

## **National Spatial Data Infrastructure**

# **Preparing for International Metadata**

North American Profile of ISO 19115: Geographic Information - Metadata

**FINAL DRAFT**

**Federal Geographic Data Committee**

**February 8, 2010**

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Federal Geographic Data Committee

Department of Agriculture • Department of Commerce • Department of Defense • Department of Energy  
Department of Health & Human Services • Department of Housing and Urban Development • Department of the Interior  
Department of Justice • Department of State • Department of Transportation • Environmental Protection Agency  
Federal Emergency Management Agency • Library of Congress • National Aeronautics and Space Administration  
National Archives and Records Administration • National Science Foundation • Tennessee Valley Authority

## Federal Geographic Data Committee

Established by Office of Management and Budget Circular A-16, the Federal Geographic Data Committee (FGDC) promotes the coordinated development, use, sharing, and dissemination of geographic data.

The FGDC is composed of representatives from the Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, Housing and Urban Development, the Interior, Justice, State, and Transportation; the Environmental Protection Agency; the Federal Emergency Management Agency; the Library of Congress; the National Aeronautics and Space Administration; the National Archives and Records Administration; National Science Foundation, and the Tennessee Valley Authority. Additional Federal agencies participate on FGDC subcommittees and working groups. The Department of the Interior chairs the committee.

FGDC subcommittees work on issues related to data categories coordinated under the circular. Subcommittees establish and implement standards for data content, quality, and transfer; encourage the exchange of information and the transfer of data; and organize the collection of geographic data to reduce duplication of effort. Working groups are established for issues that transcend data categories.

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## Executive Summary

The U.S. Government is in the process of adopting a new geospatial metadata standard that conforms to the specifications of the International Standards Organization (ISO). The *North American Profile (NAP) of ISO 19115: Geographic Information - Metadata* was formally adopted by the American National Standards Institute (ANSI) in June of 2009. However, work continues on the NAP to more fully integrate the geospatial database documentation specified by a related standard, *ISO 19110: Geographic Information: Feature Catalogue*. Once complete, the Federal Geographic Data Committee (FGDC) will process the NAP as a Federal standard and promote implementation to the geospatial community.

In the same way that the existing FGDC *Content Standard for Digital Geospatial Metadata (CSDGM)* codified geospatial data documentation for the U.S. geospatial data community in 1994, the NAP extends standardization across national borders. In addition, the NAP provides the following features:

- fewer mandatory elements and more optional elements
- extended elements and new elements to capture more specific information
- a hierarchical structure that creates ‘packages’ of metadata that can be reused and combined to form new metadata records
- support for the documentation of new geospatial data topologies and technologies including geodatabases, web mapping applications, data models, data portals, ontologies, etc.
- suggested best practices for populating metadata elements in a manner that enhances the quality and usefulness of the metadata.

All levels of government, non-governmental organizations (NGOs), and the private sector are strongly encouraged to prepare for the transition to this new, international, metadata standard, by:

- editing existing metadata records to add new content and convert some ‘free text’ elements to a NAP designated code list using either a manual or automated process,
- testing available transform tools for converting the above edited records,
- informing management and technical staff of pending changes and planning a strategy for transition to the NAP once it is established as the Federal standard.

Resources will be available to assist the community in making this transition. This document serves as an overview to the NAP and provides specific guidance on preparing for the transition. An implementation guide, similar to the *CSDGM Workbook*, will include a graphical representation of the NAP and detailed explanations of the NAP structure, individual elements and best practices. GIS vendors and Federal Agencies are actively developing new applications to transform, create, validate, publish and distribute NAP metadata. With these resources in hand, geospatial data and service providers can be fully prepared to update and enhance their geospatial metadata to better support data management, discovery, distribution, application and archive both within, and external to, their organization.

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## North American Profile of ISO 19115 Guidance Document Series



### North American Profile of ISO 19115: Guidance Document Series

This document is the first published, though second in order, of a series of documents that describe the purpose and value of geospatial metadata and support the application of the *North American Profile of ISO 19115:2003 Geographic Information – Metadata* (NAP). The series is composed of the following documents and the intended audience for each is specified:

#### *Geospatial Metadata Primer (pending)*

An introduction to the purpose, value and application of geospatial metadata. Intended for those new to geospatial metadata

#### *Preparing For International Metadata*

An introduction to the North American Profile of ISO 19115:2003 Geographic Information - Metadata, description of significant changes from the FGDC Content Standards for Digital Geospatial Metadata (CSDGM), and strategies for making the transition from the CSDGM to the NAP. Intended for geospatial data developers currently implementing the CSDGM V2 and preparing for the transition to the NAP.

#### *NAP Implementation Guidance (pending)*

A detailed description of the North American Profile of ISO 19115 (NAP) including the structure and content of the standard and best practices for documenting geospatial data using the NAP. Intended for geospatial data developers actively using the NAP to create geospatial metadata.

#### *NAP Desktop Reference (pending)*

A reference document that expresses the standard in Unified Modeling Language (UML) and Extensible Mark-up Language (XML) and details options for extending domains and developing profiles and extensions. Intended for those that prefer to work directly with the published standard and are active in either customizing the standard or building software applications in support of the NAP.

## Development of the North American Profile of ISO 19115

1994	CSDGM, Vers. 1.0
1998	CSDGM, Vers. 2.0
2003	ISO 19115, Vers. 1.0
2007	ISO 19139, Vers. 1.0
2009	NAP of 19115, Vers. 1.0



### Development of the North American Profile of ISO 19115

The Federal Geographic Data Committee (FGDC) approved the first version of the Content Standard for Digital Geospatial Metadata (CSDGM) in June 1994. Executive Order 12906, "Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure," required Federal agencies to use the standard to document data that they produced beginning in 1995. In 1998, the CSDGM was revised and Version 2.0 was published.

Since it was introduced, the CSDGM has been adopted by many organizations external to the U.S. Federal Government including state and local governments, private sector companies and other nations including Canada. The CSDGM is a valuable resource for documenting geospatial data in a standardized manner that facilitates discovery, access, use, and archive. In addition, the standard has been used to document web-mapping applications, data-acquisition projects, data models, and other 'non-traditional' geospatial resources. As these new forms of geospatial resources evolve, new requirements for documentation emerge.

In 1999 the International Standards Organization (ISO) Technical Committee (TC) 211 Geographic Information / Geomatics was tasked with harmonizing the CSDGM with other geospatial metadata standards and a range of de facto standards that had emerged to address new requirements for geospatial documentation. The result was the publication of *ISO 19115: Geographic Information – Metadata*. Since then, individual organizations and nations have developed implementation 'profiles' of the standard. The American National Standards Institute (ANSI), the U.S. member body of the ISO, adopted ISO 19115 in December of 2003.

ISO 19115 is an *abstract* standard. It specifies the definition of elements and the relationship among elements but does not provide guidance as to how the content is organized into a formal record and presented to the reader. Without this critical component, the standard could not be promoted for

implementation. A separate ISO TC 211 effort, *ISO 19139 - Geographic information -- Metadata -- XML schema implementation*, was undertaken to provide an Extensible Mark-up Language (XML) implementation schema to specify the ISO 19115 metadata record format and to support the description, validation, and exchange of geospatial metadata.

Even with the XML schema under development, concerns remained as to the adequacy of ISO 19115 to meet the needs of the CSDGM community. One key concern was the lack of elements for the documentation of the geospatial database. Known as 'Entities and Attributes' within the CSDGM, TC 211 had designated the development of the database documentation elements to yet another separate standard, *ISO 19110 - Methodology for Feature Cataloging*.

It was not until the finalization of the ISO 19110 in 2005 and ISO 19139 in 2007, that the resources were in place to develop a profile of ISO 19115 that provided both the structure and content needed to support migration of CSDGM metadata to the international suite of geospatial metadata standards.

#### Why Change Standards?

ISO 19115 development was initiated to:

- provide an internationally standardized means of documenting geospatial data resources
- incorporate international references including language and character set
- address new geospatial data structures and models
- include geospatial data applications and services.

As members of the international geospatial community, it is incumbent upon us to employ standards that enhance and support the discovery, access, and application of geospatial data. In 1994, when the CSDGM was published, there was little interest in data sharing beyond the U.S. borders. Since then, the world has come to recognize that pressing environmental, political, health, and financial issues require international and, often, global perspectives. By developing a national profile of ISO 19115, the U.S. joins other nations in a global spatial data infrastructure (GSDI) that shares a common standard for geospatial data documentation and extends our capabilities to document a broader range of geospatial resources.

#### Coordination with the Canadian Government

In 2005, the U.S. and Canada began independent efforts to develop national profiles of ISO 19115. Since metadata creators and managers in both nations used the CSDGM, it was decided to align profile development efforts. Outreach was made to the Mexican geospatial community to join the cooperative development of a North American Profile (NAP) and, while receptive to the concept, the Mexican Government pursued other profile development efforts.

The U.S. and Canada continued with development of the NAP. Profile development requires adoption of 22 core elements, open selection of other elements, options to extend fixed domains and to increase, but not relax, conditionality. Once drafted the NAP was subject to a series of public reviews and revisions. An initial NAP document was approved by ANSI in July of 2009 but work continues on the integration of *ISO 19110 - Methodology for Feature Cataloging*.

#### Standards Bodies and Processing

OMB Circular A-119 directs Federal agencies to participate in voluntary consensus standards bodies including:

- American National Standards Institute (ANSI)
- International Standards Organization (ISO)

- InterNational Committee for Information Technology Standards; Technical Committee L1, Geographic Information Systems (INCITS\_L1)
- Open Geospatial Consortium (OGC).

Additional information about standards bodies and standards implementations are maintained at: <http://www.fgdc.gov/standards/organization/external-standards-organizations> (accessed February 8, 2010)

#### Federal and National Standards

When the CSDGM was created it was processed by the FGDC as a Federal standard. As such, only Federal agencies were obligated to create geospatial metadata using the CSDGM. However, as discussed above, many nonfederal organizations realized the benefit of standardizing their geospatial data documentation and chose to formally, and informally, adopt the CSDGM.

The NAP, however, was processed by ANSI. ANSI develops 'voluntary national consensus standards' that are promoted for use by the private sector as well as government and non-profit organizations. U.S. OMB Circular A119 [[http://standards.gov/standards\\_gov/a119.cfm](http://standards.gov/standards_gov/a119.cfm) (accessed February 8, 2010)] states that Federal agencies are required to use voluntary standards for regulatory and procurement purposes when appropriate. In addition, many state and local governments also formally, and informally, adopt ANSI standards. The FGDC intends to process the NAP as a Federal standard and to encourage and support nonfederal National Spatial Data Infrastructure (NSDI) stakeholders in implementation.

#### Objectives of the Standard

The NAP was developed to achieve the following objectives.

- Support geographic data producers in their efforts to:
  - maintain an inventory of geographic data and services,
  - organize and manage geographic data and services, and
  - publish information internationally about available geographic data and services.
- Support geographic data consumers in their efforts to:
  - discover and access needed geographic data and services internationally,
  - assess the fitness for use of available geographic data and services, and
  - apply geographic data and services accessed from other organizations.
- Implement an internationally standardized set of geospatial metadata information and a common set of terminology and definitions for concepts related to metadata, including:
  - the names of data attributes (individual metadata elements) and classes (groups of data attributes) to be used,
  - the relations among these attributes and classes,
  - the definitions of these attributes and classes, and
  - information about the values that are to be provided for the data attributes.
- Implement an internationally standardized geospatial metadata record format.
- Promote an internationally standardized method for extending the standard to better address the specialized geographic data documentation needs of a specific community.



## What's New with NAP?

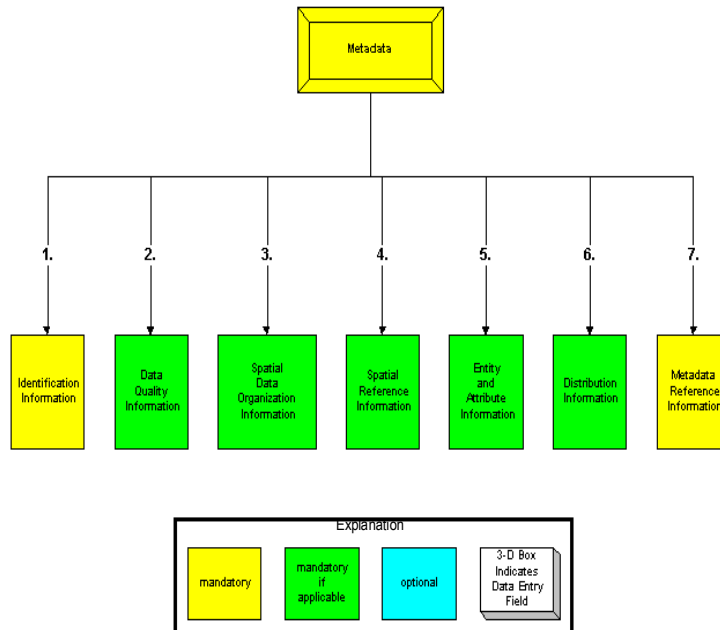
Design Model  
Organization  
Best Practices  
Multiplicity  
Multi-level Metadata  
New Content



What's New with the North American Profile of ISO 19115?

### Design Model

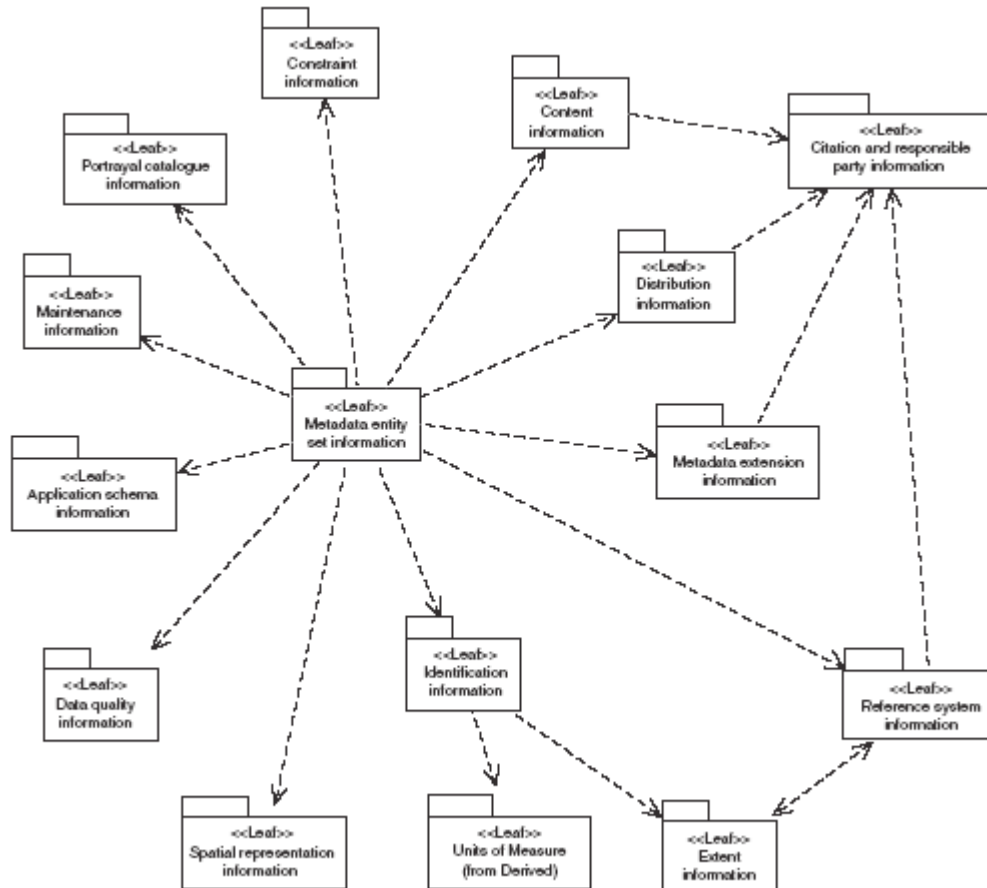
The key differences between the CSDGM and the ISO 19115 design models are the manner in which they are arranged. The CSDGM design model is a plain document, also known as a 'flat file', presented as a structured list where all sections are equal as illustrated below.



### CSDGM Graphical Representation

(Source: *Content Standard for Digital Geospatial Metadata Workbook*)

ISO 19115 was developed using Unified Modeling Language (UML). The UML data model provides a far more robust, object-oriented structure that helps to visualize more complex relations among the sections, the information contained with the sections, as well as information from related standards.



The UML design model is similar to a bubble diagram that might be used to sketch out the design of project tasks, a landscape plan, or a computer system. For example:

Conceptual designs for a:

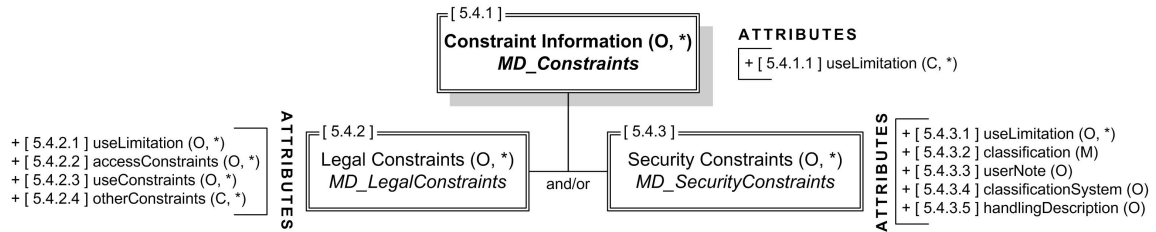
- project task diagram
- landscape plan
- computer system requirements.

might lack:

- specific due dates,
- plant size and numbers.
- specifics as to hard-drive capacity or memory

In the same way, the ISO 19115 UML does not provide the specific guidance needed to format a metadata record in a standardized presentation. The XML schema, ISO 19139, was developed to provide a consistent manner for presenting and transferring the metadata among different organizations and applications.

So...what does this mean to the Metadata Creator? Does one have to learn UML to use the NAP? The simple answer is no. The NAP was developed and documented in a manner intended to interpret the ISO 19115 UML into a more practical and applicable format. UML diagrams were replaced with simplified diagrams, a data dictionary is provided, and best practices are integrated to provide insight and guidance. Current efforts are underway to further translate the NAP diagrams into the traditional format of the CSDGM graphical representation. An example NAP diagram and associated data dictionary complete with best practices are presented below and explained in detail the following section.



### NAP Diagram for Constraint Information

(Source: North American Profile of ISO 19115:2003 – Geographic Information – Metadata)

Clause No	Name/ RoleName	Multiplicity	Type	Description	Best Practices
	Constraint Information	O,Repeatable	MD_Constraints	The limitations, restrictions, or statements on the resource fitness for use.	
1.1.1.1	useLimitation	C,Repeatable	free text (CharacterString)	Statement on the fitness for use or limitations on the use of the resource or metadata.	The attribute <i>useLimitation</i> is mandatory unless <i>Legal Constraints</i> (5.4.2) or <i>Security Constraints</i> (5.4.3) is provided.
	Legal Constraints	O,Repeatable	MD_LegalConstraints	The legal restrictions or prerequisites to using the resource or accessing the metadata.	Legal constraints should be repeated for multiple legal access constraints such as those associated with privacy, sensitivity, and statutory.
1.1.1.2	useLimitation	O,Repeatable	free text (CharacterString)	Statement on the fitness of use or limitations on the use of the resource or metadata.	
1.1.1.3	accessConstraints	O,Repeatable	CodeList napMD_RestrictionCode	Limitations on access to the resource or metadata to protect privacy, intellectual property, or any special limitations.	Select <i>accessConstraints</i> from napMD_RestrictionCode.
1.1.1.4	useConstraints	O,Repeatable	CodeList napMD_RestrictionCode	Restrictions or warnings to protect privacy,	Select <i>useConstraints</i> from napMD_RestrictionCode.

Clause No	Name/ RoleName	Multiplicity	Type	Description	Best Practices
				intellectual property, or other special restrictions on the resource or the metadata.	
1.1.1.5	otherConstraints	C,Repeatable	free text (CharacterString)	Other restrictions or legal prerequisites for accessing the resource or metadata.	<i>otherConstraints</i> shall be provided if <i>accessConstraints</i> (5.4.2.2) or <i>useConstraints</i> (5.4.2.3) is set to "otherRestrictions." For an example: "Data only to be used for the purposes for which they were collected."
	Security Constraints	O,Repeatable	MD_SecurityConstraints	Restrictions applied to the resource or metadata to protect security concerns.	
1.1.1.6	useLimitation	O,Repeatable	free text (CharacterString)	Statement on the fitness of use or limitations on the use of the resource or metadata.	
1.1.1.7	classification	M	CodeList napMD_ClassificationCode	Name of the handling restrictions on the resource or the metadata.	Select <i>classification</i> from napMD_classificationCode.
1.1.1.8	userNote	O	free text (CharacterString)	An explanation of the classification level applied to the resource or metadata.	
1.1.1.9	classificationSystem	O	free text (CharacterString)	Name of the security classification system.	
1.1.1.10	handlingDescription	O	free text (CharacterString)	Additional information regarding security restrictions on handling the resource or metadata.	<i>handlingDescription</i> can serve as a place to state that the data had been reviewed and had been approved for release.

**NAP Data Dictionary for Constraint Information**

(Source: *North American Profile of ISO 19115:2003 – Geographic Information – Metadata*)

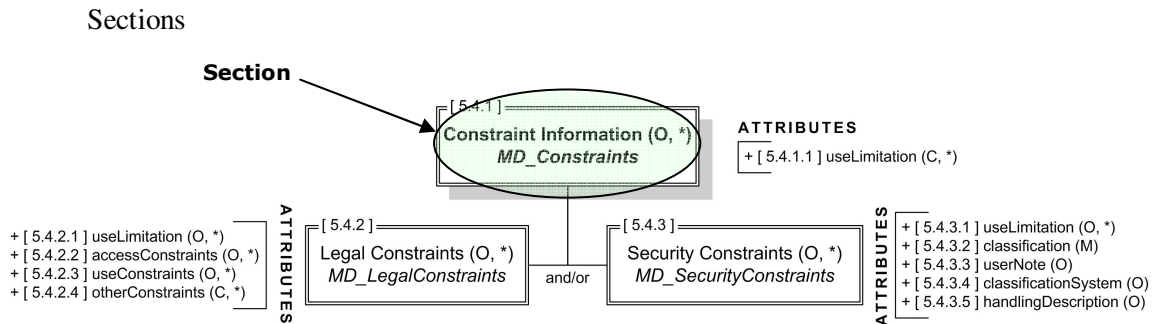
Organization of the NAP

The NAP is organized into:

- Sections**
- Classes/Subclasses**
- Attributes**
- Domains**
- Code Lists**

In *general* terms, NAP organizational components can be related to CSDGM components in the following manner:

NAP	CSDGM
Section	Section
Class/Subclass	Compound Element
Attribute	Element
Domain	Domain
Code List	Fixed Domain Values



**Example NAP Section**

(Source: *North American Profile of ISO 19115:2003 – Geographic Information – Metadata*)

Sections are the uppermost component of the metadata organization. Sixteen sections of the NAP are described below. Note that since the NAP applies to both geospatial data and services the term ‘resource’ is used as a collective reference to both.

**Metadata Record Information**

Information about the metadata record

**Identification Information**

Information needed to uniquely identify the resource (data or service)

**Constraint Information**

Information about use limitations, legal constraints and security constraints

**Data Quality Information**

Information about completeness, thematic accuracy, logical consistency, positional accuracy, temporal accuracy, sources used, and processing steps

Maintenance Information

Information about how the resource is updated

Spatial Representation Information

Information about the grid or vector models used to represent features

Reference System Information

Information about the coordinate system used to georeference the resource

Content Information

Description of the content of the database (feature catalog), discrete grid cells (coverage), and continuous grid cells (image)

Portrayal Catalogue Information

Information of the symbols used to depict features on a map

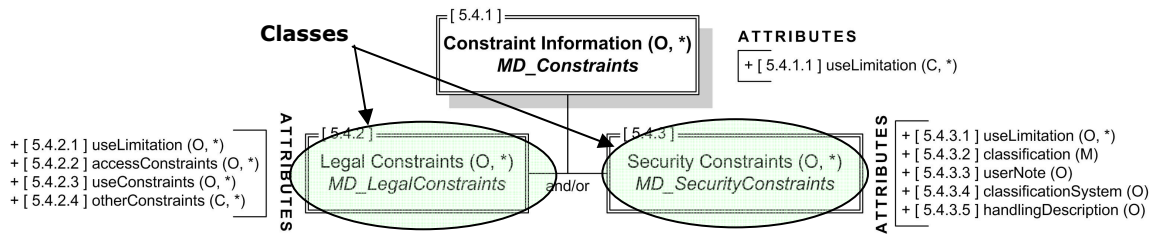
Distribution Information

Information about how one can access the resource

Application Schema

Information about published and unpublished data and process models that were applied to the resource

Classes

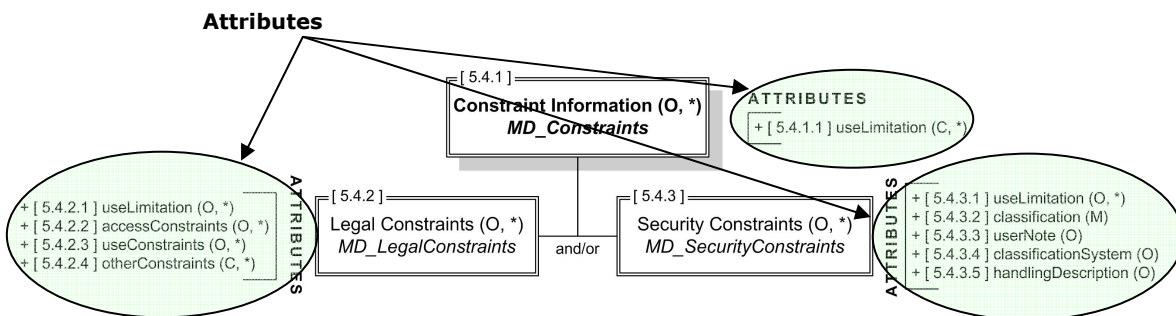


**Example NAP Classes**

(Source: *North American Profile of ISO 19115:2003 – Geographic Information – Metadata*)

Classes are the secondary component of the metadata organization. Classes are used to organize related metadata information and may contain both subordinate ‘sub classes’ and attributes.

Attributes



**Example NAP Attributes**

(Source: *North American Profile of ISO 19115:2003 – Geographic Information – Metadata*)

Attributes are the most primary component of the metadata organization. Unlike Sections and Classes, attributes contain actual data about the resource. Attributes can be associated with Sections and Classes and the initial letters of attribute names are written in lower case.

#### Attribute Types

Compared to the CSGDM, the NAP provides an expanded list of designated attribute types that includes:

- Boolean (true/false)
- Date / Time
- Distance
- Free Text
- Generic Name
- Integer
- Measure
- Real Number
- URL

In addition, the NAP employs a significant number of code lists that serve as fixed domains. Each code list includes a set of values and definitions for each value. The values are referenced, internally, by a numeric value. By employing code lists, the NAP:

- 1) enhances the ability to locate specific content by standardizing the descriptors, and
- 2) enhances the international value of the content by the association of each value with a numeric code that requires no language translation.

For example, the CSGDM element ‘Originator’ is defined as ‘the name of an organization or individual that developed the data set’. This presented a challenge to organizations that procure data development from outside vendors but assumed ownership upon completion. The CSGDM did allow for the inclusion of multiple ‘Originators’ and the formal designation of the ‘Originator’ as the data set editor (ed.) or compiler (comp.) but neither option fully addressed the problem and metadata creators were left to generate their own solutions to the dilemma.

The NAP addresses this problem by providing a code list of contact ‘roles’ that can be used to more fully describe the relationship of the individual or organization to the resource.

NAP Section: Contact

Attribute: role

Type: Code List: Role Code

*resource provider*

*custodian*

*owner*

*user*

*distributor*

*originator*

*point of contact*

*principal investigator*

*processor*  
*publisher*  
*author*  
*collaborator*  
*editor*  
*mediator*  
*rights holder*

NAP code lists are extendible. A registry of the NAP code lists and user extensions is maintained at: <http://www.fgdc.gov/nap/metadata> (*accessed February 8, 2010*).

#### Best Practices

Because the NAP is a more flexible document than the CSDGM with fewer mandatory elements, it was decided that ‘best practices’ should be included in the attribute descriptions where applicable. The best practices provide guidance on:

- the intended purpose of the component
- the level of detail that best supports metadata function
- available thesauri, and other standardized resources that can be used
- suggested values
- conditions
- other guidance that may facilitate stronger content or utilization of the standard.

#### Multiplicity

‘Multiplicity’ is an indication of the number of times a component must or can be used. The CSDGM includes a ‘Conditionality’ feature to indicate whether an element is: ‘mandatory’, ‘mandatory if applicable’ or ‘optional’ and a ‘Repeatability’ feature to indicate whether an element can be used more than once. ‘Multiplicity’ combines these features into a single feature to indicate if an element is:

- M – Mandatory, must be provided, one value only
- C – Conditional, must be provided based on some described condition. Conditions may include the requirement that related attributes are also provided or that the attribute itself becomes ‘mandatory’ when related attributes are provided
- O – Optional, at the discretion of the provider
- ‘Repeatable’

The conditions are combined if multiple values are allowed. . For example, ‘O, Repeatable’.

#### Multilevel Metadata

Metadata creators have long struggled with the concept of data granularity, The CSDGM was designed to document a single ‘data set’ defined as “a collection of related data”. This vague description becomes increasingly problematic with the advent of new data and feature models and variations among geospatial software data organization and management applications.

The NAP introduces a hierarchy for the documentation of related ‘levels’ of data including:

- collection
- series
- dataset
- feature
- attribute.



When creating a metadata record, the author indicates the level of data that is being documented as well as related data levels. In this manner, the author records the metadata content specific to the specified data level. For example, data quality measurements vary among features but the values generally are aggregated when reported for the data set as a whole. To extend the example, if a single instance of an attribute, such as one out of a group of salinity measurements, varied widely from the others, the ‘attribute’ level of metadata would enable the author to report the anomaly and give context to the reported ‘average salinity value’.

While the CSDGM supported the inclusion of multiple ‘quantitative’ accuracy reports, the reports were contained within the broader metadata record. By creating metadata files specific to the level of data, the metadata is tied to the attribute, feature, data set or series and can be ‘inherited’ when compiled into a new data product.

Multilevel metadata facilitates the:

- creation of highly specific metadata
- reuse of metadata
- distribution of metadata creation among data contributors.

Implementation of hierarchical metadata will be a challenge. Data managers will need to determine the optimal level of documentation to support their project and organization and to identify the metadata content that applies to each level. In addition, as metadata is reused, as in the case of a road feature that is integrated into multiple datasets, the metadata will be duplicated and potentially altered presenting additional concerns about metadata lineage and accuracy. These challenges serve as great opportunities for geospatial software developers to create applications that effectively incorporate hierarchical metadata, facilitate user implementation and ease the burden on the metadata creator to scope the effort.

#### New Content

The general content of the NAP correlates closely to that of the CSDGM. Metadata records developed using the CSDGM can be manually crosswalked or automatically translated using stylesheets (XSLT’s) to the NAP. However, because the NAP includes new elements, extended elements, changes domains, and includes code lists, translated records *may* not be complete with respect to the NAP and additional information *may* be required. New content was developed to:

- address the international scope of the standard
- expand existing elements to provide more specific information
- change domains and incorporate code lists to standardize information
- address the documentation of new technologies and data models, and
- create new elements to facilitate discovery and access.

#### International Scope

To accommodate the writing of metadata for multiple nations and international organizations, the NAP includes attributes to record:

- *Dataset Language*
- *Dataset Character Set*
- *Metadata Language*
- *Metadata Character Set.*

While most U.S. applications will include default values, in Canada there is significant, and sometimes required, use of multiple languages. In addition, the attributes will prove useful to U.S. researchers searching for data that extend across international boundaries.

#### Expansion of Existing Elements

The CSDGM was designed for use by a broad spectrum of geospatial data developers and consumers. When applying the CSDGM, some metadata creators have found it limiting with respect to the level of detail they are able to capture. The NAP addresses many of these shortcomings by expanding some CSDGM elements to include a more robust set of attributes. The following elements have been significantly expanded.

##### Data Quality

Like the CSDGM, the NAP Data Quality section includes attributes to describe both data assessment reports and lineage (sources and processing). The NAP Lineage class was extended to include information about:

- source reference systems
- source extent
- process step rationale.

The NAP Assessment Report classes were extended to include:

- thematic accuracy
- temporal accuracy.

The NAP Data Quality reporting section also provides a standardized set of attributes for use within all Assessment Report types: completeness, thematic accuracy, logical consistency, positional accuracy, attribute accuracy, and temporal accuracy. The Data Quality attribute set includes:

- name of measures
- measure identification (for registered standard data quality procedures)
- measure description
- evaluation method type
- evaluation procedure citation
- date and time
- result.

Since the attributes set is more robust than the CSDGM and can be repeated multiple times, it enables a more detailed and consistent documentation of assessment reporting.

##### Citations

Similar to the use of a consistent set of attributes to describe Data Quality assessments, the use of Citations has been expanded within the NAP to document external references and authorities for a broader range of metadata components including:

- Keyword thesauri
- Data Quality evaluation procedures
- Data Quality conformance specifications
- Spatial Representation grid referencing parameters
- Reference System authorities
- Data Content feature catalogs (data dictionaries)

- Portrayal catalogs (symbology sets)
- Application schemas (models and analyses)
- Metadata Identifier (unique file name/number) authorities.

#### Online Resource

Given the expanded number of available online resources and the array of functions provided by these resources, the following attributes are provided to better describe online linkages referenced within the metadata:

- linkage (URL)
- connection protocol (http, ftp, etc.)
- applications used by the resource (web mapping, decision support, etc.)
- name
- description
- function (code list).

#### Maintenance Information

Metadata can serve as a geospatial data management resource. If the metadata information is robust and kept current, it can be used to identify data sets in need of archive or update, to schedule updates, and to inform data implementers of pending updates. The NAP enhances metadata data management capabilities by providing the following attributes:

- maintenance and update frequency
- date of next update
- user defined maintenance frequency
- scope of the update (code list)
- description of the scope of the update
- requirements for maintaining the resource
- maintenance contact.

#### Changed Domains

Changes to the domains of several metadata elements represent the greatest challenge facing the translation of CSDGM metadata to NAP format. In those cases where domains have simply been extended, the metadata information will translate with the original value and it will be dependent on the metadata manager to change to a newer, more specific value. However, in those cases where CSDGM domains values were dropped, converted from free text to fixed domain ('Code list'), or the format changed, translation will be dependent on either manual input or the use of smart strategies (look up tables, if/then programming, etc.) by translation applications. Problems with the fixed domain 'Code lists' should be minimal since only eight of the twenty-nine NAP code lists relate to existing CSDGM elements and, in those eight cases, the CSDGM domain values, with the exception of the 'free text' values, are either fully integrated or can be mapped to a value in the related NAP code list.

Date elements present another challenge. The CSDGM allows the use of text values such as 'unknown', 'present', and 'unpublished' in date fields. The NAP restricts dates to numeric values. CSDGM-to-NAP translation applications should provide options for replacing text strings in date fields by either prompting for a value or utilizing xml capabilities such as 'nilReason' to clarify why a required item is missing, e.g. nilReason="Present".

### New Technologies

Many new geospatial data technologies have emerged or expanded since the 1998 publication of the CSDGM Version 2.0 including, but not limited to:

- web mapping
- data models
- online data catalogs, warehouses and sales
- online data processing
- ontologies, thesauri, data hierarchies and classification systems.

While not ‘datasets’, these ‘services’ are valuable geospatial data resources that are frequently coupled with geospatial data. For example, a particular data set may be available for use in a specific web mapping application, available for download from a data warehouse, or developed using a specific data model. Even when not coupled directly with a data set, data developers benefit greatly from the ability to discover, access, assess, apply, and archive these services.

The NAP expands on the ISO 19115 ‘service’ metadata content and incorporates additional attributes from *ISO 19119:2005 Geographic Information – Services*. Similar to the ‘Data Identification’ class, the ‘Service Identification’ includes many of the same attributes but provides additional service specific attributes such as:

- service type, for example, ‘OGC Catalog’
- coupled data resources
- operations the service can perform.

### New Metadata Elements

After ten years of application, it is inevitable that users would discover documentation needs simply not perceived earlier. The NAP includes the following new elements to address those shortcomings.

#### Vertical Extent

While the CSDGM provided elements to document the geographic and temporal extents of a data set, there was no means to document the vertical extent of the data. The NAP provides new attributes for the maximum and minimum vertical extent of the data; characteristics common to atmospheric, bathymetric, subsurface geology and elevation data.

#### Topic Categories

One of the most common requests presented to metadata managers and trainers is the need for a single ‘thesaurus’ for theme keywords. The CSDGM provides no specific guidance as to a standard list of the key words but managers and trainers have long recommended that metadata creators use published thesauri such as the *Global Change Master Directory (GCMD)* and the *Canadian Core Subject Thesaurus (CST)* as well as discipline-specific thesauri including *Cowardin Wetlands Classification System* and the *Glossary of Geologic Terms*.

The NAP provides the ‘Topic Categories’ element to serve as a single, high level set of subject headings that can be used to coarsely sort data into logical thematic categories. Metadata creators are required to select one or more of the Topic Categories. These concatenated terms with their unusual capitalization appear odd because they reflect the UML origins of the standard. Metadata editors and other

applications can present the terms in a more easily read style but the content should remain as presented in the table below.

farming	intelligenceMilitary
biota	inlandWaters
boundaries	location
climatologyMeteorologyAtmosphere	oceans
economy	planningCadastre
elevation	society
environment	structure
geoscientificInformation	transportation
health	utilitiesCommunications
imageryBaseMapsEarthCover	

### ISO Topic Categories

(Source: *ISO 19115 Geographic Information – Metadata*)

#### Online Linkage Function Code

As discussed earlier, the CSDGM Online Linkage option has been expanded to include a number of descriptors including a 'Function Code'. This code list is used to qualify the operations of any given URLs. By providing this information, the user has better insights as to 'what happens' when they select a dynamic link from the metadata record. NAP online linkage functions include:

- download
- information
- offline access
- order
- search
- upload
- web service
- email service
- browsing
- file access
- web mapping service

#### Portrayal Catalog

In the same way that Topic Categories encourage the use of a standardized set of subject headings, 'Portrayal Catalog' enables metadata creators to provide a citation for the use of standard symbologies. This may include externally published symbologies, such as the *Anderson Land Use Land Cover Mapping Standard*, or internally developed symbologies. While the NAP only supports reference to a citation, a related TC 211 Standard, ISO 19117 Portrayal Catalog, outlines the methodology for describing symbols.

#### Application Schema

In the same spirit of standardization, the Application Schema provides a method to describe the use of standard software-applications such as a hydrology data model, a process methodology for extracting impervious services from imagery or delineating a watershed, or a land suitability

analysis. In addition to a citation of the application schema, the NAP provides attributes to describe the schema language, constraints to the application, software dependencies as well as the ability to fully embed the schema as an ASCII file, graphic depiction or operational software development file.

#### Eliminated Elements

CSDGM content correlates closely to the NAP content. Though some CSDGM elements have been expanded into a broader set of attributes in the NAP and will require manual review/edits, most content can be transferred directly from one standard to the next. A few CSDGM elements, however, were deemed unnecessary and not included in the NAP. Items were deprecated for the following reasons:

- Based on use of old technology:
  - Dial-up instruction for the use of a modem to transfer data
- Information is apparent from the values provided
  - Planar Coordinate Encoding Method
  - Distance and Bearing Representation
- Rarely applied or applied as intended
  - Landsat satellite and path number: intended to 'define the space oblique mercator projection' and not intended for documenting data collected via a remote sensing application
- Already specified by the NAP or some referenced standard
  - Metadata Time Convention.

## Software Applications

CSDGM to NAP Conversion  
Metadata Editors  
Metadata Validation  
Metadata Publication and Distribution



### ISO and NAP Metadata Software Applications

A number of software applications have been developed to assist in ISO and NAP implementation.

#### CSDGM to NAP Conversion

GIS vendors, Federal agencies, and other organizations have developed various transforms to support CSDGM to NAP conversion. Some transforms are intended as internal resources to convert application or organization specific metadata but others have been developed to support a broader community.

Working with examples and guidance from the FGDC metadata community, Intergraph, under contract to the FGDC, has developed a spreadsheet (.xls) mapping of all FGDC content to elements of ISO-19115 (Metadata), ISO-19110 (Feature Catalogue), and related standards. Once the mapping of Feature Catalogue elements is complete, this spreadsheet will be implemented as an XSLT transformation file that can be used to convert an FGDC-compliant XML file into an ISO-19139-compliant XML file. It will be provided with a simple interface and user help program. The transformation will process most FGDC elements, and others will be included as “supplemental” elements as part of the XML output. Users will be able to copy and modify the XSLT for their own purposes.

NOAA developed a set of transforms (XSLT’s) to support CSDGM to NAP conversion within its MERMAid metadata editor. However, the transforms have been developed as public resources and NOAA is soliciting public input to refine the transforms. The transforms include certain levels of logic that are able to interpret content to ensure minimal, if any, manual edits. Users are encouraged to apply and customize the transforms to support their own data and workflow.

Links to both the Intergraph spreadsheet and the NOAA transforms are included in Appendix C.

### Metadata Editors

Several editors have been developed to support the creation of ISO 19115 metadata. Most editors are designed to support the generic standard with options to support various national and community profiles.

The FGDC maintains an online review of ISO Metadata Editors that includes information provided by the application developers about editor capabilities and profile support as well as independent user reviews. In the 2009 version of the review, approximately one third of the respondents indicated that they were in the process of developing NAP metadata creation capabilities. The CSDGM community is encouraged to monitor the ISO Metadata Editor Review and the FGDC Metadata website for information about available NAP metadata editors. Until NAP editors are available, however, users can explore the ISO editors to learn more about ISO 19115 metadata.

The FGDC Metadata Editor Review is maintained at: <http://www.fgdc.gov/metadata/iso-metadata-editor-review> (accessed February 8, 2010).

### Metadata Validation

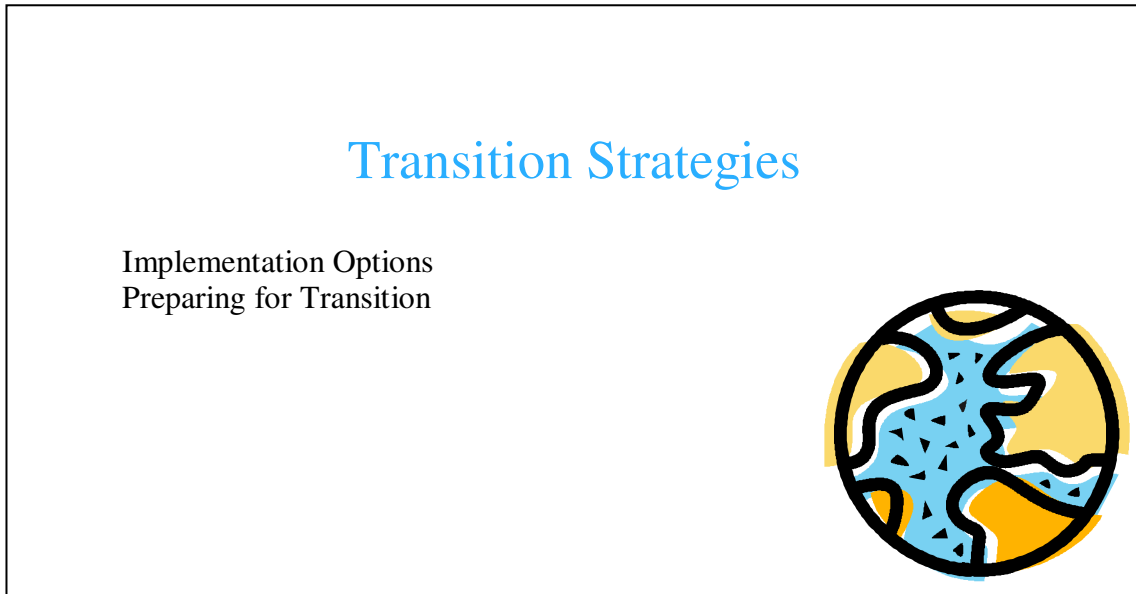
Because NAP metadata are presented using XML, the record can be easily validated using schemas and schematrons. Schemas (.xsd files) define the XML rules for structure, content, and semantics and define the objects and attributes of an XML document. Schematrons are stylesheets (XSLTs) that further enforce rule-based validation not addressed by the schemas, for example, 'end' dates cannot occur before 'begin' dates. In addition, schematrons can be applied to present cryptic error messages using more descriptive, 'human', language.

Current ISO 1911\* series XSDs do not support NAP-specified domains and conditionality. CSDGM metadata producers are encouraged to implement XSDs and schematrons that are identified as NAP compliant. An 'authoritative' NAP XSD is currently under development by the NAP development team that will use the ISO 1911\* series schemas as the base. Several GIS vendors support NAP/19139 compliant metadata validation. Publicly available metadata editors developed by NOAA (MERMAid) and EPA (EME) also include NAP validation capabilities.

### Metadata Publication and Distribution

NAP metadata can be published and otherwise made available via web folders and other applications that are not specific to any metadata standard. Formal metadata publication applications that standardize metadata to support enhanced search and discovery, including Z39.50 Clearinghouses and the Geospatial OneStop (GOS) portal at <http://www.geodata.gov> (accessed February 8, 2010), require new utilities and validation routines to enable the publication of NAP formatted metadata. There are numerous applications that can validate and publish ISO 19115 metadata but, as discussed above, they may not be specific to the NAP.





## Transition Strategies

As stated earlier, the NAP is a national (ANSI) standard. As such, it is up to individual organizations to determine if the standard supports their mission and objectives and if it is in their best interest to adopt the standard. The FGDC promotes the adoption of the NAP as a Federal standard and, if adopted, nonfederal organizations will be obligated, as with the CSDGM, to create NAP compliant metadata if they apply Federal funds to the development of geospatial data. However, it is not yet determined if that requirement may be satisfied by the ability to translate their metadata records to the NAP.

In the interim, organizations are encouraged to consider the following transition options, methods, and resources.

### Implementation Options

1. Continue with CSDGM metadata creation with no NAP implementation

#### Benefits:

- continued return on investment of existing CSDGM expertise, capabilities, and resources

#### Considerations:

- no increases in metadata capabilities and richness
- challenges using NAP metadata created by others including need for NAP-to-CSDGM translation application and staff time and expertise to convert
- eventual 'phasing out' of CSDGM support by metadata applications

2. Begin creating new metadata using the NAP and convert CSDGM records as used or distributed

#### Benefits:

- greater flexibility in developing custom metadata templates because of fewer mandatory elements and more robust optional elements
- improved discovery and use of geospatial services because of added elements for the

documentation of geospatial services’

- more efficient metadata compilation using code lists and multilevel metadata features
- translation effort is limited to active datasets
- improved data portal participation and discovery utilizing Topic Categories
- improved international interoperability

Considerations:

- increased time and expense required for NAP metadata training and software implementation
- effective multilevel metadata performance requires development and implementation of a strategic approach

### 3. Full implementation of the NAP for new and existing metadata records

Benefits:

- similar to partial implementation benefits listed above
- no need to translate CSDGM metadata at time of use or distribution
- opportunity to establish a fresh approach to metadata that encourages new ways of thinking about metadata and broader participation.

Considerations:

- similar to partial implementation concerns listed above
- translation of all metadata requires development and implementation of a strategic approach and significant effort

## Preparing for Transition

Organizations that chose to make the transition to the NAP can prepare now for implementation. The following steps outline a strategy for updating the content and format of your CSDGM metadata to ease translation and engaging colleagues so that they are informed and ready.

1. Assess current data holdings to determine:
  - current value and frequently accessed
  - current value and infrequently accessed
  - historic value
  - none or limited value.
2. Delete or archive data and metadata considered of none or limited value.
3. Archive data of historic value to remote drive or media.
4. Convert the metadata records of current value data to XML if stored in other format. CSDGM metadata records that are stored in text (.txt) or SGML format can be converted to XML via using the:
  - ‘output format’ function of most metadata editors
  - Metadata Parser (mp) utility developed by Peter Schweitzer (USGS) and available for free from: <http://geology.usgs.gov/tools/metadata/> (accessed February 8, 2010)
  - Metadata Enterprise Resource Management Aid (MERMAid) available from: <http://www.ncddc.noaa.gov/accountRequest> (accessed February 8, 2010)

CSDGM metadata records that are stored as HTML cannot be directly convert to XML. However, ESRI outlines a detailed procedure for converting HTML to txt that can then be converted to XML using another Peter Schwitzer (USGS) utility, 'Chew N Spit' (cns). An article describing the process is available from:

<http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=23071> (accessed February 8, 2010)

5. Add one or more Topic Categories to the CSDGM metadata Theme\_Keywords of data deemed of current value.  
To ensure that CSDGM to NAP translation applications are able to identify the Topic Categories, it is recommended that you enter the Topic Category name with the concatenation and capitalization presented in the standard, for example, 'geoscientificInformation', 'imageryBaseMapsEarthCover', 'intelligenceMilitary', etc

Starting with most frequently accessed holdings and distributing the effort over a reasonable period of time, consider one of the following methods:

- **Manual Edit of Theme\_Keywords**  
For small collections of metadata records, applicable Topic Categories can be added to the Theme\_Keywords of each metadata record using a metadata editor. The Topic Categories should be added using 'ISO 19115 Topic Category' as the Theme\_Keyword\_Thesaurus.
  - **Automated Edit of Theme\_Keywords**  
For large collections of metadata, it may be more efficient to 'map' your existing Theme\_Keywords to the ISO Topic Categories and automate the addition of the Topic Categories using either a Look-up Table (LUT) or Stylesheet (XSLT).  
Resources for each are included in Appendix A.
6. Educate and inform management and technical staff  
Both management and technical staff should be made aware of the new standard and options for implementation. This can be achieved through discussion, meetings, and presentations. An individual or working group should be tasked to lead the effort and to consider the following recommendations.
    - Review this document, referenced sources and other available information to determine and document the NAP features and issues of key significance to the organization.
    - Meet with management to discuss options for implementation and determine the appropriate level of implementation.
    - If management recommends NAP implementation, meet with technical staff to discuss preparation strategies and outline a series of implementation tasks complete with assigned roles and due dates.
    - Manage the implementation effort and participate quarterly telecons of the FGDC Metadata Working Group (info at: <http://www.fgdc.gov/participation/working-groups-subcommittees/mwg/index.html>) (accessed February 8, 2010).
    - Participate in national dialogs regarding NAP implementation at conferences, meetings and the metadata list server at <http://lists.geocomm.com/mailman/listinfo/metadata> (accessed February 8, 2010).

## Appendix A

### Automation of Topic Categories as Theme\_Keywords



#### **Appendix A:** Automation of Topic Categories as Theme\_Keywords

Directions for scripting metadata to extract keywords using Tcl, created by Peter Schweitzer  
<http://geology.usgs.gov/tools/metadata/tools/doc/mq.html> (accessed February 8, 2010)

Use of ISITE software to build a Theme Keyword LUT  
<http://registry.godi.org/statuschecker/counselorTools.php> (accessed February 8, 2010)

A Topic Category Thesaurus for Theme Keywords created by Bruce Westcott  
[http://registry.fgdc.gov/reports/docs/smms\\_thesaurus.txt](http://registry.fgdc.gov/reports/docs/smms_thesaurus.txt) (accessed February 8, 2010)

How to use XML templates and Stylesheets to transform data  
[http://en.wikipedia.org/wiki/XSL\\_Transformations](http://en.wikipedia.org/wiki/XSL_Transformations) (accessed February 8, 2010)

## Appendix B

### Glossary of Terms and Acronyms



**Appendix B:** Glossary of Terms and Acronyms (as used in this publication)

**ANSI-** The American National Standards Institute.

**Attribute** – Most basic metadata element, requires a data value.

**Class / Sub Class** – Description of a set/ subset of metadata elements.

**Code Lists** – Fixed list (domain) of values for a specified metadata element.

**CSDGM** – The Content Standard for Digital Geospatial Metadata.

**Domain** – Description of a set of valid values for a specified metadata element.

**INCITS L1** – The InterNational Committee for Information Technology Standards; Technical Committee L1, Geographic Information Systems.

**ISO** – The International Standards Organization.

**Ontology** – The organization of information into a relationship-based hierarchy such as a subject index or disciplines within a field of knowledge.

**Section** – Category of metadata information including classes, sub-classes and attributes.

**Services** – The online functions provided through a user interface <adapted from NAP definition>.

**UML** – The Unified Markup Language – a technical language used to define entities and visualize the relationship among entities.

**XML** – The Extensible Markup Language – a technical language used to describe data in a way that supports data transfer and storage. Differs from HTML in that HTML is used to describe how to display data.

**XSD** – The XML Schema Definition.

**XSLT** – The Extensible Stylesheet Language Transformations (XSLT), or ‘transform’ is an XML-based language used for the transformation of XML documents into other XML or "human-readable" documents. The original document is not changed; rather, a new document is created based on the content of an existing one. XSLT is the language for transforming the XML documents. XPath is a query language used to select nodes from an XML document. XPath is used by XSLT as a mechanism to access and refer to a place within the XML document in order for it to be transformed. XPath and XSLT share the same data model library of functions and operators.

## Appendix C

### ISO/NAP References and Resources



#### Appendix C: ISO/NAP References and Resources

ANSI publication: *North American Profile of ISO 19115:2003 Geographic Information - Metadata*  
<http://webstore.ansi.org/RecordDetail.aspx?sku=INCITS+453-2009> (accessed February 8, 2010)

CSDGM to NAP Conversion xslt  
<http://www.ncddc.noaa.gov/metadatasource/metadatasandxml> (accessed February 8, 2010)

FGDC NAP Webpage  
<http://www.fgdc.gov/standards/projects/incits-11-standards-projects/NAP-Metadata> (accessed February 8, 2010)  
<http://www.fgdc.gov/nap/metadata> (accessed February 8, 2010)

FGDC ISO Metadata Editor Review  
<http://www.fgdc.gov/metadata/iso-metadata-editor-review> (accessed February 8, 2010)

FGDC Online Training Materials  
<http://www.fgdc.gov/training/training-materials> (accessed February 8, 2010)

GeoCommunities Metadata Listserver  
<http://lists.geocomm.com/mailman/listinfo/metadata> (accessed February 8, 2010)

ISO 19115 Sample Metadata Record: Marine Community Profile  
<http://www.metoc.gov.au/geonetwork/srv/en/metadata.show?id=322&currTab=simple> (accessed February 8, 2010)

ISO Publication: *ISO 19110: Geographic Information – Methodology for Feature Cataloging*  
[http://www.isotc211.org/Outreach/Overview/Factsheet\\_19110.pdf](http://www.isotc211.org/Outreach/Overview/Factsheet_19110.pdf) (accessed February 8, 2010)

ISO Publication: *ISO 19115:2003 Geographic Information – Metadata*

[http://www.isotc211.org/Outreach/Overview/Factsheet\\_19115.pdf](http://www.isotc211.org/Outreach/Overview/Factsheet_19115.pdf) (accessed February 8, 2010)

ISO Publication: *ISO 19115-2:2009 Geographic Information – Metadata = Part 2: Extensions for Imagery and Gridded Data*

[http://www.isotc211.org/Outreach/Overview/Factsheet\\_19115-2.pdf](http://www.isotc211.org/Outreach/Overview/Factsheet_19115-2.pdf) (accessed February 8, 2010)

ISO Publication: *ISO 19119:2005 Geographic Information – Services*

[http://www.isotc211.org/Outreach/Overview/Factsheet\\_19115.pdf](http://www.isotc211.org/Outreach/Overview/Factsheet_19115.pdf) (accessed February 8, 2010)

NAP Metadata Register (includes code lists)

<http://www.fgdc.gov/nap/metadata/register/index.html> (accessed February 8, 2010)

Unified Modeling Language (UML) Tutorial by Exforsys

<http://www.exforsys.com/tech-articles/uml/uml-tutorial-for-beginners.html> (accessed February 8, 2010)

Transformation Service for automation of translation between standards

<http://www.ncddc.noaa.gov/technology/mermaid-2.0> (accessed February 8, 2010)

(XML) Extensible Markup Language Tutorial by w3schools

<http://www.w3schools.com/xml/default.asp> (accessed February 8, 2010)