GNIS in Montana:
Final Report from the National Center for Landscape Fire Analysis to the USGS

June 2008
Lee Macholz

Introduction

The Geographic Names Information System (GNIS) was developed by the USGS in cooperation with the U.S. Board on Geographic Names (BGN). The GNIS contains information about proper names for places, features, and areas throughout the United States; both natural and man-made. This project resulted from funding made available by the USGS for the purpose of increasing state stewardship potential of the GNIS.

The National Center for Landscape Fire Analysis (NCLFA) at the University of Montana has developed a Geographic Information System (GIS) and web application known as the Montana Wildland Fire Base Map. The NCLFA proposed to incorporate the GNIS into the Wildland Fire Base Map and in so doing, design a data model for a Montana-specific GNIS. In addition, the NCLFA has been working with the state GIS leadership to initiate discussion of establishing state stewardship of GNIS in Montana. A final component of the NCLFA's proposal was a comparison of the federal GNIS to existing Montana framework data-sets, analyzing the GNIS dataset for spatial accuracy and name consistency against the accepted Montana data.

This report will address three key topics:

- The results of the comparison analysis between the federal GNIS dataset and several key Montana framework data sets;
- The presentation of a proposed data model for a Montana GNIS;
- The potential future of state stewardship for GNIS in Montana.

GNIS Analysis

Objectives

The objective of the GIS analysis of the federal GNIS dataset for Montana was to determine the potential extent of data discrepancies between the federal GNIS and the Montana framework datasets. The GNIS is first and foremost a names repository, but the associated spatial data is often used for GIS and cartographic purposes. The NCLFA wanted to assess the accuracy of the spatial data within the GNIS in

order to understand the potential for using the GNIS as a source for spatial information for point features not otherwise represented in a Montana framework dataset.

Methods

The sample GNIS dataset used in the comparison analysis was selected from the standard Montana GNIS dataset available for download from the BGN's Domestic Names State and Topical Gazetteer Download site (http://geonames.usgs.gov/domestic/download_data.htm). The sample dataset was derived by using the PLSS grid for the state of Montana, evenly selecting four sections from each Township-Range pair in the state (sections 9, 18, 27, and 36 – for a total of 16,314 selected sections), and selecting all GNIS points that intersected those sections. This resulted in a total of 8,177 GNIS points in the initial analysis dataset; this sample size accounts for approximately 10 percent of the full Montana GNIS dataset. It was determined that certain feature classes within the GNIS dataset could not be validated accurately and therefore were removed from the analysis dataset. These feature classes included: any feature that included "historic" in the name, wells, springs, mines, churches, and cemeteries. The final analysis dataset included 4,289 points; a 5.6 percent sample of the full Montana GNIS dataset.

The federal GNIS was analyzed for four sources of error: spatial error, class error, name error, and duplicate points. GNIS points were analyzed in comparison with the appropriate Montana framework GIS dataset; for example, a stream feature in the GNIS was analyzed in comparison with the National Hydrologic Dataset (NHD) for Montana. All GNIS features were also compared against Digital Raster Graphics (DRG) and National Agriculture Imagery Program (NAIP) imagery. Table 1 presents a listing of major GNIS feature classes and the Montana framework dataset they were referenced against.

Table 1 – Reference sources for comparison analysis.

Montana Framework Dataset	GNIS Feature Class
NHD	Stream, lake, rapid, reservoir, canal, bar, beach, bay, channel, falls, dam, harbor, island, swamp
Cadastral	Civil
Stewardship	Forest, park, preserve
Transportation	Bridge, interchange, building, school, hospital, post office

Analysis of spatial error was based on U.S. National Map Accuracy Standards which indicate that "not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale," which means approximately 66.67 feet at a scale of 1:24,000 (http://rockyweb.cr.usgs.gov/nmpstds/nmas647.html). To assess this, a 67-foot buffer was created on each GNIS point in the analysis dataset; the buffered dataset was then compared to appropriate GIS datasets based on feature class. If the associated point was identified on the Montana dataset to be

outside of the 67-foot buffer (based on the rules given for the location of the primary point within the GNIS dataset), the GNIS point was attributed as in spatial error.

Analysis of class error consisted of verifying that the feature class was attributed properly in the federal GNIS dataset. Analysis of name error was based on the match between the GNIS feature and the identified feature within the Montana framework dataset. In the case that the names did not match, the GNIS feature was attributed as having a naming error, but the error is not assumed to reside in the GNIS dataset. A duplicate point error was recorded where multiple points at one location were identified or if multiple points with the same feature name were identified within the GNIS dataset.

Results

A total of 4,289 points were assessed in this analysis. Of the total, 1,747 points were found to be in error (regardless of the type of error); this results in a total error of 40.73 percent. Appendix A provides a listing of error counts by feature classification.

The largest portion of the total error is attributed to spatial error. Of the 4,289 points analyzed, 1,592 had spatial errors; this equates to a 37.1 percent error (91 percent of the total error). Many of the GNIS points that were found to be in error spatially were relatively close (100 to 300 feet) to the appropriate location for the point; the remaining GNIS points were generally over 1,000 feet from their appropriate location. This result may not be statistically significant based on only a 5.6 percent sample size, but it is nonetheless indicative that a good deal of work needs to be done to validate the federal GNIS dataset for Montana spatially.

Errors in the classification of GNIS features attributed for only 1.77 percent of the total error (76 of 4,289 points). This error is relatively insignificant and does not necessarily indicate many potential problems for the use of the GNIS dataset.

The smallest portion of the total error can be attributed to name error. Of the 4,289 points analyzed, only 74 were found to have a difference in the name between the GNIS dataset and the Montana framework dataset; this equates to a 1.73 percent error. The results here do not imply that the official name in the GNIS is incorrect, but more likely that the Montana datasets have not been updated to reflect the most current official names for features. This is supported by the observation that the two feature classes with the highest numbers of name errors are lakes and streams. This is surprising due to the fact that the NHD is supposed to carry the GNIS ID for all features and maintain the name attributes with the official federal name. While the level of error is relatively insignificant, the fact that there is error here is a significant factor in proposing that the state of Montana establish stewardship of its GNIS dataset. The GNIS is the recognized source for official (and alternative) names, so the Montana framework datasets should carry the GNIS ID, which will allow the datasets to be joined and the GNIS will always provide the most current name for any given feature. This should be one of the foundations on which Montana builds a federated data model.

Duplication error attributed for 2.2 percent of the total error (94 of 4,289 points). Duplication error took two forms within the GNIS dataset; multiple points with the same spatial coordinates, and multiple dispersed points with the same feature name. Both forms of duplication error can be explained a

number of ways: primarily, that the scale of the coordinates may cause generalization and adjacent features may appear with the same spatial coordinates, and that multiple features truly do have the same name (e.g. Hidden Lake is a somewhat common name for remote lakes in Montana). The level of error is relatively insignificant and like the classification errors, duplication in itself does not necessarily indicate many potential problems for the use of the GNIS dataset.

The NCLFA recommends that the level of error found by this study should precipitate an active effort for validating the spatial component of the GNIS, specifically for those features that are not otherwise represented in a Montana framework dataset. The NCLFA further recommends that Montana framework datasets carry the GNIS ID for all named features.

GNIS Data Model

The NCLFA has developed a proposed data model for a Montana GNIS database (Figure 1). The intent of this proposed data model is to facilitate the pursuit of state-level stewardship of GNIS in Montana. The primary requirements for the data model are as follows:

- The ability for the state to receive federal GNIS updates;
- The ability for the state to submit changes to the federal GNIS;
- The ability for the state to add attributes to features that would not be incorporated into the federal GNIS;
- The ability for the state to add named features to the state GNIS that would not be incorporated into the federal GNIS.

The NCLFA started the data model work by requesting a full copy of the federal GNIS dataset for Montana, includeing all primary and secondary features, and all data tables. This dataset was brought within a SQL Server implementation at the NCLFA and the data model was examined. The NCLFA determined that the federal GNIS data model is very well designed and almost fully functional for the requirements of a Montana GNIS data model. Thus, the NCLFA has replicated the federal GNIS data model as the foundation of the proposed Montana GNIS data model.

The NCLFA held a series of workshops and presentations for the professional GIS community in Montana for the purpose of determining the requirements for state-specific data (attributes and features) to include in the proposed data model. The workshops were well attended and resulted in a list of feedback that fell into five categories: dataset enhancements, functionality, relationships to Montana framework data models, data collection, and data correction. This list is included in this report as Appendix B. The NCLFA selected several of the issues within the dataset enhancements category to implement within the proposed GNIS data model:

- Use an alias of ‘GNIS_ID’ when referring to the Feature_ID field;
- Features created at a state level that are not to be uploaded to the federal dataset must have a unique ‘GNIS_ID’ that cannot be duplicated within the federal GNIS;

- Features created at a state level that are not to be uploaded to the federal dataset must be identifiable such that they can be queried and excluded when synchronizing the state and federal GNIS datasets;
- Implement the same scheme for unique identifiers as has been adopted by all Montana framework datasets;
- Implement the ability to include voice clips and images for features within the data model;
- Implement the ability to localize the Government Units table (e.g. to city level);
- Implement the ability to identify those GNIS features that have feature representations in Montana framework datasets and identify which dataset.

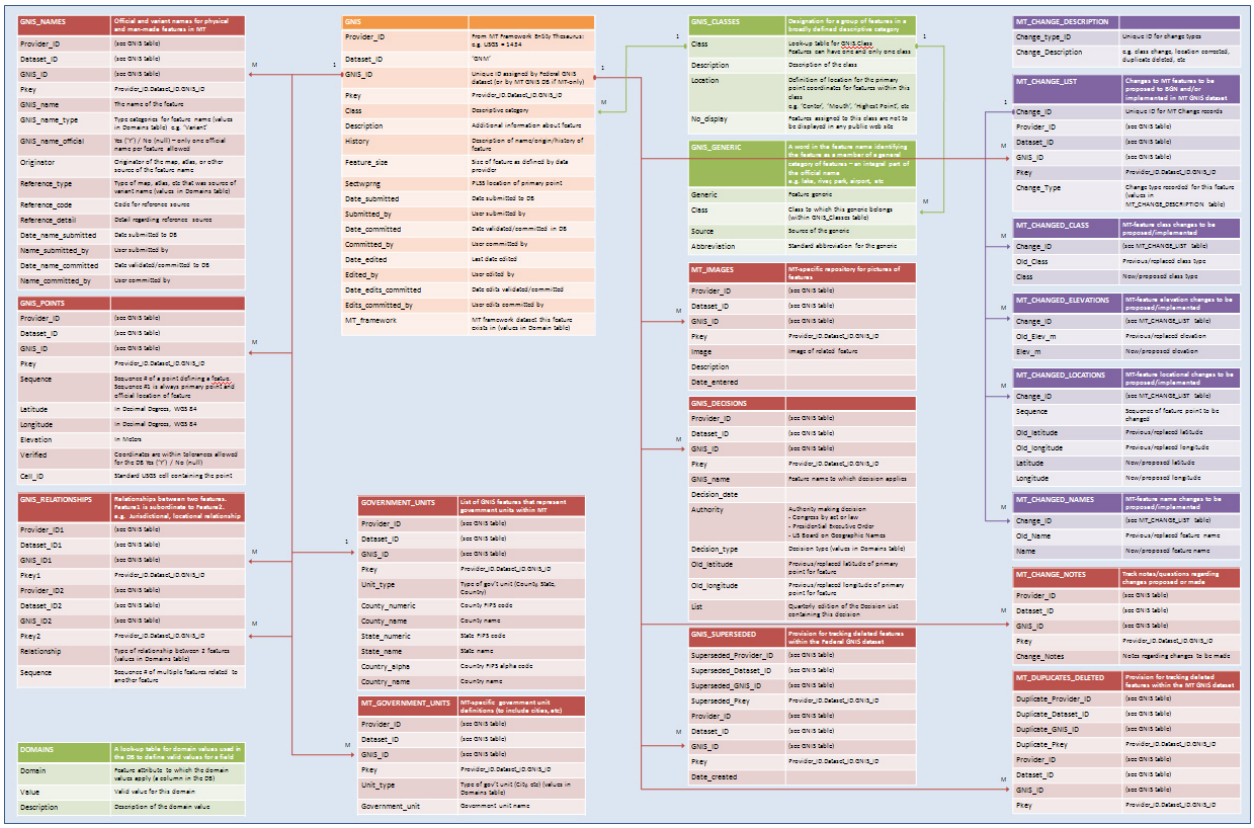

Figure 1 – Proposed Montana GNIS data model.

Dataset enhancements were addressed either by adding fields to the existing federal data model's tables or by adding new tables. Following this approach will allow the state's GNIS data steward to easily maintain data originating from the federal dataset while actively maintaining state-specific data within the same data model and maintaining the relational integrity of the database. Details of the proposed Montana GNIS data model can be found in Appendix C.

Enhancements made by adding fields to existing tables were intentionally limited to attributes that are very static in nature, in order to minimize potential conflicts or errors when synchronizing the federal and Montana GNIS datasets. Three fields (Provider_ID, Dataset_ID, and Pkey) were added to every table that included the GNIS_ID (originally known as the feature_ID in the federal GNIS data model) for the

purpose of implementing the unique identifier scheme. The unique ID is a combination of three fields that consist of a Provider ID, a Dataset ID, and a Local ID. The Provider ID is a long integer (10 characters or less) that is derived from a standardized list of Provider IDs for Montana framework datasets. For example, the Provider ID for USGS is 1434, thus all GNIS features originating from the federal dataset would have a Provider ID of 1434. The Dataset ID is a text field (three characters) that is also standardized for Montana framework datasets. The Dataset ID for the GNIS would be "GNM" thus all features within the GNIS dataset would have a dataset ID of "GNM". The Local ID is a persistent unique ID within a given dataset, which is determined by the data provider; the only requirement being that it is a long integer 10 characters or less. In the case of the GNIS, the existing GNIS_ID (a.k.a. the feature_ID) that is assigned as the unique ID by the federal dataset would be the local ID for all features originating from the federal GNIS. Features that are added to the GNIS dataset on a state-level and are not sent up to the federal GNIS would carry a local ID assigned by the data provider. These three fields are concatenated into a field called "Pkey" (Primary Key), which provides the unique ID for each record in the database. For example, the Pkey for the Missouri River would be 1434.GNM.756398. The Pkey field is the final unique ID field. It is recommended that each table in the data model that carries this Pkey field also carry a separate field for each of the three components. This recommendation is based on experience in designing and utilizing this ID scheme in several Montana framework datasets; this four-field structure will give the user the ability to quickly sort out all the federal data from the state-specific data based on the Provider ID without having to rely on a substring search of the Pkey.

All other dataset enhancements provided within the proposed data model for the Montana GNIS are provided through additional state-specific tables. The proposed data model includes new tables for Montana government units, images, and change tracking. The Montana government units table allows for the enhancement of place-name searches by providing more locational detail for search results. The images table allows for the storage of images within the database which can be implemented in an application such that the data steward and/or public can upload images of specific features to the database; this is a purely value-added functionality. The change tables provide the Montana GNIS data steward with a system for tracking changes to both federal and state-specific data that are submitted to the steward. The change list table is a comprehensive list of all changes made to the data within the database and is then related to a series of secondary change tables that detail the old and the new values for tracking purposes. Additional tables may be added to the data model as needs are identified in the future. The primary requirements are to maintain the relational integrity of the database and to maintain the unique identifier scheme throughout the data model.

GNIS Stewardship in Montana

The GNIS is first and foremost a table of names. The fact that these names have spatial data associated with them is a benefit, but is not the focal point or purpose of the dataset. A geographic names table should be considered to be an enterprise-level table that supports multiple framework datasets and applications. To implement this at the state level, the NCLFA recommends the following actions be studied and implemented in a phased approach:

1. Establish a data steward for GNIS in Montana;

2. Implement an enterprise-level GNIS database based on the proposed data model given in this report or its equivalent;
3. Establish a protocol with the federal GNIS effort to synchronize the federal GNIS to the Montana GNIS on a daily basis;
4. Establish a protocol for updating content within the Montana GNIS and submitting that content to the federal GNIS effort;
5. Implement a data-management structure that distributes content (both tabular and spatial) from the Montana GNIS to applications;
6. Reference geographic names within the Montana GNIS to their supporting framework dataset;
7. Integrate (and populate) a Montana GNIS identifier into Montana framework datasets;
8. Leverage Montana framework data efforts in creating place-based spatial queries (e.g. utilizing county boundaries within framework cadastral for spatial queries for places within a given county or the county itself);
9. Improve metadata on submissions and identification of contribution authorities;
10. Add value-added content (e.g. images);
11. Incorporate road names as Montana-specific content within the GNIS;
12. Application-based enhancements such as (but not limited to):
    a. Automated delivery of geographic names content to applications such as the Montana Portal, Wildland Fire Base Map, and E911 centers;
    b. A request for framework geometry also returns a valid names table that corresponds to the geographic extent of the query;
    c. A notification service that notifies locales of changes in geographic names content that is pertinent to their locale;
    d. Development of web services that support the retrieval of content.

The most important step to be taken, once the Montana GNIS database is established, is to develop and implement a series of protocols with the federal GNIS effort to enable the Montana GNIS to be synchronized with the federal GNIS. This can be accomplished programmatically (via custom programming or through the use of a commercial software package such as FME). The complexity of these protocols will be impacted by the extent of the difference between the federal and state GNIS data models. These issues will be simplified if the Montana GNIS data model follows the recommendations set forward in this document by adding MT-specific attribute data to separate tables. However, the protocol will have to take into consideration that there will be GNIS features within the state database that are not to be moved up to the federal GNIS or overwritten in the state database. Once the synchronization protocols (download from and submitting changes to the federal GNIS) are implemented, then the stewardship effort in Montana becomes a combination of maintenance and implementing value-added functionality.

The Montana Land Information Advisory Council (MLIAC) has recently initiated a process to investigate state stewardship of the GNIS. This process will begin with an informal presentation at the September 2008 MLIAC meeting.

Partners

Lee Macholz, NCLFA Project Lead
Craig Comstock, NCLFA GIS Analyst
Aden Fulford, NCLFA GIS Analyst
LiMei Piao, NCLFA Application Developer
Michael Sweet, University of Montana Project Advisor
Lance Clampitt, USGS Coordination Contact
Lou Yost, USGS Technical Contact
Lowell Whitney, MT DNRC (Former State Names Authority)
Gerry Daumiller, Montana State Library (State Names Authority)

Funding for this project was provided by the U.S. Geological Survey and the National Center for Landscape Fire Analysis.

Appendix A

Detailed report of error by feature class.

Feature Class	# Points	# Points In Error	Position Error	Class Error	Name Error	Duplicate Error	Dataset Referenced
Airport	32	23	23				Transportation, DRG, NAIP
Arch	1	0					DRG
Area	2	0					DRG, NAIP, Internet
Bar	2	0					DRG, NAIP
Basin	19	2	2				DRG
Bay	4	0					DRG, NAIP
Bench	7	0					DRG
Bend	9	3	1	2			DRG, NAIP
Bridge	26	8	8				Transportation, NAIP
Building	114	20	14		3	6	Transportation, DRG, NAIP
Canal	100	30	22	2	9		NHD
Cape	9	5	2	3			NHD, DRG, NAIP
Channel	2	1	1				NHD, DRG, NAIP
Civil	10	0					Cadastral, DRG, MT Quads
Cliff	8	3	3				DRG
Crossing	22	6	6				Transportation, DRG, NAIP
Dam	404	359	357		2	3	NHD, DRG, NAIP
Falls	7	2	2				NHD, DRG
Flat	51	7	4	1	1	1	DRG
Gap	23	4	4				DRG
Glacier	4	0					NHD, DRG, NAIP
Gut	3						NHD, DRG, NAIP
Harbor	2	0	0				
Hospital	3	10	7			3	Transportation, DRG, NAIP
Island	16	0					NHD, DRG, NAIP
Lake	210	33	12	1	15	5	NHD, DRG, NAIP
Levee	1	0					NHD, DRG, NAIP
Locale	454	102	77	10	4	15	DRG, NAIP, MT Cities and Places
Oilfield	2	0					DRG
Park	116	21	13	1	1	6	Stewardship, NHD, DRG, NAIP
Pillar	7	1	1				DRG, NAIP
Plain	1	0					DRG, NAIP
Post Office	34	6	6				Transportation, DRG, NAIP
Populated Place	199	54	24	32		6	Transportation, MT Cities and Places, DRG, NAIP
Range	14	3	2		1		DRG, NAIP
Rapids	4	1	1				NHD, DRG, NAIP
Reserve	2	0					Stewardship, DRG
Reservoir	158	62	55	4	2	5	NHD, DRG, NAIP
Ridge	46	3	2		1		DRG
School	101	17	12	1	6		Transportation, DRG, NAIP
Slope	1	0					DRG
Stream	1050	709	706	1	13		NHD
Summit	372	105	85	16	8	4	DRG
Swamp	5	1		1			NHD, DRG, NAIP
Tower	18	11	10	1			DRG, NAIP
Trail	86	49	49			37	Transportation, DRG
Tunnel	2	0					DRG
Valley	491	86	81		8	3	DRG, NAIP
TOTAL	**4289**	**1747**	**1592**	**76**	**74**	**94**	
% of TOTAL In Error		**40.7%**	**37.1%**	**1.8%**	**1.7%**	**2.2%**	

Appendix B

Feedback from NCLFA workshops regarding a GNIS for Montana.

Dataset Enhancements

- Use an alias of 'GNIS_ID' when referring to the feature_ID field
- For features created at state level (not at or for the federal dataset)
    - Will need to be able to identify them/query them/exclude them
    - Will need to be able to create a unique ID for them
- Create unique ID scheme like the rest of the MT framework datasets by adding additional ID fields:
    - Provider ID (long integer, 10 characters max)
    - Dataset ID (text, 3 characters)
    - Local ID (long integer, 10 characters max) – use existing feature_ID as the Local ID
    - Pkey – concatenation of above - <Provider ID>.<Dataset ID>.<Local ID>
- Possibility of an elevation table with sources?
    - E.g. the elevation for a peak may vary depending on the source – National Elevation Dataset versus USGS topo map versus DEM
- Elevation listed in feed with decimal places (conversion functionality in applications)
- Coordinates given in multiple coordinate systems (conversion functionality in applications):
    - Decimal Degrees, MT State Plane, National Grid
- Include native language variant names (beyond what exists already in federal GNIS)
- Include voice clips (e.g. for pronunciation of native language names)
- Include images
- Include road names
- Add a 'place name' field to the Government Units table / create a MT-specific government units table so can search on a more localized level (e.g. City of Missoula)
- Need the ability to identify if the GNIS feature is represented in a MT Framework data layer, and if so, which one.

Relationship to Other Framework Data Models

- Is the GNIS feature represented in a MT Framework data layer? If so, which one?
- Use state GNIS to add structure names to the Critical Infrastructure Database
- Use state GNIS to add place names to the Addressing data model / database
- Attach a MT Framework Feature ID to all GNIS features versus adding the GNIS ID to all framework data models (the latter is the recommendation)
- MT framework datasets that already contain the GNIS_ID
    - NHD
- MT framework datasets that should/could contain the GNIS_ID
    - Critical Infrastructure
    - Address
    - Cadastral

- Stewardship
- Transportation (if road names are to be included in state GNIS dataset)
- Governmental Units
- Hydrologic Units

Functionality

- Do we have a need to mask features (e.g. those that are numerous and not typically used such as wells or mines) – would want this to be optional
- Do we have a need to implement the 'no display' field to exclude some features from standard public downloads? (e.g. federal exclusions and/or homeland security)
- What is the database's ability to handle disjoint features?
- Provide the ability to support context-driven name queries – where you are using the name type field to retrieve a specific name set
- Ability to get a list of which counties a feature intersects (primary and secondary points)
- Ability to get a list of which quads a feature intersects (primary and secondary points)
- Idea to create a web-based interface where the public can submit local/variant names for features
  - How does this functionality differ from what is in existence for the federal GNIS?
- Ability to select out features (and spatial data) that are not in an existing MT framework dataset.

Data Collection

- Include native variant names
- Include voice clips
- Include images
- Include road names
- Visible versus invisible features (physical features versus non-physical features such as most boundaries)
  - What is relevant to include in the dataset?
  - What is excessive?
  - Are we going to try and name everything?
  - Maintenance/policy issue versus application search issue *one does not preclude the other

Data Correction in Federal Dataset

- Need to correct locations in Federal GNIS dataset
  - How determine which features need correction?
  - How submit corrections?
- Need to correct classifications in Federal GNIS dataset
  - E.g. National Bison Range has a class of 'Range' but it should be 'Park'?
- Need to add FWP public lands
  - Fishing access points, state parks, wildlife management areas, etc

Appendix C

Proposed GNIS data model for Montana.

Table: **GNIS**

Description: This is the primary table of the data model containing the Pkey as the primary key; it is comparable to the FEATURES table within the Federal GNIS data model.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	A persistent unique ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Class	Txt(50)	Y	Descriptive category (values from GNIS_CLASSES table)
Partner	Txt(50)	Y	The partner providing the feature data to the Federal GNIS dataset. (values from DOMAINS table)
Partner_code	Txt(50)	Y	A feature code defined and assigned by the data partner for the use of the partner
Description	Txt(3000)	Y	Additional information about a feature
History	Txt(3000)	Y	Description of name/origin/history of a feature
Map_addendum	Txt(1000)	Y	Descriptive information appended to feature name when printed on a USGS topo map
Feature_size	Txt(1000)	Y	Size of feature as defined by provider
Sectwprng	Txt(100)	Y	PLSS location of primary point. Recommendation for MT GNIS: implement a standard for data entry.
Date_submitted	DateTime	Y	Date submitted to DB
Submitted_by	Txt(50)	Y	User submitted by
Date_committed	DateTime	N	Date validated/committed to DB
Committed_by	Txt(50)	Y	User committed by
Date_edited	DateTime	Y	Date last edited
Edited_by	Txt(50)	Y	User edited by
Date_edits_committed	DateTime	N	Date last edits validated/committed
Edits_committed_by	Txt(50)	N	User edits committed by
MT_framework	*Txt(50)*	*N*	*MT framework dataset this feature exists in (values from DOMAIN table)*

Table: **GNIS_NAMES**

Description: The names table contains all official and variant names for all features in the database. The feature name may be: 1. The official name of a feature approved by the President or Congress, or by the U.S. Board on Geographic Names by decision or policy. 2. The name of a country, state, county, or equivalent entity as listed in the Federal Information Standards (FIPS) publications. 3. The name of a government of jurisdictional entity other than country, state, or county such as a national park or congressional district. 4. A variant. A variant is a name entered into the database as an unofficial name. There are four types of variants: 1. An historic name that is no longer official. 2. A name that is less used than the official name but is recognized locally. 3. A name that is not the official name but is incorrectly recorded on a map or in a document. 4. A misspelling of an official name. This table is equivalent to the FEATURE_NAMES table within the Federal GNIS data model.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
GNIS_name	Txt(100)	N	The name of the feature. The name may be the official name or a variant.
GNIS_name_type	Txt(50)	N	Type category for the feature name (values from DOMAIN table) e.g. 'Variant'
GNIS_name_official	Txt(1)	N	Yes ('Y') / No (null) – only one official name per feature is allowed
Originator	Txt(2)	N	Originator of the map, atlas, or other source of the feature name
Reference_type	Txt(10)	N	Type of map, atlas, etc that was the source of the variant name (values from DOMAIN table)
Reference_code	Int(8,0)	N	Code for reference source
Reference_detail	Txt(100)	N	Detail regarding reference source
Date_name_submitted	DateTime	N	Date submitted to DB
Name_submitted_by	Txt(50)	N	User submitted by
Date_name_committed	DateTime	N	Date validated/committed to DB
Name_committed_by	Txt(50)	N	User committed by

Table: **GNIS_POINTS**

Description: The points table contains the spatial location for all primary and secondary points for all features in the database. Point features are represented as a single (primary point) location. Line features are represented as a series of point locations with the primary point being the official location, which falls at the location on the feature as defined by the feature class (see GNIS_CLASSES table), and secondary points falling along the feature at a spacing of one secondary point within each quad map in which the feature is found. Polygon features are represented by a primary point at the geographic center of the original polygon extent, with secondary points at a spacing of one secondary point within each quad map in which the feature is found.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Sequence	Int(3,0)	N	Sequence # of a point defining a feature. Sequence #1 is the primary point and official location of the feature.
Latitude	Dbl(10,7)	N	Latitude in Decimal Degrees, WGS 84
Longitude	Dbl(11,7)	N	Longitude in Decimal Degrees, WGS 84
Elevation	Int(5,0)	Y	Elevation in meters
Verified	Txt(1)	Y	Coordinates are within tolerances allowed for the DB: Yes ('Y') / No (null)
Cell_ID	Int(10,0)	Y	Standard USGS cell containing the point. The standard cell is 7.5 x 7.5 degrees, except in Alaska where it is 15 x 15 degrees.

Table: **GOVERNMENT_UNITS**

Description: A table containing a list of each feature within the GNIS that is a government unit within or associated with the United States including: Countries, States, and Counties.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Unit_type	Txt(50)	N	Type of government unit (County, State, Country)
County_numeric	Int(3,0)	Y	County FIPS code
County_name	Txt(100)	Y	County name
State_numeric	Int(2,0)	Y	State FIPS code
State_alpha	Txt(2)	Y	State FIPS alpha code
State_name	Txt(100_	Y	State name
Country_alpha	Txt(2)	N	Country FIPS alpha code
Country_name	Txt(100)	N	Country name

Table: **MT_GOVERNMENT_UNITS**

Description: A Montana-specific table containing a list of each feature within the MT GNIS that is a government unit including: Counties, Cities, etc.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Unit_type	Txt(50)	N	Type of government unit (down to City, etc) (values from DOMAINS table)
Government_unit	Txt(100)	N	Government unit name

Table: **GNIS_RELATIONSHIPS**

Description: A relationship between two features. The feature with GNIS ID 1 is in or bears a subordinate relationship to the feature with GNIS ID2. The relationship can be locational, jurisdictional, administrative, or other as defined.

Column Name	Data Type	Null Allowed	Description
Provider_ID1	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID1	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID1	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey1	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Provider_ID2	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID2	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID2	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey2	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Relationship	Txt(50)	N	Type of relationship between 2 features (values from DOMAINS table)
Sequence	Int(3,0)	N	Sequence # of multiple features related to another feature

Table: **MT_IMAGES**

Description: A repository containing pictures of features within the MT GNIS dataset.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Image	Image	N	Image of related feature
Image_type	Txt(4)	N	Image file type
Description	Txt(2000)	Y	Description of image
Date_entered	DateTime	N	Date image entered to DB
Source	Txt(50)	N	Source of image

Table: **GNIS_DECISIONS**

Description: A listing of Federal decisions regarding the feature name or its application. Decisions may be made by: 1. Congress by act or law. 2. The President by Executive Order. 3. The U.S. Board on Geographic Names by decision. 4. The U. S. Board on Geographic Names by policy.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
GNIS_name	Txt(100)	N	Feature name to which decision applies
Decision_date	DateTime	N	Decision date
Authority	Txt(20)	N	Authority making decision
Decision_type	Txt(20)	N	Decision type (values from DOMAINS table)
Old_latitude	Dbl(10, 7)	Y	Previous/replaced latitude of primary point for feature
Old_longitude	Dbl(11, 7)	Y	Previous/replaced longitude of primary point for feature
List	DateTime	Y	Quarterly edition of the Decision List containing this decision

Table: **GNIS_SUPERSEDED**

Description: In the case where a feature is deleted from the database, the deleted GNIS ID is entered into the GNIS_SUPERSEDED table as the Superseded ID. This GNIS ID for the new feature that replaced the deleted feature is associated to the superseded ID. Thus, features may be deleted from the database but any remaining reference to the deleted feature will be re-directed to the newer feature.

Column Name	Data Type	Null Allowed	Description
Superseded_Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Superseded_Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
Superseded_GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Superseded_Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Date_created	DateTime	Y	Date superseding record created

Table: **GNIS_CLASSES**

Description: A designation for a group of features in a broadly defined descriptive category. All features are assigned to one and only one class. Class terms were initially chosen to facilitate computer search and retrieval; they do not individually classify all kinds of cultural and natural features.

Column Name	Data Type	Null Allowed	Description
Class	Txt(50)	N	Look-up table for GNIS.Class field; features can have one and only one class
Description	Txt(500)	N	Description of the class
Location	Txt(50)	N	Definition of location for the primary point coordinates for features within this class (e.g. 'Center', 'Mouth', etc)
No_display	Txt(1)	Y	Features assigned to this class are not to be displayed in any public web site

Table: **GNIS_GENERIC**

Description: A feature generic is a word in the feature name identifying the feature as a member of a general category of features. Examples include lake (Flathead Lake), river (Missouri River), park (Glacier National Park), and airport (Missoula International Airport). A feature generic should not be confused with the feature class. The generic is an integral part of the official name.

Column Name	Data Type	Null Allowed	Description
Generic	Txt(50)	N	Feature generic
Class	Txt(50)	N	Class to which this generic belongs (values from GNIS_CLASSES table)
Source	Txt (1000)	Y	Source of the generic
Abbreviation	Txt(20)	Y	Standard abbreviation for the generic

Table: **DOMAINS**

Description: Look-up table for domain values used in the database to define a valid set of values for a given field and in applications to provide valid values for a pick list for an attribute.

Column Name	Data Type	Null Allowed	Description
Domain	Txt(50)	N	Feature attribute to which the domain values apply
Value	Txt(50)	N	Valid value for this domain
Description	Txt(2000)	N	Description of the domain value

Table: **MT_CHANGE_NOTES**

Description: A Montana-specific table intended to track notes, questions, concerns regarding changes proposed or made to features within the MT GNIS.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Change_notes	Txt(1000)	N	Notes regarding changes to be made

Table: **MT_DUPLICATES_DELETED**

Description: A provision for tracking deleted features within the MT GNIS dataset that are not deleted from the Federal GNIS dataset.

Column Name	Data Type	Null Allowed	Description
Dup_Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dup_Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
Dup_GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Dup_Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID of duplicate feature to be deleted
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID

Table: **MT_CHANGE_DESCRIPTION**

Description: A look-up table providing a list of change types for the MT GNIS.

Column Name	Data Type	Null Allowed	Description
Change_type_ID	Txt(4)	N	Unique ID for change types
Change_description	Txt(50)	N	Description of change type (e.g. class change, location corrected, duplication removed, etc)

Table: **MT_CHANGE_LIST**

Description: Primary table for tracking changes to the MT GNIS to be proposed to the BGN and.or implemented in the MT GNIS dataset.

Column Name	Data Type	Null Allowed	Description
Provider_ID	Int(10,0)	N	From MT Framework Entity Thesaurus: e.g. USGS = 1434
Dataset_ID	Txt(3)	N	GNIS Dataset ID = 'GNM'
GNIS_ID	Int(10,0)	N	ID assigned by provider (feature_ID from Federal GNIS database)
Pkey	Txt(25)	N	Unique ID: Provider_ID.Dataset_ID.GNIS_ID
Change_ID	Int(10,0)	N	Unique ID assigned to each change recorded
Change_type	Txt(4)	N	Change type (value from MT_CHANGE_DESCRIPTION)
Change_date	DateTime	N	Date of change
Changed_by	Txt(50)	N	User changed by

Table: **MT_CHANGED_CLASS**

Description: A table to track class changes to be proposed and/or implemented.

Column Name	Data Type	Null Allowed	Description
Change_ID	Int(10,0)	N	Unique ID assigned to each change recorded
Old_class	Txt(50)	N	Old class
Class	Txt(50)	N	New class

Table: **MT_CHANGED_ELEVATIONS**

Description: A table to track elevation changes to be proposed and/or implemented.

Column Name	Data Type	Null Allowed	Description
Change_ID	Int(10,0)	N	Unique ID assigned to each change recorded
Old_elev	Int(5,0)	N	Old elevation in meters
Elev	Int(5,0)	N	New elevation in meters

Table: **MT_CHANGED_LOCATIONS**

Description: A table to track locational changes to be proposed and/or implemented.

Column Name	Data Type	Null Allowed	Description
Change_ID	Int(10,0)	N	Unique ID assigned to each change recorded
Sequence	Int(3,0)	N	Sequence of changed point
Old_latitude	Int(10,7)	N	Old latitude (Decimal Degrees, WGS 84)
Old_longitude	Int(11,7)	N	Old longitude (Decimal Degrees, WGS 84)
Latitude	Int(10,7)	N	New latitude (Decimal Degrees, WGS 84)
Longitude	Int(11,7)	N	New longitude (Decimal Degrees, WGS 84)

Table: **MT_CHANGED_NAMES**

Description: A table to track name changes to be proposed and/or implemented.

Column Name	Data Type	Null Allowed	Description
Change_ID	Int(10,0)	N	Unique ID assigned to each change recorded
Old_name	Txt(100)	N	Old name
Name	Txt(100)	N	New name
Name_type	Txt(50)	Y	Type category for the feature name (values from DOMAIN table) e.g. 'Variant'

Relationships within the proposed Montana GNIS data model.

Relationship	Source Table	Primary Key	Destination Table	Foreign Key
1:M	GNIS	GNIS_ID	GNIS_NAMES	GNIS_ID
1:M	GNIS	GNIS_ID	GNIS_POINTS	GNIS_ID
1:M	GNIS	GNIS_ID	GNIS_RELATIONSHIPS	GNIS_ID1
1:M	GNIS	GNIS_ID	GNIS_RELATIONSHIPS	GNIS_ID2
1:1	GNIS	GNIS_ID	GOVERNMENT_UNITS	GNIS_ID
1:1	GNIS	GNIS_ID	MT_GOVERNMENT_UNITS	GNIS_ID
1:M	GNIS	GNIS_ID	MT_IMAGES	GNIS_ID
1:M	GNIS	GNIS_ID	GNIS_DECISIONS	GNIS_ID
1:M	GNIS	GNIS_ID	GNIS_SUPERSEDED	GNIS_ID
1:M	GNIS	GNIS_ID	MT_CHANGE_NOTES	GNIS_ID
1:M	GNIS	GNIS_ID	MT_DUPLICATES_DELETED	GNIS_ID
1:M	GNIS	GNIS_ID	MT_CHANGE_LIST	GNIS_ID
1:M	GNIS_CLASSES	CLASS	GNIS	CLASS
1:M	GNIS_CLASSES	CLASS	GNIS_GENERIC	CLASS
1:M	MT_CHANGE_LIST	CHANGE_ID	MT_CHANGED_CLASS	CHANGE_ID
1:M	MT_CHANGE_LIST	CHANGE_ID	MT_CHANGED_ELEVATIONS	CHANGE_ID
1:M	MT_CHANGE_LIST	CHANGE_ID	MT_CHANGED_LOCATIONS	CHANGE_ID
1:M	MT_CHANGE_LIST	CHANGE_ID	MT_CHANGED_NAMES	CHANGE_ID