Guidance for Flood Risk Analysis and Mapping

Metadata

February 2018

FEMA

This guidance document supports effective and efficient implementation of flood risk analysis and mapping standards codified in the Federal Insurance and Mitigation Administration Policy FP 204-07801.

For more information, please visit the Federal Emergency Management Agency (FEMA) Guidelines and Standards for Flood Risk Analysis and Mapping webpage (www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping), which explains the policy, related guidance, technical references and other information about the guidelines and standards process.

Nothing in this guidance document is mandatory other than standards codified separately in the aforementioned Policy. Alternate approaches that comply with FEMA standards that effectively and efficiently support program objectives are also acceptable.

Table of Revisions

The follow summary of changes details revisions to this document subsequent to its most recent version in May 2017.

Affected Section or Subsection	Date	Description
4.1.1 MIP Upload	February 2018	Updated to note that metadata files should be named using the CID selected during Mapping Information Platform (MIP) Task Creation until MetaMan is updated to allow other file naming.
4.2 Error Resolution	February 2018	Updated to note that metadata files should be named using the CID selected during MIP Task Creation until MetaMan is updated to allow other file naming.

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1.0   Metadata Overview

This document contains guidance for the development and submission of National Flood Insurance Program (NFIP) metadata, which are used to characterize and inventory Flood Risk Project datasets and associated data artifacts in the Mapping Information Platform (MIP). The NFIP metadata profile specifications can be found in the Metadata Profiles Technical Reference at www.fema.gov/guidelines-and-standards-flood-risk-analysis-and-mapping and an example metadata file compliant with each of the NFIP metadata profiles can be found at the same location.

1.1   Importance of Metadata to the NFIP

Metadata is often referred to as "data about data" or structured information that defines the important characteristics of a dataset. When used in relation to digital geospatial data, metadata is critical information that describes the content, quality, condition, and characteristics of the data. Metadata is a critical component of any geospatial data sharing framework, in that it allows for interoperability at the level of the data set and down to the level of individual features and their properties. In this capacity, it plays an important role in informing users about the quality of data and their intended use, to ensure that data are correctly utilized by the end user community.

The key purpose for collecting and publishing metadata is to:

- Maintain an organization's internal investment in geospatial data.

- Provide information about an organization's data holdings to data catalogs, clearinghouses and brokerages.

- Provide information needed to process and interpret data to be received through a transfer from an external source.

The ability to describe, search, discover and reuse Flood Risk Project artifacts is a key requirement of the Risk MAP Program. To achieve this, metadata about Flood Risk Project artifacts must be recorded and updated throughout the Flood Risk Project lifecycle, from Discovery to data collection, storage and management, production, publication, dissemination, and use.

The Risk MAP program has developed operational procedures that institutionalize metadata production and maintenance as part of MIP Data Capture tasks, content management infrastructure and maintenance tools. Metadata based on industry-standard information models is a key component of the data development and management process.

1.2   Metadata Resources

This section identifies useful metadata resources.

1.2.1   Content Standard for Digital Geospatial Metadata (CSDGM)

The Federal Geographic Data Committee (FGDC) is a 19-member interagency committee composed of representatives from the Executive Office, Cabinet-level and independent agencies. To address the need for an open, consensus-based standard for geospatial metadata, the FGDC has developed the Content Standard for Digital Geospatial Metadata (CSDGM), FGDC-STD-001-1998. This standard has been the U.S. geospatial metadata standard since the mid 1990's and is

in use across the federal community, with active participation by many producers and consumers of geospatial data. In the United States, most state and federal agencies adhere to the CSDGM.

The FGDC is also charged with developing the National Spatial Data Infrastructure (NSDI), in cooperation with state, local and tribal governments, as well as the academic community and the private sector. A key component of the NSDI is the NSDI Clearinghouse, which is an electronic service that provides access to geospatial data and metadata from distributed sources. FEMA is mandated in the revised OMB Circular A-16 (Executive Order 12906, as amended by E.O. 13286) to fully participate in the NSDI, which includes making metadata available to the NSDI Clearinghouse.   The NSDI Clearinghouse is implemented as the GeoPlatform at https://www.geoplatform.gov/.

The FGDC CSDGM standards are available in several useful formats at the following link:

- www.fgdc.gov/metadata/geospatial-metadata-standards#csdgm.

1.2.2 Other Resources

In addition to the Metadata Profiles Technical Reference and the sample metadata XMLs, other potentially useful resources related to National Flood Insurance Program (NFIP) metadata preparation and validation are provided:

- Graphical representation of the Content Standard for Digital Geospatial Metadata

    https://www.fgdc.gov/csdgmgraphical/index.html

- USGS Online CSDGM Geospatial Metadata Validation Service

    https://mrdata.usgs.gov/validation/

- FGDC Metadata Resources

    https://www.fgdc.gov/metadata/geospatial-metadata-standards

- FGDC List of Metadata Tools

    https://www.fgdc.gov/metadata/geospatial-metadata-tools

2.0 Mapping Information Platform Metadata Data Capture Task Submissions

Metadata is a critical asset for the inventory and documentation of FEMA geospatial data products and specifically those Flood Risk Project data artifacts held and managed by the Mapping Information Platform (MIP). Metadata permits rapid search and access across data collections or among the individual elements of a collection, based on common queries (e.g., search by theme/topic category, publication date, publishing organization, geographic extent, or time period).

Metadata development is a requirement that must be met by Mapping Partners when submitting spatial data to the MIP and is mandatory to submit to be able to advance many of the MIP tasks. Metadata plays a pivotal role in facilitating data discovery, documentation and access by helping to both build the catalog of available data elements available within the MIP and by providing information to consumers of the data on the history and appropriate use of data layers being accessed.

Mapping Partners are responsible for producing metadata at a number of different points during the Flood Risk Project lifecycle including those related to Discovery, base maps, orthoimagery, terrain, field surveys, hydrology, hydraulics, coastal, alluvial fan, floodplain mapping/redelineation, the Flood Insurance Rate Map (FIRM) Database and the Flood Risk Database (FRD).

A metadata file in XML format that complies with the NFIP Metadata Profile applicable to the MIP Data Capture task must be included with MIP submittals. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements that are mandatory for FEMA, based on the specific submittal type.

The metadata files should be named using the file names specified in the Metadata Profiles Technical Reference and the Data Capture Technical Reference. The metadata files should be submitted to the MIP in the folder structure specified in the Data Capture Technical Reference.

3.0   Metadata Content and Use in Study Process

As noted above, metadata is collected, developed and submitted at each stage of the Flood Risk Project lifecycle. Each stage in the project lifecycle serves to build the components of the FIRM Database and the FRD. The submitted metadata files will document this process of building the final regulatory and non-regulatory products such that by the end, the metadata files progressively and cumulatively document the completed Flood Risk Project, similar to how the FIRM Database S_Submittal_Info feature class progressively and cumulatively documents the spatial extent of each Data Capture task in the Flood Risk Project.

3.1   Geospatial Data Coordination

Mapping Partners perform geospatial data coordination throughout the Flood Risk Project lifecycle to avoid duplication of effort during a Flood Risk Project. Metadata provided by data sources allows Mapping Partners to understand the characteristics of available data and evaluate and rank their usefulness to the project. The assigned Mapping Partner should identify and use existing digital data whenever possible, while still meeting required specifications and quality of work. As geospatial data to be used in a project are received, checked and accepted, the appropriate NFIP metadata file should be completed. The data and related metadata are then loaded into the MIP.

Once relevant data sources have been identified, Mapping Partners should acquire the existing data following the data acquisition procedures in the current State-specific Geospatial Data Coordination Procedures. Each distinct dataset that is gathered should be accompanied by metadata that is FGDC compliant. Mapping Partners should check that sufficient documentation is available to produce metadata that comply with the NFIP metadata profiles, and should correct any deficiencies found.

The best time to collect metadata is when the data are being developed, as it can be difficult to recover information about the development of a set of data after the fact. Because of this potential difficulty and due to the requirement that compliant metadata be submitted with other data for the project, participants will benefit greatly from asking data sources to provide compliant metadata with geospatial data supplied for the project, from working with data sources to recover information that has not been recorded and for requiring vendors to provide compliant metadata for any newly collected data.

There can be no restrictions on FEMA's use or redistribution of metadata. Metadata accompanies the flood risk data when distributed to the public and FEMA needs to be able to distribute the metadata freely. Distribution methods include but, are not limited to, incorporating information from the metadata in collar information and annotation on printed flood maps, distributing metadata with other digital flood data online and on media and providing metadata on the web with flood maps. FEMA also participates in interagency exchanges of metadata and participants can expect the metadata to appear on publicly available data portals and clearinghouses. The metadata also may appear in other applications that acquire data from such portals and clearinghouses, even if FEMA does not participate in these other applications directly.

3.2   MIP Data Capture Tasks

Once a Flood Risk Project is initiated, it will follow the defined MIP business flow and include all of the MIP Data Capture tasks that are included in the project Scope of Work. Because the Flood Risk Project lifecycle successively builds the FIRM Database and the FRD, the metadata files that document each MIP submittal have a similar structure and requirements. These include information about points of contact, the type of data, the sources of data, the quality, lineage, and processes applied to the data, the coordinate system, the information content, and the transfer media for the data.

3.3   NFIP Metadata Content

Metadata files should be submitted using the most recent metadata profiles even if the FIRM Database for the Flood Risk Project is being submitted in the 2003 database schema.

The following guidance is provided for NFIP metadata file content. Note that the numeric references in this section (e.g., 2.5.1.6) are to specific elements of the metadata file and correspond to the element numbering used within the metadata profiles.

3.3.1   Listing of Submitted Tables

Mapping Partners will often only submit data that cover the geographic area of their work. The tables that are applicable to a specific Flood Risk Project will vary, depending on the specific scope of that activity. Table 2 – FIRM Database Submittal Table in the <u>FIRM Database Technical Reference</u> presents the FIRM Database tables that apply to the different MIP Data Capture tasks of a regulatory Flood Risk Project.

Because not all database tables are included in every database submittal, the Entity and Attribute Information Section 5.1 should include a list of all FIRM Database or Flood Risk Database (FRD) layers and tables included in the submittal. The Flood Insurance Rate Map (FIRM) Database Verification Tool (DVT) will check that this listing agrees with the submitted data.

If additional non-standard FRD layers and tables are included with the submittal, they should be documented in the Entity and Attribute Overview Section 5.2.1. See the Flood Risk Database (<u>FRD) Guidance</u> for additional information about documenting any non-standard data that are submitted in the FRD.

3.3.2   Sources Used

Only one NFIP metadata file is required for most MIP Data Capture task submittals for a Flood Risk Project. Within the metadata file, the assigned Mapping Partner should distinguish between the different origins of the various datasets included in the submittal. If more detailed metadata is available from an agency or organization that provided data for use in the flood risk project, it should be included in the metadata submittal to the extent it can be made compliant with the NFIP Metadata Profiles. Reference the data providers' original metadata record in the Lineage Section 2.5 of the NFIP metadata file. If there is a Web-accessible metadata record for the original data set, the URL to the metadata may be provided in the optional Source Citation - Online Linkage element (2.5.1.1.1.10). Otherwise, the Source Contribution [free text] element (2.5.1.6) may include information on how to access the metadata record for the data sets obtained. It is also a best practice to upload the data provider's metadata file to the MIP in the Data Capture Tasks Supplemental_Data folder. Refer to the <u>Data Capture Technical Reference</u> for information on the folder structure for MIP uploads.

The metadata file should include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the final digital files. The description should include the data sources, date of collection or digitizing, scale of digitizing, projections, coordinate systems, horizontal datum, vertical datum, and units of all digital data used and submitted. Some of this information will already be provided in the FIRM Database S_Submittal_Info feature class and in the L_Source_Cit table.

The date assigned to a source should reflect the date that the information corresponds to the ground condition. If the Mapping Partner does not know this date, the Mapping Partner may use the date of publication and indicate as such.

For each data source used in the database and described in the metadata file, the Mapping Partner should assign a unique Source Citation Abbreviation using the SOURCE_CIT field that is included in each spatial table in the database.

Each Source Citation Abbreviation used in the database should be documented in a record in the FIRM Database L_Source_Cit table and with a corresponding Source Citation entry in the metadata file in the Lineage section (2.5) under Data Quality.

The SOURCE_CIT field and L_Source_Cit table use a standard set of prefixes followed by a sequential number (e.g., BASE1, BASE2, STUDY1, STUDY2) to categorize the data sources as defined in the <u>FIRM Database Technical Reference</u> and the <u>Flood Risk Database Technical Reference</u>.

If, during the incorporation of revised data, an existing FIRM Database layer is completely superseded by a new layer, the old source citation abbreviation and its description in the metadata file should be retired in favor of a new source citation abbreviation and its description in the metadata file.

If, during the incorporation of revised data, only portions of a FIRM Database layer are updated, both the old and new source citation abbreviations should be included in the FIRM Database and documented in the metadata file.

When documenting the incorporation of revised data, new source citations in L_Source_Cit should start with the next available number. For example, a FIRM Database with "STUDY1" as the highest numbered Flood Risk Project record would get a new record coded "STUDY2". Unmodified areas on a revised FIRM panel would remain coded "STUDY1". The boundary between "STUDY1" and "STUDY2" areas should be coded in S_FLD_HAZ_LN with the line type "OTHER BOUNDARY". Features revised by a Letter of Map Revision (LOMR) should have a SOURCE_CIT value that identifies that they were updated by the LOMR (e.g., LOMC1, LOMC2, etc.).

The Mapping Partner should describe the data obtained from distinct sources in sufficient detail to identify the actual source for each element in the file. The Lineage section (2.5) should be used to describe each source. A sample Source Citation entry within the Lineage section for a Letter of Map Revision (LOMR) is shown below.

```
<srcinfo>
    <srccite>
            <citeinfo>
                    <origin>Federal Emergency Management Agency</origin>
                    <pubdate>20110622</pubdate>
                    <title>Letter of Map Revision, Case Number 10-04-3939P, Wake County, NC</title>
                    <geoform>Vector digital data</geoform>
                    <pubinfo>
                            <pubplace>Washington, DC</pubplace>
                            <publish>Federal Emergency Management Agency</publish>
                    </pubinfo>
                    <othercit>A Letter of Map Revision is a letter, usually accompanied by a map attachment, that revises Base Flood Elevations (BFEs), flood hazard zones, floodplain boundaries and/or floodways shown on the FIRM.</othercit>
            </citeinfo>
    </srccite>
    <srcscale>6000</srcscale>
    <typesrc>CD-ROM</typesrc>
    <srctime>
            <timeinfo>
                    <sngdate>
                            <caldate>20110622</caldate>
                    </sngdate>
            </timeinfo>
            <srccurr>Effective date</srccurr>
    </srctime>
    <srccitea>LOMC27</srccitea>
    <srccontr>Spatial and attribute information for Floodplains, BFEs, cross sections, water lines, transportation features, general structures, and LOMR area of revision.</srccontr>
</srcinfo>
```

When documenting the incorporation of revised data, unique source citation abbreviations should be used to document any new data sources so that when the revised data are stitched into the existing effective data for the subject jurisdiction in the NFHL, the source citation abbreviations are distinct. This applies regardless of whether the FIRM Database submitted to the MIP is jurisdiction-wide or covers only the footprint of the revised area.

3.3.3   Other Documentation

Any variations from the standards and guidelines provided for the applicable dataset should be documented in the accompanying metadata file. This includes granted exceptions, variations agreed to by the FEMA Regional Office, unique characteristics of the submitted data or unique procedures used by the Mapping Partner.

Any use of non-populated values should be documented and explained in the metadata.

The version of any submitted Personal or File Geodatabases must be accurately documented in the metadata file in the Native Data Set Environment Section 1.13.

The metadata file should document the projection of the submitted database. If a different projection was used for FIRM production or flood risk analysis, this should be documented in the Process Description Section 2.5.2.1.

The metadata file should document the vertical datum conversion factor if the average countywide vertical datum conversion factor is less than +/-0.1 foot and the conversion is considered to be executed passively.   This should be documented in the Process Description Section 2.5.2.1.

4.0   Metadata Quality Assurance

This section provides information about Quality Assurance tools that can be used to check metadata files and ways to resolve some common errors found during quality assurance reviews.

4.1   Quality Assurance Tools

Several Quality Assurance tools are used to validate metadata files that are submitted within the MIP Data Capture tasks. The DVT is invoked when users choose "Validate Contents" as Draft FIRM Database, Produce Preliminary Products, and Develop Final Mapping Products Data Capture uploads are made in the MIP. Studies must pass DVT before moving to the next MIP Data Capture step. MIP Black Belts are also tasked with checking MIP submittals for required tables/feature classes in submitted FIRM and FRD Databases and accompanying metadata files. Studies will fail MIP validation if the required tables/fields are missing. The FIRM Database Technical Reference lists the required tables and fields.

4.1.1   MIP Upload

All MIP Data Capture upload screens include a "Run Validation" button (see Figure 1). Selecting this option runs the Metadata Manager (MetaMan) tool on the submitted metadata file. The tool checks the uploaded metadata file against the metadata profile applicable to the MIP Data Capture task on which the user is working. The results of the MetaMan validation are displayed under "Submission Status".

For the Draft FIRM Database, Produce Preliminary Products, and Final Map Production and Distribution Data Capture tasks, the user must choose the FIRM Database schema for the data being submitted. If the submitted metadata passes the MetaMan validation, DVT is automatically started.
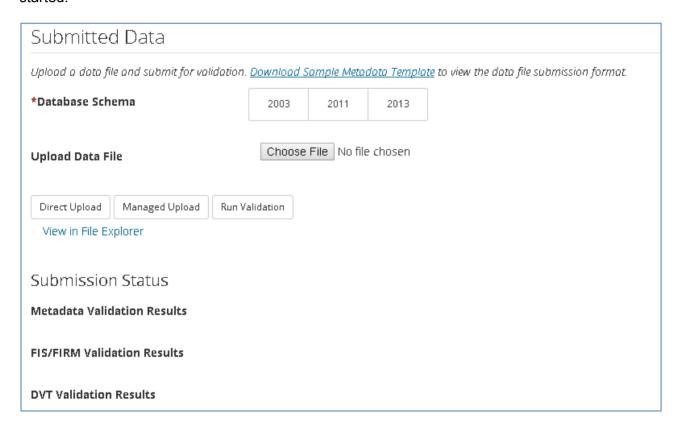

Figure 1: MIP Upload and Metadata Validation

Note that until such time as MetaMan is updated, only metadata files named using a CID, not a Hydrologic Unit Code (HUC-8) or project name, will pass MetaMan validation. Users should name the metadata file using the CID that was selected during the MIP Task Creation. Alternatively, users can request a bypass for files named with a HUC-8 or project name.

Additionally, until MetaMan is updated, the metadata file name of FEMA-Terrain-Capture will fail. Users should continue to use the Terrain metadata file naming convention of FEMA-DCS-Terrain.

4.1.2   Metadata Manager (MetaMan)

MetaMan can also be run from the MIP Meta Data Test Submission tab. It is recommended that users use MetaMan to check their metadata files before they are uploaded and run through the DVT checks. To run MetaMan, users need to enter a case number and Community ID, and then choose a schema (i.e. metadata profile) as shown in Figure 2. The schema should correspond with the MIP Data Capture task for which the metadata file will be uploaded. Then click "Continue" to browse to the metadata file to be validated, then click "Submit" to run MetaMan. The validation results will be displayed in the Results window.

Figure 2: MetaMan Interface

MetaMan checks the submitted metadata file for conformance to FGDC metadata standards. It also includes checks for specific FEMA metadata requirements. These checks are specific to the metadata profile used for the metadata file being submitted. MetaMan does not include any checks for consistency between the submitted spatial data and the metadata. Those consistency checks are performed by DVT.

The MetaMan checks are summarized below.

- Conformance to FGDC Metadata XML Schema.

- Existence of required metadata sections as defined in FEMA metadata profiles.

- Use of FEMA domain values for specific sections within the metadata file as required by the specific metadata profile against which the submitted metadata file is being checked (these requirements vary by metadata profile). For example, MetaMan checks that the theme keywords listed in the submitted metadata file are within the domain of the theme keywords for the applicable metadata profile. MetaMan also checks that specific verbiage listed as FEMA specific domain values in the metadata profiles is included in the submitted metadata file. For example, the text provided for the Abstract field in the metadata file is checked for agreement against the text in the applicable metadata profile.

4.1.3 FIRM Database Verification Tool

DVT is run on the submitted FIRM Database and its corresponding metadata file. DVT performs several checks on the submitted metadata file as well as several checks for consistency between the metadata file and the FIRM Database. The <u>FIRM Database Verification Tool</u> guidance document lists metadata checks performed by DVT.

4.1.4   U.S. Geological Survey CSDGM Validation Service

The U.S. Geological Survey Online CSDGM Geospatial Metadata Validation Service at https://mrdata.usgs.gov/validation/ is a tool that allows users to upload a metadata XML file and validate its content against the FGDC CSDGM standards.

4.2   Error Resolution

Each of the metadata validation tools described above provides error reports that describe the detected error(s). Most of the error messages provided by these tools are reasonably clear and specific and cite the line in the metadata file that has caused the error, although others can be somewhat cryptic.

Errors stemming from non-conformance to the FGDC Metadata Schema can usually be resolved by reviewing the placement of specific sections of the metadata to ensure correct parent-child relationships are met or the XML tags to ensure their correct spelling, syntax or placement. Examples of frequent errors include:

- XML closing tag is missing.

- Parent/child relationship within the XML file is not correct.

MetaMan errors often result from non-conformance with FEMA metadata profile "rules" regarding whether an item is required or not or whether a specific domain is used. These errors can generally be resolved by ensuring that the FEMA metadata profile has been correctly followed. Examples of frequent errors include:

- Disagreement between metadata "Currentness Reference" and "Progress". As described in the metadata profiles, the Progress element must synchronize with Currentness Reference (1.3.2) as follows: when Progress is "*In work",* Currentness Reference is "*MIP Submission Date";* alternatively, when Progress is "*Complete",* Currentness Reference is "*FIRM and FIS Effective Date".*

- "Place Keyword" (1.6.2.2) REGION number contains a leading zero (e.g., "06"); "6" for REGION is correct.

- "Place Keyword" (1.6.2.2) COUNTY name should be all caps and should not include the word "County or Parish" at the end of the name. For a watershed, this must be the first county listed alphabetically in the watershed and must match the set-up in the MIP.

- "Place Keyword" (1.6.2.2) COUNTY-FIPS code includes a "C" on the end of county FIPS code. The value should be only 5 digits. For a watershed, this must be the first county listed alphabetically in the watershed and must match the set-up in the MIP.

- "Source Citation Abbreviation" (2.5.1.5) prefix listed in the metadata file (e.g., BASEx, STUDYx) does not match the FIRM Database domain.

FIRM DVT metadata errors typically result from lack of consistency between the FIRM Database and the metadata file and can be resolved by ensuring the required consistency is met. The FIRM Database Verification Tool guidance document lists some common errors and provides recommendations for resolving them.

Special or hidden characters may cause metadata files to fail the MetaMan and/or DVT checks. These may include but are not limited to ampersand (&), quotation marks ("") and symbols or accent marks used in foreign languages such as the tilde used in Spanish (~). Resolving these errors will typically involve spelling out, replacing or removing the symbol.

One method that can be used to find these special or hidden characters is as follows:

- Open XML using a text editor such as Notepad ++.

- Click on 'Encoding' in the banner bar.

- Select "Encode in ANSI".

- Perform a search using special characters: â€.

- When found, delete the special characters and add back the apostrophe or other symbol that is associated with the special character.

Occasionally the user may get a "Fatal Error" that does not include any details of its cause. One possible solution is to save the file as an ANSI file as shown in Figure 3.
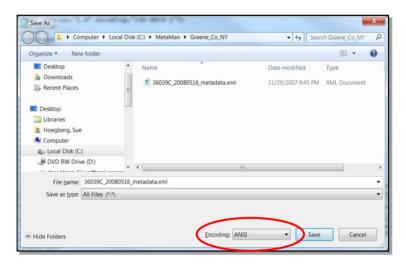

Figure 3: Fatal Error Solution

If the metadata error(s) cannot be resolved and a MIP Help request for a bypass is needed, be sure to include the following information in your MIP Help ticket:

- CID

- FIRM Database schema year (e.g., 2003, 2011, 2013) and metadata profile schema (e.g., 2006, 2013) used for validation.

- The validation activity that failed metadata (e.g., Preliminary FIS/FIRM, DVT).

Note that all North Carolina metadata files will require a MIP Help bypass for Draft FIRM Database, Produce Preliminary Products, and Develop Final Mapping Products Data Capture tasks.

As noted previously, until such time as MetaMan is updated, only metadata files named using a CID, not a HUC-8 or project name, will pass MetaMan validation. Users should name the metadata

file using the CID that was selected during the MIP Task Creation. Alternatively, users can request a bypass for files named with a HUC-8 or project name.