



## **Specifications for GIS Products and Deliverables**

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### **Purpose**

These guidelines were developed for Geographic Information Systems (GIS) products created by, or submitted to, the North Coast and Cascades Network (NCCN) of the National Park Service (NPS). The primary goal is to improve GIS data quality and usability.

This document provides detailed guidance and specifications about the required software and formatting standards for spatial data generated by or for the Inventory and Monitoring (I&M) program of the NPS. These guidelines:

- provide direction to GIS users and data contributors about required GIS formats and products
- promote consistency among GIS data formats
- promote GIS product quality
- state metadata requirements
- facilitate GIS product identification
- facilitate appropriate use of GIS products
- facilitate links between spatial and non-spatial data
- minimize data errors and data format problems when GIS data are exchanged and used

### **Scope and Applicability**

These guidelines apply to all NCCN staff, contractors and cooperators responsible for generating and submitting data for permanent retention. Compliance with these guidelines is required for all I&M project databases (including geospatial databases), and for other projects as stipulated by project study plans, cooperative agreements, contracts or research permits. Specifically, all data that will be maintained on one of the NCCN I&M Servers, or submitted to any of the NPS national databases/clearinghouses will be subject to these guidelines. Beyond these requirements, it is hoped that these guidelines will be adopted by others as a way to increase operational efficiency and compatibility among data sets.

### **Definitions and Acronyms**

<i>Database</i>	A collection of data organized according to a conceptual structure describing data characteristics and relationships among corresponding entities. For example, a GIS database includes data about the position and characteristics of spatial features.
<i>Data dictionary</i>	A list of tabular fields and their properties. Each field is described and defined in terms of its data type, field size, format, domain values, validation rules, etc.
<i>Domain values</i>	The range of values allowed in a field. For example, aspect can be any whole number between 1 and 360.
<i>ESRI</i>	Environmental Systems Research Institute. Company that creates and maintains ArcGIS®, including ArcMap, ArcCatalog and ArcToolbox.
<i>FGDC</i>	Federal Geographic Data Committee. Federal interagency organization that developed the National Spatial Data Infrastructure (NSDI). The NSDI creates policies, standards, and procedures for geographic data production, metadata, and distribution.

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<i>Geodatabase</i>	The ESRI name for ‘geographic database’. The Geodatabase model is an ArcGIS version 8.0 and above data format. A geodatabase represents geographic features and attributes as objects and is hosted inside a relational database management system (DBMS).
<i>GIS</i>	Geographic Information Systems. A computer system for creating, storing, checking, integrating, manipulating, analyzing, and displaying spatial data.
<i>I&amp;M Metadata</i>	Inventory and Monitoring Program of the National Park Service Documentation describing a data set. Typically describes purpose, geographic extent, content, condition, distribution, creator, and contact information.
<i>NBII</i>	National Biological Information Infrastructure. Collaborative program that developed the “Biological Data Profile” portion of the FGDC metadata standards. NBII extends FGDC standards to include information about biological aspects of data, such as taxonomy.
<i>NCCN</i>	North Coast and Cascades Network <a href="http://science.nature.nps.gov/im/units/nccn/">http://science.nature.nps.gov/im/units/nccn/</a>
<i>Normalization</i>	The process of organizing the fields and tables of a relational database to minimize redundancy and dependency. Normalization usually involves dividing large tables into smaller (and less redundant) tables and defining relationships between them. The objective is to isolate data so that additions, deletions, and modifications of a field can be made in just one table and then propagated through the rest of the database using the defined relationships.
<i>NPS Primary key</i>	National Park Service A tabular field that uniquely identifies each record in a relational table. It can either be a normal attribute that is guaranteed to be unique or it can be generated by the DBMS (such as a globally unique identifier, or GUID, in Microsoft SQL Server). Primary keys may consist of a single attribute or multiple attributes in combination.
<i>Raster</i>	A data model that stores data by rows and columns, forming cells. Each cell is a discrete, uniform, geographically located unit containing a single data value that represents a feature or characteristic. ESRI raster data sets are called grids.
<i>Shapefile</i>	An ESRI GIS data format that stores non-topological geometry and attribute information for the spatial features. The geometry for a feature is stored as a shape comprised of a set of vector coordinates. Shapefiles can support point, line and area features.
<i>Vector</i>	A data model that stores points, lines, or polygons. The spatial features’ locations are defined by x, y coordinates (points) or a series of x, y coordinates connected by linear segments (lines, polygons).
<i>XML</i>	Extensible mark-up language.

## Overview

These guidelines outline required documentation and formats for spatial data created by or submitted to the NCCN. Spatial data product specifications, NCCN coordinate system and datum standards, quality assurance and quality control considerations, and metadata requirements are discussed. A list of products required by NCCN is provided in Table 1.

Table 1. Required spatial products and associated information for delivery to NCCN.

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### Required

- Spatial data
- Associated attribute information (Access Database, dBase files, etc.)
- FGDC-compliant metadata (XML or HTML format) or descriptive documentation text file

### If Applicable

- Associated map legends, specialized map symbology
  - Linked documents, graphics, digital photographs
  - File geodatabase schema
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## Procedures and General Requirements

### NCCN GIS Software

Products submitted to NCCN should conform to the latest version of software used by the NPS. NCCN primarily uses ESRI ArcGIS products on Microsoft® Windows operating systems.

### Spatial Data Products Specifications

#### *GIS Formats*

Acceptable vector spatial data formats are file geodatabases (.gdb) and shapefiles (.shp, .shx, .dbf, and .prj at a minimum). Acceptable raster data formats include file geodatabases, georeferenced TIFFs, ERDAS Imagine files (.img) and Mr.Sid files.

#### *Non-GIS Formats*

If no GIS support is readily available, then spatial data may be provided in tabular or map format that can be converted into GIS products by NCCN GIS specialists.

#### Maps

Hardcopy or digital maps may be submitted. Typically, these consist of a background map with graphics drawn on top to represent the spatial features of interest. Stable base transparencies are recommended for projects involving a large number of features. Using GIS software, these graphics are then transcribed (digitized) onto a computer and are tied to geographic locations thus becoming spatial data with real-world coordinates. The features can then be linked to tabular data containing attribute information via a common field (primary key).

A United States Geological Survey (USGS) 7.5 minute (1:24,000 scale) quadrangle map is a good example of a standard product that can be used as a background for graphics (points, lines, or polygons) representing spatial data. These maps provide sufficient detail from which data can be accurately transcribed. Contact park GIS specialists for information about other background map options, including digital raster graphics (DRGs), digital orthophoto quadrangles (DOQs) and quarter-quadrangles (DOQQ's), air photos, etc.

#### Minimum map requirements:

- Maps must be clear and legible.
- Maps should include a title, a graphic scale, a north arrow, and a legend.
- Maps must be at an appropriate scale for the context of the spatial data being displayed.
- Maps must include labeled graticules or at least four corner tic marks showing coordinates preferably in Universal Transverse Mercator (UTM), or other projected coordinate systems.
- Spatial features should be labeled in a manner that matches submitted tabular data or report.
- Digital maps may be submitted in any standard image format such as JPEG (.jpg), Microsoft Windows bitmap (.bmp), or Tagged Image Format (.tiff), or they may be inserted into a Word (.doc), PowerPoint (.ppt), or Adobe Acrobat (.pdf) document.
- Depending on project objectives, spatial data on maps should be accompanied by tabular data. See the specifications below for tabular data formats.
- Maps must be accompanied by a text file containing information about map author, date of map creation, and source of data. Digital maps should also include a pathway indicating file location.

#### Tabular Spatial Data

GIS layers can be created from tabular data. Point feature data will be accepted in Excel spreadsheet, MS Access table, .DBF table, or comma delimited text file formats. Tabular data to create a point feature GIS layer must, at a minimum, have:

- one column containing a unique record number (GIS\_Loc\_ID)
- one column containing X coordinates (defined as numeric)
- one column containing Y coordinates (defined as numeric)
- one column defining estimated horizontal accuracy in a numeric format (specify measure units in column heading, e.g. 'elev\_m' for elevation in meters)

See [GIS Naming Conventions](#) (NCCN 2013b) for more detailed information about standard fields and formats for NCCN GIS data.

#### *Coordinate System*

The current NCCN coordinate system standard is Universal Transverse Mercator (UTM), Zone 10. Measure units for the UTM projection system are meters.

#### *Datum*

The current NPS standard is North American Datum (NAD) 1983.

#### *Ellipsoid*

The current NPS standard is the Geodetic Reference System (GRS) 80.

### *Spatial Scale*

A spatial scale appropriate to accomplishing project spatial objectives should be used. Consult with NCCN GIS staff to discuss spatial scale details.

### *Spatial Accuracy*

Spatial accuracy must be appropriate to project objectives. Consult with NCCN GIS staff and project lead to discuss accuracy requirements and appropriate protocols to meet those requirements.

### *Tabular Attribute Data*

Spatial features rarely consist of simply coordinate information. Most spatial features have associated data, called attributes (also called “fields” in a table), that describe characteristics of those features. A GIS allows users to query, analyze, and display spatial data based on these attributes. Spatial features can be associated with tabular data a number of ways. Spatial features can link to external databases using Open Database Connections (ODBC), using join and relate GIS functions, or using specialized software such as ArcGIS® extensions.

### Data Format

Tabular attribute data should be submitted in comma or space delimited text files, Microsoft Excel spreadsheet files or Microsoft Access tables.

### Attribute Requirements

Tabular attribute data should:

- be related to spatial coordinate information in either the same or a different delimited text, Excel or Access file. For point features, these data can be either presented in columns alongside coordinate data or provided in a separate table or file with a primary key specified. For all other feature types, attribute data should be provided in a separate table.
- have an explicitly defined primary key (GIS\_Loc\_ID) that relates spatial coordinates to attribute data in a separate file.
- be in the most normalized form possible.
- conform to GIS field naming standards such as having ten or fewer characters in each field name for attributes that are to be spatially queried or analyzed in GIS. See [GIS Naming Conventions](#) (NCCN 2013b).
- be accompanied by a data dictionary document (this is part of FGDC metadata) that states attribute definitions, such as field format and size and domain values. For example, a field containing aspect would be defined as numeric with a domain of values between 1 and 360; this avoids confusion about whether 0 or 360 designates north.

### Attribute Accuracy

There should be a minimum attribute accuracy of 95%. Consult [GIS Development Guidelines](#) (NCCN 20013a) for appropriate protocols to meet data quality objectives.

### Associated Symbology, Documents, Graphics, Digital Photographs

Associated files should be stored with the data set. Unique map symbol sets and legend files (e.g. `_.lyr`) should be included with GIS data. Graphics, digital photos, or documents linked to GIS layers should be organized into a folder along with a text document describing file naming conventions and relationships to spatial data (i.e. data set, table, and field names). Links to these associated files should be stored in GIS attribute tables using relative pathnames. Consult ArcMap help files for information on linking text and image files with spatial data. See [GIS Naming Conventions](#) (NCCN 2013b) for further guidance.

### Quality Assurance/Quality Control

A small subsample, approximately 10% of the data, should be entered into the GIS and tested before all data are entered. Coordinate and attribute data should be verified and validated periodically as they are entered. Spatial accuracy should be evaluated at a scale appropriate at which data were collected and intended to be used. Data *verification* is checking that digitized data match source data. Data *validation* is checking that data are free from logical errors. Steps taken for quality assurance and control standards used in producing the information must be formally documented in metadata or in a descriptive document file. See [GIS Development Guidelines](#) (NCCN 2013a) for details.

### Metadata

Whenever possible, spatial data should be submitted in a GIS format with accompanying FGDC or ISO compliant metadata, preferably in XML (.xml) or HTML (.html) format. For more information on FGDC metadata see <http://www.fgdc.gov/metadata/metadata>.

In the absence of FGDC or ISO metadata, there must be a descriptive document (Word, PDF, or Readme.txt file). This descriptive document must specify at a minimum:

- List of CD, DVD, or .zip file contents
- GIS data layer creation date and version
- Date of data collection
- Contact information (name, phone number, address, agency or organization) for person responsible for the data
- GIS data format(s)
- Short description of each GIS layer and associated files (tables, images, databases, etc.)
- Coordinate system and measurement units
- Datum
- Ellipsoid
- Data set purpose
- Spatial scale or resolution (for raster data)
- Horizontal accuracy estimates (in same unit of measure as coordinate system)
- Attribute accuracy level (percent)
- Source(s) from which data set was derived
- Methods describing how data set was created
- Indication if the data contain sensitive information
- Data dictionary
- Corresponding thematic information such as legend files, specialized symbology, hyperlinked images, or documents.
- Corresponding relational data (such as MS Access databases, Excel files, or dBase files)
- Primary key identification between GIS layers and corresponding relational data

### Spatial Data Products Delivery

Spatial products are to be delivered to one of the NCCN's GIS specialists or data managers.

Data should be digital whenever possible. Digital data can be compressed using WinZip or using Window's "Send to: Compressed (zipped) Folder" function. Files should be delivered on CD or DVD. Compact discs should be in CD-R and ISO 9660 format to allow cross-platform use. Alternatively, File Transfer Protocol (ftp) sites or e-mail may be used to deliver products. FTP sites and e-mail should not be used for data containing sensitive information (see [Sensitive Information Procedures](#) (NCCN 2008). E-mail should not be used for files larger than 10 MB.

Refer to Table 1 for summary of required spatial products delivered to NCCN.

### **Responsibilities**

- Project managers, data managers, and NPS cooperators and contractors who will create spatial data or use GIS capabilities are responsible for consulting with NCCN GIS staff during data design and development.
- NCCN GIS staff members are responsible for providing support to all parties requesting information about I&M GIS data development and delivery within the NCCN.
- NCCN GIS Specialists will verify that submitted GIS layers adhere to formats outlined in this document.

### **Recommended Citation**

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## Reference Documents

### Related Guidance

- North Coast and Cascades Network – National Park Service. 2013a. GIS Development Guidelines. USDI National Park Service. Available at: <http://science.nature.nps.gov/im/units/nccn/datamanagement.cfm>.
- North Coast and Cascades Network – National Park Service. 2013b. GIS Naming Conventions. USDI National Park Service. Available at: <http://science.nature.nps.gov/im/units/nccn/datamanagement.cfm>.
- North Coast and Cascades Network – National Park Service. 2006. NCCN Project Data Certification Form. USDI National Park Service. Available at: <http://science.nature.nps.gov/im/units/nccn/datamanagement.cfm>.
- North Coast and Cascades Network – National Park Service. 2008. Sensitive Information Procedures. USDI National Park Service. Available at: <http://science.nature.nps.gov/im/units/nccn/datamanagement.cfm>.

### Tutorials

- Federal Geographic Data Committee (FDGC) tutorial information <http://www.fgdc.gov/training/metadata-tutorials>

### Other Citations and References

- Boetsch, J. R., B. Christoe, and R. E. Holmes. 2009. Data management plan for the North Coast and Cascades Network Inventory and Monitoring Program (2005). Natural Resource Report NPS/NCCN/NRR—2009/078. National Park Service, Fort Collins, Colorado. Available at: <http://science.nature.nps.gov/im/units/nccn/datamanagement.cfm>

## Revision History

Revision Date	Description of Change	Author	Effective Date
Feb 03, 2010	Updated links	Natalya Antonova	Feb 10, 2010
Nov 16, 2013	Updated accepted data formats and links	Natalya Antonova	Dec 19, 2013