FERC Requirements for Submitting GIS Inundation Zones

General Specifications of GIS data

The following five (5) types of data files will be required for submitting GIS inundation zones to the FERC. The GIS files can then be converted into a variety of data formats (CAD, ArcGIS online, QGIS, Google Earth, etc.) or incorporated directly into systems used by emergency management authorities.

1. Point File
    The point file will be used both for locating project structures, such as dams and powerhouses, as well as for reference points for georeferencing raster format inundation maps. Points can be acquired by survey, GPS, or by identification of electronic coordinates of features (such as road intersections) from a USGS DRG or DOQQ. A minimum of three points are required for each map panel on the inundation map sheets and the points should be spread over the entire raster dataset rather than concentrating them in one area. Most inundation map sheets will have a single map panel, but if inset maps are used to illustrate different resolutions, these insets must have three or more reference points as well.

2. Rasters
    A raster map is simply a digital copy of the paper inundation map used in the EAP. The digital copy can either be a scanned copy of an existing paper map, or a digitally created map from GIS or CAD software. This copy will be georeferenced by FERC staff using the required point file, and used to verify the accuracy of the GIS failure inundation polygon files.

    The raster (and paper) maps must have a minimum of three reference points for each map panel. If a sheet has insets or a split drawing with match lines, then each inset or split must have its own 3 reference points. The point file labels when plotted on the actual inundation map should not be so prominent as to obscure important features.

    The inundation area delineated on the map must overlay the failure inundation polygon (see 3 below) EXACTLY when georeferenced using the reference points provided by the licensee. The map must overlay the USGS QUADs or the DOQQs with a positional error no greater than 40 ft.

3. Failure Inundation Polygon
    The failure inundation zone should be a single shapefile feature for each flood scenario (i.e. fair weather, PMF, etc), and should be a closed polygon.

This polygon can be used by emergency management authorities to delineate the affected area, which can then be cross-referenced with other GIS layers.

Gridded data from 1-D and 2-D hydraulic modeling to develop the inundation area can be created as part of the flood modeling process. The gridded data can be useful in assessment of life loss and damage estimates. Submittal of the inundation flood depth grid file is optional and can be submitted in binary (*.flt) or ASCII (*.asc) electronic formats.

4.   Cross Section File
The cross section file is used for determining the timing and depth of flooding at a given location. This information can be used by emergency responders to identify houses or subdivisions that are high priority due to early flooding or excessive flooding depths. For 1-dimensional models, submit only information from the cross sections shown on the inundation maps.

In 2-dimensional models, there are no "true" cross-sections. Thus, cross-section file can be created from the raster (grid) output of the 2-dimensional model. Flood characteristics can be displayed in various ways (e.g. isoline/contours, polylines, vectors, etc.) or can also be averaged across the entire cross-section or separated by main channel and overbank areas on a 2-dimensional inundation map. Appendix 6-N contains examples of these options. There are two options for submitting flood data timing and severity information. The licensee should coordinate with the FERC Regional Office staff and the emergency management authorities regarding these options prior to submittal to ensure that the most effective 2-dimensional inundation map is created.

(1) Submit only the artificially created cross-sections.

(2) Submit a point file from the raster (grid) output of the 2-dimensional model showing the inundation depth grid and include a data table for the artificial cross-sections on the inundation map.

Note: When using a 2-dimensional model it is imperative that the methods used to display and tabularize the data be clearly and thoroughly described in the Metadata file.

Similar to inundation depth grids, the arrival time and duration grids can be created from 1-D or 2-D engineering models. Such grid files can be submitted in binary (*.flt) or ASCII (*.asc) electronic formats. Arrival time

and duration grids are optional.

5.   Metadata Text File
      A metadata file is literally "data about data." Metadata is a text file that
      describes the details of the data set such as the source, the year the data was
      produced, the coordinate system used to create the data (Albers Equal Area
      – see Technical specs below), the datum (NAD 83 should be used – NAD
      27 should not be used unless there is no other alternative), and the units of
      measurement (meters should be used). One metadata file should be
      included with each of the above four files.

Technical Specifications

All data submitted should meet the following requirements.

1.   Spatial Projection
      All data files shall be filed in Alber's Equal Area Conic Projection, a
      readily available national scale spatial projection, which has the following
      specifications:

      Parameters:
            False Easting: 0.000000
            False Northing: 0.000000
            Central Meridian: -96.000000
            Standard Parallel 1: 29.500000
            Standard Parallel 2: 45.500000
            Latitude of Origin: 37.500000

      Units: meters

      Horizontal Datum: North American Datum 1983
      Vertical Datum: North American Datum (NAVD88) is preferred, however,
      if a local datum is used a conversion to NAVD88 should be provided.

2.   Accuracy
All georeferenced electronic data files must be positionally accurate to
±40 feet in order to comply with National Map Accuracy Standards for maps at a
1:24,000 scale.

We recognize available base data is not as accurate in Alaska. These projects
should attempt to meet our standards to the best extent possible. If the accuracy
standards above cannot be met, include a written description of the base data used
to georeference the inundation area.

The following data requirements are unique to each data type:

Point File

A minimum of three reference points will be required for map panel. The points should be spread out or triangular in orientation to facilitate accurate georeferencing of the raster files. Typically, each inundation map will have one map panel per sheet. If a sheet has more than one map panel, such as an inset at a different scale or a split drawing with match lines, each of the map panels should have three reference points. Include points at the main section of the dam and other major project features, such as the powerhouse or saddle dike. The location of the coordinate for the dams should be the spillway or the approximate center of the impounding structure, if possible. The location of the powerhouse should be the approximate center of the building.

The following data fields should be included in any point file submittal:

Field Name	Field Type	Units	Description
ID	ObjectID	None	Field reserved by GIS data – the ID of the point
Shape	Geometry	Point	Field reserved by GIS data – where the point geometry is stored
Project	Integer	None	FERC Project Number
Dam_Name	Text	None	Name of Dam
Sheet	Integer	None	Sheet number that reference points refer
DESC	Text	None	A description of the point, i.e. center of dam crest, road intersection

Raster

Each sheet of the inundation maps must be contained in a separate electronic raster file, which meets the following format specification:

IMAGERY - black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) or equivalent with world file

RESOLUTION –300 dpi desired, (200 dpi min)
FILE SIZE – less than 10 MB desired

These desired formats minimize file storage space on computer servers, and are universally read by most computer software. Each sheet must contain a minimum of three known reference points. The positional coordinates of each reference point must be shown.

Failure Inundation Polygon

The dam failure inundation polygon should match the inundation area on the EAP paper maps. Each inundation area must be a closed polygon. A collection of line segments, such as from a converted CAD file, will not be accepted.

The following data fields should be included in the failure inundation area attribute table:

Field Name	Field Type	Units	Description
ID	ObjectID	None	Field reserved by GIS data – the ID of the polygon
Shape	Geometry	Polygon	Field reserved by GIS data – where the polygon geometry is stored
Project	Integer	None	FERC Project Number
Dam_Name	Text	None	Name of Dam
Scenario	Text	None	Fair weather or IDF

Cross Section

The cross section file should include a single polyline feature for each of the cross section locations shown on the inundation maps. For 2D models, either the point file should be submitted or the single polyline feature cross section file created for those cross sections plotted on the inundation maps.

Alternatively, a simple text box could be used to convey the different flooding severity hazards at each cross section with the technical detail in the following table shown on the index map. See Appendix 6-N for examples of these types of inundation maps.
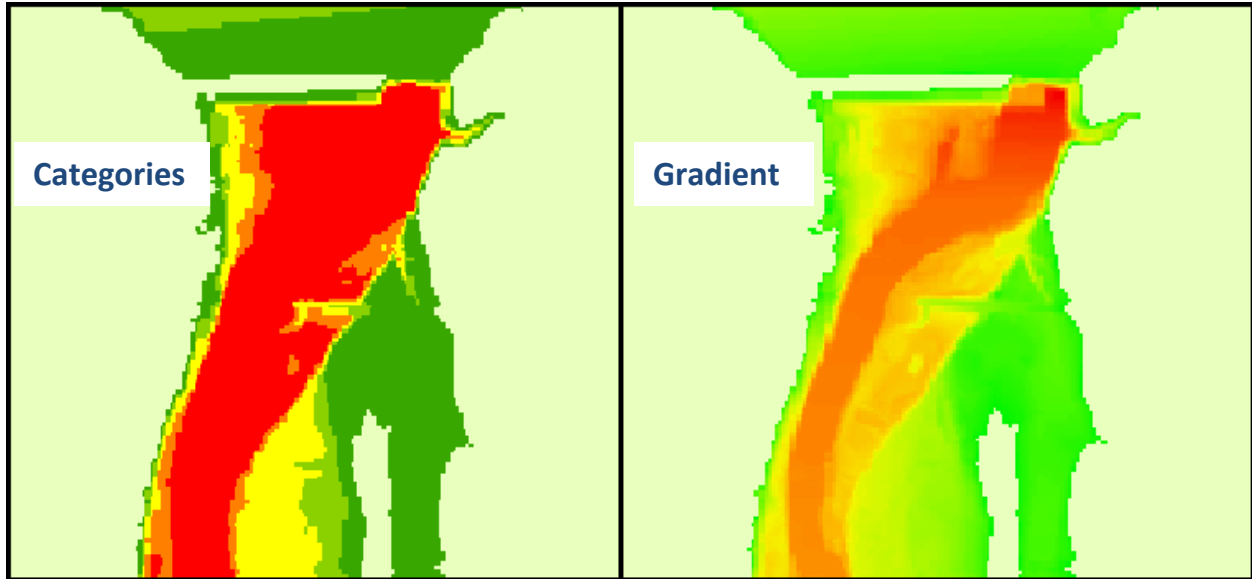
The following data fields should be included in the cross section attribute table (or point file for 2D):

Field Name	Field Type	Units	Description
ID	ObjectID	None	Field reserved by GIS data – the ID of the cross section line
Shape	Geometry	Lines	Field reserved by GIS data – where the line geometry is stored
Project	Integer	None	FERC Project Number
Dam_Name	Text	None	Name of Dam
DIST	Float	Miles	The distance of the cross section downstream of the dam
IDF_TOA	Float	Hours	Time of arrival of leading edge of IDF failure hydrograph
IDF_TTP	Float	Hours	Time to peak of IDF failure hydrograph
IDF_WSEL	Float	Feet	Peak water surface elevation of IDF failure hydrograph
IDF_RISE	Float	Feet	Incremental rise due to IDF dam failure
IDF_FLOW	Float	CFS	Peak flow of IDF failure hydrograph
IDF_DUR[1]	Float	Hours	Time of IDF failure inundation
IDF_VEL[1]	Float	Feet/sec	Velocity of IDF dam breach flow
FW_TOA	Float	Hours	Time of arrival of leading edge of fair weather failure hydrograph
FW_TTP	Float	Hours	Time to peak of fair weather failure hydrograph
FW_WSEL	Float	Feet	Peak water surface elevation of fair weather failure hydrograph
FW_RISE	Float	Feet	Incremental rise due to fair weather dam failure
FW_FLOW	Float	CFS	Peak flow of fair weather failure hydrograph
FW_DUR[1]	Float	Hours	Time of fair weather failure inundation
FW_VEL[1]	Float	Feet/sec	Velocity of fair weather dam breach flow

[1]Optional/Suggested: The selection of the reported dam breach velocities should consider the location of structures in the critical downstream areas. Only if the impacted structures are obviously well into the flood plain should overbank velocity be reported. Otherwise, the fastest velocity from the model rather than the average velocity of the entire cross section should be reported.

Important notes for 2D inundation maps:

- A minimum of 1-2 cross sections with flood wave characteristics should be displayed per inundation map sheet if there are no critical areas (i.e. rural or forested downstream areas).
- The deepest depth from the model should be used to compute the incremental rise.
- A map legend should be provided on the map for gridded values. It is preferable to use categories rather than a smooth color gradient (see example below showing categories on the left and a gradient on the right).

Metadata

One metadata file should be included with each of the other four file types. The metadata should be a simple text file and should contain background information about each of the data sources. Metadata should be submitted in Federal Geographic Data Committee format (http://www.fgdc.gov/metadata). Items that are required in the metadata are: the model used to calculate the inundation, the date of the dam break model run, the source and date of the elevation data for the model, and the PMF/IDF, and fair weather flows used in the model.