Map MODERNIZATION

Federal Emergency Management Agency

FEMA's Flood Hazard Mapping Program

Guidelines and Specifications for Flood Hazard Mapping Partners

Appendix N: Data Capture Standards

FEDERAL EMERGENCY MANAGEMENT AGENCY

FINAL
May 2005

Summary of Changes for Appendix N, Data Capture Standards

The Summary of Changes below details changes to Appendix N subsequent to the initial publication of the Draft Appendix N in April 2004. These changes represent new or updated guidance for Flood Hazard Mapping Partners.

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	All	Required files and optional files are clearly identified.
December 2004	All	Applied naming conventions from Appendix L of these Guidelines, including the use of underscores, identification of Spatial data tables with S_ and Look-up tables with L_, and the use of _LID in field names that reference a domain table.
December 2004	All	Corrected cross references to tables and sections.
December 2004	All	Standardized all references to Wtr_Nm_ID.
December 2004	N.1.1	Added text to clarify relationship to Appendix L of these Guidelines.
December 2004	L_Submittal_Info Table	Added row for SW_TF for statewide mapping. (Was Table N-1. [Dec. 2004] Now Table N-2. [April 2005])
December 2004	Figure N-1	Revised figure.
December 2004	Table - Accepted File Formats for Terrain Data	Added "2-D or" to 3-D Polyline shapefile format. (Was Table N-2. [Dec. 2004] Now Table N-3. [April 2005])
December 2004	N.2.2.3	Revised title and text to refer to continuous spatial files rather than non-tiled terrain files.

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - Continuous Terrain Spatial Files	Removed S_TileIndex row. (Was Table N-3. [Dec. 2004] Now Table N-9. [April 2005])
December 2004	N.2.2.3 and Tables - S_TileIndex Spatial File and S_SinkBreach Spatial File	Moved content of S_TileIndex Spatial File to Subsection N.2.2.4 and removed duplicated text. Moved Table N-4 Subsection N.2.2.4 and labeled as Table N-10. (S_SinkBreach Spatial File was Table N-4. [Dec. 2004] Now Table N-10. [April 2005])
December 2004	S_SinkBreach Spatial File	Moved Table N-4 to Subsection N.2.2.4. (Was Table N-4. [Dec. 2004] Now Table N-10. [April 2005])
December 2004	Table - S_TileIndex Spatial File	Revised "TileIndex" in title and table to "S_TileIndex" and corrected all references to Tile Index spatial file. (Was Table N-10. [Dec. 2004] Now Table N-4. [April 2005])
December 2004	Table - S_SinkBreach Spatial File	Changed "SinkBreach" to "S_SinkBreach" and provided additional information on placing breach lines. (Was Table N-4. [Dec. 2004] Now Table N-10. [April 2005])
December 2004	Table - S_NoData Spatial File	Changed "NoData" to "S_NoData". (Was Table N-5. [Dec. 2004] Now Table N-11. [April 2005])
December 2004	Table - S_VoidArea Spatial File	Changed "VoidArea" to "S_VoidArea". (Was Table N-6. [Dec. 2004] Now Table N-12 [April 2005])
December 2004	Table - S_ExternalBoundary Spatial File	Changed "ExternalBoundary" to "S_ExternalBoundary". (Was Table N-7. [Dec. 2004] Now Table N-13. [April 2005])
December 2004	Table - S_Island Spatial File	Changed "Island" to "S_Island". (Was Table N-8. [Dec. 2004] Now Table N-14. [April 2005])
December 2004	Table - S_StreamsDEM Spatial File	Changed "StreamsDEM" to "S_StreamsDEM". (Was Table N-9. [Dec. 2004] Now Table N-15. [April 2005])

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	N.2.2.4	Changed references to "TileIndex" to "S_TileIndex" and corrected reference to Table N-2.
December 2004	N.2.3.3 Digital Deliverables, Directory Structure and Naming Conventions	Changed "Submittal_Info table" to "L_Submittal_Info table".
December 2004	N.3.1	Changed "Elevation Reference Marks" to "Temporary Bench Marks (or Elevation Reference Marks)".
December 2004	Table - Database Tables and Spatial Files for Cross Sections	Corrected names of referenced tables and revised description of L_SXSPht from "structure" to "cross section". (Was Table N-13. [Dec. 2004] Now Table N-17. [April 2005])
December 2004	Figure N-4	Revised figure to add color coding and legend to indicate the type of shapefile. Corrected figure to agree with Table N-14 and the Database Dictionary. Removed Easting and Northing. Added SOURCE_CIT to shapefile attributes.
December 2004	Table - Attributes for Spatial Files for Cross Sections	Corrected names of referenced tables. Corrected description for SOURCE_CIT. Deleted WTR_NM row. Corrected figure to agree with ERD and Database Dictionary. (Was Table N-14. [Dec. 2004] Now Table N-26. [April 2005])
December 2004	Survey Files, Naming Convention	Corrected references to fields and tables.
December 2004	Digital Photographs, Attributes	Corrected reference to table.
December 2004	N.3.2.2 and Attributes for Spatial Files for Elevation Reference Marks	Changed all references to "Elevation Reference Mark" or "ERM" to "Temporary Bench Mark" or "TBM". Added clarification that a database table is not required. (Was Table N-15. [Dec. 2004] Now Table N-27. [April 2005])

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - Attributes for Spatial Files for Elevation Reference Marks	Added data type "number" for ELEV. Added description for SOURCE_CIT to shapefile attributes. Changed "S_Struc table" to "S_TBM spatial file". (Was Table N-15. [Dec. 2004] Now Table N-27. [April 2005])
December 2004	N.3.2.3	Added clarification that no spatial file is required for high water marks and deleted Spatial File subsection.
December 2004	Table - Database Tables and Spatial Files for High Water Marks	Updated references to table names. Added Table HWMWtnss and revised the description. Corrected description for L_HWMPht to refer to photographs rather than sketches. Added Table L_HWMSkt. (Was Table N-16. [Dec. 2004] Now Table N-28. [April 2005])
December 2004	Figure N-5	Revised figure to agree with the Database Dictionary and Table N-17. Added new domain D_Frequency.
December 2004	Table - Database Tables and Spatial Files for Structures for Detailed Studies	Revised references to table names and corrected table to agree with Database Dictionary. (Was Table N-17. [Dec. 2004] Now Table N-38. [April 2005])
December 2004	N.3.2.4 Spatial File	Revised culvert description to match the description for Limited Detailed Study.
December 2004	Figure N-6	Added SOURCE_CIT to shapefile attributes.
December 2004	Table - Attributes for Spatial Files for Structures	Revised Field Name for SOURCE_CIT. (Was Table N-18. [Dec. 2004] Now Table N-39. [April 2005])
December 2004	Survey Files, Attributes	Revised text to indicate that each survey file should include all survey data.

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - Database Tables and Spatial Files for Structures for Limited Detail Studies	Revised references to table names and corrected fields to match Database Dictionary. (Was Table N-19. [Dec. 2004] Now Table N-73. [April 2005])
December 2004	Figure N-7	Revised figure to match Database Dictionary.
December 2004	Spatial File, Description	Text revised for clarification.
December 2004	Table - Attributes for Spatial Files for Structures	Revised references to table names to match Table N-21. Added SOURCE_CIT to shapefile attributes. Removed TORXS, TOPOXS and GPSPt_ID. Added ApxStr_ID as foreign key to SXS table. (Was Table N-20. [Dec. 2004] Now Table N-39. [April 2005])
December 2004	N.3.2.5	Revised dam description revised to a line "…that is aligned to the centerline along the top of the dam". Revised culvert description to match that used for Detailed Survey.
December 2004	N.3.3	Added SOURCE_CIT to shapefile attributes. Corrected references to tables.
December 2004	Table - File Formats for Photographs	Added Tagged Image File Format and corrected fields to match Database Dictionary. (Was Table N-21. [Dec. 2004] Now Table N-87. [April 2005])
December 2004	Table - File Formats for Spatial Files	Added table. (Was Table N-21. [Dec. 2004] Now Table N-88. [April 2005])
December 2004	Table - Hydrology Database and Spatial Data	Revised references to table names. (Was Table N-25. [Dec. 2004] Now Table N-90. [April 2005])
December 2004	Figure N-8	Revised.

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	N.4.2.2	Revised references to table names.
December 2004	HydroLink Spatial File	Corrected text to indicate that features "follow the profile baseline wherever available".
December 2004	Table - S_Hydrolink Spatial File	Revised references to table names. (Was Table N-29. [Dec. 2004] Now Table N-94. [April 2005])
December 2004	Table - S_HydroBasin Spatial File	Revised references to table names. (Was Table N-30. [Dec. 2004] Now Table N-95. [April 2005])
December 2004	Table - L_HydroResult Table	Revised references to table names. (Was Table N-31. [Dec. 2004] Now Table N-96. [April 2005])
December 2004	Table - L_ Wtr_Nm Table	Referenced Appendix L of these Guidelines.
December 2004	Table - L_Wtr_Nm Table	Revised references to table names. (Was Table N-32. [Dec. 2004] Now Table N-97. [April 2005])
December 2004	Table - L_HydroEvent Table	Revised table name to include "L_".(Was Table N-33. [Dec. 2004] Now Table N-98. [April 2005])
December 2004	N.4.2.3	Revised references to table names.
December 2004	Table - S_HydroGage S_Hydro Soil S_HydroLandUse S_HydroImpervious S_HydroTC L_HydroEquation L_HydroNodeParam	Revised table names to include "S_" or "L_". (Were Tables N-34–N-40. [Dec. 2004] Now Tables N-99–105. [April 2005])
December 2004	Table - D_HydroParam Table	Corrected lengths for ShortName and Descript fields. Corrected Type of Descript field. (Was Table N-41. [Dec. 2004] Now Table N-106. [April 2005])

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - L_HydroCNResult L_HydroCNLookup L_HydroStormInfo L_HydroStormCurve	Revised table names revised to include "L_".(Were Tables N-43–N-46. [Dec. 2004] Now Tables N-108–111. [April 2005])
December 2004	N.5.1	Revised text to reference Appendix C of these Guidelines.
December 2004	Table - Hydraulics Tables and Spatial Data	Revised references to table names. (Was Table N-47. [Dec. 2004] Now Table N-112. [April 2005])
December 2004	Table - Minimum Required Datasets by Model Type	Revised references to table names. (Was Table N-48. [Dec. 2004] Now Table N-113. [April 2005])
December 2004	N.5.2.2	Revised references to table names.
December 2004	Table - L_HydraModel Table	Revised table name to include "L_". Corrected type and length for Hydra_LID field. (Was Table N-49. [Dec. 2004] Now Table N-114. [April 2005])
December 2004	Table - S_StreamCntrLine Spatial File	Revised table name to include "S_". Revised WATER_LID, CHAN_LID, and WTR_NM_LID fields. (Was Table N-50. [Dec. 2004] Now Table N-115. [April 2005])
December 2004	Table - S_HydraCrossSection Spatial File	Revised table extensively. (Was Table N-51. [Dec. 2004] Now Table N-116. [April 2005])
December 2004	Table - S_Stn_Start Spatial File	Changed table name to "S_RefPoint Spatial File". See following item.
December 2004	Table - S_RefPoint Spatial File	Added primary key RefPtID. (Was Table N-52. [Dec. 2004] Now Table N-117. [April 2005])

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - L_HydraResult Table	Revised field names and descriptions for Len_LID and Length_LID fields. Added V_Datum_LID field. (Was Table N-53. [Dec. 2004] Now Table N-118. [April 2005])
December 2004	Table - L_WtrName Table	Revised table name. Revised text to reference Appendix L of these Guidelines. (Was Table N-55. [Dec. 2004] Now Table N-120. [April 2005])
December 2004	Table - L_WtrName Table	Revised name, type, and length for WtrNameID field. (Was Table N-55. [Dec. 2004] Now Table N-120. [April 2005])
December 2004	N.5.2.3	Revised references to table names.
December 2004	Table - S_HydraMapping Spatial File	Revised table name and WtrNameID field. (Was Table N-56. [Dec. 2004] Now Table N-121. [April 2005])
December 2004	Table - S_BFE Spatial File	Added reference to Appendix L of these Guidelines. (Was Table N-57. [Dec. 2004] Now Table N-122. [April 2005])
December 2004	N.5.2.4	Revised references to table names.
December 2004	Table - S_HydraFlowPath Spatial File	Revised table name and WtrNameID field. (Was Table N-58. [Dec. 2004] Now Table N-123. [April 2005])
December 2004	Table - S_HydraJunction Spatial File	Revised table name and references to other table names, and added V_DATM_LID and LEN_ID foreign keys. (Was Table N-59. [Dec. 2004] Now Table N-124. [April 2005])
December 2004	Table - L_HydraXsPt Table	Revised table name. (Was Table N-60. [Dec. 2004] Now Table N-125. [April 2005])

Date	Affected Section(s)/Subsection(s)	Description of Changes
December 2004	Table - S_HydraNvalue Spatial File	Revised table name. (Was Table N-61. [Dec. 2004] Now Table N-126. [April 2005])
December 2004	Table - S_Ovrbnkln Spatial File	Revised field names for Overbnk_ID, WtrName_ID, and WtrName. Revised type and length for renamed field WTR_NM_LID. (Was Table N-62. [Dec. 2004] Now Table N-127. [April 2005])
December 2004	N.6	Added references for Appendices B and J of these Guidelines.
April 2005	All	Sections have been re-arranged in the Terrain Section and tables added or deleted throughout. The citation in the "Affected Section" column in this chart refers to the previous section numbers.
April 2005	N.1.1 and a Table	Added text and a new table (Table N-1) to describe correlation of required tables between Appendices L and N.
April 2005	N.1.6	Minor text revisions to clarify additions to DCS.
April 2005	N.1.7	Submittal_Info table reference changed to L_Submittal_Info. Revised text to indicate that this table is required.
April 2005	Submittal_Info Table	Table name changed to "L_Submittal_Info". Field CASE_ZIP removed.Revised descriptions for META_NM, and STUDY_ZIP to remove path and add requirement for General folder. Length for effective date removed. V_DATM_LID type changed to "Long"and length deleted and reference to D_V_Datum domain table added. LG_PAN_NO type changed to "Text" and Length changed to "4". (Was Table N-1 [December 2004] Now Table N-2 [April 2005])
April 2005	N.2.2.1	Text revised to specify L_Submittal_Info table in Dbase IV or Microsoft Access format and requirements.

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	Figure - Terrain Submittal Flowchart	Figure deleted. (Was Figure N-1 [December 2004]).
April 2005	N.2.2.2 and Table - Accepted File Formats for Source Terrain Data	Section and table renamed. For 3-D Point shapefile and 2-D or 3-D Polyline shapefile, prj is also required. (Was Table N-2 [December 2004]. Now Table N-3 [April 2005]).
April 2005	N.2.2.3 and Tables – Supplemental Terrain Spatial Files	Section moved and renumbered. Section and table title revised to add "Supplemental" and requirement for Supplemental Info folder. Text revised to clarify description of names of tiled data files. (Was Table N-3 [December 2004]. Now Table N-9 [April 2005]).
April 2005	Figure - File Naming Convention	(Was Figure N-2 [December 2004]. Now Figure N-1 [April 2005]).
April 2005	Tables S_SinkBreach, S_NoData, S_VoidArea, S_ExternalBoundary, and S_Island spatial files	Deleted Decimal Place column. (Were Table N-4, N-5, N-6, N-7, N-8 [December 2004]. Now Table N-10, N-11, N-12, N-13, N-14 [April 2005]).
April 2005	Table S_NoData Spatial File	Deleted "0" decimal places for NoDataID. Added LEN_LID and V_DATM_LID fields. (Was Table N-5 [December 2004]. Now Table N-11 [April 2005]).
April 2005	N.2.2.3 Subsection Raster Elevation Data	Revised text to specify that if DEMs are used, they must be submitted.
April 2005	Table S_StreamsDEM Spatial File	LEN_LID field added. (Was Table N-9 [December 2004]. Now Table N-15 [April 2005]).
April 2005	N.2.2.4	Now section N.2.2.3. Revised text.
April 2005	Table Data Types	Table renamed to "Source Data Types" and moved under N.2.2.4 Source Terrain Data. (Was Table N-11 [December 2004]. Now Table N-7 [April 2005]).

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	New Section	New section N.2.2.4 Source Terrain Data added.
April 2005	Figure N-2 Prioritization of Overlapping Datasets	Figure added.
April 2005	Table N-8 Contour Spatial File	LEN_LID and V_DATM_LID fields added.
April 2005	N.2.2.5 and Raster Elevation Data	Moved into new section, N.2.2.4 Source Terrain Data
April 2005	New Section	New section N.2.2.6 Output Terrain Data added. Contour Spatial File, Raster (formerly Tiled) Elevation Data, Flow Vector Data moved into section.
April 2005	N.2.3.3 Digital Deliverables	Preference for CD_ROM removed.
April 2005	N.2.3.3 Subsection Directory Structure and Folder Naming Conventions	Revised text to specify folder structures and names and file names in greater detail.
April 2005	N.3	Table N-24 Data Dictionary has been broken into individual tables and inserted into sections.
April 2005	N.3.1	Revised text to indicate that survey data must specify horizontal and vertical datums in the L_Submittal_Info table.
April 2005	N.3.2.1	Re-organized section. Added master table of Database Tables for Cross Sections. Moved tables for cross sections from Data Dictionary to this section. Revised table names and added references to tables.
April 2005	Figure N-4 Entity Relationship Diagram for Cross Sections	Revised figure to correspond to tables.

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	N.3.2.2	Revised text. Moved tables for TBM from Data Dictionary to this section.
April 2005	N.3.2.3	Re-organized section. Added master table of Database Tables for HWM. Moved tables for HWMs from Data Dictionary to this section. Revised table names and added references to tables.
April 2005	Figure N-5 Entity Relationship Diagram for High Water Marks	Revised figure to correspond to tables.
April 2005	N.3.2.4	Re-organized section. Added master table of Database Tables for Structures for Detailed Studies. Moved tables for structures from Data Dictionary to this section. Revised table names and added references to tables.
April 2005	Figure N-6 Entity Relationship Diagram for Structures for Detailed Study	Revised figure to correspond to tables.
April 2005	N.3.2.5	Re-organized section. Added master table of Database Tables for Structures for Limited Detailed Studies. Moved tables for structures from Data Dictionary to this section. Revised table names and added references to tables.
April 2005	Figure N-7 Entity Relationship Diagram for Structures for Limited Detailed Study	Revised figure to correspond to tables.
April 2005	N.3.3.3 Digital Deliverables	Preference for CD_ROM removed.

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	N.3.3.3 Subsection Directory Structure and Folder Naming Conventions	Revised text to specify "XML-format metadata file".
April 2005	Table N-24	Data Dictionary has been broken into individual tables and inserted into sections. Revised table names to include appropriate prefixes (L_, S_, _D). Revised tables to correspond to ERDs and for accuracy.
April 2005	Table - Hydrology Database and Spatial Data	S_HydroLink description revised to specify lines. (Was Table N-25 [December 2004]. Now Table N-90 [April 2005]).
April 2005	Table - L_HydroModel Table	Lengths for Descript, ZipName, and RPTName revised to "254". WtshdFldr, BasinFname, NodeFname, LinkFname, SoilFname, and ImpFname deleted. IsNew field added. Fields revised to eliminate path references and require placement in specific folder. (Was Table N-27 [December 2004]. Now Table N-92 [April 2005]).
April 2005	N.4.2.1	Revised text to include spatial projection information.
April 2005	Table - S_HydroNode Spatial File	NodeName length revised to "254" and requirement added to Description for uniqueness across a watershed. IsPourPt description revised to include outlets. (Was Table N-28 [December 2004]. Now Table N-93 [April 2005]).
April 2005	Table - S_HydroLink Spatial File	WTR_NM_LID type revised to "Long" and length removed. LinkName length revised to "254" and requirement added to Description for uniqueness across a watershed. (Was Table N-29 [December 2004]. Now Table N-94 [April 2005]).

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	N.4.2.2 Subsection S_HydroBasin Spatial File	Revised text to include outlet/pour point.
April 2005	Table - S_HydroBasin Spatial File	BasinName requirement added to Description for uniqueness across a watershed. WtshdFldr field added. (Was Table N-30 [December 2004]. Now Table N-95 [April 2005]).
April 2005	Table - S_HydroResult Spatial File	Decimal Places column added. Discharge type revised to "Numeric", "9" as length with "1" decimal place. Disch_LID type revised to "Long" and length deleted. (Was Table N-31 [December 2004]. Now Table N-96 [April 2005]).
April 2005	Table - L_Wtr_Nm Table	WTR_NM_LID type revised to "Long" and length deleted. WTR_NM length revised to "254". (Was Table N-32 [December 2004]. Now Table N-97 [April 2005]).
April 2005	Table - L_HydroEvent Table	Decimal Places column added. ReturnPer type revised to "Numeric", "6" as length with "1" decimal place. (Was Table N-33 [December 2004]. Now Table N-98 [April 2005]).
April 2005	Table - S_HydroGage Spatial File	Lengths for GageDesc and TimeFname revised to "254". WtshdFldr field required. Gage_LID and Time_LID types revised to "Long" and length deleted. Start_PD and End_PD lengths deleted. TimeFName revised to eliminate path references and require placement in Simulations folder. (Was Table N-34 [December 2004]. Now Table N-99 [April 2005]).
April 2005	Table - S_HydroLandUse Spatial File	Field names revised to "LUType" and "LUDesc" and lengths revised. LUType allows use of abbreviations. LUType required, LUDesc not required. (Was Table N-36 [December 2004]. Now Table N-101 [April 2005]).

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	Table - S_HydroImpervious Spatial File	ImpervPerc type revised to "Numeric" and length "6" added. (Was Table N-37 [December 2004]. Now Table N-102 [April 2005]).
April 2005	Table - S_HydroTC Spatial File	TC and Time_LID types revised and lengths and decimal places revised. (Was Table N-38 [December 2004]. Now Table N-103 [April 2005]).
April 2005	Table - L_HydroEquation Table	Length for Equation revised to "254". TR type revised to "Numeric" and length and decimal places added. (Was Table N-39 [December 2004]. Now Table N-104 [April 2005]).
April 2005	Table - L_HydroNodeParam table	Field revised to "NodeParID". Value type revised to "Numeric" and length and decimal places added. Value field renamed to "ParamValue". (Was Table N-40 [December 2004]. Now Table N-105 [April 2005]).
April 2005	Table - D_HydroParam Table	Length for Descript revised to "254". UnitId type revised to "Long" and length deleted. (Was Table N-41 [December 2004]. Now Table N-106 [April 2005]).
April 2005	Table N-43 L_HydroCNResult Table	WtshdFldr field added and description revised to remove path reference. CN type revised to "Numeric" and length and decimal places added. SoilFname and LandFname deleted. (Was Table N-43 [December 2004]. Now Table N-108 [April 2005]).
April 2005	Table - L_HydroCNLookup Table	Field names revised to "SCSSoil", "LUType", and "SCSLUType". Description for SCSSoil revised. Length and description for LUType revised. CN type revised to "Numeric" and length and decimal places added. Length for Source revised to "254". (Was Table N-44 [December 2004]. Now Table N-109 [April 2005]).

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	Table - L_HydroStormInfo Table	Storm_LID type revised to "Long" and length deleted. (Was Table N-45 [December 2004]. Now Table N-110 [April 2005]).
April 2005	Table - L_HydroStormCurve Table	Revised Time_LID, Depth, Len_LID, Intensity, Vel_LID types, length, and decimal places. (Was Table N-46 [December 2004]. Now Table N-111 [April 2005]).
April 2005	N.4.3.3 Digital Deliverables	Preference for CD_ROM removed.
April 2005	N.4.3.3 Subsection Data Directory Structure and Folder Naming Conventions	Revised text to specify "XML-format metadata file" and folders and file names. Supplemental Info folder and L_Submittal_Info table added.
April 2005	N.5.2.1	Revised text to include spatial projection information.
April 2005	Hydraulics Tables and Spatial Data	S_RefPoint revised for downstream point.
April 2005	Table - L_HydraModel Table	Lengths for Descript, ZipName, RptName, and TimeFname revised to "254". Hydra_LID type revised to "Long" and length deleted. StreamFldr and IsNetwork fields added. MapFname, BfeFname, FlowFname, JunctFname, NvalFname, and OverFname fields deleted. Descriptions revised to eliminate path references and require placement in specific folders. (Was Table N-49 [December 2004]. Now Table N-114 [April 2005]).
April 2005	Table - S_StreamCntrLine Spatial File	WATER_LID, CHAN_LID, and WTR_NM_LID types changed to "Long" and length deleted. Length for SegName revised to "254" and requirement added to description that SegName be unique to a stream. (Was Table N-50 [December 2004]. Now Table N-115 [April 2005]).

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	Table - S_HydraCross Section Spatial File	XS_LTR not required. RefPtID, WTR_NM_LID, LEN_LID, and V_DATM_LID types revised to "Long" and length deleted. WSEL_REG, TOP_WIDTH, XS_AREA, AREA_LID, VELOCITY, and VEL_LID fields deleted. Length for XS_LTR changed to "10". STREAM_STN description revised to add "reference point". BED_ELEV description revised to add "Lowest". (Was Table N-51 [December 2004]. Now Table N-116 [April 2005]).
April 2005	Table - S_RefPoint Spatial File	RefPtID type revised to "Long" and length deleted. (Was Table N-52 [December 2004]. Now Table N-117 [April 2005]).
April 2005	Table - L_HydraFloodResult Table	Elevation field deleted. WSEL_Model, WSEL_Reg, TOP_WIDTH, XS_AREA, AREA_LID, VELOCITY, and VEL_LID fields added. DISCH_LID, LEN_LID and V_DATM_LID types revised to "Long" and length deleted. Description for Discharge revised to delete cfs. (Was Table N-53 [December 2004]. Now Table N-118 [April 2005]).
April 2005	Table - L_Wtr_Nm Table	WTR_NM_LID type revised to "Long" and length deleted. Length for WTR_NM revised to "254". (Was Table N-55 [December 2004]. Now Table N-120 [April 2005]).
April 2005	Table - S_HydraMapping Spatial File	WTR_NM_LID type revised to "Long" and length deleted. HydraID field added. (Was Table N-56 [December 2004]. Now Table N-121 [April 2005]).
April 2005	Table - S_BFE Spatial File	BFE_LN_ID, LEN_LID, and V_DATM_LID types revised to "Long" and length deleted. HydraID field added. (Was Table N-57 [December 2004]. Now Table N-122 [April 2005]).
April 2005	N.5.2.3 Stream Profiles	Text revised for clarification and to specify RASPLOT layer.

Date	Affected Section(s)/Subsection(s)	Description of Changes
April 2005	N.5.2.3 Floodway Data Tables	Text revised for clarification and to reference Appendix J. Removed reference to template.
April 2005	Table - S_HydraFlowPath Spatial File	WTR_NM_LID, Water_LID, and Len_LID types revised to "Long" and length deleted. Length for PathName revised to "254". (Was Table N-58 [December 2004]. Now Table N-123 [April 2005]).
April 2005	Table - S_HydraJunction Spatial File	LEN_LID and V_DATM_LID types revised to "Long", lengths deleted, and these are only required if Invert is populated. (Was Table N-59 [December 2004]. Now Table N-124 [April 2005]).
April 2005	Table - L_HydraXsPt Table	XsectID required. Len_LID type revised to "Long" and length deleted. Station description expanded to include orientation. (Was Table N-60 [December 2004]. Now Table N-125 [April 2005]).
April 2005	Table - S_HydraNvalue Spatial File	All fields now are required. (Was Table N-61 [December 2004]. Now Table N-126 [April 2005]).
April 2005	Table - S_Ovrbnkln Spatial File	Field name revised to "OVRBNK_ID". OVRBNK_ID and WTR_NM_ID types revised to "Long" and lengths deleted. (Was Table N-62 [December 2004]. Now Table N-127 [April 2005]).
April 2005	N.5.3.3 Subsection Data Directory Structure and Folder Naming Conventions	Revised text to specify "XML-format metadata file", file names, and Supplemental Info folder. Supplemental Info folder added. Hydraulic Databases files include L_Submittal_Info table.
May 2005	N.1.1 Introduction	Revised text to clarify that DCS tables are in addition to Appendix L tables and can be used to populate Appendix L tables.
May 2005	N.2.2.2 Accepted File Formats	Revised text to delete "source" and specify "accepted for terrain data."
May 2005	N.2.3.1 Metadata	Revised text to clarify metadata requirements.

Date	Affected Section(s)/Subsection(s)	Description of Changes
May 2005	N.2.3.3 Digital Deliverables	Revised requirements for Output/DEM_xx folder by deleting "Any files that don't fit into the other categories".
May 2005	Figure N-7 Entity Relationship Diagram for Structures for Limited Detailed Study	Removed fields ExPpDia and RsrDia and renamed ExPpPpHt to ExPpRise to be consistent with changes to Table N-79, L_ApxRsr Table.
May 2005	Table N-77. L_ApxRsr Table	Removed fields ExPpDia and RsrDia. Field ExPpHt renamed to ExPpRise and description revised to include diameter. Descriptions for fields RsrHlLn and RsrLn revised to include diameter.
May 2005	Table N-109 L_HydroCNLookup	Revised field name in description from "Soil_Type" to "SoilType".
May 2005	N.3.3.1 Metadata	Revised text to clarify metadata requirements.
May 2005	N.3.3.3 Digital Deliverables	Revised text in the Metadata subsection to remove reference to Appendix L.
May 2005	N.4.3.1 Metadata	Revised text to clarify metadata requirements.
May 2005	N.5.3.1 Metadata	Revised text to clarify metadata requirements.

Table of Contents

List of Figures

List of Tables

Appendix N

Data Capture Standards for Mapping Partners

N.1   Overview

N.1.1   Introduction   [May 2005]

The purpose of the Data Capture Standards (DCS) in this Appendix is to provide a consistent framework for collection, analysis, storage and retrieval of the data needed for a Flood Insurance Study (FIS) or Flood Insurance Rate Map (FIRM) revision. Providing this framework is intended to make the study assessment process more efficient; make the data more available for future use; and preserve the investment made in the data. It is part of a 5-year plan to collect and provide data to the Mapping Information Platform (MIP) for sharing through the data federation.

For those Mapping Partners that use the engineering and mapping tools provided by FEMA, the required data will be automatically archived in the recommended format. In the case of Mapping Partners who have developed other automated processes for performing production style flood mapping, these data standards serve as the mechanism for collecting and archiving the required data.

These data standards are the vehicles used to help collect and manage the engineering deliverables that result from the flood insurance study process. The DCS also facilitate the building of an Enhanced Digital Flood Insurance Rate Map (DFIRM) database by providing information that is needed in manageable pieces during the progression of the mapping process. The DCS will also support queries to the MIP that will track and evaluate progress metrics on studies and report these metrics to the process stakeholders.

Similarities have been drawn between the DCS in this Appendix and Appendix L of these Guidelines. The clear difference between Appendix L and the DCS is that the DCS is a collection of databases for use as part of the intermediate processes of creating a DFIRM. Appendix L is associated with the output and final deliverables of the flood hazard mapping.

There is some overlap between the two data standards, specifically in areas where the DCS, once capture points have been reached, reports end result data. There are also places where the two datasets have no overlap at all. Examples of this would be how Appendix L captures data such as planimetric data and pre-/post-Preliminary DFIRM mapping information. Conversely, the DCS stores data types such as terrain processing and field survey information, neither of which are stored in Appendix L tables.

As a part of the ongoing review and refinement of all FEMA datasets, Appendix L of these Guidelines and the DCS will undergo a review to specifically see how best to account for the data stored in the two datasets and how this can be made clearer to all Mapping Partners. The

result of this review could involve refinements to the datasets or the joining of the data into one comprehensive dataset.

In the interim, Mapping Partners should submit DCS tables defined in this appendix for all re-modeled areas. All Standard Appendix L tables should be submitted for the entire community or county being mapped. The correlations between required tables defined by Appendices L and N are listed in Table N-1. The records stored in the DCS tables listed in Table N-1 are usually a subset of the total number of records required for Appendix L and so should be used to help populate the corresponding Appendix L tables.

Table N-1. Correlation of Required Tables between Appendices L and N

DFIRM Tables in Appendix L	DCS Tables in Appendix N
S_XS	S_HydraCrossSection
S_Wtr_Ln	S_StreamCntrLine
L_Stn_Start	S_RefPoint
S_Riv_Mark	S_RefPoint
S_Fld_Haz_Ln	S_HydraMapping
S_Gen_Struct	S_Struc and S_ApxStr (and associated lookup tables)

The data standards are provided in subsections. Each subsection corresponds to major engineering data capture points and includes guidance on collecting terrain, survey, hydrologic, and hydraulic data. These sections describe the minimum dataset of deliverables established by FEMA for floodplain mapping submittals. These data standards will serve in addition to the Technical Support Data Notebook and other standards detailed in other parts of these Guidelines.

N.1.2   Terrain   [December 2004]

The Terrain section describes what is needed for capture of the digital topographic data that was used to create the elevation data representing the terrain environment of a watershed and/or floodplain. It allows for flexibility in the types of information provided while describing in detail the specifics of the deliverables. Once this type of data is provided, FEMA will be able to account for the origins of the flood study elevation data. The requirements in Appendix A of these Guidelines must still be met to define the quality of the topographic data used.

N.1.3   Survey   [December 2004]

The Survey section describes those spatial datasets and data tables necessary to digitally represent data collected in the survey phase of the study. The survey phase has traditionally been one of the most expensive portions of the study. These standards describe how the survey data shall be submitted for features such as dams, culverts, bridges, and channels.

In an effort to aid the Mapping Partner in disseminating the data requirements to field surveyors, FEMA has prepared *Data Capture Guidelines* for survey data. This manual will guide surveyors in collecting the type of information the engineer requires to create a digital representation of a floodplain hydraulic structure. The *Data Capture Guidelines* are considered "guidelines" because they describe how to collect data and are not required data submittal. The tables in the Survey section of the DCS serve the purpose of archiving the data needed for the application of hydraulic models.

N.1.4   Hydrology   [December 2004]

The Hydrology section describes those spatial datasets and data tables necessary for documenting the hydrologic procedures for estimating flood discharges for the flood insurance study. The goal of this section is to describe the format and type of hydrologic data expected by FEMA for new riverine studies. The objective is to archive the hydrologic data in a database so that this data can be revised and used with minimum effort in future flood insurance studies or map revisions. Another objective is to collect sufficient data on hydrologic procedures to populate the Enhanced DFIRM database.

The minimum required dataset for documenting the hydrologic procedures is described in this section of the DCS. This minimum requirement includes input and output files for all hydrologic models and spatial datasets that are needed to implement the models. Because of the frequent use of hydrologic models such as HEC-1 and HEC-HMS that utilize a design storm event and the Natural Resources Conservation Service hydrologic procedures and regional regression equations, more detailed data is requested to describe these methodologies. Detailed information on continuous simulation models like HSPF, SWMM and MIKE 11 RR are not required but the input and output files and supporting spatial data files are archived. As metrics are collected on the types of hydrologic models used most frequently by Mapping Partners, additional tables will be added in the future to capture this data in more detail.

N.1.5   Hydraulics   [December 2004]

The development of a hydraulic model to provide water-surface elevations for floodplain mapping requires a significant investment in time and resources to obtain and process topographic survey data including cross-section and bridge surveys. Recent developments in digital terrain and geospatial database management technology make it possible to protect this investment for existing and future projects to a much greater extent than was possible in the past. This section describes the format and type of hydraulic data to be provided to FEMA for new riverine flood insurance studies.

The minimum required dataset for documenting the hydraulic procedures is described in this section of the DCS. This minimum requirement includes input and output files for all hydraulic models and spatial datasets that are needed to implement the models. As with hydrology, there is a focus on HEC hydraulic models such as HEC-2 and HEC-RAS due to their frequency of use and the intent is to capture the data required to populate the Enhanced DFIRM database. Detailed information on one- and two-dimensional unsteady flow models like FEQ, ICPR, FLO-2D, and MIKE 11 HD are not required but the input and output files and supporting spatial data

files are archived. As metrics are collected on the frequency of use of hydraulic models, additional tables will be added to capture the data from these models in a true database format.

N.1.6   Updates   [December 2004]

It is the intention of the NSP to provide yearly management reports as a part of the data standards process. These reports will detail metrics collected on study types and other key study factors associated with flood mapping. Coastal data is currently not included in the data standards. Methodologies for coastal studies are presently being reviewed and developed. Once this process is complete, detailed description of coastal data submittal as dictated by the study process will be included in the data standards. Data capture standards for other more specialized flow regimes and processes (for example alluvial fans, closed system pipe flow and interconnected pond hydraulics) will also be evaluated for inclusion in the future. These updates will be done on a yearly basis.

N.1.7   Submittal Information   [April 2005]

The L_Submittal_Info table is a required database table. This table holds essential information about the FEMA Case, datums and projections, and location of metadata and study-related zip files. This table is submitted along with the data given in the four subsections to describe who collected the data and where the data is coming from.

The L_Submittal_Info table contains the attributes shown in Table N-2.

Table N-2. L_Submittal_Info Table

Field	Type	Length	Required	Description
SubInfoID	Long		Yes	Primary key for this table.
CASE_NO	Text	12	Yes	FEMA Case Number for study.
CASE_DESC	Text	254	Yes	General description of the study.
EFF_DATE	Date		Yes	Effective date of the case.
STUDY_PRE	Text	20	No	Study prefix, i.e. "City of".
STUDY_NM	Text	50	Yes	Study name.
STATE_NM	Text	50	Yes	State name.
CNTY_NM	Text	50	Yes	County name.
JURIS_TYP	Text	50	No	Political jurisdiction type.
LG_PAN_NO	Text	4	Yes	Largest panel number.
OPP_TF	Boolean		Yes	Only panel printed?
H_DATUM	Text	10	Yes	Horizontal datum. Valid Entries include "NAD27" or "NAD83".
V_DATM_LID	Long		Yes	Vertical datum lookup identification and foreign key to D_V_Datum domain table (see Appendix L of these Guidelines).
PROJECTION	Text	50	Yes	Map projection used for the hard copy FIRM publication.
PROJ_ZONE	Text	10	No	Projection zone.
CW_TF	Boolean		Yes	Countywide?
SW_TF	Boolean		Yes	Statewide?
CBRS_PHONE	Text	15	No	Coastal Barrier Resources System (CBRS) Phone number.
CBRS_REG	Text	1	No	CBRS Coordinator's region.
RTROFT_TF	Boolean		Yes	Retrofit?
META_NM	Text	50	Yes	Metadata file name. Must be stored in *General* folder.
STUDY_ZIP	Text	254	No	File name of the zipped file that contains the FIS report or auxiliary data that is relevant to the entire study. Must be stored in *General* folder.
SUBMIT_BY	Text	100	Yes	Company name of Mapping Partner who is submitting this dataset.
SUBMIT_CON	Text	100	Yes	Contact person for this submittal.
SUBMIT_PHO	Text	15	Yes	Phone number of Mapping Partner
Restricted	Boolean		Yes	Some data in this submittal can't be distributed freely. See the metadata file.

N.1.8   Future Vision   **[December 2004]**

This document presents an interim solution to enable data capture in the short term. The long-term objective is to adopt an approach to data exchange that is open and vendor independent. This release of the standards mandates specific file naming and folder structure. In upcoming versions, the plan is to require a metadata file (read me file) that describes file names and their location in the folder structure of the submittal. This will enable Mapping Partners to submit data without restrictions on file naming and folder structure.

The vision of FEMA is to establish an Interoperable Framework for Open Data Exchange Standards (OpenDES) that enables the full potential of its information holdings in all mission areas. This framework will consist of common information models and tools for data sharing and exchange based on adopted information technology standards such as: OGC/ISO Geography Markup Language (GML), FGDC/ISO (Federal Geographic Data Committee/International Organization for Standardization) Metadata, and W3C Web Service technologies such as eXtensible Markup Language (XML) and Simple Object Access Protocol (SOAP).

The objectives of this open standards-based approach are to:

- Eliminate interoperability barriers to sharing hazard resources managed by different organizations using different technologies

- Enable Mapping Partners to share and exchange data irrespective of their underlying technologies

- Define secure and robust formats for data capture and exchange for use across multiple platforms, applications and devices

- Realize the full integration of resources with Web enabled technologies

- Deploy the framework to enhance processes and tools for hazard data production, management and dissemination

- Leverage related private, local, State, Federal, and international initiatives, such as:

  o E-Government (e.g. Geospatial One-Stop, DHS, FGDC NSDI, etc)

  o Industry-driven standards consortia that rapidly seed the market with certified Standards-based Commercial Off The Shelf (SCOTS) products and tools

N.2 Terrain Submittal Standards

N.2.1 Overview [April 2005]

The goal of this subsection is to describe the format and type of terrain data expected by FEMA for new Flood Insurance Studies. The Mapping Partner should refer to Appendix A of these Guidelines for guidance on terrain data production.

There is a broad range of methods that Mapping Partners can use to gather terrain data and extract useful information for hydraulic and hydrologic models. The simplest method, but least accurate, is to use hard copy U.S. Geological Survey (USGS) quadrangles with contours and streams. Using an engineering scale, planimeter, and map wheel, Mapping Partners can calculate cross-section geometries and basin areas. The main disadvantage of this technique is that the underlying terrain data is not captured in a digital format for potential future use.

Other Mapping Partners may have aerial photography performed and receive contours digitally. This data is useful for automating many hydraulic and hydrologic computations. Its main disadvantage is that the contour maps leave out the details of what is happening in between adjacent contours. This is especially troublesome in coastal areas.

The best type of terrain data is based on three-dimensional spot elevations and breaklines. Many commercial software packages can use this type of data to create Triangular Irregular Networks (TINs). A TIN is the most precise approximation of the earth's surface, but it is also the most costly in terms of storage size. A TIN can be used to create digital elevation models (DEMs) that are evenly spaced elevations. DEMs are useful for hydrologic analysis and for generating approximate floodplain boundaries rapidly; however, like contours, they are still approximations of a better data source and should only be used when necessary.

The rest of this subsection will explain the data requirements for a terrain submittal.

N.2.2 Requirements [April 2005]

N.2.2.1 Data Files [April 2005]

The minimum required data for a terrain submission is the source terrain data. This data can be contained in a single file, or more commonly, a tiled set of files. If any terrain processing has been performed, the intermediate and final files are to be submitted as well. Examples of these additional files are spatial files used to indicate locations for breaching sinks, flow vectors files, and hydrologically correct DEMs.

Certain spatial features, as indicated below, must be stored in an ESRI shapefile or Open GML document with the necessary attribute fields and spatial projection information. Other terrain data must be submitted in the file formats specified in Table N-3. All database tables must be populated in Dbase IV format or Microsoft Access format.

N.2.2.2 Accepted File Formats [May 2005]

Table N-3 shows the file formats that are accepted for terrain data. This data can be contained in a single file or a tiled set of files. If the data is tiled, it is important to note that DTM files must not overlap each other. Any tiled data must have an accompanying index spatial file.

Airborne Light Detection and Ranging (LIDAR)-generated data shall be submitted as two series of files: one for bare earth only, one for all returns.

Table N-3. Accepted File Formats for Terrain Data

Format	Extension	References
ArcInfo Tin Generate (line)	LIN	See ESRI support: www.esri.com
ArcInfo Tin Generate (point)	PNT	See ESRI support: www.esri.com
AutoCAD DXF version 12	DXF	www.autodesk.com
ESRI Grid Ascii	ASC	See ESRI support: www.esri.com
Comma delimited point text	XYC	
Space delimited point text	XYS	
LAS Binary LIDAR points	LAS	http://www.lasformat.org/
3-D Point shapefile	SHP (include shx,dbf and prj)	See ESRI support: www.esri.com
2-D or 3-D Polyline shapefile	SHP (include shx,dbf and pdf	See ESRI support: www.esri.com

N.2.2.3 Tiled Terrain Spatial Files [April 2005]

All tiled terrain data shall be submitted with an accompanying S_TileIndex polygon spatial file. Tiles must have only one part and cannot self-intersect (must be simple). Adjacent tiles must not overlap or have gaps between them. The tile shape must completely contain the DTM data in the associated file. The attributes of the S_TileIndex Spatial File are provided in Table N-4.

Table N-4. S_TileIndex Spatial file

Field	Type	Length	Required	Description
GridID	Text	20	Yes	Primary key for table. Used to identify tiled data sources. Example: G05, F1254.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

The names of tiled data files will be constructed using the GridId, an underscore, the data type suffix (see Table N-7), and the file format extension (see Table N-3). The format is ***GridId_datatype.FileformatExtension.***

For example, file G104_CNT.DXF would be the AutoCAD contour file for panel G104, and file G104_DEM_50.ASC would be the 50-foot cell size DEM for panel G104.

Figure N-1. File Naming Convention

A01	B01	C01	D01	E01	F01	G01	H01
A02	B02	C02	D02	E02	F02	G02	H02
A03	B03	C03	D03	E03	F03	G03	H03
A04	B04	C04	D04	E04	F04	G04	H04
A05	B05	C05	D05	E05	F05	G05	H05
A06	B06	C06	D06	E06	F06	G06	H06
A07	B07	C07	D07	E07	F07	G07	H07
A08	B08	C08	D08	E08	F08	G08	H08
A09	B09	C09	D09	E09	F09	G09	H09
A10	B10	C10	D10	E10	F10	G10	H10
A11	B11	C11	D11	E11	F11	G11	H11

Attributes of Sample_index.shp

Shape	GridId
Polygon	G06
Polygon	F06
Polygon	E06
Polygon	D06
Polygon	C06
Polygon	A06
Polygon	B06
Polygon	H07

D06_DEM_50.asc

Data Type:

ARL = LIDAR - All Returns
BE = Bare Earth Points
3DL = 3D Breaklines
2DL = 2D (soft) Breaklines
CNT = Contours
DEM_*xx* = DEM with a minor cell
    spacing of *xx*
HDEM_*xx* = Hydrologically corrected
    DEM with a minor cell
    spacing of *xx*
VEC = Flow vectors
Other = Any files that don't fit in the
    other categories

File Format:

ASC = ArcInfo Grid ASCII
LIN = ArcInfo TIN generate (line)
PNT = ArcInfo TIN generate (point)
SHP = ESRI Shapefile
DXF = AutoCAD DXF
XYC = Comma-delimited ASCII Point
    file (*X,Y,Z*)
XYS = Space-delimited ASCII Point file
    (*X Y Z*)
LAS = ASPRS LIDAR data Exchange
    Format

N.2.2.4 Source Terrain Data **[April 2005]**

The minimum required data for a terrain submission is the source terrain data. This data can be contained in a single file, or more commonly, a tiled set of files. Data of various types can be grouped together into datasets and prioritized based on accuracy.

Perimeter Information

A dataset contains all terrain data files from each source of digital terrain data. A typical submittal could contain one dataset for LIDAR, another dataset for DEM data, and a third dataset for private developer data. The spatial perimeters of datasets can overlap each other.

A name is assigned to each dataset to describe the source of digital terrain data (such as "2001 LIDAR Aerial Data"). This name will be stored in a perimeter bounding polygon for each dataset. This perimeter polygon delineates the outer boundary of data from one dataset

A user prioritizes the datasets by arranging them according to their importance for the submittal, and entering a priority number from 1 to x into the S_Perimeter spatial file (where 1 is highest priority and x is the number of polygons). This, in effect, produces a set of rules that are used for the TIN creation.

As an example, assume that a submittal has DEM data, aerial LIDAR data, and a private developer's point and breakline data. The level of confidence in the LIDAR data is highest but the data is only available at one location. The developer's data is good but may not cover the entirecounty or watersheds of interest. The DEM data may cover the entire state but it is less accurate than the other available sources.

To use the best available data, prioritize the data from highest (LIDAR data) to lowest (DEM data). Without prioritization, all the points and break lines overlap each other. After the datasets have been prioritized, only the most accurate data is utilized at any location within the submittal. Figure N-2 illustrates how prioritization is used to resolve overlapping datasets.

Figure N-2. Prioritization of Overlapping Datasets

Section N.2
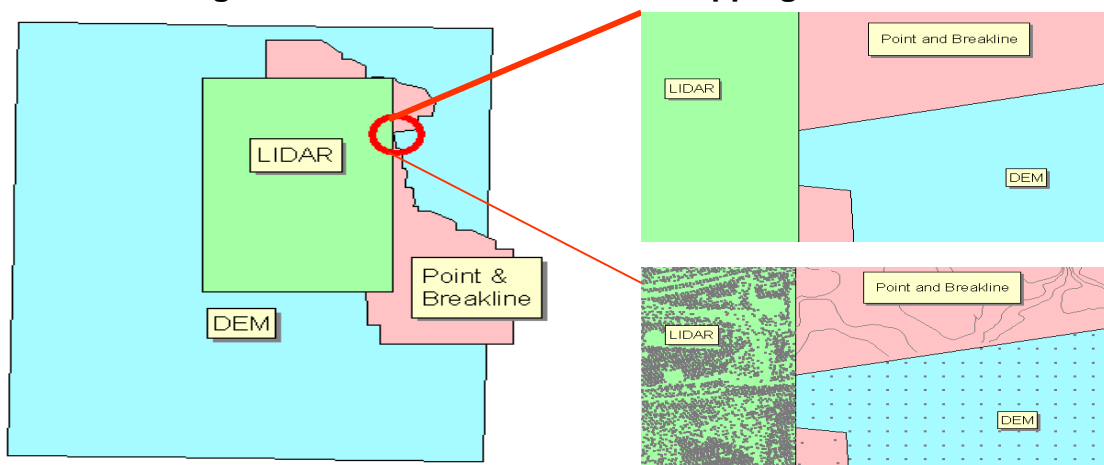
S_Perimeter Spatial File

This polygon spatial file is required. These polygons define the perimeter of a dataset and can be irregularly shaped. Perimeters must have only one part and cannot self-intersect (must be simple). Perimeter polygons can overlap, because each polygon represents a different dataset. The attributes of the S_Perimeter Spatial File are provided in Table N-5.

Table N-5. S_Perimeter Spatial File

Field	Type	Length	Required	Description
PerimID	Long		Yes	Primary key for table
Priority	Long		Yes	A value from 1 to X where 1 is highest priority. No duplicates allowed.
Descript	Text	50	Yes	Unique descriptive name of a dataset (i.e. "City of Matthews 2001 LIDAR")
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

L_PerimFile Table

The L_PerimFile table is a database table. It is required for all terrain submittals. This table defines the list of files that are contained by each perimeter polygon in S_Perimeter. The L_PerimFile table contains the elements presented in Table N-6.

Table N-6. L_PerimFile Table

Field	Type	Length	Required	Description
PerimID	Long		Yes	Foreign key to S_Perrimeter spatial file
FileName	Text	254	Yes	File title, i.e. "G04_3DL.shp"
Folder	Text	50	Yes	Submittal folder, i.e. "Source\3DL"

Source Data Types

Terrain files are organized for submittal under folders corresponding to each available data type in Table N-7.

Section N.2

Table N-7. Source Data Types

Submittal Folder	Data Type	Description
Source\ARL	ARL	LIDAR – All Returns
Source\BE	BE	Bare Earth Points (LIDAR and non-LIDAR)
Source\3DL	3DL	3D Breaklines
Source\2DL	2DL	2D (soft) Breaklines
Source\CNT	CNT	Elevation contours
Source\DEM_xx	DEM_xx	DEM with the minor cell spacing of xx
Source\HDEM_xx	HDEM_xx	Hydrologically corrected DEM with minor cell spacing of xx
Source\Supplemental Spatial Files	Other	Any files that don't fit in the other categories

Contour Spatial File

These linear spatial files shall be submitted if used.   The file naming convention in the "TileIndex" section should be used (i.e. G04_CNT.shp). Contours cannot self-intersect (must be simple). The attributes of the Contour Spatial File are provided in Table N-8.

Table N-8. Contour Spatial file

Field	Type	Length	Decimal Places	Required	Description
ContourID	Long			Yes	Primary key for table
Elev	Numeric	10	3	Yes	Elevation in feet
LEN_LID	Long			Yes	A foreign key to the D_Length_Units table (see Appendix L).
V_DATM_LID	Long			Yes	A foreign key to the D_V_Datum table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

Raster Elevation Data

If DEMS are used, they must be submitted. The standard ESRI Grid ASCII format can be used to create a tile of elevations at a uniform spacing interval. These elevations can represent both uncorrected and hydrologically corrected DEMs.

Supplemental Spatial Files

Supplemental spatial files for a terrain submittal are listed in Table N-9. These files are continuous over an entire project area, unlike the Tiled Data. These files are not required in all cases, but if they are used, they shall be submitted in the *Source/Supplemental Spatial Files* folder.

Table N-9. Supplemental Terrain Spatial Files

Spatial File	Description
S_SinkBreach	A linear spatial file representing sink breaches used to hydrologically correct terrain models.
S_NoData	A polygon spatial file that is used to modify DEM elevations.
S_VoidArea	A polygon spatial file used to delete unwanted points before building TINs.
S_ExternalBoundary	A polygon spatial file used to define the outer extents of a TIN model.
S_Island	A polygon spatial file used to represent an island within a void area.
S_StreamsDEM	A linear spatial file used for enforcing flow directions.

S_SinkBreach Spatial File

This linear spatial file shall be submitted if used. Sink breach polylines are used to breach sinks in the DEM in order to create a hydrologically correct DEM. Breach lines are placed at the toe of fill of culverts and other depressions that need to be breached (drained). Breaches must have only one part and cannot self-intersect (must be simple). The attributes of the S_SinkBreach Spatial File are provided in Table N-10.

Table N-10. S_SinkBreach Spatial File

Field	Type	Length	Required	Description
BreachID	Long		Yes	Primary key for table
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_NoData Spatial File

This polygon spatial file shall be submitted if used. NoData zones are used primarily for applying a "no data" value like –9999 to specific areas of a DEM. These areas are usually at the fringes of a dataset, where the TIN may be inaccurate. This spatial file can also be used to

enforce elevations in other areas such as lakes. NoData zones must have only one part and cannot self-intersect (must be simple). NoData zones should not overlap. The attributes of the S_NoData Spatial File are provided in Table N-11.

Table N-11. S_NoData Spatial File

Field	Type	Length	Decimal Places	Required	Description
NoDataID	Long			Yes	Primary key for table
Elev	Numeric	10	3	No	Elevation to use other than –9999. Useful for elevation enforcement in lakes, quarries, etc.
LEN_LID	Long			No	A foreign key to the D_Length_Units table (see Appendix L). Required if an elevation is used.
V_DATM_LID	Long			No	A foreign key to the D_V_Datum table (see Appendix L). Required if an elevation is used.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

S_VoidArea Spatial File

This polygon spatial file shall be submitted if used. VoidArea polygons are used to delete unwanted points before building TINs, usually in "obstructed" areas.   VoidAreas must have only one part and cannot self-intersect (must be simple). VoidAreas should not overlap. The attributes of the S_VoidArea Spatial File are provided in Table N-12.

Table N-12. S_VoidArea Spatial File

Field	Type	Length	Required	Description
VoidID	Long		Yes	Primary key for table
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_ExternalBoundary Spatial File

This polygon spatial file shall be submitted if used. ExternalBoundary polygons can be used to define the outer extents of a TIN model. ExternalBoundary polygons must have only one part and cannot self-intersect (must be simple). ExternalBoundary polygons should not overlap. The attributes of the S_ExternalBoundary Spatial File are provided in Table N-13.

Table N-13. S_ExternalBoundary Spatial File

Field	Type	Length	Required	Description
BoundaryID	Long		Yes	Primary key for table
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_Island Spatial File

This polygon spatial file shall be submitted if used. Island polygons can be used to represent an area within a void area where it is desired to build TINs. An example would be the case where a Void Area is used to represent a lake, but an Island polygon is used to build the TIN model for an island within the lake. Islands must have only one part and cannot self-intersect (must be simple). Islands should not overlap. The attributes of the S_Island Spatial File are provided in Table N-14.

Table N-14. S_Island Spatial File

Field	Type	Length	Required	Description
IslandID	Long		Yes	Primary key for table
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_StreamsDEM Spatial file

This linear spatial file shall be submitted if used. These single-line streams are a typical by-product of cartography but are also useful during the hydro-correction process. These same streams are often used in the hydraulics portion of a submittal as a modeling baseline. Streams must have only one part and cannot self-intersect (must be simple). Streams should be drawn upstream to downstream and connect endpoint to endpoint. The attributes of the S_StreamsDEM Spatial File are provided in Table N-15.

Table N-15. S_StreamsDEM Spatial File

Field	Type	Length	Decimal Places	Required	Description
StreamID	Long			Yes	Primary key for table
InvAdjust	Numeric	10	3	No	Elevation offset of line.
LEN_LID	Long			No	A foreign key to the D_Length_Units table (see Appendix L). Required if InvAdjust is used.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

N.2.2.5 Output Terrain Data   [April 2005]

Any intermediate and final files are to be submitted, if created. Examples include flow vectors calculated from hydrologically corrected DEMs or contours created from a TIN surface.

Output Data Types

Terrain files are organized for submittal under folders corresponding to each available data type in Table N-16.

Table N-16. Output Data Types

Submittal Folder	Data Type	Description
Output\CNT	CNT	Elevation contours
Output\DEM_xx	DEM_xx	DEM with the minor cell spacing of xx
Output\HDEM_xx	HDEM_xx	Hydrologically corrected DEM with minor cell spacing of xx
Output\VEC	VEC	Flow vectors
Supplemental Info	Other	Any files that don't fit in the other categories

Contour Spatial File

These linear spatial files shall be submitted if used. The file naming convention in the "TileIndex" section should be used (i.e. G04_CNT.shp). Contours cannot self-intersect (must be simple). The attributes of the Contour Spatial File are provided in Table N-8.

Raster Elevation Data

If DEMs are generated, they must be submitted. The standard ESRI Grid ASCII format can be used to create a tile of elevations at a uniform spacing interval. These elevations can represent both uncorrected and hydrologically corrected DEMs.

Flow Vector Data

Flow vector raster files shall be submitted if available. They should follow the D-8 format shown in Figure N-3. The standard ESRI Grid ASCII format can be used to create a tile of vectors at a uniform spacing interval.

Figure N-3. Flow Direction Values
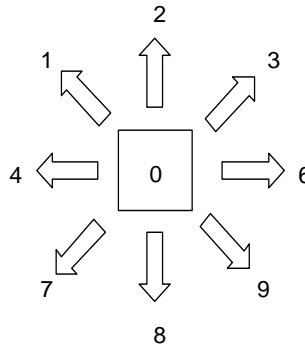
N.2.3   Deliverables   [May 2005]

N.2.3.1 Metadata   [May 2005]

A metadata file that complies with the FEMA/FGDC Metadata Profiles (available under separate cover from FEMA Headquarters) in XML-format shall be included with the submittal. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements and those elements that are mandatory for FEMA based on the specific submittal type.

There are specific items in the FGDC metadata standards that the submitter shall address. For each spatial data source in the metadata file, the Mapping Partner shall assign a Source Citation Abbreviation. The overview description subsection of the entity and attribute information of the metadata file must include a list of all DCS database tables included in the submittal.

N.2.3.2 Hard Copy Deliverables   [December 2004]

There are no hard copy deliverables for submittal of terrain data.

N.2.3.3 Digital Deliverables [May 2005]

Transfer Media

Mapping Partners must submit files on one of the following electronic media:

- CD-ROM
- DVD
- Upload to the Mapping Information Platform (MIP) (http://www.hazards.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Directory Structure and Folder Naming Conventions

A metadata file compliant with FEMA/FGDC Metadata Profiles shall be placed in the *General* folder on the root directory of Disk1. Database files are stored in a *Database* folder. If submitting in Microsoft Access format, this file will be named "Terrain.mdb". If submitting in Dbase IV format, each table will be stored in its own file (i.e. "L_Submittal_Info.dbf"). The Mapping Partner is required to submit the source terrain data as well as any files used to process this data. Any additional data used to assist in the modeling of this study not described in these specifications can be submitted in the *Supplemental Info* folder.

Terrain files are arranged into appropriate directories based on data type. The index spatial file used for each data type must be placed in each applicable directory (if the files are tiled). For example, the file G104_CNT.DXF, which is an indexed contour output file, should be placed in the Output\CNT directory, along with the appropriate index spatial file. The source file G104_DEM_50.ASC would be placed in the Source\DEM_50 directory, along with the appropriate index spatial file.

> *\General*
> o XML_format metadata file
> *\Database*
> o Database file(s), including the L_Submittal_Info and L_PerimFile tables
>
> *\Source\Perimeter Info*
> o S_Perimeter spatial file
>
> *\Source\ARL*
> o LIDAR data – All Returns
> o LIDAR S_TileIndex spatial file (if used)

\Source\BE
- o LIDAR data – Bare Earth Points
- o LIDAR S_TileIndex spatial file (if used)

\Source \3DL
- o 3D breakline spatial files
- o 3D breakline S_TileIndex spatial file (if used)

\Source \2DL
- o 2D breakline spatial files
- o 2D breakline S_TileIndex spatial file (if used)

\Source \CNT
- o Contour spatial files
- o Contour S_TileIndex spatial file (if used)

\Source \DEM_xx
- o Uncorrected DEM files with a minor cell spacing of xx (i.e.“DEM_50”)
- o S_TileIndex spatial file (if used)

\Source \HDEM_xx
- o Hydrologically correct DEM files with a minor cell spacing of xx (i.e. “HDEM_50”)
- o S_TileIndex spatial file (if used)

\Source\Supplemental Spatial Files
- o Continuous spatial files (i.e. “S_SinkBreach.shp”)
- o Any files that don't fit into the other categories

\Output \CNT
- o Contour spatial files
- o Contour S_TileIndex spatial file (if used)

\Output \DEM_xx
- o Uncorrected DEM files with a minor cell spacing of xx (i.e. “DEM_50”)
- o S_TileIndex spatial file (if used)

\Output \HDEM_xx
- o Hydrologically correct DEM files with a minor cell spacing of xx (i.e. “HDEM_50”)
- o S_TileIndex spatial file (if used)

\Output\VEC
- o Flow vectors
- o S_TileIndex spatial file (if used)

\Supplemental Info
- o Any files that don't fit into the other categories

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name

- Community name and state for which the FIS was prepared

- Terrain Data

- Date of submission (formatted mm/dd/yyyy)

- Disk [*sequential number*] of [*number of disks*]

The media must be numbered sequentially, starting at Disk 1. The [*number of disks*] is the total number of disks in the submission.

N.3   Survey Submittal Standards

N.3.1   Overview   **[December 2004]**

The purpose of this section is to provide guidance and specifications to the Mapping Partner that prepares digital data for DFIRM production. This section is not intended to specify in-process compilation or procedures, but rather to present the specifications and requirements for output and deliverables. The Mapping Partner should refer to Appendix A of these Guidelines for guidance on the performance of surveying.

This section will focus on the data that is obtained during the survey of the following features:

- Cross Sections

- Temporary Bench Marks (or Elevation Reference Marks)

- High Water Marks

- Structures for Detailed Study

    o Bridges
    o Channels
    o Culverts
    o Dams
    o Levees

- Structures for Limited Detail Study

    o Bridges
    o Culverts
    o Dams

A major aspect of a Geographic Information System (GIS) is horizontal and vertical position on the earth. Survey data must be referenced to a standard coordinate system, employ a standard projection, and specify in the L_Submittal_Info table both the horizontal and the vertical datums used. These positional references are established prior to the field data collection and topographic mapping phase of the project. All planimetric and topographic features must be collected and referenced to this coordinate system and projection. A detailed discussion of aerial mapping and surveying specifications, which includes horizontal and vertical control for new mapping is provided in Appendix A of these Guidelines. A discussion of vertical datum selection and conversion is provided in Appendix B of these Guidelines.

Considerations for transfer of digital data also must include the file structure of the data, the transfer medium, and acceptable data formats. The organization and accepted formats for the intermediate submittal of survey data are discussed in Subsection N.3.3.

N.3.2   Requirements   **[April 2005]**

N.3.2.1 Cross Sections   **[April 2005]**

The following deliverables are required whenever cross sections are shown on the Flood Profile:

- Database Tables and Spatial Files
- Survey Files
- Digital Photographs
- Digital Sketches

The following subsections detail the requirements for each deliverable.

Database Tables and Spatial Files

The database tables and spatial files needed for cross sections are provided in Table N-17.

Table N-17. Database Tables and Spatial Files for Cross Sections

Table	Description
L_SXS	A database table of survey data related to cross sections.
L_SXSPht	A look up table for the photos associated with the cross sections.
L_SXSSkt	A look up table for the sketches associated with the cross sections.
L_Sketch	A lookup database table of data about that contains information related to sketches that were created during the survey.
L_Wtr_Nm	This is a lookup table of stream names.
S_Photo	A point spatial file used to represent the locations where of photos were taken.
S_Struc	A linear spatial file used to represent surveyed structures.
D_DatTyp	A domain table used to store the valid lookup identification keys to identify cross section type.
S_SXS	A point spatial file used to represent the survey shots or points of the cross sections.
S_TBM	A point spatial file used to represent the locations of temporary bench marks or elevation reference marks.

See Figure N-4 for an entity relationship diagram of the tables and spatial files for cross sections.

Figure N-4. Entity Relationship Diagram for Cross Sections
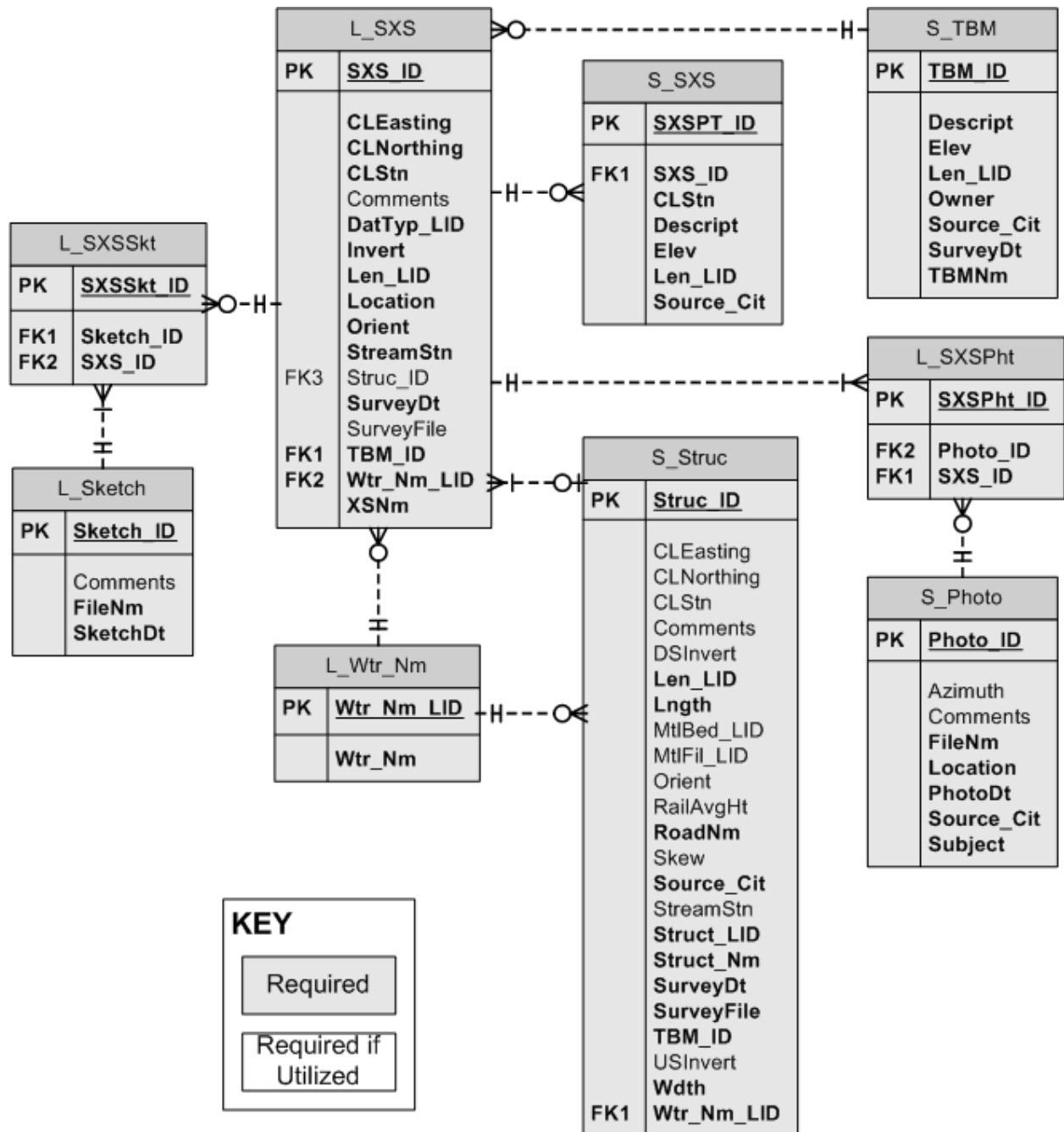
The L_SXS table is a database table. It is required for all surveyed cross sections. The L_SXS table contains the attributes presented in Table N-18.

Table N-18. L_SXS Table

Field	Type	Length	Decimal Places	Required	Description
SXS_ID	Long			Yes	Primary key for table.
CLEasting	Numeric	12	2	Yes	X-coordinate at stream crossing.
CLNorthing	Numeric	12	2	Yes	Y-coordinate at stream crossing.
CLStn	Numeric	8	2	Yes	Cross section station at intersection of cross section and stream centerline.
Comments	Text	254		No	General comments or notes.
DatTyp_LID	Long			Yes	Cross section or data type lookup identification. A code that provides a valid link to a valid entry from D_DatTyp.
Invert	Numeric	8	2	Yes	Lowest elevation in cross section.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Location	Text	254		Yes	Description of location.
Orient	Text	1		Yes	Direction in which survey shots were taken. From left to right, looking downstream - D, or looking upstream – U.
StreamStn	Numeric	12	2	Yes	Distance along stream.
Struc_ID	Long			No	Foreign key to S_Struc. Note: Required if cross section is associated with a structure.
SurveyDt	Date			Yes	Date and time of survey.
Wtr_Nm_LID	Long			Yes	Foreign key to L_Wtr_Nm. Surface water feature name.
XSNm	Text	65		Yes	Cross Section Name. This is the name of the cross section and the name that will be shown on the hardcopy FIRM.
SurveyFile	Text	254		No	Name of the survey text file. Not required for cross sections associated with structures.
TBM_ID	Long			Yes	Foreign key to S_TBM. Elevation reference point of cross section.

The L_SXSPht is a lookup table for the photos associated with the cross sections. The L_SXSPht table contains the attributes presented in Table N-19.

Table N-19. L_SXSPht Table

Field	Type	Length	Required	Description
SXSPht_ID	Long		Yes	Primary key for table.
Photo_ID	Long		Yes	Foreign key to S_Photo.
SXS_ID	Long		Yes	Foreign key to S_SXS.

The L_SXSSkt is a lookup table for the sketches associated with the cross sections. The L_SXSSkt table contains the attributes presented in Table N-20.

Table N-20. L_SXSSkt Table

Field	Type	Length	Required	Description
SXSSkt_ID	Long		Yes	Primary key for table.
Sketch_ID	Long		Yes	Foreign key to L_Sketch.
SXS_ID	Long		Yes	Foreign key to L_SXS.

The L_Sketch table is a database table that contains information related to sketches that were created during the survey. The L_Sketch table contains the elements presented in Table N-21.

Table N-21. L_Sketch Table

Field	Type	Length	Required	Description
Sketch_ID	Long		Yes	Primary key for table.
Comments	Text	254	No	General comments or notes.
FileNm	Text	254	Yes	Name of the sketch file.
SketchDt	Date		Yes	Date the sketch was created.

The L_Wtr_Nm table is a lookup table. This table identifies the unique list of stream names used in the submittal. This is the same table defined in Appendix L of these Guidelines, but it is listed here for completeness.

The L_Wtr_Nm table contains the attributes presented in Table N-22.

Table N-22. L_Wtr_Nm Table

Field	Type	Length	Required	Description
Wtr_Nm_LID	Long		Yes	Unique identifier for L_Wtr_Nm. Primary key.
Wtr_Nm	Text	254	Yes	Name of surface water feature.

The S_ Photo is a spatial file used to represent the locations of the digital photographs that were taken during the survey. The S_Photo attribute table contains the information presented in Table N-23.

Table N-23. S_Photo Spatial File

Field	Type	Length	Decimal Places	Required	Description
Photo_ID	Long			Yes	Primary key for table.
Azimuth	Numeric	6	2	No	Horizontal angle of the bearing for the photo.
Comments	Text	254		No	General comments or notes.
FileNm	Text	254		Yes	Name of the photo file.
Location	Text	254		Yes	A description of the geographic location where the picture was taken.
PhotoDt	Date			Yes	The date that the picture was taken.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_STRUC spatial file.
Subject	Text	50		Yes	Description of feature or view.

The S_Struc table contains general data about structures surveyed for detailed studies and includes the attributes presented in Table N-39. If the cross section is associated with a structure, the field Struc_ID should be populated in L_SXS. Struc_ID is the unique identifier for the structure and is included in the S_Struc spatial file. See Table N-39 for a list of attributes included in the S_Struc spatial file.

The D_DatTyp is a domain table that contains the valid lookup identification keys that may be used to identify cross section type. The D_DatTyp table contains the attributes presented in Table N-24. Table N-25 contains the domain values for D_DatType

Table N-24. D_DatTyp Table

Field	Type	Length	Required	Description
DatTyp_LID	Long		Yes	Primary key - Data type look-up identification key.
DatTypDes	Text	50	Yes	Describes different type of cross sections: Field or Top Of Road (TOR).

Table N-25. Domain Values for D_DatTyp

DatTyp_LID	DatTypDes
1	Field
2	Top of Road

S_SXS is a spatial file that contains location information and also relates to the data table, L_SXS. Each survey shot or entry in the survey text file for a cross section should be represented spatially by a single point (See section 3.2.1 Survey Files). The spatial file containing the locational information for the cross sections will be named S_SXS and the extension appropriate for the file format. For example, the components of a shapefile would be named S_SXS.shp, S_SXS.dbf, S_SXS.shx, and S_SXS.prj.

The S_SXS attribute table contains the information presented in Table N-26.

Table N-26. S_SXS Spatial File

Field	Type	Length	Decimal Places	Required	Description
SXSPT_ID	Long			Yes	Primary key for table.
SXS_ID	Long			Yes	Foreign key to L_SXS.
CLStn	Numeric	8	2	Yes	Station of surveyed shot or point (referencing profile view of cross section).
Descript	Text	100		Yes	Description of surveyed cross section shot or point.
Elev	Numeric	8	2	Yes	Elevation of surveyed cross section shot or point.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid entry from D_Length_Units. See Appendix L.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_SXS spatial file.

The S_TBM is a spatial file used to represent the locations of the temporary benchmarks or elevation reference marks that were used during the survey. All TBMs that were used during the survey of cross sections should be included in S_TBM.

See Table N-27 for a list of attributes included in the S_TBM spatial file.

Survey Files

Description

A separate survey file must be submitted for each surveyed cross section, unless the cross section is associated with a structure. If the cross section is associated with a structure and the survey data for the cross section has been included with the survey files for the structure, then a separate survey file is not required for the cross section.

Naming Convention

The file name for the survey file will be based upon the name of the cross section, which is found in the XSNm field in L_SXS table. However, the file name will use underscores to indicate spaces in the name of the cross section. In a submission, each survey file must have a unique file name.

For example, XS_1.TXT

The file name of the survey file for a cross section must be populated in the SurveyFile field in the *L_SXS* table, in the record corresponding to that cross section.

Attributes

Each survey file should include all survey data for a cross section.

Digital Photographs

Description

A minimum of two digital photographs must be submitted for each cross section. The required aspects or view of the photographs include:

- Standing at cross section, looking upstream at the channel (USC)

- Standing at cross section, looking downstream at the channel (DSC)

Naming Convention

The file name of the digital photograph will be based on the name of the cross section (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique file name.

For examples, XS_1_USC.PNG
             XS_1_DSC.PNG

Attributes

A record must be populated in the S_Photo table for each photograph. The file name of the photograph must be populated in the FileNm field in the S_Photo table, corresponding to that photograph. In addition, a record must be populated in the L_SXSPht table for each photograph.

See Table N-19 for a list of attributes included in the L_SXSPht table.

See Table N-23 for a list of attributes included in the S_Photo spatial file.

Digital Sketches

Description

Any sketch that is prepared during the survey of a cross section must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Naming Convention

The file name of the digital sketch will be based on the name of the cross section (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch file must have a unique file name.

For example, XS_1_SK1.PNG

Attributes

A record must be populated in the L_Sketch table for each sketch. The file name of the sketch must be populated in the FileNm field in the L_Sketch table, corresponding to that sketch. In addition, a record must be populated in the L_SXSSkt table for each sketch.

See Table N-19 for a list of attributes included in the L_SXSSkt table.

N.3.2.2 Temporary Bench Marks   [April 2005]

The S_TBM is a spatial file used to represent the locations of the temporary benchmarks (TBMs) or elevation reference marks that were used during the survey. Each TBM is to be represented spatially by a single point. A database table is not required for TBMs. The spatial files for the

TBMs are to be named S_TBM and the extension appropriate for the file format. For example, the components of a shapefile would be named S_TBM.shp, S_TBM.dbf, S_TBM.shx, and S_TBM.prj.

The S_TBM attribute table contains the information presented in Table N-27.

Table N-27. S_TBM Spatial File

Field	Type	Length	Decimal Places	Required	Description
TBM_ID	Long			Yes	Primary key for table.
Descript	Text	254		Yes	Description of directions to location Temporary Benchmark.
Elev	Numeric	8	2	Yes	Elevation of Temporary Benchmark.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Owner	Text	50		Yes	Agency or municipality owns or maintains the monument.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_TBM spatial file.
SurveyDt	Date			Yes	Date the Temporary Benchmark was surveyed.
TBMNm	Text	50		Yes	Temporary Benchmark Name. This is the name of the temporary benchmark and the name that will be shown on the hard copy FIRM.

N.3.2.3 High Water Marks   [April 2005]

The following deliverables are required whenever high water marks have been identified and surveyed during the performance of a Flood Insurance Study:

- Database Tables and Spatial Files
- Digital Photographs
- Digital Sketches

The following subsections detail the requirements for each deliverable.

Database Tables and Spatial Files

The database tables and spatial files used for high water marks are provided in Table N-28.

Table N-28. Database Tables and Spatial Files for High Water Marks

Table	Description
S_HWM	A point shapefile containing information about High Water Marks (HWM).
L_HWMWtns	Contains information about witnesses associated with high water marks.
L_HWMPht	A look up table for the photos associated with each high water mark.
L_HWMSkt	A look up table for the sketches associated with each high water mark.
L_Sketch	A database table that contains information related to sketches that were created during the survey.
L_Wtr_Nm	A look up table for streams.
S_Photo	A point spatial file used to represent the locations where photos were taken.
D_HWLnTp	A domain table used to store the valid lookup identifcation keys used to identify types of high water marks.

See Figure N-5 for an entity relationship diagram of the tables for high water marks.

Figure N-5. Entity Relationship Diagram for High Water Marks
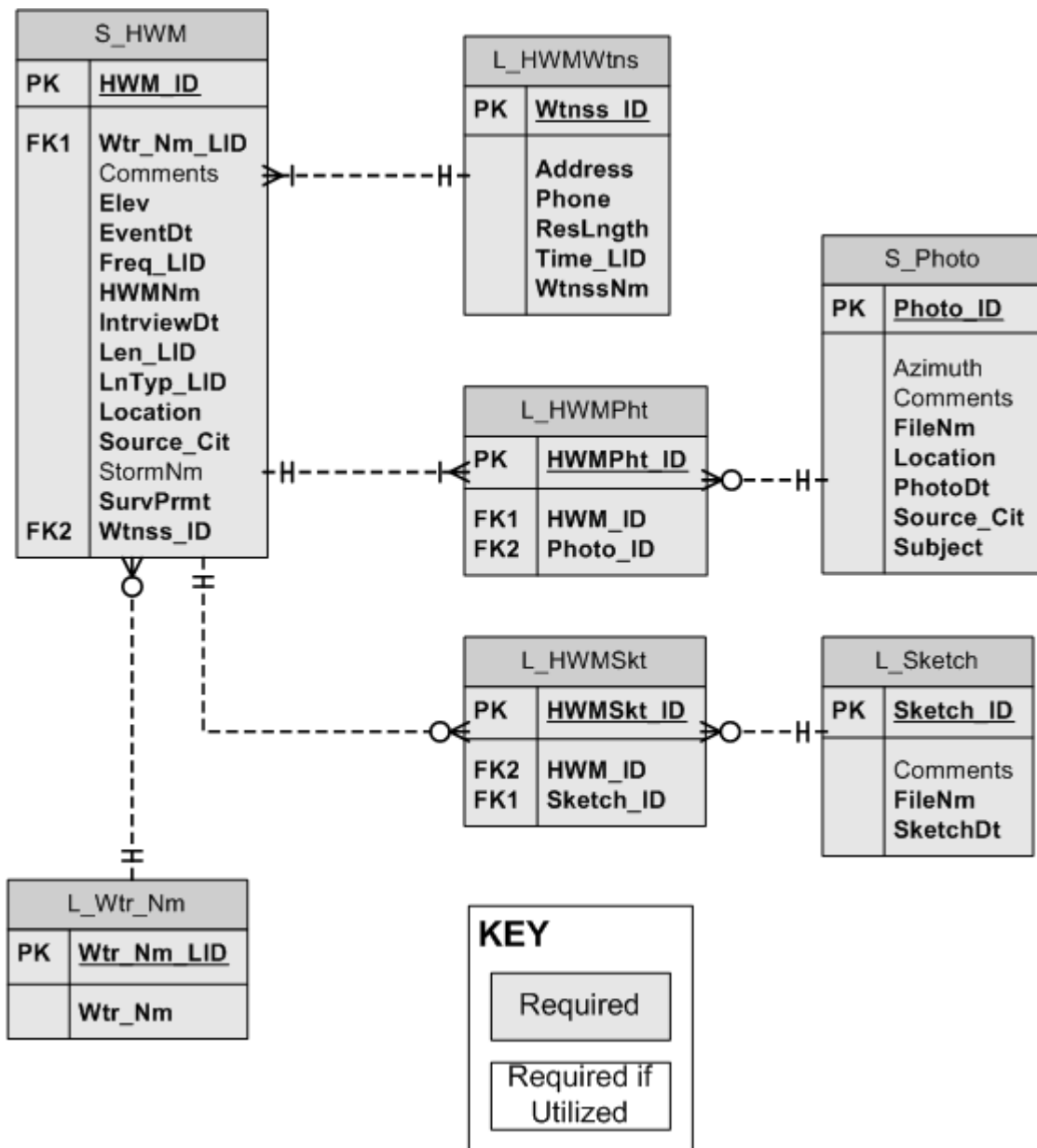
S_ HWM is a spatial file that contains attributes and the locations of the high water marks (HWMs) that were surveyed. Each HWM is to be represented spatially by a single point. The spatial files for the HWMs are to be named S_ HWM and the extension appropriate for the file format. For example, the components of a shapefile would be named S_HWM.shp, S_ HWM.dbf, S_ HWM.shx, and S_ HWM.prj.

The S_HWM attribute table contains the information presented in Table N-29.

Table N-29. S_HWM Spatial File

Field	Type	Length	Decimal Places	Required	Description
HWM_ID	Long			Yes	Unique identifier for L_HWM. Primary key.
Wtnss_ID	Long			Yes	Foreign key to L_HWMWtns table.
Wtr_Nm_LID	Long			Yes	Foreign key to L_Wtr_Nm. Surface water feature name.
Comments	Text	254		No	General comments or notes.
Elev	Numeric	8	2	Yes	Elevation of water mark.
EventDt	Date			Yes	Date of the storm.
Freq_LID	Long			Yes	Lookup identification for the frequency of the storm event. A code that provides a valid link to a valid entry from D_Frequency. See Appendix L.
HWMNm	Text	50		Yes	Name of high water mark.
IntrviewDt	Date			Yes	Date of interview with witness to high water mark.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
LnTyp_LID	Long			Yes	HWM type lookup identification. A code that provides a valid link to a valid entry from D_HWLnTp.
Location	Text	254		Yes	Location of the high water mark.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_HWM spatial file.
StormNm	Text	50		No	Name of storm.
SurvPrmt	Yes/No			Yes	Do the surveyors have permission to survey? Yes/No.

The L_HWMWtns table is a database table. This table contains information about each witness to high water marks that occurred during flooding events. The L_HWMWtns table contains the attributes presented in Table N-30.

Table N-30. L_HWMWtns Table

Field	Type	Length	Required	Description
Wtnss_ID	Long		Yes	Primary key for table.
Address	Text	254	Yes	Physical address of witness to high water mark.
Phone	Text	20	Yes	Telephone number of witness to high water mark.
ResLngth	Long		Yes	The length of time a witness has lived at a particular residence.
Time_LID	Long		Yes	Units of temporal measure. A code that provides a valid link to a valid entry from D_Time_Units. See Appendix L.
WtnssNm	Text	60	Yes	Name of witness to high water mark.

The L_ HWMPht is a lookup table for the photos associated with the high water marks. The L_ HWMPht table contains the attributes presented in Table N-31.

Table N-31. L_HWMPht Table

Field	Type	Length	Required	Description
HWMPht_ID	Long		Yes	Primary key for table.
HWM_ID	Long		Yes	Foreign key to S_HWM.
Photo_ID	Long		Yes	Foreign key to S_Photo.

The L_ HWMSkt is a lookup table for the sketches associated with the high water marks. The L_ HWMSkt table contains the attributes presented in Table N-32.

Table N-32. L_HWMSkt Table

Field	Type	Length	Required	Description
HWMSkt_ID	Long		Yes	Primary key for table.
HWM_ID	Long		Yes	Foreign key to S_HWM.
Sketch_ID	Long		Yes	Foreign key to L_Sketch.

The L_Sketch table is a database table that contains information related to sketches that were created during the survey. The L_Sketch table contains the attributes presented in Table N-33.

Table N-33. L_Sketch Table

Field	Type	Length	Required	Description
Sketch_ID	Long		Yes	Primary key for table.
Comments	Text	254	No	General comments or notes.
FileNm	Text	254	Yes	Name of the sketch file.
SketchDt	Date		Yes	Date the sketch was created.

The L_Wtr_Nm table is a database lookup table. This is the same table defined in Appendix L of these Guidelines, but it is listed here for completeness.

The L_Wtr_Nm table contains the attributes presented in Table N-34.

Table N-34. L_Wtr_Nm Table

Field	Type	Length	Required	Description
Wtr_Nm_LID	Long		Yes	Unique identifier for L_Wtr_Nm. Primary key.
Wtr_Nm	Text	254	Yes	Name of surface water feature.

S_Photo is a point spatial file used to represent the locations where photos were taken. The S_Photo attribute table contains the attributes presented in Table N-35.

Table N-35. S_Photo Spatial File

Field	Type	Length	Decimal Places	Required	Description
Photo_ID	Long			Yes	Primary key for table.
Azimuth	Numeric	6	2	No	Horizontal angle of the bearing for the photo.
Comments	Text	254		No	General comments or notes.
FileNm	Text	254		Yes	Name of the photo file.
Location	Text	254		Yes	A description of the geographic location where the picture was taken.
PhotoDt	Date			Yes	The date that the picture was taken.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_STRUC spatial file.
Subject	Text	50		Yes	Description of feature or view.

The D_ HWLnTp is a domain table that contains the valid lookup identification keys that may be used to identify the types of high water marks.

The D_HWLnTp table contains the attributes presented in Table N-36. Table N-37 contains the domain values for D_HWLnTP.

Table N-36. D_HWLnTp Table

Field	Type	Length	Required	Description
LnTyp_LID	Long		Yes	Primary key - High water mark line type look-up identification key.
LnTypDes	Text	20	Yes	Type of line: mud, debris, etc.

Table N-37. Domain Values for D_HWLnTp

LnTyp_LID	LnTypDes
1	Mud
2	Debris
3	Other

Digital Photographs

Description

A minimum of one digital photograph is to be submitted for each high water mark. The photographs should be in color. The required aspects or view of the photograph include standing approximately 20 feet away from the high water mark.

Naming Convention

The file name of the digital photograph is to be based on the name of the high water mark (with underscores rather than spaces), an underscore and a number, and the extension. In a submission, each digital photograph must have a unique file name. For example, HWM_1_1.PNG

Attributes

A record must be populated in the ***S_Photo*** spatial file for each photograph. The file name of the photograph must be populated in the ***FileNm*** field in the ***S_Photo*** attribute table, corresponding to that photograph. In addition, a record must be populated in the ***L_HWMPht*** table for each photograph.

See Table N-31 for a list of attributes included in the L_HWMPht table.

Digital Sketches

Description

Any sketch that is prepared during the survey of a high water mark must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Naming Convention

The file name of the digital sketch will be based on the name of the high water mark (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch file must have a unique file name. For example, HWM_1_SK1.PNG

Attributes

A record must be populated in the L_Sketch table for each sketch. The file name of the sketch must be populated in the FileNm field in the Sketch table, corresponding to that sketch. In addition, a record must be populated in the L_HWMSkt table for each sketch.

See Table N-33 for a list of attributes included in the L_Sketch table.

See Table N-32 for a list of attributes included in the L_HWMSkt table.

N.3.2.4 Structures for Detailed Study   [April 2005]

These deliverables are required whenever hydraulic structures have been surveyed to support Detailed Studies. They are also required if levees are shown on the FIRM, channels containing the flooding are shown on the FIRM, or any other structure that impacts the area's flood risk is shown on the FIRM.

- Database Tables and Spatial Files
- Survey Files
- Photographs
- Sketches

For cross sections related to structures, refer to Subsection N.3.2.1 and to the *Data Capture Guidelines*. The following subsections detail the requirements for each deliverable.

Database Tables and Spatial Files

The database tables and spatial files needed for structures surveyed for detailed studies are provided in Table N-38.

Table N-38. Database Tables and Spatial Files for Structures for Detailed Studies

Table	Description
S_Struc	The S_Struc table contains information about the hydraulic structures that have been surveyed within the study area. It should include all structures shown in the flood profiles. In addition, levees, sea walls, channels that contain flooding and other significant flood control structures shown on the Digital Flood Insurance Rate Map (DFIRM) should be included.
L_Brdg	Each record in this contains information specific to a bridge, such as abutment stations.
L_CulPp	Each record in this table contains information about one pipe, at a culvert crossing.
L_Dam	Each record in this table contains information specific to a dam, such as embankment type or location of a drain valve.
L_LChrd	Each record in this table contains information about a low chord shot. Only bridges may have low chord shots.
L_Levee	Each record in this table contains information specific to a levee, such as type of levee.
L_Orfc	Each record in this table contains information specific to the size and number of similar orifices clustered together on a riser barrel.
L_OtlPp	Each record in this table contains information specific to one outlet pipe, at the bottom of a riser barrel, which transports water underneath the dam structure.
L_Pier	This table contains information on piers, such as pier width and shape. Only bridges may have related records to this table.
L_Rail	Each record in this table contains information about a top of rail shot.
L_RsrBrl	Each record in this table contains information specific to one riser barrel, such as size and trash rack information.
L_Sketch	A database table that contains information related to sketches that were created during the survey.
L_StrPht	This table is a look up table for the photos of each structure.
L_StrSkt	This table is a look up table for the sketches of each structure.
L_SWy	Each record in this table contains information about a relief device (e.g. spillway) at a dam, used to prevent overtopping during a large flood.

Table	Description
L_SXS	A database table of survey data related to cross sections.
L_Wtr_Nm	This is a look up table for streams.
S_Photo	A point spatial file used to represent the locations where photos were taken.
S_TBM	A point spatial file used to represent the locations of temporary bench marks or elevation reference marks.
D_AbtTyp	A domain table used to store valid abutment types.
D_ShpTyp	A domain table used to store valid shape types.
D_PpTyp	A domain table used to store valid types used to describe the ends of pipes or culverts.
D_MtlTyp	A domain table used to store valid types of material used.
D_ClsTyp	A domain table used to store valid types of closures required to operate structure.
D_LevTyp	A domain table used to store valid types of levees.
D_SwyTyp	A domain table used to store valid types of spillways.
D_DamTyp	A domain table used to store valid types of dams.

See Figure N-6 for an entity relationship diagram of the tables for structures surveyed for detailed studies.

Figure N-6. Entity Relationship Diagram for Structures for Detailed Studies

S_Struc is a spatial file that contains attributes and locational information for each structure. Each structure is to be represented spatially by a single line. Each line is to represent the primary characteristic of the structure.

- Each bridge is to be represented by a single line that is aligned to the transportation centerline carried by the bridge.

- Each culvert is to be represented by a single line that is aligned to the transportation centerline carried by the culvert.

- Each dam is to be represented by a single line aligned to the centerline along the top of the dam.

- Each levee is to be represented by a single line aligned to the top or crest of levee.

The spatial files containing the locational information for the general structures are to be named S_Struc and the extension appropriate for the file format. For example, the components of a shapefile would be named S_Struc.shp, S_Struc.dbf, S_Struc.shx, and S_Struc.prj. S_Struc must contain the attributes shown in Table N-39.

Table N-39. S_Struc Spatial File

Field	Type	Length	Decimal Places	Required	Description
Struc_ID	Long			Yes	Primary key for table.
CLEasting	Numeric	12	2	No	Easting or X-coordinate of centerline station. Required for bridges, culverts, and dams.
CLNorthing	Numeric	12	2	No	Northing or Y-coordinate of centerline station. Required for bridges, culverts, and dams.
CLStn	Numeric	8	2	No	Cross section station, in profile view, along structure of intersection of structure and stream centerline. Note: Required for bridges, culverts, and dams.
Comments	Text	254		No	General comments or notes.
DSInvert	Numeric	8	2	No	Elevation of the lowest point in stream, under structure on downstream side. Note: Required for bridges, culverts, and dams.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Lngth	Numeric	8	2	Yes	Distance from beginning of structure to end. Measured across stream for bridges, culverts and dams. Measured along crest of levee or centerline of channel.

Field	Type	Length	Decimal Places	Required	Description
MtlBed_LID	Long			No	Bed material type lookup identification. A code that provides a valid link to a valid entry from D_MtlTyp. Required for bridges, culverts, and dams.
MtlFil_LID	Long			No	Fill material type lookup identification. A code that provides a valid link to a valid entry from D_MtlTyp. Note: Required for bridges, culverts, and dams.
Orient	Text	1		No	Direction in which survey shots were taken. From left to right, looking downstream - D, or looking upstream - U. Note: Required for bridges, culverts, and dams.
RailAvgHt	Numeric	8	2	No	Average rail height. Note: Required for bridges, culverts, and dams.
RoadNm	Text	254		Yes	Road name or location of structure.
Skew	Numeric	8	4	No	Angle of structure, if not perpendicular to stream. Note: Required for bridges, culverts, and dams.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_STRUC spatial file.
StreamStn	Numeric	12	2	No	Distance along stream from a user-defined reference point to where structure intersects stream. Note: Required for bridges, culverts, and dams.
Struct_LID	Long			Yes	Structure Type Lookup Identification. A code that provides a link to a valid entry from the D_Struct_Typ table. See Appendix L.
Struct_Nm	Text	50		Yes	Field name of the structure.
SurveyDt	Date			Yes	Date and time of survey
SurveyFile	Text	254		Yes	Name of the survey text file.
TBM_ID	Long			Yes	TBM_ID of benchmark provides link to spatial file S_TBM.
USInvert	Numeric	8	2	No	Elevation of the lowest point in stream, under structure on upstream side. Note: Required for bridges, culverts, and dams.
Wdth	Numeric	8	2	Yes	For bridges, culverts and dams, the hydraulic distance from one edge of structure to the other, parallel to stream. For other structures, average

Field	Type	Length	Decimal Places	Required	Description
					width of structure.
Wtr_Nm_LID	Long			Yes	Foreign key to L_Wtr_Nm. Surface water feature name.

L_Brdg is a database table. Each record in this table contains information specific to a bridge, such as abutment stations. The L_Brdg table contains the attributes presented in Table N-40.

Table N-40. L_Brdg Table

Field	Type	Length	Decimal Places	Required	Description
Brdg_ID	Long			Yes	Primary key for table.
Struc_ID	Long			Yes	Foreign key to S_Struc.
AbtTyp_LID	Long			Yes	Abutment type lookup identification. A code that provides a valid link to a valid entry from D_AbtTyp.
DeckThick	Numeric	8	2	Yes	Measurement from top of road to bottom of bridge.
LAbtmntStn	Numeric	8	2	Yes	Left station of abutment, input from survey data (referencing profile view of structure).
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
LFillStn	Numeric	8	2	Yes	Station of left toe of fill (referencing profile view of structure).
LSideSlope	Numeric	5	2	Yes	Slope of left fill station.
RAbtmntStn	Numeric	8	2	Yes	Right station of abutment, input from survey data (referencing profile view of structure).
RFillStn	Numeric	8	2	Yes	Station of right toe of fill (referencing profile view of structure).
RSideSlope	Numeric	5	2	Yes	Slope of right fill station.

L_CulPp is a database table. Each record in this table contains information about one pipe or box, at a culvert crossing. The L_CulPp table contains the attributes presented in Table N-41.

Table N-41. L_CulPp Table

Field	Type	Length	Decimal Places	Required	Description
CulPp_ID	Long			Yes	Primary key for table.
Struc_ID	Long			Yes	Foreign key to S_Struc.
CLStn	Numeric	12	2	Yes	Centerline station of pipe (referencing profile view of structure).
DSInvert	Numeric	8	2	Yes	Elevation at bottom of downstream pipe opening.
InTyp_LID	Long			Yes	Type of inlet. A code that provides a valid link to a valid entry from D_PpTyp.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
MtlTyp_LID	Long			Yes	Pipe material. A code that provides a valid link to a valid entry from D_MtlTyp.
OutTyp_LID	Long			Yes	Type of outlet. A code that provides a valid link to a valid entry from D_PpTyp.
PipeLn	Numeric	8	2	Yes	Length of pipe.
Rise	Numeric	8	2	Yes	Height or diameter of pipe.
ShpTyp_LID	Long			Yes	Lookup identification for the c ross sectional shape of culvert. A code that provides a valid link to a valid entry from D_ShpTyp.
USInvert	Numeric	8	2	Yes	Elevation at bottom of upstream pipe opening.
Wdth	Numeric	8	2	Yes	Width or span of pipe.

Section N.3

L_Dam is a database table. Each record in this table contains information specific to one dam. The L_Dam table contains data specific to dams. The L_Dam table contains the attributes presented in Table N-42.

Table N-42. L_Dam Table

Field	Type	Length	Decimal Places	Required	Description
Dam_ID	Long			Yes	Primary key for table.
Struc_ID	Long			Yes	Foreign key to S_Struc.
Area_LID	Long			Yes	Units of area measure. A code that provides a valid link to a valid entry from D_Area_Units. See Appendix L.
DamHt	Numeric	8	2	Yes	Height of Dam.
DamTopElv	Numeric	8	2	Yes	Elevation at top of dam.
DamTyp_LID	Long			Yes	Dam type lookup identification. A code that provides a valid link to a valid entry from D_DamTyp.
EmbSlope	Numeric	5	2	Yes	Slope of embankment.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
NormalArea	Numeric	10	2	Yes	Area of pool at normal water surface elevation.
NWSElv	Numeric	8	2	Yes	Normal water surface elevation (level pool elevation).
ValveEasting	Numeric	12	2	No	Easting or X-coordinate of drain valve.
ValveNorth	Numeric	12	2	No	Northing or Y-coordinate of drain valve.

The L_Chrd table is a database table. Each record in L_Chrd contains information about a low chord shot. Only bridges may have low chord shots. The L_LChrd table contains the attributes presented in Table N-43.

Table N-43. L_LChrd Table

Field	Type	Length	Decimal Places	Required	Description
LChrd_ID	Long			Yes	Primary key for table.
Brdg_ID	Long			Yes	Foreign key to L_Brdg.
Easting	Numeric	12	2	Yes	X-coordinate.
Elev	Numeric	8	2	Yes	Feet above sea level.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units.See Appendix L.
Northing	Numeric	12	2	Yes	Y-coordinate.
Station	Numeric	8	2	Yes	Cross section station (referencing profile view of structure).

The L_ Levee table contains data specific to levees. The L_Levee table contains the attributes presented in Table N-44.

Table N-44. L_Levee Table

Field	Type	Length	Decimal Places	Required	Description
Levee_ID	Long			Yes	Primary key for table.
Accredit	Text	50		Yes	Accreditation or verification: Meets FEMA policy - FEMA, credited prior to FEMA's policy - PRIOR, or certified by another Federal agency as providing 100-year protection - FEDERAL
Area_LID	Long			Yes	Units of area measure. A code that provides a valid link to a valid entry from D_Area_Units. See Appendix L.
Bank	Text	1		Yes	Side of channel on which structure is located, when looking downstream: Left - L, or right – R.
ClsTyp_ID	Long			Yes	Closure type lookup identification. A code that provides a valid link to a valid entry from D_ClsTyp.
FreeBoard	Numeric	8	2	Yes	Minimum freeboard of structure.
HasFailed	Yes/No			Yes	Have failures occurred? Yes/No.
IsMaint	Yes/No			Yes	Is there a FEMA-approved maintenance plan? Yes/No.
IsOpPlan	Yes/No			Yes	Is there an approved operational plan? Yes/No.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
LevTyp_LID	Long			Yes	Levee type lookup identification. A code that provides a valid link to a valid entry from D_LevTyp.
ProtectAr	Numeric	10	2	Yes	Area protected.
ProtectLU	Text	1		Yes	Area protected by structure is primarily developed - D, or undeveloped – U.
ProtectYr	Long			Yes	Exceedence frequency in years that flood structure was designed to protect against.
SideSlope	Numeric	5	2	Yes	Average side slope.
Struc_ID	Long			Yes	Foreign key to S_Struc.
TopElv	Numeric	8	2	Yes	Average top elevation of levee.

The L_Orfc table contains specific information about the orifices of the riser. The L_Orfc table contains the attributes presented in Table N-45.

Table N-45. L_Orfc Table

Field	Type	Length	Decimal Places	Required	Description
Orfc_ID	Long			Yes	Primary key for table.
RsrBrl_ID	Long			Yes	Foreign key to L_RsrBrl.
CLElv	Numeric	8	2	Yes	Elevation at center of orifice.
Diameter	Numeric	8	2	Yes	Diameter of orifice.
Height	Numeric	8	2	Yes	Height of orifice.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
OrfcCnt	Integer			Yes	Number of same size orifices at a given elevation.
ShpTyp_ID	Long			Yes	Orifice shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp.
Wdth	Numeric	8	2	Yes	Width of orifice.

The L_ OtlPp table contains specific information about the outlet pipes from each riser. The L_OtlPp table contains the attributes presented in Table N-46.

Table N-46. L_OtlPp Table

Field	Type	Length	Decimal Places	Required	Description
OtlPp_ID	Long			Yes	Primary key for table.
RsrBrl_ID	Long			Yes	Foreign key to L_RsrBrl.
CLStn	Numeric	12	2	Yes	Centerline station where outlet pope is located.
Diameter	Numeric	8	2	Yes	Diameter of outlet pipe.
DSInvert	Numeric	8	2	Yes	Elevation at downstream invert of outlet pipe.
Height	Numeric	8	2	Yes	Height of outlet pipe.
InTyp_LID	Long			Yes	Inlet type lookup identification. A code that provides a valid link to a valid entry from D_PpTyp.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Lngth	Numeric	8	2	Yes	Length of outlet pipe.
MtlTyp_LID	Long			Yes	Pipe material type lookup identification. A code that provides a valid link to a valid entry from D_MtlTyp.
OutTyp_LID	Long			Yes	Outlet type lookup identification. A code that provides a valid link to a valid entry from D_PpTyp.
ShpTyp_LID	Long			Yes	Pipe shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp.
USInvert	Numeric	8	2	Yes	Elevation at upstream invert of outlet pipe.
Wdth	Numeric	8	2	Yes	Width of outlet pipe.

The The L_ Pier table is a database table. Each record in L_ Pier contains information about a pier. Only bridges may have piers. The L_Pier table contains the attributes presented in Table N-47.

Table N-47. L_Pier Table

Field	Type	Length	Decimal Places	Required	Description
Pier_ID	Long			Yes	Primary key for table.
Brdg_ID	Long			Yes	Foreign key to L_Brdg.
CLStn	Numeric	8	2	Yes	Station at centerline of pier (referencing profile view of structure).
ColumnCnt	Integer			Yes	Number of columns of piers occurring at one station.
Easting	Numeric	12	2	Yes	X-coordinate.
Northing	Numeric	12	2	Yes	Y-coordinate.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
ShpTyp_LID	Long			Yes	Pier shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp.
Wdth	Numeric	8	2	Yes	Width or span of pier, measured perpendicular to the streamflow.

The L_Rail table contains information about the surveyed rail shots. The L_Rail table contains the attributes presented in Table N-48.

Table N-48. L_Rail Table

Field	Type	Length	Decimal Places	Required	Description
Rail_ID	Long			Yes	Primary key for table.
Struc_ID	Long			Yes	Foreign key to S_Struc.
CLStn	Numeric	8	2	Yes	Station at centerline of rail (referencing profile view of structure).
Easting	Numeric	12	2	Yes	X-coordinate.
Elev	Numeric	8	2	Yes	Elevation at top of rail.
Height	Numeric	8	2	Yes	Height of rail.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Northing	Numeric	12	2	Yes	Y-coordinate.

The L_RsrBrl table contains data specific to risers. The L_RsrBrl table contains the attributes presented in Table N-49.

Table N-49. L_RsrBrl Table

Field	Type	Length	Decimal Places	Required	Description
RsrBrl_ID	Long			Yes	Primary key for table.
Dam_ID	Long			Yes	Foreign key to L_Dam.
BaseElv	Numeric	8	2	Yes	Elevation at the bottom of the riser barrel.
CLStn	Numeric	8	2	Yes	Station where riser barrel is located.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Lngth	Numeric	8	2	Yes	Length of the riser barrel.
MtlTyp_LID	Long			Yes	Riser material type lookup identification. A code that provides a valid link to a valid entry from D_MtlTyp.
ShpTyp_LID	Long			Yes	Riser shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp.
TopElv	Numeric	8	2	Yes	Elevation at the top of riser barrel.
TrHt	Numeric	8	2	Yes	Height of trashrack.
TrLn	Numeric	8	2	Yes	Length of trashrack.
TrTopElv	Numeric	8	2	Yes	Elevation at top of trashrack.
TrWd	Numeric	8	2	Yes	Width of trashrack.
Wdth	Numeric	9	2	Yes	Width of the riser barrel.

The L_Sketch table is a database table that contains information related to sketches that were created during the survey. The L_Sketch table contains the attributes presented in Table N-50.

Table N-50. L_Sketch Table

Field	Type	Length	Required	Description
Sketch_ID	Long		Yes	Primary key for table.
Comments	Text	254	No	General comments or notes.
FileNm	Text	254	Yes	Name of the sketch file.
SketchDt	Date		Yes	Date the sketch was created.

The L_StrPht is a lookup table for the photos associated with the structures. The L_StrPht table contains the attributes presented in Table N-51.

Table N-51. L_StrPht Table

Field	Type	Length	Required	Description
StrPht_ID	Long		Yes	Primary key for table.
Photo_ID	Long		Yes	Foreign key to S_Photo.
Struc_ID	Long		Yes	Foreign key to S_Struc.

The L_ StrSkt is a lookup table for the sketches associated with the structures. The L_StrSkt table contains the attributes presented in Table N-52.

Table N-52. L_StrSkt Table

Field	Type	Length	Required	Description
StrSkt_ID	Long		Yes	Primary key for table.
Sketch_ID	Long		Yes	Foreign key to L_Sketch.
Struc_ID	Long		Yes	Foreign key to S_Struc.

The L_ SWy table contains specific information about the spillways for each dam. The L_SWy table contains the attributes presented in Table N-53.

Table N-53. L_SWy Table

Field	Type	Length	Decimal Places	Required	Description
SWy_ID	Long			Yes	Primary key for table.
Dam_ID	Long			Yes	Foreign key to L_Dam.
BotWd	Numeric	8	2	Yes	Width at the bottom of spillway.
CLStn	Numeric	8	2	Yes	Centerline station of spillway.
CrestElv	Numeric	8	2	Yes	Elevation at crest of spillway.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
SWyTyp_LID	Long			Yes	Spillway type lookup identification. A code that provides a valid link to a valid entry from D_SWyTyp.
TopElv	Numeric	8	2	Yes	Elevation at top of spillway.
TopWd	Numeric	8	2	Yes	Width at top of spillway.

The L_SXS is a database table that contains general information about each surveyed cross section. The L_SXS table contains the attributes presented in Table N-54.

Table N-54. L_SXS Table

Field	Type	Length	Decimal Places	Required	Description
SXS_ID	Long			Yes	Primary key for table.
CLEasting	Numeric	12	2	Yes	X-coordinate at stream crossing.
CLNorthing	Numeric	12	2	Yes	Y-coordinate at stream crossing.
CLStn	Numeric	8	2	Yes	Cross section station at intersection of cross section and stream centerline.
Comments	Text	254		No	General comments or notes.
DatTyp_LID	Long			Yes	Cross section or data type lookup identification. A code that provides a valid link to a valid entry from D_DatTyp.
Invert	Numeric	8	2	Yes	Lowest elevation in cross section.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Location	Text	254		Yes	Description of location.
Orient	Text	1		Yes	Direction in which survey shots were taken. From left to right, looking downstream - D, or looking upstream - U
StreamStn	Numeric	12	2	Yes	Distance along stream.
Struc_ID	Long			No	Foreign key to S_Struc. Note: Required if cross section is associated with a structure.
SurveyDt	Date			Yes	Date and time of survey.
SurveyFile	Text	254		No	Name of the survey text file. Note: Not required for cross sections associated with structures.
TBM_ID	Long			Yes	Foreign key to S_TBM. Elevation reference point of cross section.
Wtr_Nm_LID	Long			Yes	Foreign key to L_Wtr_Nm. Surface water feature name.
XSNm	Text	65		Yes	Cross Section Name.

The L_Wtr_Nm table is a database lookup table. This is the same table defined in Appendix L of these Guidelines, but it is listed here for completeness.

The L_Wtr_Nm table contains the attributes presented in Table N-55.

Table N-55. L_Wtr_Nm Table

Field	Type	Length	Required	Description
Wtr_Nm_LID	Long		Yes	Unique identifier for L_Wtr_Nm. Primary key.
Wtr_Nm	Text	254	Yes	Name of surface water feature.

The S_ Photo is a spatial file used to represent the locations of the digital photographs that were taken during the survey. The S_Photo table contains the attributes presented in Table N-56.

Table N-56. S_Photo Spatial File

Field	Type	Length	Decimal Places	Required	Description
Photo_ID	Long			Yes	Primary key for table.
Azimuth	Numeric	6	2	No	Horizontal angle of the bearing for the photo.
Comments	Text	254		No	General comments or notes.
FileNm	Text	254		Yes	Name of the photo file.
Location	Text	254		Yes	A description of the geographic location where the picture was taken.
PhotoDt	Date			Yes	The date that the picture was taken.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_STRUC spatial file.
Subject	Text	50		Yes	Description of feature or view.

S_TBM is a spatial file used to represent the locations of the temporary benchmarks or elevation reference marks that were used during the survey. All TBMs that were used during the survey of structures for detatiled studies should be included in S_TBM.

See Table N-27 for a list of attributes included in the S_TBM spatial file.

D_AbtTyp is a domain table that lists the valid abutment types. The D_AbtTyp table contains the attributes presented in Table N-57. Table N-58 contains the domain values for D_AbtTyp.

Table N-57. D_AbtTyp Table

Field	Type	Length	Required	Description
AbtTyp_LID	Long		Yes	Primary key - Abutment type look-up identification key.
AbtTypDes	Text	20	Yes	Type of abutment: Spill through or vertical wall.

Table N-58. Domain Values for D_AbtTyp

AbtTyp_LID	AbtTypDes
1	Spill Through
2	Vertical Wall
3	Other
4	Unknown

D_ShpTyp is a domain table that lists the valid shape types. The D_ShpTyp table contains the attributes presented in Table N-59. Table N-60 contains the domain values for D_ShpTyp.

Table N-59. D_ShpTyp Table

Field	Type	Length	Required	Description
ShpTyp_LID	Long		Yes	Primary key - shape type look-up identification key.
ShpTypDes	Text	20	Yes	Shape of feature: Circular, Box, Rectangular, Elliptical, Octagonal,Trapezoidal, etc.

Table N-60. Domain Values for D_ShpTyp

ShpTyp_LID	ShpTypDes
1	Circular
2	Box
3	Rectangular
4	Elliptical
5	Octagonal
6	Other
7	Trapezoidal
9	Unknown

D_PpTyp is a domain table that lists the valid types used to describe the ends of pipes or culverts. The D_PpTyp table contains the attributes presented in Table N-61. Table N-62 contains the domain values for D_PpTyp.

Table N-61. D_PpTyp Table

Field	Type	Length	Required	Description
PpTyp_LID	Long		Yes	Primary key - pipe inlet or outlet type look-up identification key.
PpTypDes	Text	20	Yes	Inlet or outlet type: Socket, Projecting from fill, Bell, etc.

Table N-62. Domain Values for D_PpTyp

PpTyp_LID	PpTypDes
1	Socket
2	Projecting from fill
3	Bell
4	Other
5	Unknown

The D_MtlTyp is a domain table that lists the valid descriptions for construction material. D_MtlTyp table contains the attributes presented in Table N-63. Table N-64 contains the domain values for D_MtlTyp.

Table N-63. D_MtlTyp Table

Field	Type	Length	Required	Description
MtlTyp_LID	Long		Yes	Primary key - material type look-up identification key.
MtlTypDes	Text	20	Yes	Type of material: Gravel, Silt, Clay, Earthen, Concrete, etc.

Table N-64. Domain Values for D_MtlTyp

MtlTyp_LID	MtlTypDes
1	Gravel
2	Silt
3	Clay
4	Earthen
5	Concrete
6	Other
7	Unknown

D_ClsTyp is a domain table that lists the valid types used to describe the closure required to operate a structure. The D_ClsTyp table contains the attributes presented in Table N-65. Table N-66 contains the domain values for D_ ClsTyp.

Table N-65. D_ClsTyp Table

Field	Type	Length	Required	Description
ClsTyp_ID	Long		Yes	Primary key - Closure type look-up identification key.
ClsTyp	Text	20	Yes	Type of closure: Sandbags, Stop logs, Floodgates, Combination, etc.

Table N-66. Domain Values for D_ClsTyp

ClsTyp_ID	ClsTypDes
1	Combination
2	Floodgates
3	Other
4	Sandbags
5	Stop logs
6	None

D_LevTyp is a domain table that lists the valid types of levees. The D_LevTyp table contains the attributes presented in Table N-67. Table N-68 contains the domain values for D_ ClsTyp.

Table N-67. D_LevTyp Table

Field	Type	Length	Required	Description
LevTyp_LID	Long		Yes	Primary key - levee type look-up identification key.
LevTypDes	Text	20	Yes	Type of levee: Levee & floodwall, Levee, Floodwall, Ring Levee, Road embankment, RR Embankment, etc.

Table N-68. Domain Values for D_LevTyp

LevTyp_LID	LevTypDes
1	Floodwall
2	Levee
3	Levee & floodwall
4	Ring levee
5	Road embankment
6	RR embankment
7	Other

Section N.3

D_SwyTyp is a domain table that lists the valid types of levees. The D_SwyTyp table contains the attributes presented in Table N-69. Table N-70 contains the domain values for D_ SwyTyp.

Table N-69. D_SwyTyp Table

Field	Type	Length	Required	Description
SWyTyp_LID	Long		Yes	Primary key - Spillway type look-up identification key.
SWyTypDes	Text	20	Yes	Type of spillway: Auxiliary/Emergency, Service/Principal, etc.

Table N-70. Domain Values for D_SwyTyp

SWyTyp_LID	SWyTypDes
1	Auxiliary/Emergency
2	Service/Principal
3	Other
4	Unknown

D_LevTyp is a domain table that lists the valid types of dams. The D_DamTyp table contains the attributes presented in Table N-71. Table N-72 contains the domain values for D_ SwyTyp.

Table N-71. D_DamTyp Table

Field	Type	Length	Required	Description
DamTyp_LID	Long		Yes	Primary key - Dam type look-up identification key.
DamTypDes	Text	20	Yes	Engineering descriptor: Concrete Arch, Masonry, Rubber, Timber Crib, RCC, Rockfill, Earthen, etc.

Table N-72. Domain Values for D_DamTyp

DamTyp_LID	DamTypDes
1	Concrete Arch
2	Concrete Gravity
3	Earthfill
4	Masonry
5	RCC
6	Rockfill
7	Rubber
8	Timber Crib
9	Other
10	Unknown

Survey Files

Description

A separate survey file must be submitted for all bridges, culverts, and dams. Survey files are not required for channels or levees.

Naming Convention

The file name for the survey file is to be based on the name of the structure, which is found in the StrucNm field in the S_Struc table. However, the file name is to use underscores to indicate spaces in the name of the structure. In a submission, each survey file must have a unique file name. For example, SOMEWHERE_RD.TXT

The file name of the survey file for a structure must be populated in the SurveyFile field in the S_Struc table, in the record corresponding to that structure.

Attributes

Each survey file is to include all survey data for a structure. The file name of the survey file for a structure must be populated in the **SurveyFile** field in the **S_Struc** table, in the record corresponding to that structure.

Digital Photographs

Description

A minimum of four digital photographs will be submitted for each bridge, culvert, and dam. The required aspects or view of the photographs include:

- Standing upstream of structure, looking downstream at structure (USF)
- Standing on or below the structure, looking upstream at the channel (USC)
- Standing on or below the structure, looking downstream at the channel (DSC)
- Standing downstream of structure, looking upstream at structure (DSF)

A minimum of two digital photographs are to be submitted for each channel and levee. The required aspects or view of the photographs include:

- Standing at midpoint of the structure, looking upstream at the channel or levee (USC)
- Standing at midpoint of the structure, looking downstream at the channel or levee (DSC)

Naming Convention

The file name of the digital photograph is to be based on the name of the structure (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique file name.

For examples, SOMEWHERE_RD_USF.PNG
        SOMEWHERE_RD_USC. PNG
        SOMEWHERE_RD_DSC. PNG
        SOMEWHERE_RD_DSF. PNG

Attributes

A record must be populated in the S_Photo table for each photograph. The file name of the photograph must be populated in the FileNm field in the S_Photo table, in the record corresponding to that photograph. In addition, a record must be populated in the L_StrPht table for each photograph.

See Table N-56 for a list of attributes included in the S_Photo spatial file.

Digital Sketches

Description

All sketches that are prepared during the survey of a structure must be submitted in digital format. If a sketch is drawn on paper in the field, it must be scanned into digital format. Each sketch must be in a separate digital file.

Naming Convention

The file name of the digital sketch is to be based on the name of the structure (with underscores rather than spaces), an underscore, "SK" and a number, and the extension. In a submission, each sketch files must have a unique file name. For example, SOMEWHERE_RD_SK1.PNG

Attributes

A record must be populated in the L_Sketch table for each sketch. The file name of the sketch must be populated in the FileNm field in the L_Sketch table, corresponding to that sketch. In addition, a record must be populated in the L_StrSkt table for each sketch

See Table N-50 for a list of attributes included in the L_Sketch table.

N.3.2.5 Structures for Limited Detailed Study   [April 2005]

The following deliverables are required whenever hydraulic structures have been surveyed to support Limited Detailed Studies; levees are shown on the FIRM, channels containing the flooding are shown on the FIRM; or any other structure that impacts the area's flood risk is shown on the FIRM:

- Database tables and Spatial Files
- Digital Photographs

The following subsections detail the requirements for each deliverable.

Database Tables and Spatial Files

Description

The database will contain the tables related to survey data for structures listed in Table N-73.

**Table N-73. Database Tables and Spatial Files
for Structures for Limited Detail Studies**

Table	Description
S_ApxStr	The ApxStr table contains information about the hydraulic structures that have been surveyed within the study area in support of limited detailed studies.
L_ApxCul	Each record in this table contains information about one pipe, at a culvert crossing.
L_ApxDam	Each record in this table contains information specific to a dam.
L_ApxRsr	Each record in this table contains information specific to one riser barrel.
L_ApxSWy	Each record in this table contains information about a relief device at a dam.
L_ApxPht	This table is a look up table for the photos of each structure.
L_ApxBrdg	Each record in this table contains information specific to a bridge.
S_Photo	A point spatial file used to represent the locations where photos were taken.
L_WtrNm	This is a look up table for streams.
D_MtlTyp	A domain table used to store the valid types of construction material.
D_ShpTyp	A domain table used to store the valid shape of a culvert/riser/exit pipe.

See Figure N-7 for an entity relationship diagram of the tables for structures surveyed for limited detailed studies.

Figure N-7. Entity Relationship Diagram for Structures for Limited Detailed Study
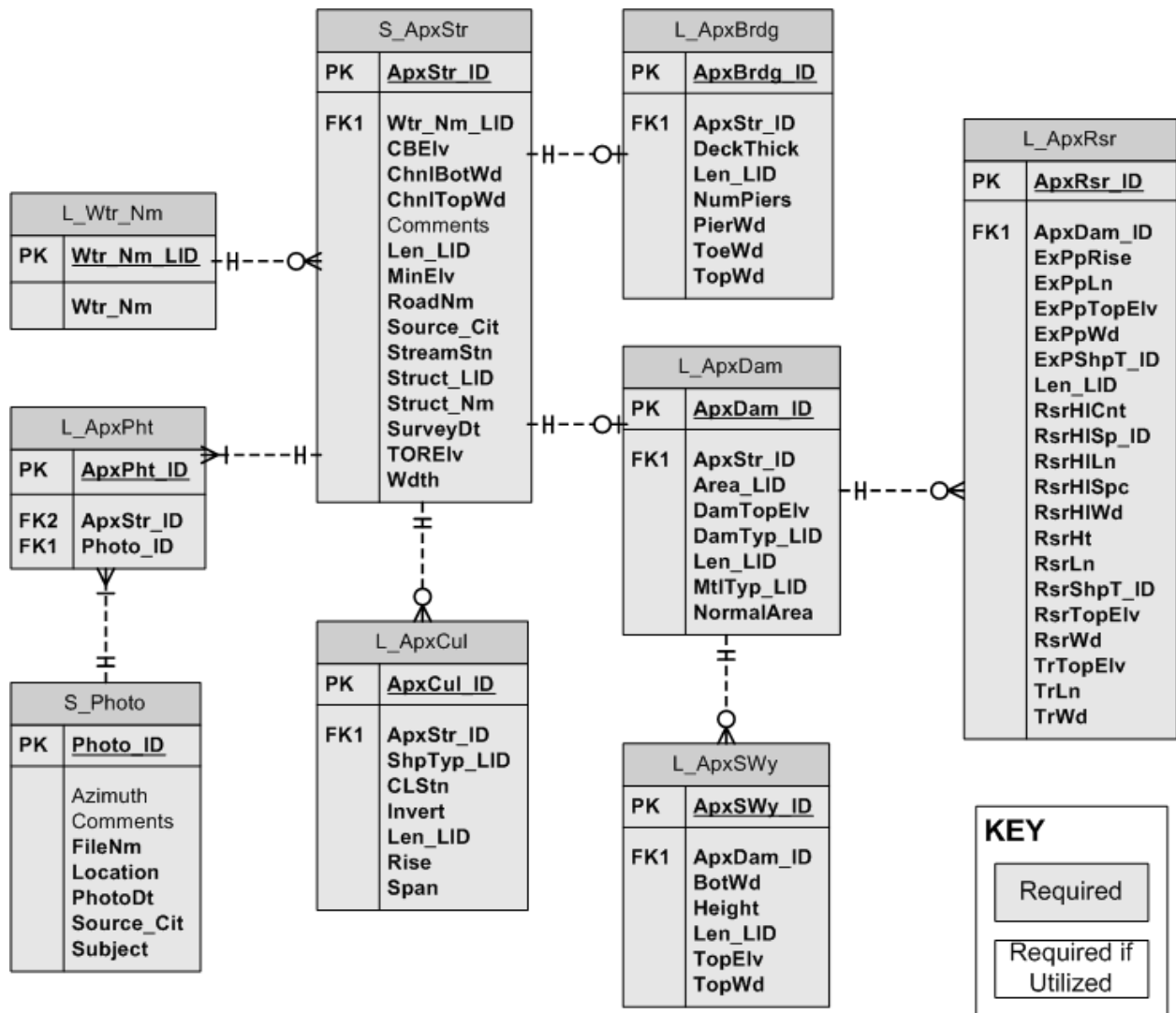
The S_ApxStr spatial file contains general data and locational information about structures surveyed for limited detailed studies. Each structure is to be represented spatially by a single line. Each line is to represent the primary characteristic of the structure.

- Each bridge is to be represented by a single line that is aligned to the transportation centerline carried by the bridge.

- Each culvert is to be represented by a single line that is aligned to the transportation centerline carried by the culvert.

- Each dam is to be represented by a single line that is aligned to the centerline along the top of the dam.

The spatial files are to be named S_ApxStr and the extension appropriate for the file format. For example, the components of a shapefile would be named S_ApxStr.shp, S_ApxStr.dbf, S_ApxStr.shx, and S_ApxStr.prj.

S_ApxStr must contain the attributes shown in Table N-74.

Table N-74. S_ApxStr Spatial File

Field	Type	Length	Decimal Places	Required	Description
ApxStr_ID	Long			Yes	Primary key for table.
Wtr_Nm_LID	Long			Yes	Foreign key to L_Wtr_Nm. Surface water feature name.
CBElv	Numeric	8	2	Yes	Average channel bank elevation.
ChnlBotWd	Numeric	8	2	Yes	Width at the bottom of channel.
ChnlTopWd	Numeric	8	2	Yes	Width at the top of channel.
Comments	Text	254		No	General comments or notes.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
MinElv	Numeric	8	2	Yes	Minimum elevation at structure.
RoadNm	Text	100		Yes	Road name or location of structure
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_ApxStr spatial file.
StreamStn	Numeric	12	2	Yes	Distance along stream where structure intersects stream.
Struct_LID	Long			Yes	Structure Type Lookup Identification. A code that provides a link to a valid entry from the D_Struct_Typ table. See Appendix L.
Struct_Nm	Text	50		Yes	Field name of the structure.
SurveyDt	Date			Yes	Date of survey.
TORElv	Numeric	8	2	Yes	Maximum top of road elevation at structure.
Wdth	Numeric	8	2	Yes	Hydraulic distance from one edge of structure to the other, parallel to stream.

Section N.3

L_ApxCul is a database table. Each record in this table contains information about one pipe or box, at a culvert crossing. The L_ApxCul table contains the attributes presented in Table N-75.

Table N-75. L_ApxCul Table

Field	Type	Length	Decimal Places	Required	Description
ApxCul_ID	Long			Yes	Primary key for table.
ApxStr_ID	Long			Yes	Foreign key to S_ApxStr.
ShpTyp_LID	Long			Yes	Culvert shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp.
CLStn	Numeric	8	2	Yes	Cross section station, in profile view, along structure of intersection of structure and stream centerline.
Invert	Numeric	8	2	Yes	Elevation at bottom of upstream pipe opening.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
Rise	Numeric	8	2	Yes	Height or diameter of pipe.
Span	Numeric	8	2	Yes	Width or span of pipe.

The L_ApxDam is a database table. Each record in this table contains information specific to one dam. The L_ApxDam table contains the attributes presented in Table N-76.

Table N-76. L_ApxDam Table

Field	Type	Length	Decimal Places	Required	Description
ApxDam_ID	Long			Yes	Primary key for table.
ApxStr_ID	Long			Yes	Foreign key to S_ApxStr.
Area_LID	Long			Yes	Units of area measure. A code that provides a valid link to a valid entry from D_Area_Units. See Appendix L.
DamTopElv	Numeric	8	2	Yes	Elevation at top of dam.
DamTyp_LID	Long			Yes	Dam type lookup identification. A code that provides a valid link to a valid entry from D_DamTyp.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
MtlTyp_LID	Long			Yes	Material type lookup identification. A code that provides a valid link to a valid entry from D_MtlTyp.
NormalArea	Numeric	10	2	Yes	Area of pool at normal water surface elevation.

The L_ApxRsr contains data specific to risers. The L_ApxRsr table contains the attributes presented in Table N-77.

Table N-77. L_ApxRsr Table

Field	Type	Length	Decimal Places	Required	Description
ApxRsr_ID	Long			Yes	Primary key for table.
ApxDam_ID	Long			Yes	Foreign key to L_ApxDam.
ExPpRise	Numeric	8	2	Yes	Diameter or height of the exit pipe.
ExPpLn	Numeric	8	2	Yes	Length of the exit pipe.
ExPpTopElv	Numeric	8	2	Yes	Elevation at the top of the exit pipe.
ExPpWd	Numeric	8	2	Yes	Width of the exit pipe.
ExPShpT_ID	Long			Yes	Exit pipe shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp, field ShpTyp_LID.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
RsrHlCnt	Integer			Yes	Number of riser holes.
RsrHlSp_ID	Long			Yes	Riser hole shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp, field ShpTyp_LID.
RsrHlLn	Numeric	8	2	Yes	Length or diameter of riser holes.
RsrHlSpc	Numeric	8	2	Yes	Spacing between riser holes.
RsrHlWd	Numeric	8	2	Yes	Width of riser holes.
RsrHt	Numeric	8	2	Yes	Height of riser.
RsrLn	Numeric	8	2	Yes	Length or diameter of riser top opening.
RsrShpT_ID	Long			Yes	Riser shape type lookup identification. A code that provides a valid link to a valid entry from D_ShpTyp, field ShpTyp_LID.
RsrTopElv	Numeric	8	2	Yes	Elevation at the top of the riser.
RsrWd	Numeric	8	2	Yes	Width of riser.
TrTopElv	Numeric	8	2	Yes	Elevation at the top of trashrack.
TrLn	Numeric	8	2	Yes	Length of the trashrack.
TrWd	Numeric	8	2	Yes	Width of the trashrack.

The L_ApxSWy table contains specific information about the spillways for each dam. The L_ApxSWy table contains the attributes presented in Table N-78.

Table N-78. L_ApxSwy Table

Field	Type	Length	Decimal Places	Required	Description
ApxSWy_ID	Long			Yes	Primary key for table.
ApxDam_ID	Long			Yes	Foreign key to L_ ApxDam.
BotWd	Numeric	8	2	Yes	Width at bottom of spillway.
Height	Numeric	8	2	Yes	Height of spillway.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
TopElv	Numeric	8	2	Yes	Elevation at top of spillway.
TopWd	Numeric	8	2	Yes	Width at top of spillway.

The L_ApxPht table is a lookup table for the photos associated with structures that have been surveyed to support limited detailed studies. The L_ApxPht table contains the attributes presented in Table N-79.

Table N-79. L_ApxPht Table

Field	Type	Length	Required	Description
ApxPht_ID	Long		Yes	Primary key for table.
ApxStr_ID	Long		Yes	Foreign key to S_ApxStr.
Photo_ID	Long		Yes	Foreign key to S_Photo.

The L_ ApxBrdg is a database table. Each record in this table contains information specific to one bridge. The L_ApxBrdg table contains the attributes presented in Table N-80.

Table N-80. L_ApxBrdg Table

Field	Type	Length	Decimal Places	Required	Description
ApxBrdg_ID	Long			Yes	Primary key for table.
ApxStr_ID	Long			Yes	Foreign key to S_ApxStr.
DeckThick	Numeric	8	2	Yes	Measurement from top of road to bottom of bridge.
Len_LID	Long			Yes	Units of linear measure. A code that provides a valid link to a valid entry from D_Length_Units. See Appendix L.
NumPiers	Integer			Yes	Number of piers.
PierWd	Numeric	8	2	Yes	Average width or span of piers, measured perpendicular to the streamflow.
ToeWd	Numeric	8	2	Yes	Width of a structure, measured between the abutments.
TopWd	Numeric	8	2	Yes	Width of structure, measured between outermost low chords.

The S_ Photo is a spatial file used to represent the locations of the digital photographs that were taken during the survey. The S_Photo table contains the attributes presented in Table N-81.

Table N-81. S_Photo Spatial File

Field	Type	Length	Decimal Places	Required	Description
Photo_ID	Long			Yes	Primary key for table.
Azimuth	Numeric	6	2	No	Horizontal angle of the bearing for the photo.
Comments	Text	254		No	General comments or notes.
FileNm	Text	254		Yes	Name of the photo file.
Location	Text	254		Yes	A description of the geographic location where the picture was taken.
PhotoDt	Date			Yes	The date that the picture was taken.
Source_Cit	Text	11		Yes	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_STRUC spatial file.
Subject	Text	50		Yes	Description of feature or view.

The L_Wtr_Nm table is a database lookup table. It is required for all types of hydraulic analyses. This table identifies the unique list of stream names used in the submittal. This is the same table defined in Appendix L of these Guidelines, but it is listed here for completeness.

The L_Wtr_Nm table contains the attributes presented in Table N-82.

Table N-82. L_Wtr_Nm Table

Field	Type	Length	Required	Description
Wtr_Nm_LID	Long		Yes	Unique identifier for L_Wtr_Nm. Primary key.
Wtr_Nm	Text	254	Yes	Name of surface water feature.

D_MtlTyp is a domain table that lists the valid types used to describe construction material. The D_MtlTyp table contains the attributes presented in Table N-83. Table N-84 contains the domain values for D_MtlTyp.

Table N-83. D_MtlTyp Table

Field	Type	Length	Required	Description
MtlTyp_LID	Long		Yes	Primary key - material type look-up identification key.
MtlTypDes	Text	20	Yes	Type of material: Gravel, Silt, Clay, Earthen, Concrete, etc.

Table N-84. Domain Values for D_MtlTyp

MtlTyp_LID	MtlTypDes
1	Gravel
2	Silt
3	Clay
4	Earthen
5	Concrete
6	Other
7	Unknown

D_ShpTyp is a domain table that lists the valid types used to describe the shape. The D_ShpTyp table contains the attributes presented in Table N-85. Table N-86 contains the domain values for D_ ShpTyp.

Table N-85. D_ShpTyp Table

Field	Type	Length	Required	Description
ShpTyp_LID	Long		Yes	Primary key - shape type look-up identification key.
ShpTypDes	Text	20	Yes	Shape of feature: Circular, Box, Rectangular, Elliptical, Octagonal,Trapezoidal, etc.

Table N-86. Domain Values for D_ShpTyp

ShpTyp_LID	ShpTypDes
1	Circular
2	Box
3	Rectangular
4	Elliptical
5	Octagonal
6	Other
7	Trapezoidal
9	Unknown

Digital Photographs

Description

A minimum of one digital photograph is to be submitted for each structure. The required aspects or view of the photographs include standing upstream of structure, looking downstream at structure (USF).

Naming Convention

The file name of the digital photograph is to be based on the name of the structure (with underscores rather than spaces), an underscore, the aspect or view of the photograph, and the extension. In a submission, each digital photograph must have a unique file name. For example,
    SOMEWHERE_RD_USF.PNG

Attributes

A record must be populated in the S_Photo table for each photograph. The file name of the photograph must be populated in the FileNm field in the S_Photo table, in the record

corresponding to that photograph. In addition, a record must be populated in the L_ApxPht table for each photograph.

See Table N-81 for a list of attributes included in the S_Photo spatial file.

N.3.3   Deliverables   [May 2005]

N.3.3.1 Metadata   [May 2005]

A metadata file that complies with the FEMA/FGDC Metadata Profiles (available under separate cover from FEMA Headquarters) in XML-format shall be included with the submittal. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements and those elements that are mandatory for FEMA based on the specific submittal type.

There are specific items in the FGDC metadata standards that the submitter shall address. For each spatial data source in the metadata file, the Mapping Partner shall assign a Source Citation Abbreviation. The overview description subsection of the entity and attribute information of the metadata file must include a list of all DCS database tables included in the submittal.

N.3.3.2 Hard Copy Deliverables   [December 2004]

There are no hard copy deliverables for submittal of inventory data.

N.3.3.3 Digital Deliverables   [May 2005]

Transfer Media

Mapping Partners must submit files on one of the following electronic media or via the internet:

- CD-ROM
- DVD
- Upload to Mapping Information Platform (MIP) (http://www.hazards.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA and the Mapping Partner receiving the data.

Files must not be compressed.

Data Format

Metadata

Each submittal of survey data must include one metadata file.

Database

Each submittal will include only one database. The database must be a Microsoft Access 2000 database (mdb) or dBASE IV files. The file name for the database will be based upon the name of the study name. No spaces will be allowed in the file name.

For example, FLOODUSA.MDB.

Photographs

The photographs must be in color and must be submitted digitally. Table N-87 provides the file formats acceptable for submittal of digital photographs.

Table N-87. File Formats for Photographs

Format	Extension	References
JPEG	JPG	Joint Photographics Experts Group.
Bitmap	BMP	Microsoft Corporation.
Portable Network Graphic	PNG	
Tagged Image File Format	TIFF	

Spatial Files

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields. Table N-88 provides the file formats acceptable for data submittal.

Table N-88. File Formats for Spatial Files

Format	Extension	Vendor Information
Shapefile	SHP (including related files such as .SHX, .DBF, and .PRJ)	See ESRI support: www.esri.com.

Sketches

Each sketch must be in a separate digital file. Table N-89 provides the file formats acceptable for submittal of survey files.

Table N-89. File Formats for Sketches

Format	Extension	References
Portable document	PDF	See Adobe support: www.adobe.com.
JPEG	JPG	Joint Photographics Experts Group.
Portable Network Graphic	PNG	

Survey Files

The survey file must be an ASCII-formatted file.

Directory Structure and Folder Naming Conventions

A metadata file compliant with FEMA/FGDC Metadata Profiles shall be placed in the *General* folder on the root directory of Disk1. These directories must be located in the root directory of the disk(s). No sub-folders or sub-directories will be allowed under these directories. Data must be located in the appropriate directory, as follows. The *General* folder must be located on the first disk.

> *\Database*
> > o   Database file(s), including the L_Submittal_Info table
>
> *\General*
> > o   XML-format metadata file
>
> *\Photos*
> > o   All digital photographs
>
> *\Sketches*
> > o   All digital sketches
>
> *\Spatial*
> > o   Cross section spatial file (S_SXS)
> > o   Temporary Benchmarks or Elevation Reference Marks spatial file (S_TBM)
> > o   Structures for detailed study spatial file (S_Struc)
> > o   Structures for limited study spatial file (S_ApxStr)
> > o   High water marks spatial file (S_HWM)
> > o   Photos spatial file (S_Photo)
>
> *\Survey*
> > o   All survey files

Section N.3

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name
- Community name and state for which the FIS was prepared
- Survey Data
- Date of submission (formatted mm/dd/yyyy)
- Disk [*sequential number*] of [*number of disks*]

N.4　Hydrology Submittal Standards

N.4.1　Overview　　　　　　　　　　　　　　　　　　**[December 2004]**

The goal of this section is to describe the format and type of hydrologic data expected by FEMA for new riverine flood insurance studies. The objective is to archive the hydrologic data in a database so that these data can be revised and used with minimum effort in future flood insurance studies or map revisions. New techniques such as digital terrain analysis, geospatial database management, and digital hydrologic and hydraulic models make it possible to protect the data investment and make these data available for reuse in existing and future studies to a much greater extent than in the past.

As described in Appendix C of these Guidelines, there are three broad categories of hydrologic procedures used in the National Flood Insurance Program (NFIP):

- flood-frequency analyses for gaged streams using Bulletin 17B, "Guidelines For Determining Flood Flow Frequency" (Interagency Advisory Committee on Water Data, 1982)

- Regional regression equations for ungaged streams, generally those developed by USGS (http://water.usgs.gov/software/nff.html)

- Rainfall-runoff models for ungaged streams that utilize rainfall data to estimate flood discharges.

Within the category of rainfall-runoff models, the HEC-1 and HEC-HMS models developed by the U.S. Army Corps of Engineers (USACE), Hydrologic Engineering Center (HEC), are used most frequently in the NFIP. In addition to the two USACE models, FEMA accepts hydrologic results from over a dozen other rainfall-runoff models (for a list of accepted models see http://www.fema.gov/fhm/en_hydro.shtm) and it is likely that new models will be added in the future. Considering the widely varying data requirements for these models, initial efforts to archive the hydrologic data will concentrate on a minimum dataset required to describe the hydrologic procedures.

In recent years, pre- and post-processors have been developed that automate the application of hydrologic models and provide links to Geographic Information Systems, hydraulic models, and floodplain mapping procedures. Some examples of pre- and post processor systems that implement rainfall-runoff models include the Watershed Modeling System (WMS) developed by Brigham Young University, the Modular Modeling System (MMS) developed by USGS, BASINS developed by the U.S. Environmental Protection Agency, and the Watershed Information System (WISE) developed by Watershed Concepts. These automated systems create input and output files that can be easily archived.

Using FEMA-accepted hydrologic modeling methods such as flood-frequency analyses for gaged streams, application of regional regression equations or a rainfall-runoff model, the

Minimum Required Dataset is described in detail in this section and includes the following items:

- A georeferenced/projected hydrologic link network (typically the same as the stream channel network)

- A georeferenced point dataset showing the locations of computed discharges and the design discharges obtained from the hydrologic analysis that can be converted to a FIS Discharge Summary Table

- Input and output files for an approved hydrologic model where used (see http://www.fema.gov/fhm/en_hydro.shtm for an updated list of these models)

- A series of database tables summarizing key data

- A design hydrology report

- A georeferenced /projected polygon feature class of watershed areas contributing runoff to the stream channel network, subdivided into the subcatchments, if utilized for hydrologic modeling

- Optional geospatial datasets and database tables utilized for parameter calculation

A detailed description of each of these data requirements is provided in the body of this section. Because of the frequent use of applications such as HEC-1 and HEC-HMS that utilize a design rainfall event and the Natural Resources Conservation Service runoff curve number and time of concentration approach, these data are requested in the tables described in this section. Additional tables will be added in the future to capture data from other methods as well.

N.4.2   Requirements   [April 2005]

N.4.2.1 Data Files   [April 2005]

The following deliverables are required for a hydrology submittal:

- Database Tables

- Spatial Files

- Hydrology Model Input and Output Files

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields and spatial projection information. Other domain and hydrologic results tables will be populated in Dbase IV format or Microsoft Access. All spatial data must be georeferenced and elevation data must include datum information.

Database tables and spatial datasets needed for hydrologic submittal are provided in Table N-90.

Table N-90. Hydrology Database and Spatial Data

Table Name	Description
L_HydroModel	A database table. The highest level representation of a hydrology model. Contains important information on geometry and results files.
S_HydroNode	A spatial dataset consisting of points showing the locations of computed discharge values.
S_HydroLink	A spatial dataset consisting of lines showing the hydrologic connectivity network.
S_HydroBasin	A spatial dataset consisting of polygons depicting basin boundaries.
L_HydroResult	A database table. Identifies one or more flood events per model at each point of the HydroNode spatial data.
L_Wtr_Nm	A database table. A lookup table of stream names.
L_HydroEvent	A database table. A lookup table of flood events.
S_HydroGage	A point spatial file of flow and precipitation gage locations. Required if utilized for calibration, regression, or frequency analysis.
S_HydroSoil	A polygon spatial file of soils. Required if utilized for model parameterization.
S_HydroLanduse	A polygon spatial file of land-use classifications. Required if utilized for model parameterization.
S_HydroImpervious	A polygon spatial file of impervious areas. Required if utilized for model parameterization.
L_HydroEquation	A database table. Lookup table of regression equations. Required if regression analysis utilized.
L_HydroNodeParam	A database table. Used for storing regression equation parameter values. Required if regression analysis is utilized.
D_HydroParam	A domain table used for storing regression equation parameter types. Required if regression analysis is utilized.
S_HydroTC	A linear spatial file of time of concentration calculations. Required if utilized for rainfall runoff model parameterization.
L_HydroCNResult	A database table. Contains curve numbers for subbasins. Required if utilized for rainfall runoff model parameterization.
L_HydroCNLookup	A database table. Lookup of curve numbers by soil and land use. Required if utilized for rainfall runoff model parameterization.
L_HydroStormInfo	A database table. Describes precipitation patterns. Required if utilized for rainfall runoff model parameterization.
L_HydroStormCurve	A database table. Used for storing DDF and IDF curves. Required if utilized for rainfall runoff model parameterization.

Section N.4

Depending on the scope of work, the Mapping Partner may develop a new hydrologic model with all the associated input files, may modify an existing model developed for the effective flood insurance study or a related study, or simply utilize an existing model or adopt the effective flood discharges. Table N-91 describes the minimum required datasets for each study approach and the three hydrologic modeling approaches described earlier, watershed model, regression equations and gage analysis. If existing models are not available in digital format, the hard copy output from the model or analysis should be scanned into a PDF file.

Table N-91. Minimum Required Datasets*

	Watershed Model	Regression Analysis	Gage Analysis
New Model	**Spatial File:** • S_HydroBasin • S_HydroNode • S_HydroLink **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm	**Spatial File:** • S_HydroNode • S_HydroLink **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm • L_HydroEquation • L_HydroNodeParam • D_HydroParam	**Spatial File:** • S_HydroNode • S_HydroLink • S_HydroGage **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm
Modification / Reference of existing model	**Spatial File:** • S_HydroNode • S_HydroLink **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm	**Spatial File:** • S_HydroNode • S_HydroLink **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm • L_HydroEquation • L_HydroNodeParam • D_HydroParam	**Spatial File:** • S_HydroNode • S_HydroLink • S_HydroGage **Table:** • L_HydroModel • L_HydroResult • L_HydroEvent • L_Wtr_Nm

*Additional datasets (such as S_HydroLanduse) are still required if utilized.

Figure N-8. Entity Relationship Diagram for Hydrology
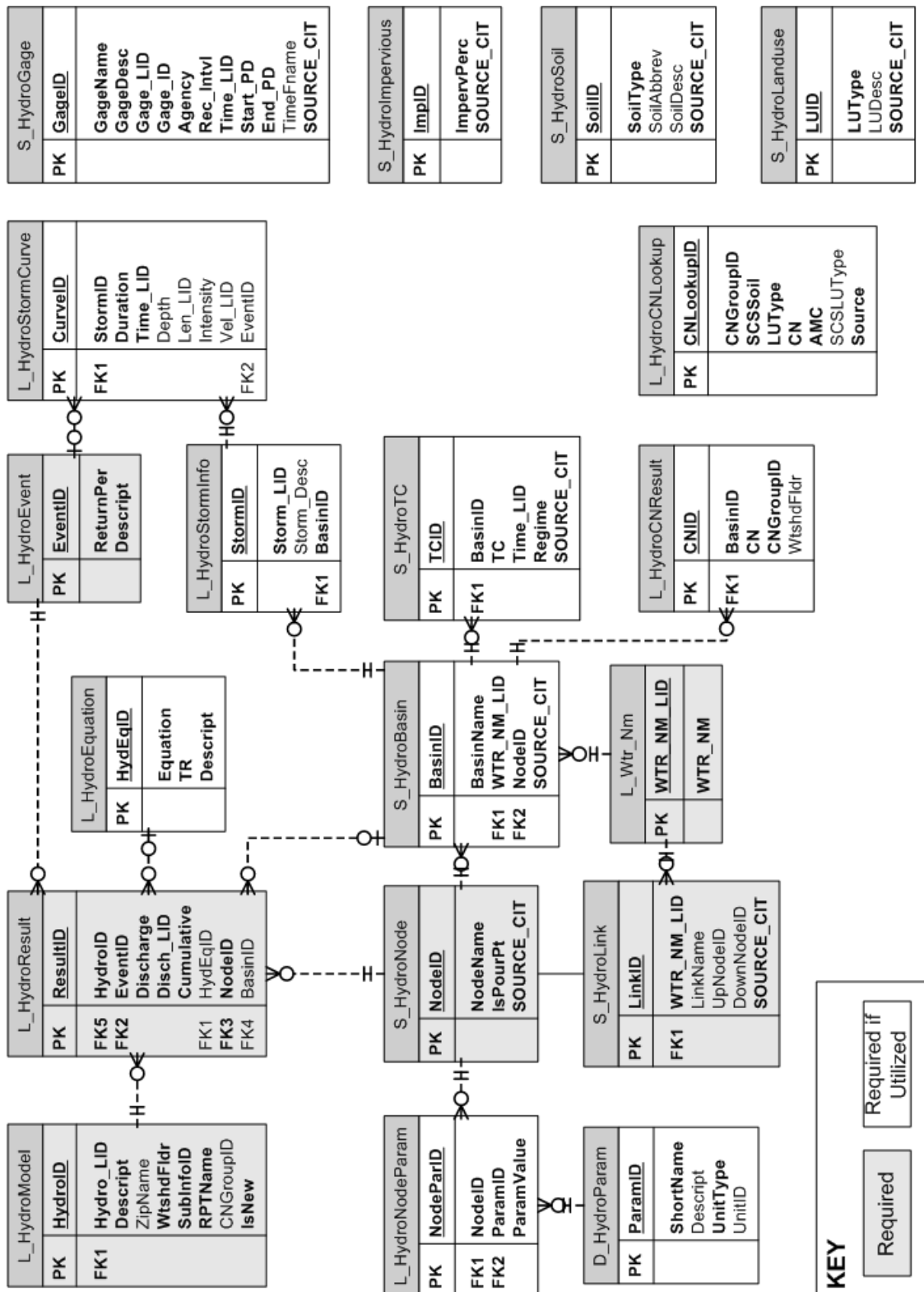
N.4.2.2 Required Hydrologic Data [April 2005]

L_HydroModel Table

The L_HydroModel table is a database table. It is required for all types of hydrologic analyses. This table identifies the model(s) and hydrologic result file(s) related to a particular watershed.

The L_HydroModel table contains the attributes provided in Table N-92.

Table N-92. L_HydroModel Table

Field	Type	Length	Required	Description
HydroID	Long		Yes	Primary key for table. AutoNumber field.
Hydro_LID	Long		Yes	A foreign key to the D_Hydro domain table.
Descript	Text	254	Yes	Model description.
ZipName	Text	254	No	File name of a compressed hydrologic model, including inputs and outputs, stored in the *Simulations* folder for this watershed.
WtshdFldr	Text	254	Yes	Folder that stores all files for this watershed.
SubInfoID	Long		Yes	Foreign key to L_Submittal_Info table.
RPTName	Text	254	Yes	File name of the design hydrology report stored in the *General* folder.
CNGroupID	Long		No	Foreign key to L_HydroCNLookup table used to identify a set of curve numbers.
IsNew	Boolean		Yes	Specifies whether this is a new model or modification/reference of an existing model.

S_HydroNode Spatial File

The S_HydroNode spatial file is required for all types of hydrologic analyses. Each point in this spatial data can have computed discharge values (in L_HydroResult table) associated with it, when paired with a HydroModel. The points must lie on the stream centerlines as shown in the S_HydroLink spatial dataset. HydroNodes can represent subbasin pour points or HydroLink confluences.

 The S_HydroNode spatial file contains the attributes presented in Table N-93.

Table N-93. S_HydroNode Spatial File

Field	Type	Length	Required	Description
NodeID	Long		Yes	Primary key for table.
NodeName	Text	254	Yes	Description of the location. This information will be included in the FIS text. Must be unique across a watershed.
IsPourPt	Boolean		Yes	Nodes can be either basin outlets/pour points or confluences.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_HydroLink Spatial File

The S_HydroLink spatial file(s) is required for all types of hydrologic analysis. This dataset is used as the base for delineation of basin boundaries and identification of discharge locations. The features in the S_HydroLink spatial file connect HydroNodes and follow the profile baseline wherever available. All link segments are to be drawn upstream to downstream and must not be multi-part shapes.

The S_HydroLink attribute table contains the information presented in Table N-94.

Table N-94. S_HydroLink Spatial File

Field	Type	Length	Required	Description
LinkID	Long		Yes	Primary key for table.
WTR_NM_LID	Long		Yes	A foreign key to the L_Wtr_Nm table.
LinkName	Text	254	No	An optional identification string for each reach. If used, LinkName must be unique across a watershed.
UpNodeID	Long		No	A foreign key to the S_HydroNode table. The upstream node of a link.
DownNodeID	Long		No	A foreign key to the S_HydroNode table. The downstream node of a link.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

Figure N-9 illustrates the proper placement of HydroNodes and HydroLinks. Note that HydroNodes are required at basin pour points and confluences.

Figure N-9. Placement of HydroNodes and HydroLinks
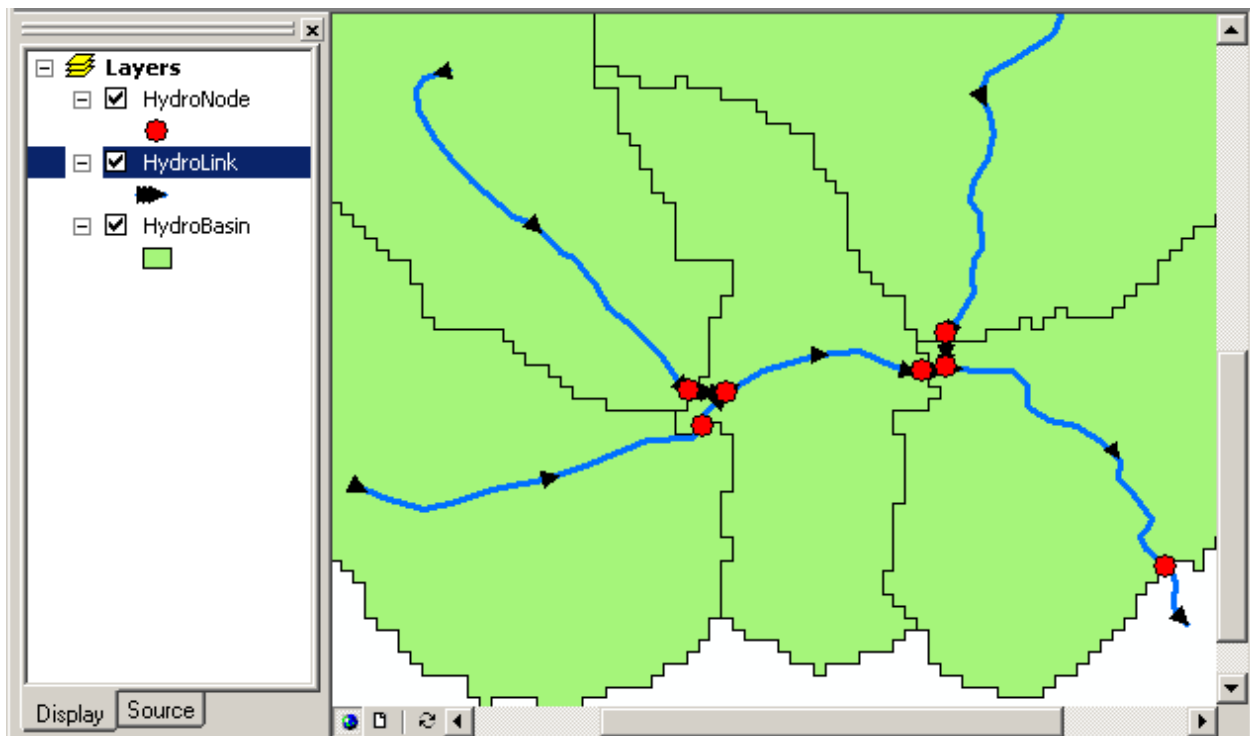
S_HydroBasin Spatial File

The S_HydroBasin spatial file is required whenever basins have been utilized for hydrologic analyses. Basins must have only one part and cannot self-intersect (must be simple). Adjacent basins should not overlap or have gaps between them. Each basin must overlay a corresponding stream segment in the S_HydroLink spatial dataset and must have a HydroNode representing the outlet/pour point.

The S_HydroBasin spatial file contains the attributes presented in Table N-95.

Table N-95. S_HydroBasin Spatial File

Field	Type	Length	Required	Description
BasinId	Long		Yes	Primary key for table.
BasinName	Text	100	Yes	An alpha-numeric name. Must be unique across a watershed.
WTR_NM_LID	Long		Yes	A reference to L_Wtr_Nm table.
NodeID	Long		Yes	A foreign key to the S_HydroNode table.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

L_HydroResult Table

The L_HydroResult table is a database table. It is required for all types of hydrologic analyses. This table identifies one or more flooding events associated with a node in the S_HydroNode table. A typical example would be four records for a 10-year, 50-year, 100-year, and 500-year flood, corresponding to one particular method/model.

The L_HydroResult table contains the attributes presented in Table N-96.

Table N-96. L_HydroResult Table

Field	Type	Length	Decimal Places	Required	Description
ResultID	Long			Yes	Primary key for table.
HydroID	Long			Yes	A reference to L_HydroModel.
EventID	Long			Yes	A reference to L_HydroEvent, which identifies the return period for this result.
Discharge	Numeric	9	1	Yes	Calculated discharge.
Disch_LID	Long			Yes	A foreign key to the D_Discharge_Units domain table.
Cumulative	Boolean			Yes	Specifies whether this result is for a subbasin discharge or a cumulative discharge.
HydEqID	Long			No	A reference to L_HydroEquation table.
NodeID	Long			Yes	A reference to S_HydroNode table.
BasinID	Long			No	A reference to S_HydroBasin table.

Section N.4

L_Wtr_Nm Table

The L_Wtr_Nm table is a database domain table. It is required for all types of hydrologic analyses. This table identifies the unique list of stream names used in the submittal. This is the same table as defined in Appendix L of these Guidelines, but it is listed here for completeness.

The L_Wtr_Nm table contains the attributes presented in Table N-97.

Table N-97. L_Wtr_Nm Table

Field	Type	Length	Required	Description
WTR_NM_LID	Long		Yes	Primary key for table.
WTR_NM	Text	254	Yes	Unique alpha-numeric name (i.e. Crooked Creek).

L_HydroEvent Table

The L_HydroEvent table is a database table. It is required for all types of hydrologic analyses. This table identifies flooding events used in HydroModels.

The L_HydroEvent table contains the attributes presented in Table N-98.

Table N-98. L_HydroEvent Table

Field	Type	Length	Decimal Places	Required	Description
EventID	Long			Yes	Primary key for table. AutoNumber field.
ReturnPer	Numeric	6	1	Yes	The recurrence interval of the event in years (i.e. 10, 27, 100).
Descript	Text	32		Yes	Brief description of flood event (i.e. 10-year or Hurricane Hugo).

N.4.2.3 Other Hydrologic Data   [April 2005]

S_HydroGage Spatial File

The S_HydroGage spatial file is a spatial file that is used to locate precipitation and flow gages. It is required if it is utilized for calibration, regression, or frequency analysis.

The S_HydroGage spatial file contains the attributes presented in Table N-99.

Table N-99. S_HydroGage Spatial File

Field	Type	Length	Required	Description
GageID	Long		Yes	Primary key for table.
GageName	Text	100	Yes	An alpha-numeric name.
GageDesc	Text	254	Yes	Information describing the location of the gage (i.e. Black River at I-95).
Gage_LID	Long		Yes	Foreign key to D_Gage domain table.
Gage_ID	Text	25	Yes	Gage Identification. Assigned by the agency maintaining the gage.
Agency	Text	150	Yes	Agency. Name of agency maintaining the gage.
Rec_Intvl	Text	11	Yes	Recording Interval. Recording interval for the gage.
Time_LID	Long		Yes	Recording Interval Time Unit Lookup Identification. A code that provides a link to a valid entry from the D_Time_Units table. This attribute establishes the unit of measure of the recording interval.
Start_PD	Date/Time		Yes	Start Period. This value is the start of the earliest period of record used in the gage analysis.
End_PD	Date/Time		Yes	End Period. This value is the end of the latest period of record used in the gage analysis.
TimeFname	Text	254	No	File name of database file with time series data (i.e. USGS WATSTORE-formatted peak discharge file, WDM files for HSPF, etc.). File should be stored in *Simulations* folder for this watershed.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_HydroSoil Spatial File

The S_HydroSoil spatial file is a polygon spatial file of soil types. It is required if utilized for model parameterization. Soil polygons must have only one part and cannot self-intersect (must be simple). Adjacent soils should not overlap or have gaps between them.

The S_HydroSoil spatial file contains the attributes presented in Table N-100.

Table N-100. S_HydroSoil Spatial File

Field	Type	Length	Required	Description
SoilID	Long		Yes	Primary key for table.
SoilType	Text	20	Yes	Soil Type (dependent on classification system utilized – to be referenced in metadata).
SoilAbbrev	Text	20	No	Abbreviation (i.e. Ch, Wg, Chcr).
SoilDesc	Text	100	No	Example: "Watauga Silty Clay Loam".
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_HydroLanduse Spatial File

The S_HydroLanduse spatial file is a polygon spatial file of land-use classifications. It is required if utilized for model parameterization. Land-use polygons must have only one part and cannot self-intersect (must be simple). Adjacent land uses should not overlap or have gaps between them.

 The S_HydroLanduse spatial file contains the attributes presented in Table N-101.

Table N-101. S_HydroLandUse Spatial File

Field	Type	Length	Required	Description
LUID	Long		Yes	Primary key for table.
LUType	Text	50	Yes	Alpha-numeric name or abbreviation used to ID this land use type (i.e. Industrial, Residential Half-Acre, R4, etc.).
LUDesc	Text	100	No	Detailed description of this land use.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_HydroImpervious Spatial File

The S_HydroImpervious spatial file is a polygon spatial file of impervious areas. It is required if utilized for model parameterization. Impervious areas must have only one part and cannot self-intersect (must be simple). Adjacent areas should not overlap.

 The S_HydroImpervious spatial file contains the attributes presented in Table N-102.

Table N-102. S_HydroImpervious Spatial File

Field	Type	Length	Decimal Places	Required	Description
ImpID	Long			Yes	Primary key for table.
ImpervPerc	Numeric	6	2	Yes	Percent of impervious areas in the polygon.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

S_HydroTC Spatial File

The S_HydroTC spatial file is a linear spatial file representing Time of Concentration flowpaths. It is required if utilized for rainfall runoff model parameterization. Time of Concentration polylines must have only one part and cannot self-intersect (must be simple). TCs are associated to a basin, and there can be one or more TCs per basin, if the engineer wishes to divide the overall path into channel, swale and overland parts.

The S_HydroTC spatial file contains the attributes presented in Table N-103.

Table N-103. S_HydroTC Spatial File

Field	Type	Length	Decimal Places	Required	Description
TCID	Long			Yes	Primary key for table.
BasinID	Long			Yes	A foreign key to the S_HydroBasin table.
TC	Numeric	6	3	Yes	Time of concentration (time is by segment, not total for a basin).
Time_LID	Long			Yes	Foreign key to D_Time_Units domain table.
Regime	Text	10		Yes	Flow regime (i.e. Channel, Swale, Lake, Overland, Pipe, etc.).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

L_HydroEquation Table

The L_HydroEquation table is a database table used to store basic regression equations utilized in regression analysis. It is required whenever basic regression equations are used in the modeling process. Variable names used in regression equations should correspond to parameter ShortNames in D_HydroParam.

The L_HydroEquation table contains the attributes presented in Table N-104.

Table N-104. L_HydroEquation Table

Field	Type	Length	Decimal Places	Required	Description
HydEqID	Long			Yes	Primary key for table. AutoNumber field.
Equation	Text	254		Yes	Textual depiction of equation (i.e. Q10 = 622*DA^0.75).
TR	Numeric	6	1	Yes	Recurrence interval.
Descript	Text	50		Yes	Details about the equation (2000 NC Regression Equations).

L_HydroNodeParam Table

The L_HydroNodeParam table is a database table used to store parameter values at nodes utilized in regression analysis. It is required whenever regression equations are used in the modeling process.

The L_HydroNodeParam table contains the attributes presented in Table N-105.

Table N-105. L_HydroNodeParam Table

Field	Type	Length	Decimal Places	Required	Description
NodeParID	Long			Yes	Primary key for table. AutoNumber field.
NodeID	Long			Yes	Foreign key to S_HydroNode.
ParamID	Long			Yes	Foreign key to D_HydroParam.
ParamValue	Numeric	16	6	Yes	Value for this parameter at this node.

D_HydroParam Table

The D_HydroParam table is a domain table used to store a list of node parameters utilized in regression analysis. It is required whenever regression equations are used in the modeling process. A sample domain table is included, but D_HydroParam is designed to expand as the user's needs expand, so this is not a comprehensive list.

The D_HydroParam table contains the attributes presented in Table N-106. Table N-107 contains the domain values for D_HydroParam.

Table N-106. D_HydroParam Table

Field	Type	Length	Required	Description
ParamID	Long		Yes	Primary key for table. AutoNumber field.
ShortName	Text	50	Yes	Name of parameter. Used in regression equation.
Descript	Text	254	No	Details about this parameter.
UnitType	Text	10	Yes	Type of unit. Used to specify which domain table the UnitID field references. Values are "Time", "Length", "Velocity", "Volume", "Area", "None". The corresponding domain tables are D_Time_Units, D_Length_Units, D_Velocity_Units, D_Volume_Units, D_Area_Units, and none.
UnitID	Long		No	Foreign key to corresponding domain table.

Table N-107. Sample Domain Values for D_HydroParam

ParamID	ShortName	Descript	UnitType	UnitID
1	DA	Drainage Area	Area	1000
2	BDF	Basin Development Factor	None	
3	Slope	Main Channel Slope	None	
4	AvgBasinElev	Average Basin Elevation	Length	1010

L_HydroCNResult Table

The L_HydroCNResult table is a database table used for describing SCS curve numbers used in models such as HEC-1 and HEC-HMS. It is required if utilized for rainfall runoff model parameterization.

The L_HydroCNResult table contains the attributes presented in Table N-108.

Table N-108. L_HydroCNResult Table

Field	Type	Length	Decimal Places	Required	Description
CNID	Long			Yes	Primary key for table. AutoNumber field.
BasinID	Long			Yes	A foreign key to S_HydroBasin.
CN	Numeric	6	2	Yes	Calculated SCS curve number.
CNGroupID	Long			Yes	A foreign key to the L_HydroCNLookup table.
WtshdFldr	Text	254		No	The folder of the watershed containing the spatial files (soil and/or land use) used to calculate these results.

L_HydroCNLookup Table

The L_HydroCNLookup table is a database table that relates various combinations of soil and land use types, to provide an appropriate curve number. It is required if curve numbers are utilized.

The L_HydroCNLookup table contains the attributes presented in Table N-109.

Table N-109. L_HydroCNLookup Table

Field	Type	Length	Decimal Places	Required	Description
CNLookupID	Long			Yes	Primary key for table. AutoNumber field.
CNGroupID	Long			Yes	Used to identify a set of Curve Number lookups.
SCSSoil	Text	2		Yes	SCS Hydrologic Soil Type (A, B, C, D). If S_HydroSoil spatial file is submitted, these values should correspond to those in the spatial file field *SoilType*.
LUType	Text	50		Yes	Land use name. If S_HydroLandUse spatial file is submitted, these values should correspond to those in the spatial file field *LUType*.
CN	Numeric	6	2	Yes	SCS curve number established for this land use / soil combination.
AMC	Integer			Yes	Antecedent moisture condition (1,2 or 3).
SCSLUType	Text	50		No	Example: "Open Space – Fair condition".
Source	Text	254		Yes	"SCS TR-55", etc.

L_HydroStormInfo Table

The L_HydroStormInfo table is a database table that is useful for describing precipitation distributions used in the hydrologic analysis. It contains basic descriptions of precipitation patterns. It is required if utilized for rainfall runoff model parameterization.

The L_HydroStormInfo table contains the attributes presented in Table N-110.

Table N-110. L_HydroStormInfo Table

Field	Type	Length	Required	Description
StormID	Long		Yes	Primary key for table. AutoNumber field.
Storm_LID	Long		Yes	Storm Type Lookup Identification. A code that provides a link to a valid entry from the D_Storms table. This attribute establishes the storm type.
Storm_Desc	Text	254	No	Storm Description. Brief text description/note for the storm.
BasinID	Long		Yes	A foreign key to the S_HydroBasin table.

L_HydroStormCurve Table

The L_HydroStormCurve table is a database table that is useful for describing precipitation data used in the hydrologic analysis. It accommodates descriptions of Depth-Duration-Frequency (DDF) and Intensity-Duration-Frequency (IDF) relationships, as well as durations of design storms and precipitation patterns of historical storms. It is required if utilized for rainfall runoff model parameterization.

The L_HydroStormCurve table contains the attributes presented in Table N-111.

Table N-111. L_HydroStormCurve Table

Field	Type	Length	Decimal Places	Required	Description
CurveID	Long			Yes	Primary key for table. AutoNumber field.
StormID	Long			Yes	Storm Identification. A code that provides a link to a valid entry from the L_HydroStormInfo table.
Duration	Text	11		Yes	Duration. Duration of precipitation event. The duration is that of a design or historical storm, or of a point on a DDF or IDF curve.
Time_LID	Long			Yes	Duration Unit Lookup Identification. A code that provides a link to a valid entry from the D_Time_Units table. This attribute establishes the unit of measure of the corresponding duration entry.
Depth	Numeric	5	2	No	Precipitation Depth. This field is populated only if entering data for a DDF curve.
Len_LID	Long			No	Precipitation Depth Unit Lookup Identification. A code that provides a link to a valid entry from the D_Length_Units table. This attribute establishes the unit of measure for the precipitation depth. This field is populated only if a precipitation depth is entered.
Intensity	Numeric	5	2	No	Rainfall intensity. This field is populated only if entering data for an IDF curve.
Vel_LID	Long			No	Rainfall Intensity Unit Lookup Identification. A code that provides a link to a valid entry from the D_Velocity_Units table. This attribute establishes the unit of measure for precipitation intensity. This field is populated only if precipitation intensity is entered.
EventID	Long			No	A foreign key to L_HydroEvent table.

N.4.3   Deliverables   [May 2005]

N.4.3.1 Metadata   [May 2005]

A metadata file that complies with the FEMA/FGDC Metadata (available under separate cover from FEMA Headquarters) Profiles in XML-format shall be included with the submittal. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements and those elements that are mandatory for FEMA based on the specific submittal type.

There are specific items in the FGDC metadata standards that the submitter shall address. For each spatial data source in the metadata file, the Mapping Partner shall assign a Source Citation Abbreviation. The overview description subsection of the entity and attribute information of the metadata file must include a list of all DCS database tables included in the submittal.

N.4.3.2 Hard Copy Deliverables [December 2004]

Supplemental information may be delivered in hard copies.

N.4.3.3 Digital Deliverables [April 2005]

Transfer Media

Mapping Partners must submit files on one of the following electronic media, or via the internet:

- CD-ROM

- DVD

- Upload to Mapping Information Platform (MIP) (http://www.hazards.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Directory Structure and Folder Naming Conventions

A metadata file compliant with FEMA/FGDC Metadata Profiles shall be placed in the *General* folder on the root directory of Disk1.

The Mapping Partner is required to submit the input and output files for any study using detailed hydrologic models such as HEC-1 or HEC-HMS. If the data that was used to estimate the hydrologic parameters is available, it shall be submitted as well.

Models are organized by watershed, with all model files in the *Simulations* folder and support spatial files in the *Spatial Files* folder. Database files are stored in a *Hydrology Databases* folder. If submitting in Microsoft Access format, this file will be named "Hydrology.mdb". If submitting in Dbase IV format, each table will be stored in its own file (i.e. "L_HydroModel.dbf"). Any additional data used to assist in the modeling of this study not described in these specifications can be submitted in the *Supplemental Info* folder. Data must be located in the appropriate directory, as follows.

\General
- o   XML-format metadata file
- o   Hydrology design report in PDF format

\Hydrology Databases
- o   Database file(s), including L_Submittal_Info table

\Hydrology Models\"Watershed Name"\Simulations
- o   Model input and output files by watershed

\Hydrology Models\"Watershed Name"\Spatial Files
- o   Spatial files by watershed

\Supplemental Info
- o   Any additional supplemental info used in this study

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name

- Community name and state for which the FIS was prepared

- Hydrologic Data

- Date of submission (formatted mm/dd/yyyy)

- Disk [*sequential number*] of [*number of disks*]

N.5   Hydraulics Submittal Standards

N.5.1   Overview   [December 2004]

The development of a hydraulic model to provide water surface elevations for floodplain mapping requires a significant investment in time and resources to obtain and process topographic survey data including cross section and bridge surveys. Recent developments in digital terrain and geospatial database management technology make it possible to protect this investment for existing and future projects to a much greater extent than was possible in the past. This Appendix describes the format and type of hydraulic data to be provided to FEMA for new riverine flood insurance studies. Information on the proper procedures to create hydraulic models is provided in Appendix C of these Guidelines.

FEMA accepts ten one-dimensional steady flow, nine one-dimensional unsteady flow, and four two-dimensional steady/unsteady flow hydraulic models for the delineation of floodplains and two models specifically developed for the delineation of floodways for any location within the United States. In addition, three models that have been developed for specific geographic locations have been approved for use by FEMA.

If the past is any indication of future trends, new-generation hydraulic models (with significantly different data requirements) will be added to the FEMA list of acceptable models in the future. Considering the widely varying data requirements for these models, the FEMA database for supporting hydraulics must be flexible.

The Minimum Required Dataset, which is described in detail in the body of this Appendix, includes the following items:

- A georeferenced/projected stream channel network, which is used for floodplain mapping

- A georeferenced line dataset showing the locations of cross sections used for the computation of water surface profiles for one-dimensional models, or a DTM file of water depths or other appropriate file structure for two-dimensional models

- A georeferenced line dataset showing draft regulatory floodway, 100-year floodplain, and 500-year floodplain boundaries, where calculated

- Input and output files for an approved hydraulic model (an updated list of these models can be obtained from http://www.fema.gov/fhm/en_hydra.shtm)

- All geospatial datasets used for parameter calculation without further processing (e.g. a spatial file of n-value polygons but not the land use polygons that they are based upon)

- An FIS narrative report

- A series of database tables summarizing key data

- Some additional geospatial and database tables if utilized (i.e. overbank distances are used in certain models such as HEC-RAS and HEC-2)

N.5.2   Requirements   [April 2005]

N.5.2.1 Data Files   [April 2005]

The following deliverables are required for a hydraulics submittal:

- Database tables
- Spatial files
- Hydraulic models

Most spatial features can be stored in an ESRI shapefile or Open GML document, with the necessary attribute fields and spatial projection information. Other domain and hydraulic results tables will be populated in dBASE IV format or Microsoft Access.

The database tables and spatial files used in a hydraulics submittal are shown in Table N-112.

Table N-112. Hydraulics Tables and Spatial Data

Table Name	Description
L_HydraModel	A database table. The highest level representation of a hydraulic model. Contains important information on geometry and results files.
S_StreamCntrLine	A spatial dataset showing the centerlines of the stream network. Used for backwater models such as HEC-RAS.
S_HydraCrossSection	A linear spatial file of cross sections.
S_RefPoint	Spatial file that describes the downstream point where a riverine model starts.
L_HydraFloodResult	A database table. Stores flood elevations and discharges for a cross section.
L_HydraEvent	A database table. Identifies flood events.
L_Wtr_Nm	A database table. A lookup table of stream names.
S_HydraMapping	A linear spatial file containing draft floodway boundaries, 100-year and 500-year flood boundaries.
S_BFE	A linear spatial file containing "work map" BFEs.
Stream Profiles	A CAD drawing file containing stream profiles. Used in the FIS narrative.
Floodway Data Tables	Microsoft Word documents used in the FIS narrative.
S_HydraFlowPath	A linear spatial file that can represent streams and/or more complicated features like bridges, culverts, dams, pipes or trapezoid channels.
S_HydraJunction	A point spatial file that identifies confluences or transition points along a stream.
L_HydraXsPt	A database table for detailed profile calculations.
S_HydraNvalue	A polygon spatial file used to assign roughness coefficients.
S_Ovrbnkln	A linear spatial file used for measuring overbank flow distances. See Appendix L of these Guidelines.

Depending on the scope of work, the Mapping Partner may develop a new hydraulic model with all the associated input files, may modify an existing model developed for the effective flood insurance study or a related study, or simply utilize an existing model or adopt the effective flood elevations. Table N-113 describes the minimum required datasets for each study approach and the two primary hydraulic modeling approaches: backwater models (i.e. HEC-RAS) or network models (i.e. SWMM and ICPR). If existing models are not available in digital format, the hard copy output from the model or analysis is to be scanned into a PDF file.

Table N-113. Minimum Required Datasets by Model Type

Hydraulic Study Type	Backwater Model	Network Model
New Model, Modified FEMA Model, or Capture of a FEMA Model	**Spatial File:** • S_StreamCntrLine • S_HydraCrossSection • S_RefPoint **Table:** • L_HydraModel • L_HydraFloodResult • L_HydraEvent • L_Wtr_Nm **Work Map Products:** • S_HydraMapping • S_BFE • Stream Profiles • Floodway Data Tables	**Spatial File:** • S_StreamCntrLine • S_HydraCrossSection • S_RefPoint • S_HydraFlowPath • S_HydraJunction **Table:** • L_HydraModel • L_HydraFloodResult • L_HydraEvent • L_Wtr_Nm **Work Map Products:** • S_HydraMapping • S_BFE • Stream Profiles • Floodway Data Tables

Figure N-10 is a schematic view of the relational database files required for the minimum hydraulic submittal. A detailed description of each of these data requirements is provided in the body of this section.

Figure N-10. Entity Relationship Diagram for Hydraulics
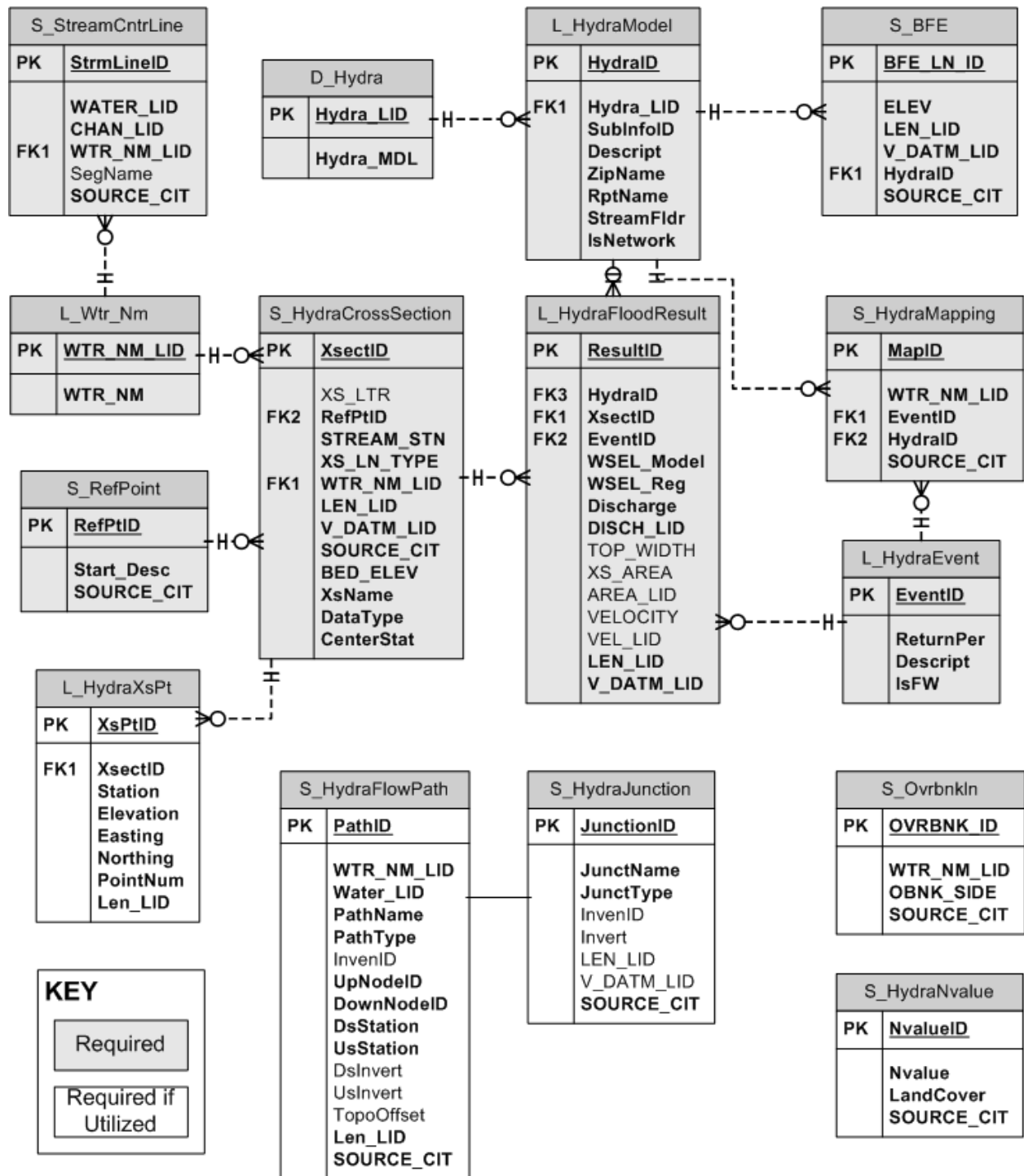
N.5.2.2 Required Hydraulic Data [April 2005]

L_HydraModel Table

The L_HydraModel table is a database table. It is required for all types of hydraulic analyses.
This table identifies the models used for the floodplain delineation study.

The L_HydraModel table contains the elements presented in Table N-114.

Table N-114. L_HydraModel Table

Field	Type	Length	Required	Description
HydraID	Long		Yes	Primary key for table.
Hydra_LID	Long		Yes	A foreign key to D_Hydra. See Appendix L of these Guidelines.
SubInfoID	Long		Yes	Foreign key to L_Submittal_Info table.
Descript	Text	254	Yes	Model description.
ZipName	Text	254	Yes	File name of a compressed hydraulic model including inputs and outputs, stored in the *Simulations* folder.
RptName	Text	254	Yes	File name of the FIS narrative report, stored in the *General* folder.
StreamFldr	Text	254	Yes	Folder that stores all files for this stream.
IsNetwork	Boolean		Yes	Specifies whether this is a network model or a backwater model.

S_StreamCntrLine Spatial File

The S_StreamCntrLine spatial file(s) is required for locating all cross-sections and for
referencing the data from the hydrologic study. This dataset is used as the base for locating
cross-section alignments and for the location of discharge locations.   Stream centerlines are not
be multipart or self-intersecting. Streams are to be drawn upstream to downstream, and
connected endpoint to endpoint with adjacent streams.

The S_StreamCntrLine attribute table contains the information presented in Table N-115.

Table N-115. S_StreamCntrLine Spatial File

Field	Type	Length	Required	Description
StrmLineID	Long		Yes	Primary key for table.
WATER_LID	Long		Yes	A foreign key to the D_Water_Typ table. See Appendix L of these Guidelines.
CHAN_LID	Long		Yes	A foreign key to the D_Chan_Rep table. See Appendix L of these Guidelines.
WTR_NM_LID	Long		Yes	A foreign key to the L_Wtr_Nm table.
SegName	Text	254	No	An optional identification string for each reach. If used, this must be unique for a stream.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_HydraCrossSection Spatial File

The S_HydraCrossSection spatial file is required for models that utilize cross sections. This file will not be submitted for two-dimensional models that do not employ cross sections for simulating water surfaces. Cross sections are associated to one stream flow path and must intersect that flow path at only one point. Stream station is used to match these sections to the hydraulic results table, so there must be a one-to-one match with the results. All cross sections must be drawn left to right facing downstream. Multi-part shapes are not allowed.

Where submitted, the S_HydraCrossSection spatial file contains the elements presented in Table N-116.

Table N-116. S_HydraCrossSection Spatial File

Field	Type	Length	Decimal Places	Required	Description
XsectID	Long			Yes	Primary key for table.
XS_LTR	Text	10		No	Example: B, AQ
RefPtID	Long			Yes	A foreign key to the S_RefPoint..
STREAM_STN	Numeric	12	2	Yes	Distance from the reference point along the stream.
XS_LN_TYPE	Text	20		Yes	"LETTERED" or "NOT LETTERED".
WTR_NM_LID	Long			Yes	A foreign key to the L_Wtr_Nm table.
LEN_LID	Long			Yes	A foreign key to the D_Length_Units table (see Appendix L).
V_DATM_LID	Long			Yes	A foreign key to the D_V_Datum table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.
BED_ELEV	Numeric	8	2	Yes	Lowest stream bed elevation, from profile.
XsName	Text	100		Yes	Unique alpha-numeric name.
DataType	Text	12		Yes	"Top of Road" or "Natural".
CenterStat	Numeric	9	2	Yes	The cross section station used in the model that corresponds to the intersection point of the stream and cross section.

S_RefPoint Spatial File

The S_RefPoint spatial file(s) is required. These points indicate the reference point that was used as the origin for distance measurements along streams and rivers.

The S_RefPoint attribute table contains the information presented in Table N-117.

Table N-117. S_RefPoint Spatial File

Field	Type	Length	Required	Description
RefPtID	Long		Yes	Primary key for table.
Start_Desc	Text	254	Yes	Description of the location of the station starting point. For example, "Feet upstream of Mecklenburg County line".
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

L_HydraFloodResult Table

The L_HydraFloodResult table is a database table. It is a required table that is used to store one or more flood elevations and discharges per cross section. The L_HydraFloodResults table contains the elements presented in Table N-118.

Table N-118. L_HydraFloodResult Table

Field	Type	Length	Decimal Places	Required	Description
ResultId	Long			Yes	Primary key for table.
HydraID	Long			Yes	A foreign key to the L_HydraModel table.
XsectID	Long			Yes	A foreign key to the S_HydraCrossSection spatial file.
EventId	Long			Yes	A foreign key to the L_HydraEvent table.
WSEL_Model	Numeric	8	2	Yes	Modeled flood elevation.
WSEL_Reg	Numeric	8	2	Yes	Regulatory flood elevation that matches profile (and floodway data table for Floodway event).
Discharge	Numeric	9	1	Yes	Discharge.
DISCH_LID	Long			Yes	A foreign key to the D_Discharge_Units table (see Appendix L).
TOP_WIDTH	Numeric	9	2	No	Floodway width, used in floodway data table. Required for Floodway event.
XS_AREA	Numeric	10	2	No	Underwater cross section area used in floodway data table. Required for Floodway event.
AREA_LID	Long			No	A foreign key to the D_Area_Units table (see Appendix L). Required if XS_Area is populated.
VELOCITY	Numeric	8	2	No	Mean velocity, used in the floodway data table. Required for Floodway event.
VEL_LID	Long			No	A foreign key to the D_Vel_Units table (see Appendix L). Required if Velocity is populated.
LEN_LID	Long			Yes	A foreign key to the D_Length_Units table (see Appendix L).
V_DATM_LID	Long			Yes	A foreign key to the D_V_Datum table (see Appendix L).

Section N.5

L_HydraEvent Table

The L_HydraEvent table is a database table. It is required for all types of hydraulic analyses. This table defines a list of modeled floods. The L_HydraEvent table contains the elements presented in Table N-119.

Table N-119. L_HydraEvent Table

Field	Type	Length	Decimal Places	Required	Description
EventId	Long			Yes	Primary key for table. AutoNumber field.
ReturnPer	Numeric	6	1	Yes	The recurrence interval of the event in years (i.e. 10, 26.5, 100).
Descript	Text	32		Yes	Brief description of flood event (i.e. 10-year or Hurricane Hugo).
IsFW	Boolean			Yes	Identifies a floodway simulation.

L_Wtr_Nm Table

The L_Wtr_Nm table is a database domain table. It is required for all types of hydraulic analyses. This table identifies the unique list of stream names used in the submittal. This is the same table as defined in Appendix L of these Guidelines, but it is listed here for completeness. The L_Wtr_Nm table contains the elements presented in Table N-120.

Table N-120. L_Wtr_Nm Table

Field	Type	Length	Required	Description
WTR_NM_LID	Long		Yes	Primary key for table.
WTR_NM	Text	254	Yes	Unique alpha-numeric name (i.e. Crooked Creek).

N.5.2.3 Work Map Products   [April 2005]

Work map products are used to assist in quality control of the hydraulic models. Some items listed below, such as S_HydraMapping and S_BFE will also be part of a subsequent Mapping Submittal, with any necessary modifications. Stream profiles and floodway data tables are direct products of a hydraulic model, so they are incorporated into the Hydraulics DCS.

S_HydraMapping Spatial File

The S_HydraMapping spatial file is a linear spatial file submittal. It contains draft floodway, 100-year and 500-year boundaries that are a pre-cursor to the preliminary maps. Because the "EventID" is an attribute of each line, it is possible to store flood boundaries for storms other than the 100-year and 500-year. The S_HydraMapping spatial file contains the elements presented in Table N-121.

Table N-121. S_HydraMapping Spatial File

Field	Type	Length	Required	Description
MapID	Long		Yes	Primary key for table.
WTR_NM_LID	Long		Yes	A foreign key to L_Wtr_Nm table.
EventID	Long		Yes	A foreign key to L_HydraEvent table.
HydraID	Long		Yes	A foreign key to L_HydraModel table.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

S_BFE Spatial File

The Base Flood Elevation (BFE) spatial file is required for any digital data where BFE lines will be shown on the corresponding Flood Insurance Rate Map (FIRM). Normally, if there are any riverine AE zones, BFE lines are required. This is the same table as defined in Appendix L of these Guidelines, but it is listed here for completeness.

The S_BFE spatial file contains information about the BFEs within a study area, as well as locational information. BFE lines indicate the rounded whole-foot water-surface elevation of the 1-percent-annual-chance flood.

The S_BFE spatial file contains the attributes listed in Table N-122.

Table N-122. S_BFE Spatial File

Field	Type	Length	Decimal Places	Required	Description
BFE_LN_ID	Long			Yes	Primary key for table. Assigned by table creator.
ELEV	Numeric	13	2	Yes	Base Flood Elevation. The rounded, whole foot elevation of the 1-percent-annual-chance flood.
LEN_LID	Long			Yes	Length Unit Lookup Identification. See D_Length_Units table (Appendix L).
V_DATM_LID	Long			Yes	Vertical datum lookup identification. A foreign key to the D_V_Datum table (see Appendix L).
HydraID	Long			Yes	A foreign key to L_Hydramodel table.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

Stream Profiles

Stream profiles are used in the Flood Insurance Study narrative and are a direct product of a hydraulic model. The NSP provides tools to convert HEC-RAS and HEC-2 models to AutoCAD DXF files. These DXF files can be imported into a template AutoCAD drawing file (DWG), and edited for content.

For the Hydraulics DCS, all stream profiles will be submitted as AutoCAD DWG files, named "StreamName_Profile.dwg". These files are to be located in the *Profiles* folder of this submittal. Additional format information on Flood Profiles is provided in Appendix J of these Guidelines. The RASPLOT layer specification should be followed, regardless of the modeling method.

Floodway Data Tables

Floodway Data Tables are used in the Flood Insurance Study report narrative and are a direct product of a hydraulic model. These tables are required to be submitted in a Microsoft Word format, named "StreamName_FWDT.doc". These files are to be located in the *FWDTs* folder of this submittal. The specifications for the Floodway Data Table are provided in the sample report in Appendix J, Section J.6, of these Guidelines.

N.5.2.4 Required If Utilized [April 2005]

S_HydraFlowPath Spatial File

The S_HydraFlowPath spatial file is required for hydraulic models other than HEC-RAS and HEC-2, such as SWMM or ICPR. Flow paths can be associated to one or more L_HydraModels. All flow paths must be drawn upstream to downstream. Multipart shapes are not allowed. S_HydraFlowPath can also be used to store modeling base lines, similar to S_Profil_Basln (see Appendix L of these Guidelines), when the stream centerline differs from the model baseline. The S_HydraFlowPath spatial file contains the attributes presented in Table N-123.

Table N-123. S_HydraFlowPath Spatial File

Field	Type	Length	Decimal Places	Required	Description
PathId	Long			Yes	Primary key for table.
WTR_NM_LID	Long			Yes	Foreign key to L_Wtr_Nm table.
Water_LID	Long			Yes	A foreign key to the D_Water_Typ table. See Appendix L of these Guidelines.
PathName	Text	254		Yes	Unique alphanumeric identifier (i.e. CC-1).
PathType	Text	15		Yes	"Stream", "Structure", "Pipe", "Simple Channel".
InvenID	Long			No	A foreign key to an inventory table (only used for non-stream path types).
UpNodeID	Long			Yes	Foreign key to S_HydraJunction table.
DownNodeID	Long			Yes	Foreign key to S_HydraJunction table.
DsStation	Numeric	12	2	Yes	Distance measured from a prominent location, such as a confluence or county line.
UsStation	Numeric	12	2	Yes	Distance measured from a prominent location, such as a confluence or county line.
DsInvert	Numeric	8	2	No	Downstream thalweg elevation.
UsInvert	Numeric	8	2	No	Upstream thalweg elevation.
TopoOffset	Numeric	4	1	No	For "Stream" path types, this is the average difference between the true thalweg and the lowest profile elevation derived from the terrain. Useful for limited detail studies. Example: True thalweg is 98.2, Topo Invert = 100, so TopoOffset = -1.8.
Len_LID	Long			Yes	A foreign key to the D_Length_Units table (see Appendix L).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

S_HydraJunction Spatial File

The S_HydraJunction spatial file is required for hydraulic models other than HEC-RAS and HEC-2, such as SWMM or ICPR. Junctions are associated to a particular S_HydraFlowPath. These junctions can represent confluences of streams or a transition point between a stream and a structure. Junctions can also represent more detailed inventory, such as manholes or curb inlets.

The S_HydraJunction spatial file contains the elements presented in Table N-124.

Table N-124. S_HydraJunction Spatial File

Field	Type	Length	Decimal Places	Required	Description
JunctionId	Long			Yes	Primary key for table.
JunctName	Text	50		Yes	Unique alphanumeric identifier (i.e. A-201).
JunctType	Text	50		Yes	"Transition", "Manhole", "Curb Inlet", "Slab Inlet", "Junction Box", "Pipe Junction"
InvenID	Long			No	Foreign key to an inventory table. Not used for junctions on most models (HEC-RAS and HEC-2)
Invert	Numeric	8	2	No	Lowest elevation at junction
LEN_LID	Long			No	A foreign key to the D_Length_Units table (see Appendix L). Required if Invert is populated.
V_DATM_LID	Long			No	A foreign key to the D_V_Datum table (see Appendix L). Required if Invert is populated.
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

L_HydraXsPt Table

The L_HydraXsPt table is a database table. It can be used to store intermediate terrain profiles, which are typically used as a major part of a cross section definition in a HEC-RAS or HEC-2 model. This database table is required for any modeling approaches that do not store 3-D cross section geometries explicitly in the model inputs. HEC-RAS and HEC-2 models store this information in geometry files, so the terrain profiles are not required for those model types.

The L_HydraXsPt table contains the elements presented in Table N-125.

Table N-125. L_HydraXsPt Table

Field	Type	Length	Decimal Places	Required	Description
XsPtID	Long			Yes	Primary key for table.
XsectID	Long			Yes	Foreign key to the S_HydraCrossSection table.
Station	Numeric	8	2	Yes	Distance from start of section to profile point. Cross section must be oriented from left to right looking downstream.
Elevation	Numeric	8	2	Yes	Elevation.
Easting	Numeric	12	2	Yes	X-coordinate.
Northing	Numeric	12	2	Yes	Y-coordinate.
PointNum	Long			Yes	Useful for ordering points when there is a vertical step. Integer values.
Len_LID	Long			Yes	A foreign key to the D_Length_Units table (see Appendix L).

S_HydraNvalue Spatial File

The S_HydraNvalue spatial file is made up of polygons. It is required when utilized for calculating the distribution of the roughness coefficients along the cross sections. The S_HydraNvalue Spatial File contains the elements presented in Table N-126.

Table N-126. S_HydraNvalue Spatial File

Field	Type	Length	Decimal Places	Required	Description
NvalueID	Long			Yes	Primary key for table. AutoNumber field.
Nvalue	Numeric	5	3	Yes	Manning's n-value. Usually a number between 0.01 and 0.20.
LandCover	Text	50		Yes	A brief description of the land cover, i.e. (short grass, boulders, dense brush, fine silty clay, etc.).
SOURCE_CIT	Text	11		Yes	Abbreviation used in the metadata file when describing the source information.

S_Ovrbnkln Spatial File

The S_Ovrbnkln spatial file is a linear spatial file submittal. This spatial file contains features representing the overbank flow distances between two adjacent cross sections.   HEC-2 and HEC-RAS models require this information when the overbank distances are not equal to the distances measured along the stream centerline.

The S_Ovrbnkln spatial file contains the attributes presented in Table N-127.

Table N-127. S_Ovrbnkln Spatial File

Field	Type	Length	Required	Description
OVRBNK_ID	Long		Yes	Primary key for table.
WTR_NM_LID	Long		Yes	A foreign key to L_Wtr_Nm table.
OBNK_SIDE	Text	1	Yes	"L" or "R", indicates Left or Right.
SOURCE_CIT	Text	11	Yes	Abbreviation used in the metadata file when describing the source information.

N.5.3   Deliverables   [May 2005]

N.5.3.1 Metadata   [May 2005]

A metadata file that complies with the FEMA/FGDC Metadata Profiles (available under separate cover from FEMA Headquarters) in XML-format shall be included with the submittal. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements and those elements that are mandatory for FEMA based on the specific submittal type.

There are specific items in the FGDC metadata standards that the submitter shall address. For each spatial data source in the metadata file, the Mapping Partner shall assign a Source Citation Abbreviation. The overview description subsection of the entity and attribute information of the metadata file must include a list of all DCS database tables included in the submittal.

N.5.3.2 Hard Copy Deliverables   [December 2004]

Supplemental information may be delivered in hard copies.

N.5.3.3 Digital Deliverables [April 2005]

Transfer Media

Mapping Partners must submit files on one of the following electronic media or via the internet:

- CD-ROM

- DVD

- Upload to Mapping Information Platform (MIP) (http://www.hazards.fema.gov)

As technology changes or in special situations, other media may be acceptable if coordinated with FEMA.

Directory Structure and Folder Naming Conventions

A metadata file compliant with FEMA/FGDC Metadata Profiles will be placed in the *General* folder on the root directory of Disk1.

The Mapping Partner is required to submit the input and output files for any study using detailed hydraulic computer models such as HEC-2 or HEC-RAS. If the data that was used to estimate the hydraulic parameters is available, it shall be submitted as well.

Models are usually organized by stream, with all model files in the *Simulations* folder and support spatial files in the *Spatial Files* folder. One set of database tables is stored in a *Hydraulic Databases* folder, for all streams. If submitting in Microsoft Access format, this file will be named "Hydraulics.mdb". If submitting in Dbase IV format, each table will be stored in its own file (i.e. "L_HydraModel.dbf"). Any additional data used to assist in the modeling of this study not described in these specifications can be submitted in the *Supplemental Info* folder. Data must be located in the appropriate directories, as follows.

\General
- o XML-format metadata file
- o Hydraulics design report in PDF format

\Hydraulic Models\"Stream Name"\Simulations
- o Model input and output files by stream

\Hydraulic Models\"Stream Name"\Spatial Files
- o Spatial files by stream

\Hydraulic Databases
- o Database file(s), including L_Submittal_Info table

\Profiles
- o CAD profile(s) by stream (i.e."StreamName_profile.dwg")

FWDTs
  o Microsoft Word floodway data tables by stream (i.e "StreamName_fwdt.doc")

Supplemental Info
  o Any additional supplemental info used in this study

Data Identification Requirements

All digital media submitted must be labeled with at least the following information:

- Mapping Partner name

- Community name and state for which the FIS was prepared

- Hydraulic Data

- Date of submission (formatted mm/dd/yyyy)

- Disk [*sequential number*] of [*number of disks*]

N.6   References   [December 2004]

Federal Geographic Data Committee, FGDC-STD-001-1998. *Content Standard for Digital Geospatial Metadata (version 2.0),* FGDC, c/o USGS, Reston, VA
http://www.fgdc.gov/metadata/metadata.html

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, *HEC-1 Flood Hydrograph Package, User's Manual,* Davis, CA, 1990.

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, *HEC-RAS, River Analysis System, User's Manual,* Version 3.0, Davis, CA, 2001.

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, *Hydrologic Modeling System, HEC-HMS, User's Manual,* Version 2.1, Davis, CA, 2001.

Watershed Concepts, *Guidelines and Specifications for Collecting Survey Data for Flood Insurance Studies*, Greensboro, North Carolina, November 2003.