statute, regulation, or policy. 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 (https://www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping), which presents the policy, related guidance, technical references, and other information about the guidelines and standards development process.

Table of Revisions

The following summary of changes details revisions to this document subsequent to its most recent version in February 2018.

Affected Section or Subsection	Date	Description
2.3 and 2.4.1	February 2019	Removal of Coastal Barrier Resource System information

Table of Contents

List of Tables

1.0 FIRM Database Verification Tool Overview

To promote delivery of high quality products in compliance with FEMA's Flood Insurance Rate Map (FIRM) Database standards, in December 2009, FEMA integrated the FIRM Database Verification Tool (DVT) into the Mapping Information Platform (MIP) to check the quality of FIRM Database submittals. DVT provides embedded quality control checks that Mapping Partners should pass to promote standardization and consistency within the Draft, Preliminary and Final FIRM database deliverables.

In May 2014, a new version of DVT was deployed to accommodate the 2011 and 2013 table structures for the FIRM Database. This release improved quality control reduced the need for workarounds and reduced the number of DVT bypasses needed by users. Producers can use Flood Map Desktop (FMD) to "pre-check" submissions; however, DVT is the primary tool FIRM Database producers should use to validate their submissions. Please note that FMD and DVT may not be aligned in all checks.

The scope of the update included the following changes:

- Update DVT to verify FIRM Databases submissions (DVT will continue to only test shapefiles) in the 2013, 2011 and 2003 schema.
- Update the verification logic for the 2003 schema to reduce the need for DVT bypass requests.
- For "Draft FIRM Database Capture task," "Produce Preliminary Products Data Capture task" and "Develop Final Mapping Products Data Capture task" activities, allow MIP users to select their DVT schema version.

This document provides information about the FIRM DVT checks and ways to resolve some common errors found during quality assurance reviews.

2.0 FIRM DVT Checks

The FIRM Database Verification Tool (DVT) checks database field requirements (i.e., type, size, precision, scale, etc.), defined attribute domain values, topologic standards and metadata compliance. The DVT also utilizes a series of logic statements to confirm that proper attribute values are used in the correct manner.

2.1 Data Integrity Checks

DVT integrity checks are run on the FIRM Database, which are submitted as shapefiles and data tables, to ensure completeness of the submitted dataset. DVT performs several checks on the submitted shapefiles for consistency of fields and primary key uniqueness. Primary Key and Secondary Key/Foreign Key verification is conducted for the 2011 and 2013 schema. Tables 1 and 2 provide details on each DVT data integrity check.

Table 1: DVT Data Integrity Checks

DVT Check ID	DVT Data Integrity Check
2.2.1.2	Submission Completeness Check.
2.3.2.2	S_LOMR layer should not be included in FIRM Database submission.
2.4.2.2	All FIRM Database submittal layers should have a projection defined.
2.5.1.1	The primary key for spatial tables should not be null, not be duplicated.
2.5.1.2	The primary key for non-spatial tables should not be null, not be duplicated.
2.6.1.1	Required fields should exist for each FIRM Database table.
2.6.2.1	The fields of each FIRM Database submittal table should have the appropriate field type. If S_Gen_Struct table is populated with a domain indicated the flood is contained in channel, then the STRUC_DESC field is a Required field.
2.6.3.1	The fields of each FIRM Database submittal table should have the appropriate input field width.

Table 2: DVT Schema-Specific Data Integrity Checks

Schema	DVT Check ID	DVT Schema-Specific Data Integrity Check
2011, 2013	2.5.1.6	IDs that are foreign keys should exist in the related table's primary key field.
2011, 2013	2.5.1.7	When L_XS_Elev LEVEE_TF is true there should be a corresponding S_Levee feature.

2.1.1 FIRM DVT Data Integrity Checks Error Resolution

To promote proper cluster tolerance for FIRM Databases submitted in the 2013 schema, which use the Geographic Coordinate System (GCS) projection, the following workflow is recommended:

- After the Floodplain Mapping Data Capture task is complete, the geodatabase should be projected to GCS.
- Ensure that the working environment is in the most recent cluster tolerance and resolution according to the FIRM Database Technical Reference.
- Perform topology checks and resolve any topology issues
- Keep the dataset in GCS for all future work.
- Export to shapefiles for submission to DVT.

Note: Please see the spatial reference section of latest FIRM Database Technical Reference for the most recent projection and requirements.

2.2 FIRM DVT Metadata Checks

DVT checks are run on the submitted FIRM Database and its corresponding metadata file. DVT performs several checks on the submitted metadata file as well as several checks for consistency between the metadata file and the FIRM Database submittal. The DVT metadata checks are summarized below.

Users must first select the metadata profile against which DVT will validate. Please refer to Table 3.

Table 3: Metadata Profile Selection for DVT

FIRM Database Schema	Select DVT Option
Schema defined by Guidelines and Specifications, Appendix L (2003).	2003
Schema defined by Guidelines and Specifications, Appendix L (2011).	2011
Schema defined by FIRM Database Technical Reference (Aug 2013 or newer).	2013

The metadata check verifies that a metadata file has been submitted with the FIRM Database submittal. This check verifies that the submitted file format is valid. It also checks for the proper naming convention for the metadata file. After successfully locating the presence of a metadata file, DVT checks the metadata file for the existence of references to FIRM Database submittal tables, source citation, publication date, and coordinate system information. Table 4 provides details on each DVT metadata check.

Table 4: DVT Metadata Checks

DVT Check ID	DVT Metadata Check
2.1.1.1	A metadata file should exist in the FIRM Database submission.
2.1.1.1	A metadata file should include the MIP Case Number.
2.1.2.1	The metadata file should include a list of at least one FIRM Database table.
2.1.3.1	The metadata should include source citation information.
2.1.4.1	The metadata filename and publication date should meet the requirements outlined in the Metadata Technical Reference and/or FIRM Database Metadata Profile.
2.1.4.2	If the metadata filename has an effective date the same date must appear in one or more records in the S_Firm_Pan table.
2.1.5.1	Metadata should provide horizontal datum information.
2.1.5.2	Metadata should provide vertical datum information.

DVT Check ID	DVT Metadata Check
2.1.5.3	Metadata should provide bounding coordinates.
2.1.5.4	Metadata should include projection information.
2.1.6.1	FEMA/Map Service Center (MSC) address listed in metadata should be correct.
2.1.6.2	Submission geography information should be properly populated in metadata.
2.1.6.2	A metadata file should have the correct community place keys.
2.3.1.1	FIRM Database submission should include all layers listed in the metadata.
2.3.2.1	All table names listed in the metadata file should follow FIRM Database Technical Reference specifications.
2.4.1.1	The horizontal datum in the metadata meets FIRM Database Technical Reference specifications.
2.4.1.2	The vertical datum in the metadata meets FIRM Database Technical Reference specifications.
2.4.1.3	The horizontal datum cited in the metadata should match the horizontal datum defined in each layer of the FIRM Database submittal.
2.4.2.1	The metadata file should cite the Geographic Coordinate System (GCS), Universal Transverse Mercator, State Plane Projection, or Lambert Conformal Conic projection (Note: GCS only for 2013 schema).
2.4.3.1	A projection zone is cited in the metadata if applicable to the cited projection.
2.4.3.2	The projection zone cited in the metadata should match the projection zone defined in each spatial FIRM Database submittal layer.
2.4.4.1	Spatial features in the FIRM Database submittal should fall within the area defined by the bounding coordinates in the metadata.
2.5.2.1	The value in the vertical datum (V_DATUM) field of the Study_Info table should match the vertical datum cited in the metadata.
2.5.2.2	The value in the PROJECTION field of the Study_Info table should match the projection cited in the metadata.
2.5.2.3	The value in the projection zone (PROJ_ZONE) field of the Study_Info table should match the projection zone cited in the metadata.
2.5.2.4	The value for the horizontal datum (H_DATUM) field in the Study_Info table should match the horizontal datum cited in the metadata file.
2.8.2.13	Source Citations in SOURCE_CIT fields in the FIRM Database submittal tables should match with the source citation abbreviations described in the metadata file.

2.2.1 FIRM DVT Metadata Checks Error Resolution

The DVT tool described above provides an error report that describes the detected errors. Most of the error messages provided are reasonably clear and specific and cite the issue in the metadata file that has caused the error, although others can be somewhat general.

FIRM DVT metadata errors typically result from lack of consistency between the FIRM Database submittal and the metadata file and can be resolved by ensuring the required consistency is met. Frequent examples include:

- Case number listed in the metadata "Title" field (1.1.1.11.1.4) does not match the MIP case number.
- If more tables are listed in the metadata than the actual FIRM Database submittal, the submission will fail.
- List of submitted files in the metadata "Entity and Attribute Detail Citation" (5.2.2) does not agree with the actual spatial files uploaded to the DVT.
- Source Citation abbreviations listed in the spatial files do not agree with those listed in the metadata file.
    - There are no issues with the metadata having more source citations than the FIRM Database submittal. The metadata simply should have at least one.

2.2.2 FIRM DVT Metadata Checks for Geographic Coordinate System (GCS) Projection

Because all FIRM Databases in the 2013 schema must have GCS projection, but the actual Flood Insurance Rate Maps (FIRM) will be in their native projection, there will be a conflict of the documented data projections in the database metadata and in the database itself. The projection in the metadata should be GCS, but the study projection value in the Study_Info table should list the native projection of the mapping data. Because of this, DVT checks 2.5.2.2 and 2.5.2.3 described above will be not be run on FIRM Databases with GCS projection in the metadata.

2.3 FIRM DVT Attribute Checks

The DVT attribute check includes checks for consistency in the coding of fields from different tables that are supposed to match as well as acceptable domain values. The DVT attribute checks are detailed in Table 5.

Table 5: DVT Attribute Checks

DVT Check ID	DVT Attribute Check
2.1.3.2	The attribute of the submitted FIRM table should not be empty.
2.5.1.3	The field values of submitted tables should match values in the corresponding domain or lookup tables as specified in the FIRM Database Technical Reference and Domain Table Technical Reference.

DVT Check ID	DVT Attribute Check
2.5.1.5	Appropriate null values are used based on field type and required vs. required if applicable in the FIRM Database Technical Reference specifications; additionally, an empty field in a shapefile is an acceptable null value for a text field (e.g., " ").
2.5.2.5	The values in the state name (STATE_NM) and county name (CNTY_NAME) fields of the Study_Info table should match a domain table.
2.5.2.6	The study prefix (STUDY_PRE) field value should correspond to the countywide true/false (CW_TF) coding in the Study_Info table.
2.5.2.7	The value in the string field should not contain leading or trailing spaces.
2.8.1.1	The value in the state Federal Information Processing Standards (FIPS) (ST_FIPS) field in the S_FIRM_PAN table should be consistent with a domain table of ST_FIPS values in the Domain Tables Technical Reference.
2.8.1.2	The PCOMM and PANEL fields of the S_FIRM_Pan table should be coded with four digit numeric characters.
2.8.1.3	The SUFFIX field of the S_FIRM_Pan table should be coded with an alphabetic character.
2.8.1.4	The FIRM_PAN field of the S_FIRM_Pan table should be eleven alphanumeric characters.
2.8.1.5	The FIRM_PAN field of the S_FIRM_Pan table should be coded with a value that is a combination of the ST_FIPS, P_COMM, PANEL and SUFFIX fields.
2.8.2.1	The AR_REVERT field should be populated when the FLD_ZONE field is populated with AR in the S_Fld_Haz_Ar table.
2.8.2.2	Flood zones A, AE, AH, AO, AR, V or VE should be designated as a Special Flood Hazard Areas (SFHA_TF = True) in the S_Fld_Haz_Ar table.
2.8.2.3	The flood zones AE, AR, AH and VE in the S_Fld_Haz_Ar table should have the STATIC_BFE field populated, or a S_BFE feature line in the S_BFE table or a MAPPED S_XS feature line in the S_XS table.
2.8.2.4	All X and D flood zones in the S_Fld_Haz_Ar table cannot be designated as a Special Flood Hazard Areas (SFHA_TF = True).
2.8.2.5	An AO flood zone cannot have a STATIC_BFE value in the S_Fld_Haz_Ar table.
2.8.2.6	Only AO or AR zones have DEPTH values in the S_Fld_Haz_Ar table.
2.8.2.7	Flood zone AO should have a DEPTH value in the S_Fld_Haz_Ar table between 1 foot and 3 feet.
2.8.2.8	If the flood zone is AO, the VELOCITY field in the S_Fld_Haz_Ar table should be populated.
2.8.2.9	If the VELOCITY field in the S_Fld_Haz_Ar table is populated with a value greater than zero, the VEL_UNITS field should be populated.

DVT Check ID	DVT Attribute Check
2.8.2.10	If the STATIC_BFE field in the S_Fld_Haz_Ar table is populated, then the DEPTH field should not be populated and vice versa.
2.8.2.11	If S_Fld_Haz_Ar has a STATIC_BFE field populated, V_DATUM should also be populated.
2.8.2.12	If STATIC_BFE or DEPTH field in the S_Fld_Haz_Ar table is populated, the LEN_UNIT field should also be populated.
2.8.2.17	If the VELOCITY field is populated in S_Fld_Haz_Ar than the VEL_UNITS field must also be populated.
2.8.3.1	The value in the DEGREES field in the S_Label_Pt table should be a numeric value between 0 and 359.
2.8.4.1	The value in the SECT_NO field in the S_PLSS_Ar table should be a numeric value between 1 and 36 or 0 for special cases.
2.8.4.2	The last character in the value of the RANGE field in the S_PLSS_Ar table should be E or W.
2.8.4.3	The last character of the value populating the TWP field in the S_PLSS_Ar table should be N or S.
2.8.6.1	Check the Community Number (COMM_NO) field of S_Pol_Ar table.
2.8.6.2	The Community Identification Number (CID) field in the S_Pol_Ar table should be a value composed of the ST_FIPS and COMM_NO field values.
2.8.6.3	County FIPS (CO_FIPS) field should be populated properly in the S_Pol_Ar table.
2.8.6.4	The State FIPS (ST_FIPS) value in the S_Pol_Ar table should be consistent with the state FIPS assigned to the state cited in the STATE_NM field.
2.8.7.1	The ALTNAME2 field in the S_Trnsport_Ln table should not be populated when the FULLNAME or ALTNAME1 fields are not populated.
2.8.8.2	S_XS and S_BFE elevations should be greater than zero.
2.8.8.3	S_XS WSEL_REG values should be greater than or equal to WSEL_REG values at lower STREAM_STN values for features using the same WTR_NM.
2.8.9.1	The REPOS_ADR2 field in the L_Comm_Info table should not be populated if the REPOS_ADR1 field is empty.
2.8.9.2	The REPOS_ST field in the L_Comm_Info table should contain a complete and valid State Name.
2.8.10.3	All true or false fields should be populated with 'T', 'F' or 'U' in S_Pol_Ar and Study_Info tables.
2.8.10.4	The printed panel true/false (OPP_TF) field should have a value of T when only one printed panel exists.

DVT Check ID	DVT Attribute Check
2.8.10.5	The Largest Panel Number (LG_PAN_NO) field in the Study_Info table should accurately represent the Largest FIRM panel number in the S_FIRM_Pan table.
2.9.1.4	The V_Datum field in the S_XS table should equal the V_Datum field in the Study_Info table.
2.9.1.5	The V_Datum field in the S_BFE table should equal the V_Datum field in the Study_Info table.
2.9.1.6	S_FIRM_Pan table should have the PNP_REASON field populated if the PANEL_TYP is coded “Countywide, Not Printed”, “Community Based, Not Printed” or “Statewide, Not Printed”.

In May 2014, a new version of DVT was deployed to accommodate the 2011 and 2013 table structures for the FIRM Database. Table 6 summarizes schema-specific attribute checks.

Table 6: DVT Schema-Specific Attribute Checks

Schema	DVT Check ID	DVT Schema-Specific Attribute Check
2011, 2013	2.5.1.11	S_XS features should have a 1-percent-annual-chance event type in L_XS_Elev table.
2011, 2013	2.5.1.9	There should be at least one record for the FIRM Database in the S_Submittal_Info table.
2011, 2013	2.5.1.10	Newly mapped or modified S_XS features should have all 5 event types in the L_XS_Elev table.
2011, 2013	2.5.1.12	The features on the profile Baseline, Transect Baseline, and/or Water line should be updated to the selected schema
2011, 2013	2.5.2.8	The FIRM Database update date, DBREV_DT in STUDY_INFO table, should match the highest effective date value in S_FIRM_Pan for final submissions.
2011, 2013	2.8.2.14	ZONE_SUBTY should match FLD_ZONE type in the S_Fld_Haz_Ar table.
2011, 2013	2.8.2.15	The S_Alluvial_Fan FLOOD_ZONE should have proper FLOOD_ZONE type populated: Zones A, AE, AO, or X one.
2011, 2013	2.8.2.16	The S_Alluvial_Fan should have proper AO and depth value populated in S_Fld_Haz_Ar table where zones overlap in the two layers.
2013	2.8.2.18	The AR_SUBTRV field in S_Fld_Haz_Ar should be populated when the FLD_ZONE field is populated with AR and with zone subtypes for Zones AE, AO, AH, A or X.
2013	2.8.2.19	The BFE_REVERT field in S_FLD_HAZ_AR should be populated when the FLD_ZONE field is populated with AR and with a STATIC_BFE value.

Schema	DVT Check ID	DVT Schema-Specific Attribute Check
2013	2.8.2.20	The DEP_REVERT field in S_FLD_HAZ_AR should be populated when the FLD_ZONE field is populated with AR and with a DEPTH value.
2011, 2013	2.8.2.21	STATIC_BFE values in S_Fld_Haz_AR should also appear in the L_Summary_Elevations table
2003	2.8.8.1	The XS_LN_TYP in the S_XS table should be populated as "LETTERED, MAPPED", "NOT LETTERED, MAPPED" or "NOT LETTERED, NOT MAPPED".
2011, 2013	2.8.10.6	The DFIRM_ID for every submitted table should match the two-digit State FIPS code and the four-digit FEMA CID code in the metadata.
2003	2.9.1.1	The LN_TYP attribute in the S_Fld_Haz_Ln table should be in agreement with the adjacent FLD_ZONE area type in the S_Fld_Haz_Ar table.

2.3.1 FIRM DVT Attribute Checks Error Resolution

DVT attribute errors typically result from lack of consistency between the attributes in different layers or usage of unacceptable domain values.

- The check for S_XS WSEL_REG values being greater than or equal to WSEL_REG values at lower STREAM_STN values will identify all cross sections with WSEL_REG values or STREAM_STN values either above or below the cross section that has a potential error. For example, if cross section E at station 1234 has a WSEL_REG value of 760.1 that should be 760.7, all cross sections with WSEL_REG values above 760.1 and below 760.7 will be flagged. But cross section E will not be included in the list of errors reported by DVT. Check the cross sections immediately above and below the cross sections listed in the DVT error report for possible errors or typos.

2.3.1.1. Conflicting Guidance in 2011 Specifications

FIRM Database attribute errors can be resolved by ensuring the required consistency is met. Nevertheless, there is conflicting guidance in the Guidelines and Standards for Flood Risk Analysis and Mapping, Appendix L: Guidance for Preparing Digital Data and Flood Insurance Rate Map Databases and Guidelines and Standards for Flood Hazard Mapping Partners, Domain Tables Guide.

- The field widths for the WATER_TYP field (multiple tables) and MTFCC field (Transportation lines) are limited to 25 characters; however, the 2011 Domain Tables Guide for these fields have acceptable domains listed in the D_Water_Typ and D_MTFCC tables that are over 25 characters in length. If one of these domains is used, it should be truncated to 25 or less characters. Below are the two tables (Tables 7 and 8) with their fields truncated to 25 characters.

Table 7: D_MTFCC

This domain table is originally referenced in Guidelines and Standards for Flood Risk Analysis and Mapping, Appendix L: Guidance for Preparing Digital Data and Flood Insurance Rate Map Databases. This version has been modified to show truncated domain values that should be used.

Type of Transportation Feature	Description of Feature	Applies to Appendix
R1011	RAILROAD FEATURE (MAIN, S	L
R1051	CARLINE, STREETCAR TRACK,	L
R1052	COG RAIL LINE, INCLINE RA	L
S1100	PRIMARY ROAD	L
S1200	SECONDARY ROAD	L
S1400	LOCAL NEIGHBORHOOD ROAD,	L
S1500	VEHICULAR TRAIL (4WD)	L
S1630	RAMP	L
S1640	SERVICE DRIVE USUALLY ALO	L
S1710	WALKWAY/PEDESTRIAN TRAIL	L
S1720	STAIRWAY	L
S1730	ALLEY	L
S1740	PRIVATE ROAD FOR SERVICE	L
S1750	INTERNAL U.S. CENSUS BURE	L
S1780	PARKING LOT ROAD	L
S1820	BIKE PATH OR TRAIL	L
S1830	BRIDLE PATH	L
S2000	ROAD MEDIAN	L

Table 8: D_Water_Typ

The domain table is originally referenced in Guidelines and Standards for Flood Risk Analysis and Mapping, Appendix L: Guidance for Preparing Digital Data and Flood Insurance Rate Map Databases. This version has been modified to show truncated domain values that should be used.

Type of Water Feature	Applies to Appendix
AREA OF COMPLEX CHANNELS	L, M
STREAM CENTERLINE	L, M
OPEN WATER AREA	L, M
WETLANDS	L, M
MANMADE WATER FEATURE	L, M
GLACIAL FEATURE	L, M
COASTLINE / ISLAND SHORE	L, M

- Text values for data submittals in the 2011 schema should use the coded values in the D_Scale domain table instead of the text values, due to field character limitations.

- The acceptable domains in the D_Orient domain table for data submittals in the 2011 schema should be truncated to six character field length (e.g., HORIZO and VERTIC).
- FIS_NM field in the Study_Info table for data submitted in the 2011 schema is only 14 characters which is not long enough to follow the file naming guidance in the Guidelines and Standards for Flood Risk Analysis and Mapping, Appendix L: Guidance for Preparing Digital Data and Flood Insurance Rate Map Databases. To satisfy the field requirement and meet the field length, data producers should leave off the file extension of the Flood Insurance Study (FIS) report name (e.g., 12345CV000A, not 12345CV000A.pdf).

2.3.1.2. Flood Zone Types and Subtypes for 2011 Schema Submission

- For FIRM Databases created in the 2011 schema, DVT does validate if the submission's Flood Zone Types correctly match their Flood Zone Subtypes. Table 9 below lists all acceptable Flood Zone Type and Subtype combinations and should be used to validate the correct combination of Flood Zone Types and Flood Zone Subtypes. For 2013 schema Flood Zone Type and Subtype combinations, refer to Table 7 in the FIRM Database Technical Reference.

Table 9: 2011 Flood Zone Type to Subtype Relationships

FLOOD_ZONE_TYPE	ZONE_SUBTYPE
A	
A	1 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE
A99	AREA WITH REDUCED FLOOD RISK DUE TO LEVEE
AE	
AE	1 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE
AE	ADMINISTRATIVE FLOODWAY
AE	AREA OF SPECIAL CONSIDERATION
AE	COLORADO RIVER FLOODWAY
AE	COMMUNITY ENCROACHMENT AREA
AE	DENSITY FRINGE AREA
AE	FLOODWAY
AE	FLOODWAY CONTAINED IN STRUCTURE
AE	FLOWAGE EASEMENT AREA
AE	NARROW FLOODWAY
AE	STATE ENCROACHMENT AREA
AH	
AO	
AO	FLOODWAY
AREA NOT INCLUDED	
D	
OPEN WATER	
V	

FLOOD_ZONE_TYPE	ZONE_SUBTYPE
V	RIVERINE FLOODWAY SHOWN IN COASTAL ZONE
VE	
VE	RIVERINE FLOODWAY SHOWN IN COASTAL ZONE
0.2 PCT ANNUAL CHANCE FLOOD HAZARD	
X	0.2 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN STRUCTURE
X	1 PCT DEPTH LESS THAN 1 FOOT
X	1 PCT DRAINAGE AREA LESS THAN 1 SQUARE MILE
X	1 PCT FUTURE CONDITIONS
X	1 PCT FUTURE CONDITIONS CONTAINED IN STRUCTURE
X	AREA OF MINIMAL FLOOD HAZARD
X	AREA WITH REDUCED FLOOD RISK DUE TO LEVEE

2.3.1.3. Combined Coastal and Riverine Zone Sub-types

In coastal areas, there is a need to spatially distinguish between coastal and riverine floodplains. It is also desirable to identify the transition zone or area of floodplain determined by combined rate of occurrence methods (versus adjacent areas that are predominantly riverine or predominantly coastal floodplains for the base flood). In order to identify these transitional areas, zone subtypes have been defined for these special cases. Note that a DVT manual bypass must be requested when zone subtype is populated for these unique coastal scenarios. The zone subtypes are listed below. Please see the FIRM Database Technical Reference document for the related flood zones with which these should be used.

ZONE_SUBTYPE
COASTAL FLOODPLAIN
COMBINED RIVERINE AND COASTAL FLOODPLAIN
RIVERINE FLOODPLAIN IN COASTAL AREA
RIVERINE FLOODWAY IN COMBINED RIVERINE AND COASTAL ZONE
0.2 PCT ANNUAL CHANCE FLOOD HAZARD IN COASTAL ZONE
0.2 PCT ANNUAL CHANCE FLOOD HAZARD IN COMBINED RIVERINE AND COASTAL ZONE

2.3.1.4. Additional DVT Tips

- All fields in a FIRM Database submittal should match the capitalization in the Guidelines and Standards Appendix or Technical Reference. For example, if a value is all capital letters (CAPS) in the Appendix or Technical Reference, it should be CAPS in the FIRM Database submittal. If a value is upper and lower case or caps lower case (CLC) in the Appendix or Technical Reference, it should be CLC in the FIRM Database submittal.
- The current version of DVT does not validate the value entered in the Version ID element.
- DVT performs check 2.8.2.3 which ensures that each S_Fld_Haz_Ar polygon with a zone value that constitutes a flood elevation has either an elevation line feature (e.g., S_BFE or S_XS feature) or a STATIC_BFE attribute value. Failures of this check do not return as errors, only a warning due to one possible yet frequent exception – when a small special flood hazard area polygon is adjacent to a floodway polygon that falls between two elevation line features. FIRM Database producers should ensure that warnings produced as a result of check 2.8.2.3 are addressed unless resulting from the above exception.
- DVT check 2.8.10.5 requires that Physical Map Revision (PMR) submittals include a complete S_FIRM_Pan layer for the entire jurisdiction (e.g., countywide study area) regardless of the PMR footprint. This DVT check validates the agreement between the highest FIRM Panel value in the LG_PAN_NO field in the Study_Info table (and the FIRM title block) and the S_FIRM_Pan table. Additionally, it promotes improved data quality at QR2 and QR5 giving the reviewers an opportunity to check the full accuracy of the index image against the S_FIRM_Pan layer.

2.4 FIRM DVT Spatial/Topology Checks

The DVT spatial and topology checks ensure correctness of spatial relationships between adjacent or neighboring features and topology correctness. These checks are detailed in Tables 10 and 11 below.

Table 10: DVT Spatial/Topology Checks

DVT Check ID	DVT Spatial/Topology Check
2.7.2.2	FIRM Database submittal layers should have the correct geometry (point, line, or polygon).
2.7.2.3	Polygon features should not self-intersect.
2.7.2.4	Polyline features should not intersect.
2.7.2.8	Polygon features should be greater than 40 units in area.
2.7.2.9	Polyline features cannot be zero length.
2.7.2.11	Features should not have dangling nodes.
2.9.1.2	S_BFE should extend from the Special Flood Hazard Area (SFHA) boundary to SFHA boundary.

DVT Check ID	DVT Spatial/Topology Check
2.9.1.3	S_BFE lines and mapped S_XS lines should not cross Flood Hazard Zone Area (AE, AH, or VE) polygons with non-null STATIC_BFE value. This check will not be performance if the S_BFE table is not populated.
2.9.1.8	The S_XS lines that are MAPPED (either type) should not cross BFE lines.
2.9.1.9	The WTR_NM field in the S_XS table should match only one stream name in the S_Profil_Basln or S_Wtr_Ln table. This check will not be performed if the S_Profil_Basln feature is not part of the submission.
2.9.1.10	The spatial feature should not be duplicated.
2.10.1.1	Lines do not intersect.
2.10.1.10	S_Fld_Haz_Ar polygons should be covered by S_Pol_Ar polygons.
2.10.1.11	S_Fld_Haz_Ln should be covered by S_Fld_Haz_Ar and S_Pol_Ln should be covered by S_Pol_Ar.
2.10.1.2	Lines do not overlap.
2.10.1.3	Lines should not self-overlap.
2.10.1.4	Lines should be single part.
2.10.1.7	Polygons should not overlap.
2.10.1.9	S_Fld_Haz_Ar boundary should be covered by S_Fld_Haz_Ln and S_Pol_Ar boundary should be covered by S_Pol_Ln.

Table 11: DVT Schema-Specific Spatial/Topology Checks

Schema	DVT Check ID	DVT Schema-Specific Spatial/Topology Check
2011, 2013	2.4.4.2	Some spatial features should not fall outside the submitted FIRM panel boundaries. Refer to section 2.4.1 below.
2011, 2013	2.4.4.3	Some spatial features should not fall outside the submitted FIRM panel boundaries. Refer to section 2.4.1 below.
2011, 2013	2.7.2.13	S_Profil_Basln features with a Version ID having a 2nd digit greater than "1" should have polyline Z values and those values should match the 1% WSEL value of the S_XS feature they intersect.
2011, 2013	2.9.1.7	S_Cst_Tsct_Ln should intersect S_Tsct_Basln.
2011, 2013	2.9.1.12	S_Stn_Start point should fall on S_Profil_Basln line.
2011, 2013	2.10.1.8	S_BFE and S_XS Lines should not have pseudo-nodes.

2.4.1 FIRM DVT Spatial/Topology Checks Error Resolution

- FIRM Database submittal layers should be clipped to the extents of the revised FIRM panels so as to not submit flood hazard data outside of the FIRM Panel revision area.
    - DVT check 2.4.4.2 will produce a warning if the following layers extend outside of the S_FIRM_PAN layer boundary: S_Datum_Conv_Pt, S_Gage S_HWM, S_Hydro_Reach, S_Label_Ld, S_Label_Pt, S_Nodes, S_PLSS_Ar, S_Pol_Ar, S_Profil_Basln, S_Riv_Mrk, S_Stn_Start, S_Subbasins, S_Submittal_Info, S_Topo_Confidence, S_Trnsport_Ln, S_Tsct_Basln, S_Cst_Gage and S_Base_Index.
    - DVT check 2.4.4.3 will produce an error if the following layers extend outside of the S_FIRM_Pan layer boundary: 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_Wtr_Ar, S_Wtr_Ln and S_XS.
- Check 2.10.1.10 – This error will appear if an S_Pol_Ar layer is larger than S_Fld_Haz_Ar in coastal areas. This check now accounts for submittal of a complete countywide political area layer for a PMR (partial FIRM panel layer).
- For version 2013 schema FIRM Database submissions, please see Section 2.1.1. of this document to resolve possible topology issues caused by GCS projection and 2013 cluster tolerance specifications prior to checking and repairing geometries as described below.
- Topology errors in the polygons may cause the FIRM Database submittal to fail DVT checks. A regular topology check may not show the error in a polygon feature; therefore, to find the error, it is recommended that data producers run the **Repair Geometry** tool in ArcToolbox first. Typically, an error will appear in the Arc Toolbox dialog window. Alternatively, the **Check Geometry** tool can be used. The **Repair Geometry** tool will attempt to correct the error, while the **Check Geometry** tool will point out the polygons that have errors. After the

Repair Geometry tool finishes executing, the topology checks and **Repair Geometry** tool should be run in that order. If the same polygon appears in the second iteration of the **Repair Geometry** execution, a manual fix will be necessary. This typically happens when there is a conflict between **Repair Geometry** tool output and topology checks. If the polygon to be fixed is large (e.g., a large Zone X polygon) the polygon should be split into smaller size polygons to help narrow down the error's location. The majority of the time, these errors are the result of a "bow tie" polygon.

To summarize, the **Repair Geometry** tool is run first, then check topology is performed, and finally **Repair Geometry** tool is run a second time. If the error persists, a manual fix will be required.

- Another possible solution to topology errors is changing the topology ranking. If rankings have the same value, the corresponding flood line will often reintroduce error into the polygon. Setting the flood lines to 3 and the flood polygons to 1, for example, will force the lines to move to the polygons and eliminate topology errors between the two feature classes. To remedy this, data producers should:
  1. Rank political boundaries and flood boundaries as 1 and 2;
  2. Rank everything else 3 or greater, then;
  3. Run the **Repair Geometry** tool, and then;
  4. Run topology checks.
- Large Datasets can cause long processing times for DVT and an increase in errors. There are several options to decrease the number of vertices to reduce processing time and errors.
  - Ensure all topology checks are being run in the GCS projection and the correct cluster tolerance as well as the resolution. Not setting the resolution can cause many of the topology errors that are seen in DVT but not in the user database.
  - The Zone X Area of Minimal Flood Hazard polygon can be cut to reduce the number of vertices per polygon. Other Boundary lines can be added to meet topology rules.
  - Reduction of vertices is a recommended option but does require more effort. First, delete the Zone X Area of Minimal Flood Hazard polygon and flood lines then run a generalize function on the remaining flood hazard areas at a one-foot cluster tolerance. One foot is the recommended tolerance; however, data should be tested to make sure the cluster tolerance used does not affect the shape of the flood hazards at map scale. Once this is done, the Zone X Area of Minimal Flood Hazard polygon can be created, then recreate lines. The previous line file can be used to find the Limit Lines and Other Boundary lines.

3.0 DVT Bypasses

Some special circumstances that are outside of the expected uses of the FIRM Database tables may fail DVT checks even though the data is in a requested or necessary format. In these instances, a DVT Bypass must be requested of MIP Help at miphelp@riskmapcds.com. An explanation of the reasoning for requesting the bypass of each failed DVT check must accompany the email request. In some cases, approval from the Regional Project Manager must accompany the bypass request. Some of the common DVT bypass needs are listed below

Check 2.5.1.6 – This check will fail if a CID in S_Pol_Ar does not appear in the L_Comm_Info table to look for agreement between the spatial and tabular community information tables. If a political area is an "Area Not Included" (ANI), has an identified and recorded CID, it should not have a record in the L_Comm_Info table. DVT will require that it does, and a DVT bypass must be requested.

Check 2.8.6.3 – This check looks at the County FIPS code values in the S_POL_AR table to make sure they agree with the information for the submitted county. If a political area polygon (in S_Pol_Ar) will be submitted with a County FIPS code other than the County FIPS for the submitted FIRM Database because the political area is a multi-county community and portions in the adjacent county will be mapped within the submitted FIRM Database, the check will fail and a DVT bypass must be requested.

Check 2.8.8.2 – This check will fail if a cross-section or BFE has a WSEL value that is null, negative, or zero. If the submitted data has correct zero or negative WSEL values because of low terrain, a bypass must be requested. Also, if the data inherited from the NFHL to begin a project has incorrect null, zero, or negative WSEL values and the correct values cannot be located, or researching the correct values is determined to be out of scope by the Regional Project Manager, a DVT bypass must be requested. In combined Riverine and Coastal zones where a null cross-section elevation is acceptable, a bypass will also be required.

Check 2.9.1.8 – This check will fail if a BFE line overlaps a cross-section line. Occasionally, this is unavoidable in a crowded map area or where the cross-section is unmapped and for reference to the hydraulic model only. If the check fails for one of these reasons, a DVT bypass must be requested.

Check 2.6.1.1 – If the S_Submittal_info record has a version ID 2nd digit of "3", DVT will request that the TOPO_SCALE field must be changed to TOPO_VERT_ACC and the CONT_INTVL field must be changed to TOPO_HORIZ_ACC. However, this is not required as per Guidelines and Standards unless the version ID 2nd digit is "4" or higher.