American National Standard
for Information Technology

Geographic Information Framework Data Content Standards – (Base Standard)

Approved Month ##, 200# Secretariat: Information Technology Industry Council (ITI)

This standard is driven by requirements of the INCITS standards process. This part of the standard depends on other parts of the standard, and will be completed once all other parts are complete and accepted by INCITS L1.

Foreword (This is not part of American National Standard [designation])

The primary purpose of this standard, Geographic Information Framework Data Content Standards – Base Standard, is to establish common requirements for the collection and exchange of National Spatial Data Infrastructure (NSDI) Framework themes. It seeks to decrease the costs of acquiring and exchanging Framework data for creators and users through a common means of describing data content. Other benefits of adopting the standard include facilitation in maintenance of the data sets.

This standard has been developed to fulfill one of the objectives of the NSDI, i.e., to create common geographic base data for seven critical data themes. These core themes are considered Framework data, of critical importance to the geographic infrastructure.

The Geospatial One-Stop initiative, a federal e-government initiative, is designed, in part, to expedite the creation of the seven Framework layers and accelerate development of the NSDI. It is part of the Office of Management and Budget's E-government initiative to accelerate federal government improvements in effectiveness, efficiency, and customer service. Geospatial One-Stop provides a geographic component for e-government. An important aspect of Geospatial One-Stop is to develop data content standards for NSDI Framework data.

This standard will have a positive impact on the overall Geographic Information Systems (GIS) community by promoting smoother data exchange among Federal, State, Local, and other governmental entities, as well as the private sector and academic community. The private sector (software developers and vendors) will benefit by developing tools that exploit data based on these data content standards. Data producers and customers will benefit from improved access to data through common data content standards.

This standard is being developed by Technical Committee L1, Geographic Information, of the InterNational Committee for Information Technology Standards (INCITS) under auspices of the American National Standards Institute (ANSI). INCITS L1 standards are drafted in accordance with the rules given in the ANSI Style manual for preparation of proposed American National Standards.

This standard contains three annexes, all of which are normative.

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1 Scope, Purpose and Application

The purpose of the Geographic Information Framework Data Content Standards – Base Standard is to establish common requirements for data exchange standards for seven themes of geospatial data identified as being required by many different Geographic Information Systems (GIS) applications. The seven geospatial data themes are: geodetic control, elevation, orthoimagery, hydrography, transportation, cadastral, and digital government unit boundaries. These themes are known as National Spatial Data Infrastructure (NSDI) Framework themes.

The standard for each of the seven Framework themes will specify a minimal level of data content that data producers, consumers, and vendors can use for the interchange of that data, including through Web services. The intended users of the standards are system architects, database designers, and software developers who will implement these standards in different GIS applications.

The standards for the seven Framework data themes do not specify a particular structure for the interchange of data. Data producers and users may structure thematic data in any format for their own internal use. The standards should not modify people's business processes or modify how organizations hold data.

The seven Framework themes are described below:

1. **Geodetic Control:**

   Geodetic control provides a common, consistent, and accurate reference system for establishing coordinates for all geographic data. All NSDI framework data and users' applications data require geodetic control to accurately register spatial data. The fundamental geodetic control for the United States is provided through the National Spatial Reference System (NSRS) managed by the National Oceanic and Atmospheric Administration (NOAA).

2. **Elevation**
   Elevation Bathymetric:

   The bathymetric data for near coastal marine, Inland, and inter- coastal waterways is highly accurate bathymetric information collected to ensure that Federal navigation channels are maintained to their authorized depths. Bathymetric survey activities support the Nation's critical nautical charting program. This data is also used to create Electronic Navigational Charts. The bathymetric data supports the elevation layer of the geospatial data framework.

   Elevation Terrestrial:

   Land elevation data contains georeferenced digital representations of terrestrial surfaces, natural or manmade, which describe vertical position above or below a datum. As with bathymetric data, terrestrial data may be modeled in various forms, such as in an evenly spaced grid or as irregularly spaced points (triangulated irregular network, hypsography, mass points). The terrestrial data, in its various forms, can contribute to the elevation layer of the geospatial data framework.

3. **Orthoimagery**

   This dataset contains georeferenced images of the Earth's surface, collected by a sensor in which image object displacement has been removed for sensor distortions and

orientation and for terrain relief. For very large surface areas, an Earth curvature correction may be applied. Digital orthoimages encode the visible and near visible portions of the electromagnetic spectrum as discrete values modeled in an array of georeferenced pixels. Digital orthoimages have the geometric characteristics of a map and image qualities of a photograph.

4. **Hydrography**

   This data theme includes surface water features such as lakes, ponds, streams and rivers, canals, oceans, and coastlines. Each hydrography feature is assigned a permanent feature identification code and may also be identified by a feature name. Spatial positions of features are encoded as flowlines and polygons. Network connectivity, direction of flow, and a linear referencing system are also encoded.

5. **Transportation**

   Transportation data are used to model the geographic locations, interconnectedness, and characteristics of the transportation system within the United States. The transportation system includes both physical and non-physical components representing all modes of travel that allow the movement of goods and people between locations.

   Sub-themes representing the physical components of the transportation infrastructure include the road, railroad, transit, and waterway networks, plus airport facilities.

6. **Cadastral:**

   Cadastral data describe the geographic extent of past, current, and future right, title, and interest in real property, including above, surface, and below ground and water, and the foundation to support the description of that geographic extent. The geographic extent includes all areas within the United States jurisdiction.

   Cadastral **(Marine):**

   The marine cadastre includes, but is not limited to: Marine Managed Areas and their boundaries; parcels of ocean uses and their boundaries; including the submerged land management system used by the United States and its coastal states; and the rights, restrictions, responsibilities, and legal authority applied to marine spaces.

7. **Governmental Unit:**
   The governmental unit boundary data theme establishes the content requirements for the collection and interchange of governmental unit (GU) and other legal entity boundary data and to facilitate the maintenance and use of that information. This standard identifies terminology, encoding schema and the data components required for describing the GU or other legal entity and its boundary, along with the metadata needed for boundary data exchange.

2 Compliance and Conformance

2.1 Compliance to National and International Standards

This standard and its associated thematic Framework Data Content Standards shall comply with the ISO 19100 series of Geographic Information standards, ANSI standards, and other standards identified in Annex A of this standard and in the individual thematic standards. The Normative

References section of the individual thematic standards shall list standards applicable only to that Framework theme.

2.2 Conformance

The model within a Framework data content standard will be tested for conformance with the ISO 19100 series of Geographic Information standards.

3 Related Standards Activities

Other standardization activities besides ISO and ANSI have yielded feature catalogs, conceptual data models, and data content standards for Framework data themes. Organizations sponsoring these activities include the Federal Geographic Data committee (FGDC), NATO's Digital Geographic Information Working Group (DGIWG), the International Hydrographic Organization (IHO), U.S. Federal, State, and local agencies, and various private and public sector organizations.

4 Maintenance

The FGDC is the maintenance agency for the Geographic Information Framework Data Content Standards and will be responsible for the direct coordination of any requirements mandated by the InterNational Committee for Information Technology Standards (INCITS).

Address questions concerning this standard to:

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5 Distribution

As these Framework Standards were developed using public funds, the FGDC shall be able to freely publish and distribute the contents of these Framework Standards, including the framework models to the public, as provided through the Freedom of Information Act (FOIA).

Upon adoption of Framework standards as American National Standards, the Information Technology Industry Council (ITI) will copyright the American National Standards version of these Framework Standards on behalf of INCITS. Upon copyrighting these Framework Standards, ITI will provide free of charge to the FGDC a non-exclusive license to these Framework Standards in a format acceptable to all parties.

6 Terms and Definitions

(Numbering of definitions – TBSL)

For the purposes of this document, the following terms and definitions apply.

absolute accuracy
measure that accounts for all systematic and random errors in a data set. Absolute accuracy is stated with respect to a defined datum or reference system.

absolute horizontal accuracy
measure of the positional quality of data with respect to a horizontal reference datum

absolute vertical accuracy
measure that relates the stated elevation to the true elevation with respect to an established vertical datum.

accuracy
closeness of a measured value or set of values to the accepted reference value(s) [ISO 19116]

NOTE Accepted reference value can be a standard or an accepted [true] value. Accuracy relates to the quality of a result, and is distinguished from precision which relates to the quality of the operation by which the result is obtained.

administrative region
geographic representation of an entity's organizational structure

anchor point
part of the linear datum that represents a physical location in the field that can be unambiguously described so that it can be clearly located in the real world using its description.

NOTE An anchor point is a link between the computer representation of the transportation system and the real world. An anchor point shall occur at the end of an anchor section.

anchor section
part of the linear datum that represents a section of roadway between two **anchor points**.

NOTE Anchor sections state the official, along the ground, length of a transportation segment.

application schema
conceptual schema for data required by one or more applications [ISO 19101]

area event
event that is represented as a **polygon**.

NOTE The representation of an area event may be specified using a polygon that overlays a portion of an area feature.

EXAMPLE An identified "bay" feature within a larger "sea/ocean" feature.

area feature
feature that is represented as a **polygon** or series of polygons.

attribute
characteristic of a **feature**.

boundary
line defining the limits of a geographic entity

coextensive with
one-to-one areal maintenance relationship between two geographic entities or **features**

coincident
boundary shared by two or more different geographic entity types or a boundary and a **feature** having the same limits

complex feature
composite feature
aggregate feature
feature composed of other **features** [ISO 19109]

composed of
conditional relationship where one or more topological or feature objects always are the ingredients of the **governmental unit** or legal entity

composes
conditional relationship where the **governmental unit** or other legal entity always forms a part of another feature

conceptual model
model that defines the concepts of a **universe of discourse** [ISO 19101]

conceptual schema
formal description of a **conceptual model** [ISO 19101]

conjoint
boundary shared by two or more adjacent geographic areas

contains nested
areal maintenance relationship where one geographic entity or feature always includes another entity or feature, but the member entity or feature does not exhaust the extent of the owner

contains only nested
areal maintenance relationship between a geographic entity or feature and other entities where a nesting relationship exists and the member entity type exhausts the extent of the owner (all entities nest within)

contiguous
descriptive of two areas that are adjacent to one another, touch at a common point, or share a boundary

contour
line connecting points of equal elevation

contour interval
difference in elevation between **contours**.

control
high-accuracy spatial data associated with a collection of well-defined ground points, usually given as coordinate data.

coordinate
one of a sequence of n numbers designating the position of a point in n-dimensional space [ISO 19111]

data content standard

standard that specifies what information is contained within a geospatial data set and provides an **application schema**

datum
parameter or set of parameters that serve as a reference or basis for the calculation of other parameters [ISO 19111]

discrete grid
three-dimensional surface representation method created by a rectangular array of points spaced at a uniform sampling interval in x and y directions relative to a common origin.

NOTE a discrete grid represents the value of the surface only at the grid points or elevation posts of the grid, rather than the value of the cell area surrounding each **grid point**.

elevation
distance measured upward along a plumb line between a point and the **geoid**

ellipsoid
surface formed by the rotation of an ellipse about a main axis [ISO 19111]

NOTE In ISO 19111, ellipsoids are always oblate, meaning that the axis of rotation is always the minor axis

ellipsoid height
h
distance of a point from the **ellipsoid** measured along the perpendicular from the **ellipsoid** to this point [ISO 19111]

equivalence relationship between transportation features
TBSL

event
element or characteristic of a **feature** that carries an attribute that specifies the **permanent identifier** of the feature to which it is associated.

NOTE Some events are experienced by the feature (e.g., toxic spill, treatment plant discharge, project, crash, or maintenance activity), others describe some aspect of the feature (e.g., waterfall, rapids, water quality measurements, speed limit, current speed, or maintenance jurisdiction) or state the location of a subordinate feature (e.g., tunnel, bridge, guardrail, or sign).

feature
abstraction of real world phenomena [ISO 19109]

feature delineation
criteria or rules for defining where a **feature** begins and ends and how it will be represented geometrically in a dataset.

EXAMPLE stream features are sections of the stream network between confluences or individual, isolated natural water channels.

feature type
classification of **features** into groups that share the same form or function.

Framework
collection of basic geospatial data upon which users may collect, register or integrate geospatial information.

NOTE Thematic categories comprising the framework include: geodetic control, digital orthoimagery, elevation, transportation, hydrography, governmental units, and cadastre (FGDC, 1995)

Framework Data Content Standard [hereafter referred to as Framework Standards]
data content standard containing a level of information content and service adequate to serve data exchange for **Framework** data themes.

functional status
status of administrative or legal activities associated with performing the legally prescribed functions of a **governmental unit** or legal entity

geodetic datum
datum describing the relationship of a coordinate system to the Earth [ISO 19111]

geoid
level surface which best fits mean sea level either locally or globally [ISO 19111]

NOTE “Level surface” means an equipotential surface of the Earth’s gravity field that is everywhere perpendicular to the direction of gravity.

geoid height
N
difference between an **ellipsoid height** and an **orthometric height**.

geometry
The shape and geo-location of a feature

geospatial data
spatial data
Information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the Earth's surface.

NOTE This information may be derived from, among other things, remote sensing, mapping, and surveying technologies

government
organized entity that has elected officials and the ability to raise revenues, has sufficient discretion in the management of its own affairs to distinguish it as separate from the administrative structure of any other governmental unit.

governmental unit
legally bounded geographic entity that has the authority of a government

grid point
point in a grid of uniformly spaced points.

NOTE Grid points are located at a constant interval in x and y directions relative to a common origin, and contain the z-values for the surface at each discrete location.

horizontal datum
geodetic datum specifying the coordinate system in which horizontal control points are located.

horizontal error

magnitude of the displacement of a feature's recorded horizontal position in a dataset from its true accurate position, as measured radially and not resolved into x and y

horizontal geodetic control
control points for which horizontal coordinates (i.e., latitude-longitude) have been accurately determined that can be identified with physical points on the Earth and used to provide horizontal coordinates for other surveys.

legal area
geographic area where boundaries, name, origin, and legal/statistical area description result from charters, laws, treaties, or other administrative or governmental action

NOTE Legal area encompasses both **governmental unit** and **legal entity**, and includes cadastral units.

legal entity
geographic unit with legally defined boundaries established under Federal, State, Tribal, or local law

line string
sequence of line segments [ISO 19107]

NOTE ISO 19107 has defined line string as a UML class

NOTE A line segment string consists of two distinct direct positions (the start point and end point) joined by a straight line. A direct position is described by a single set of coordinates within a coordinate reference system is a type of one-dimensional (1D) geometric object defined by a connected series of (x, y, and z) coordinates with two endpoints.

linear event
event that is represented as a **line string**

NOTE The representation of the linear event may be specified using the applicable portion of a linear feature or as a line within an area feature. Alternatively, a linear event may be represented by a range of addresses that have been assigned along the length of a linear feature.

linear feature
feature that is represented as a curve, defined as 1-dimensional **geometric primitive**, representing the continuous image of a line [ISO 19107].

linear referencing method
LRM
scheme used to measure a location along or beside a **linear feature** as the distance from a anchor point measured along (and optionally laterally offset from) the **linear feature**

linear referencing system
linear referencing method and associated rules and protocols governing the application of the **linear referencing method**

maintenance relationship
common areal information that must be maintained between one or more geographic entities or features

namespace
person, organization, or entity responsible for ensuring the uniqueness of the **permanent identifier** attached to the **feature**.

NOTE Namespace may be applied to features packaged in different types of exchanges, such as those for an individual dataset, a business use, or a Framework theme, as needed to ensure the uniqueness of the identifiers.

nests within
areal maintenance relationship between geographic entities or features where an entity must be contained within another entity

non-bounded
conditional relationship representing a **governmental unit** or other **legal entity** lacking a delimiting line

normative annex
annex that gives provisions additional to those in the body of the document [from ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards]

orthometric height
H
distance measured along the plumb line between the **geoid** and a point on the Earth's surface, taken positive upward from the geoid (adapted from National Geodetic Survey, 1986).

permanent identifier
persistent, unique identifier assigned to real-world **features** and their digital representations.

NOTE Each community of users modeling real-world features is required to create attribute fields to store namespace and permanent identifier values.

NOTE Permanent identifiers are mandatory for data suppliers using the event model so that data users have a way to connect the **event** to the feature on which it occurs.

polygon
two-dimensional (2D) connected geometric object defined by a set of 1D boundaries and an underlying surface to which these boundaries adhere

NOTE ISO 19107 has defined line string as a UML class

point
0-dimensional geometric primitive, representing a position [ISO 19107]

point event
An **event** that is represented as a **point**

NOTE The representation of the point event may be specified using the applicable position along a linear feature or as a point within an area feature, or as the location of a point feature. Alternatively, a point event may be represented by an address that has been assigned along the length of a linear feature.

position expression
description of a position using linear referencing and comprised of a measured value (distance expression), the curvilinear element being measured (linear element), and the **linear referencing method**

point feature
feature that is represented as a **point** or series of **points**

polygon
geographic location represented by a surface, a 2-dimensional **geometric primitive** that represents a continuous image of a region of a plane and the boundary of the surface, a set of oriented, closed curves that delineate the surface.series of (x,y) pairs of coordinates which form a closed figure. [adapted from ISO 19107]

positional accuracy
closeness of coordinate value to the true or accepted value in a specified reference system [ISO 19116]

precision
measure of the repeatability of a set of measurements

relative accuracy
measure that accounts for random errors in a data set.

NOTE Relative accuracy may also be referred to as point-to-point accuracy. The general measure of relative accuracy is an evaluation of the random errors (systematic errors and blunders removed) in determining the positional orientation (e.g., distance, azimuth, elevation) of one point or feature with respect to another.

relative horizontal accuracy
measure of the point-to-point horizontal **accuracy** within a specific data set

relative vertical accuracy
measure of the point-to-point vertical accuracy within a specific data set. To determine relative vertical accuracy, the vertical difference between two points is measured. That difference is then compared to the difference in elevation for the same two points on the reference. The difference between the two measures represents the relative accuracy. The reference must have at least three times the accuracy of the intended product accuracy, insuring that all systematic errors and blunders have been removed. Relative vertical accuracy is an important characteristic of elevation data used for calculating slope.

resolution
smallest discrete measurement that can be faithfully represented in a model.

slope
measure of change in z-value over distance, expressed either in degrees or as a percent.

EXAMPLE a rise of 4 meters over a distance of 100 meters describes a 2.3° or 4% slope.

surface
TBSL

topological relationship
spatial condition or characteristic required for creating and maintaining the internal topology of a database (or file)

topology
connectivity of the participating elements.

universe of discourse
view of the real or hypothetical world that includes everything of interest [ISO 19101]

vertical error
displacement of a feature's recorded elevation in a dataset from its true or more accurate elevation.

vertical geodetic control
control points with accurately determined orthometric and/or ellipsoidal heights identified with physical points on the Earth that can be used to provide elevations for other surveys

vertical precision
vertical resolution
smallest vertical increment that can be represented in the data.

7 Symbols and Abbreviations

7.1 OD – 0-dimensional

7.2 1D – 1-dimensional

7.3 2D – 2-dimensional

7.4 ANSI – American National Standards Institute

7.5 DGIWG – Digital Geographic Information Working Group

7.6 FGDC – Federal Geographic Data Committee

7.7 FOIA – Freedom of Information Act

7.8 GIS – Geographic Information Systems

7.9 GU – Governmental unit

7.10 H – orthometric height

7.11 h – ellipsoid height

7.12 IEC – International Electrotechnical Commission

7.13 IHO – International Hydrographic Organization

7.14 INCITS – InterNational Committee for Information Technology Standards

7.15 ISO – International Organization for Standardization

7.16 ITI – Information Technology Information Council

7.17 N – geoid height

7.18 NATO – North Atlantic Treaty Organization

7.19 NOAA – National Oceanic and Atmospheric Administration

7.20 NSDI – National Spatial Data Infrastructure

7.21 NSRS – National Spatial Reference System

7.22 SDSFIE – Spatial Data Standard for Facilities, Infrastructure, and Environment

7.23 SDTS – Spatial Data Transfer Standard

7.24 UML – Unified Modeling Language

7.25 XML – Extensible Markup Language

8 Requirements

8.1 Related Reference Model

ISO 19101:2002, Geographic Information – Reference model

8.2 Application Schema

Each of the thematic Framework Data Content Standards shall include an integrated application schema expressed in the Unified Modeling Language (UML) according to ISO 19109, Rules for application schema and its normative references. The application schema will specify, as appropriate, the feature types, attribute types, attribute domain, feature relationships, spatial representation, data organization, and metadata that define the information content of a data set.

UML is not a database model; rather, it describes the common content and structures that could be exchanged between members of the geospatial community. The use of UML and abstract modeling concepts allows the standard to be technology independent but permits current and future implementation cases to be derived from the UML model.

Wherever possible, this Standard references abstract UML object types from the ISO 19100 series of standards and OpenGIS® specifications. Specialization of these classes of objects allows each theme to inherit properties and behaviors and ensure their propagation when transformed into encoding such as XML.

UML concepts and notation are described in Annex B.

8.3 Data Dictionary

8.3.1 General requirements

Each of the thematic Framework Data Content Standards shall contain, as appropriate, documentation of all features, attributes, and relationships and their definitions. A data dictionary table shall be used to describe the characteristics of the UML model diagrams.

The data dictionary (see Table 1) is formatted as follows:

- Each UML model class equates to a data dictionary entity.
- Each UML model class attribute equates to a data dictionary element.
- Each UML model association equates to a data dictionary element.
- The shaded rows define entities.
- The entities and elements within the data dictionary are defined by six attributes (those attributes are listed below and are based on those specified in ISO/IEC 11179-3 for the description of data element concepts, i.e. data elements without representation).

	Name / Role name	Definition	Obligation / Condition	Maximum occurrence	Data type	Domain
1.						

2.						
3.						
4.						

TABLE 1 Example Data Dictionary

8.3.2 Name/role name

The name/role name is a label assigned to a data dictionary entity or to a data dictionary element.

Entity names begin with a three letter abbreviations that denotes the UML package containing a class, followed by an underscore ("_"), and followed by the class name. The class name begins with an upper case letter. Spaces do not appear in an entity name: instead, multiple words are concatenated, with each word starting with a capital letter (example: XnnnYmmm). Entity names are unique within the entire data dictionary of this Standard.

Element names start with a lower case letter. Spaces do not appear in an element name: instead, multiple words are concatenated, with subsequent words starting with a capital letter (example: xnnnYmmm). Element names are unique within an entity by the combination of the entity and element names (example: GUB_Dataset.Name).

Role names are used to identify abstract model associations and are preceded by "Role name:" to distinguish them from other elements.

8.3.3 Definition

The definition is the data or metadata entity description.

8.3.4 Obligation/Condition

8.3.4.1 General

Obligation/Condition is a descriptor indicating whether an entity or element shall always be documented (i.e. contains value(s)) or sometimes is documented. This descriptor may have the following values: M (mandatory), C (conditional), or O (optional).

8.3.4.2 Mandatory (M):

Mandatory (M) indicates that the entity or element shall be documented.

8.3.4.3 Conditional (C):

Conditional (C) specifies an electronically manageable condition under which at least one entity or element is mandatory. 'Conditional' is used for one of the three following possibilities:

- Expressing a choice between two or more options. At least one option is mandatory and must be documented.
- Documenting an entity or element if another element has been documented.
- Documenting an element if a specific value for another element has been documented. To facilitate reading by humans, the specific value is used in plain text (ex. "C/not defined by

encoding?"). However, the code shall be used to verify the condition in an electronic user interface.

If the answer to the condition is positive, then the entity or the element shall be mandatory.

8.3.4.4 Optional (O):

The entity or the element may be documented or may not be documented. Optional entities and optional elements have been defined to provide a guide to those looking to fully document their data. (Use of this common set of defined elements will help promote interoperability among U.S. geographic data users and producers). Optional entities may have mandatory elements: if the optional entity is used, the mandatory elements shall be used. If an optional entity is not used, the elements contained within that entity (including mandatory elements) will also not be used.

8.3.5 Maximum occurrence

Maximum occurrence specifies the maximum number of instances the entity or the element may have. Single occurrences are shown by "1"; repeating occurrences are represented by "N". Fixed number occurrences other than one are allowed, and will be represented by the corresponding number (i.e. "2", "3"…etc).

8.3.6 Data type

Specifies a set of distinct values for representing the elements, for example, integer, real, string, DateTime, and Boolean. The data type attribute is also used to define entities, stereotypes, and associations.

8.3.7 Domain

For an entity, the domain indicates the line numbers covered by that entity.

For an element, the domain specifies the values allowed or the use of free text. "Free text" indicates that no restrictions are placed on the content of the field. Integer-based codes shall be used to represent values for domains containing code lists.

8.4 Metadata

This Standard is compliant with ISO 19115, Geographic information – Metadata. It is also compliant with the FDGC Content Standard for Digital Geospatial Metadata version 2.0, FGDC-STD-001-1998. Table 2 presents the minimum set of metadata elements (left column) for documenting data for this standard and compares elements and obligations with requirements in ISO 19115 and the FDGC Content Standard for Digital Geospatial Metadata version 2.0, FGDC-STD-001-1998.

GOS Element	ISO Element	FGDC Element
dataset title **(M)**	dataset title **(M)**	Citation – Title (1.1 – 8.4) **(M)**
dataset reference date **(M)**	dataset reference date **(M)**	Citation – Publication Date (1.1 – 8.2) **(M)**
dataset abstract **(M)**	dataset abstract **(M)**	Abstract (1.2.1) (M)
metadata point of contact **(M)**	metadata point of contact **(M)**	Metadata Contact (7.4) **(M)**
metadata date stamp **(M)**	metadata date stamp **(M)**	Metadata Date (7.1) **(M)**
dataset language **(M)**	dataset language **(M)**	(no mapping)

GOS Element	ISO Element	FGDC Element
dataset topic category **(M)**	dataset topic category **(M)**	(no mapping)
geographic location (bounding box or identifier) **(M)**	geographic location (bounding box or identifier) **(C)**	Bounding Coordinates (1.5.1) **(M)**
dataset character set **(C)**	dataset character set **(C)**	(no mapping)
metadata language **(C)**	metadata language **(C)**	(no mapping)
metadata character set **(C)**	metadata character set **(C)**	(no mapping)
metadata standard name **(M)**	metadata standard name **(rO)**	Metadata Standard Name (7.5) **(M)**
metadata standard version **(M)**	metadata standard version **(rO)**	Metadata Standard Version (7.6) **(M)**
spatial representation type **(rO)**	spatial representation type **(rO)**	Direct Spatial Reference Method (3.2) **(O)**
distribution format **(rO)**	distribution format **(rO)**	Digital Transfer Information (6.4.2.1.1 - .2) **(O)**
dataset point of contact **(rO)**	dataset point of contact **(rO)**	Point of Contact (1.9) **(O)**
lineage **(rO)**	lineage **(rO)**	Lineage (2.5) **(O)**
online resource **(rO)**	online resource **(rO)**	Online Option (6.4.2.2.1) **(O)**
reference system **(rO)**	reference system **(rO)**	*several mappings, see expanded crosswalk* **(O)**
dataset spatial resolution **(rO)**	dataset spatial resolution **(rO)**	(no mapping)
metadata file identifier **(rO)**	metadata file identifier **(rO)**	(no mapping)
extent (vertical) **(rO)**	extent (vertical) **(rO)**	(no mapping)
extent (temporal) **(M)**	extent (temporal) **(rO)**	Time Period of Content (1.3) **(M)**
Dataset purpose **(M)**	Dataset purpose **(O)**	Purpose (1.2.2) **(M)**
Dataset progress **(M)**	Dataset progress **(O)**	Progress (1.4.1) **(M)**
Dataset Maintenance and Update Frequency **(M)**	Dataset Maintenance and Update Frequency **(O)**	Maintenance and Update Frequency (1.4.2) **(M)**
Access Constraints **(M)**	Access Constraints **(O)**	Access Constraints (1.7) **(M)**
Use Constraints **(M)**	Use Constraints **(O)**	Use Constraints (1.8) **(M)**
Keywords **(M)**	Keywords **(O)**	Theme (1.6.1) **(M)**
Dataset originator **(M)**	Dataset originator **(O)**	Citation – Originator (1.1 – 8.1) **(M)**
Currentness Reference **(M)**	Currentness Reference **(O)**	Currentness Reference (1.3.1) **(M)**

GOS Element	ISO Element	FGDC Element
C - conditional **M** - mandatory **O** - optional **rO** – recommended optional NOTE: The numbers following the metadata elements indicate the location of the definition within the FDGC Content Standard for Digital Geospatial Metadata version 2.0, FGDC-STD-001-1998. Section and element number are provided for user navigation of the Metadata Standard. They are neither authoritative nor intended for use in implementation and are subject to change in future revision of the Metadata Standard.		

TABLE 2 Minimum set of metadata elements

The data dictionary of these metadata elements is contained in Annex C (normative).

Each part shall specify the metadata necessary for documenting data for that thematic Framework Standard.

8.5 Model Integration

Figure 1 shows the dependencies among the various Framework themes and the ISO profile, which is a general package that contains the profile of standards used by several of the themes. The ISO/TC211 Standard 19123, Schema for Coverage Geometry and Functions, is used by both the Elevation and Ortho themes.

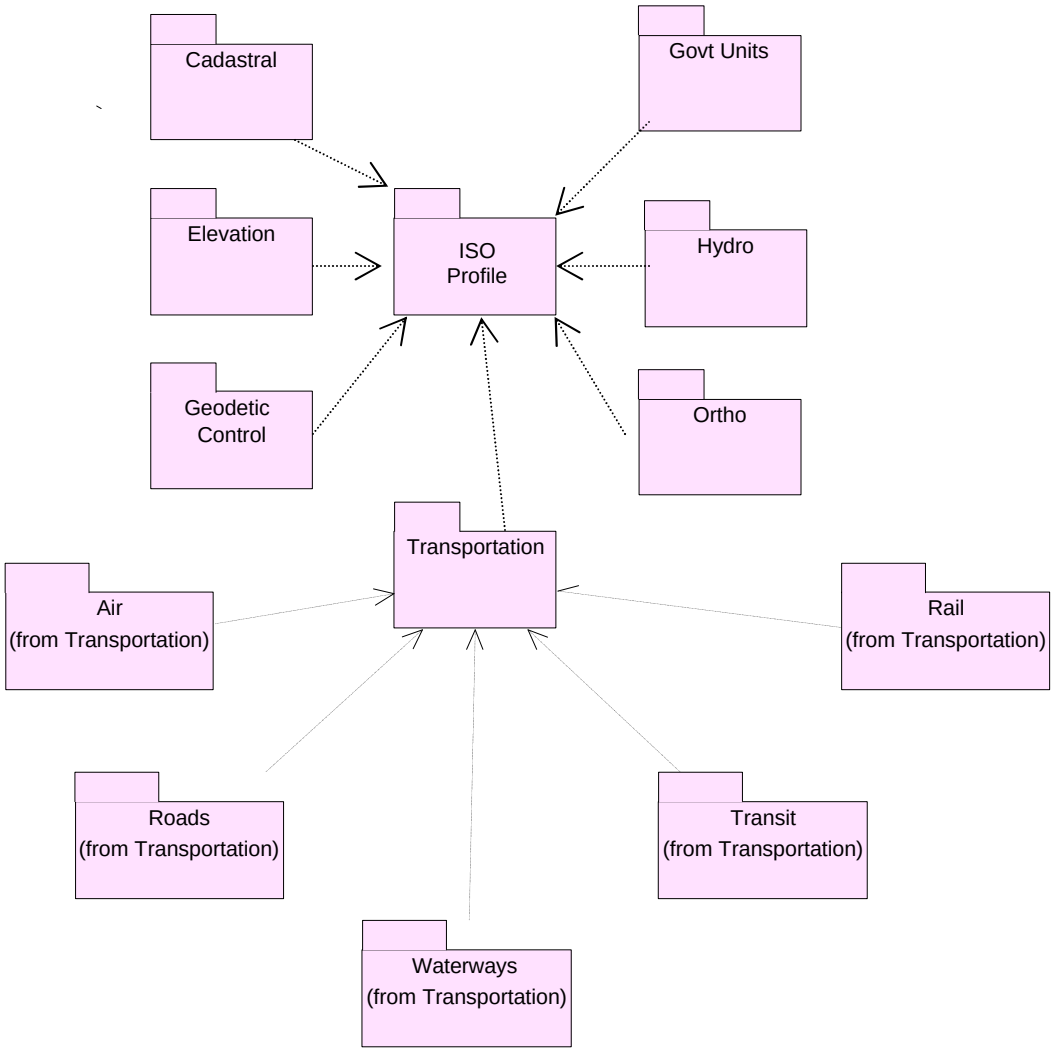

FIGURE 1 Dependencies Between Framework themes

8.6 Establishment of permanent identifiers

If a theme contains features such as bridges, roads, waterways, parcels, and governmental units, it shall include the fields 'namespace' and 'permanent identifier' in their UML models to ensure consistency in definition.

The theme/community shall decide if data suppliers are required to populate the namespace and permanent identifier fields and if permanent identifiers and namespaces will be created and managed in a standard way, including how to express equivalencies among features assigned different identifiers in multiple namespaces.

Each theme should develop a policy regarding how to populate the namespace and permanent identifier fields and how to express equivalencies for features that have been assigned different identifiers in multiple namespaces. If a theme does not adopt a standard way to create and manage identifiers, users may develop their own schema and include its description in the data set metadata.

Annex A: Standards and Standardization Activities Relevant to Geospatial One Stop

(Normative)

This Annex lists those standards that support two or more standards in the suite of thematic Framework Data Content Standards. Individual thematic standards shall list standards applicable to the particular theme.

Standards Supporting More than One Theme

ISO 19100 series of Geographic information standards

ISO 19107, Geographic information – Spatial Schema
ISO 19109, Geographic information – Rules for application schema
ISO 19110, Geographic Information- Feature cataloging methodology
ISO 19111, Geographic information – Spatial referencing by coordinates
ISO 19115, Geographic information – Metadata
ISO 19123, Geographic information - Schema for coverage geometry and functions (applies to orthoimagery and elevation)

ANSI Standards

Spatial Data Transfer Standard (SDTS), ANSI NCITS 320:1998)

Spatial Data Standard for Facilities, Infrastructure, and Environment, INCITS 353:2001

> Feature type, attribute type, domain, and feature relationship information, etc. shall be extracted from the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE), where applicable, for incorporation into Framework standards. Framework standards teams shall coordinate with maintainers of the SDSFIE recommend changes for consideration in future versions/editions of the SDSFIE. The project lead for this Framework Standards project will coordinate with the project lead for the SDSFIE as well as members of both project teams will participate and coordinate in relevant Framework standards/SDSFIE activities.

FGDC Standards

FGDC-STD-001-1998, Content Standard for Digital Geospatial Metadata (version 2.0)

FGDC-STD-002.5, *Spatial Data Transfer Standard (SDTS), Part 5: Raster Profile and Extensions*

FGDC-STD-002.7, *Spatial Data Transfer Standard (SDTS), Part 7: Computer-Aided Design and Drafting (CADD) Profile*

FGDC-STD-003*, Cadastral Data Content Standard*

FGDC-STD-007.1-1998, *Geospatial Positioning Accuracy Standard, Part 1, Reporting Methodology,*

FGDC-STD-007.3-1998, *Geospatial Positioning Accuracy Standard, Part 3, National Standard for Spatial Data Accuracy,*

FGDC-STD-007.4-2002, *Geospatial Positioning Accuracy Standard, Part 4: Architecture, Engineering Construction, and Facilities Management*

FGDC-STD-012-2002, *Content Standard for Digital Geospatial Metadata: Extensions for Remote Sensing Metadata*

Annex B: UML Notation
(Normative)

B.1 Introduction

This annex provides a description of UML notation as used in the UML diagrams in this standard.

B.2 UML Class

B.2.1 UML Class Notation

A UML class (Figure B.1) represents a concept within the system being modeled. It describes a set of objects that share the same attributes, operations, methods, relationships, and semantics. A class is drawn as a solid-outline rectangle with three compartments separated by horizontal lines. The top compartment holds the class name and other general properties of the class (including stereotypes); the middle compartment holds a list of attributes; and the bottom compartment holds a list of operations. The attribute and operation compartments may be suppressed to simplify a diagram; however, suppression does not indicate that there are no attributes or operations.

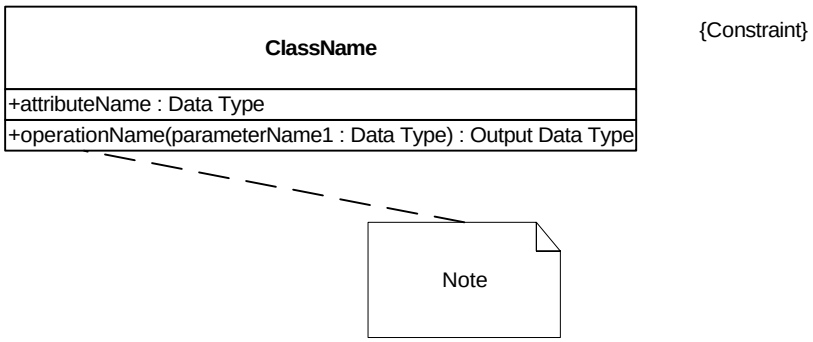

Figure B.1 — UML Class

Three letter abbreviations are used to denote the UML package that contains a class. Those abbreviations precede class names, connected by a "_". This is done to distinguish Geospatial One-Stop classes from ISO 19100 series classes, which are prefixed by a two letter abbreviation and a "_".

Class names start with an upper case letter. Spaces do not appear in a class name. Instead, multiple words are concatenated, with each new subword starting with a capital letter (example: XnnnYmmm). Class names are unique within the entire data dictionary of standard.

B.2.2 Stereotypes

A UML stereotype is an extension mechanism for existing UML concepts. Below are brief descriptions of the stereotypes used in this Standard:

a) <<DataType>> descriptor of a set of values that lack identity (independent existence and the possibility of side effects). Data types include primitive predefined types and user-definable

types. A DataType is thus a class with few or no operations whose primary purpose is to hold the abstract state of another class.

b) <<Enumeration>> data type whose instances form a list of named literal values. Both the enumeration name and its literal values are declared. Enumeration means a short list of well-understood potential values within a class.

c) <<CodeList>> used to describe a more open enumeration. <<CodeList>> is a flexible enumeration. Code lists are useful for expressing a long list of potential values. If the elements of the list are completely known, an enumeration should be used; if the only likely values of the elements are known, a code list should be used.

d) <<Abstract>> class (or other classifier) that cannot be directly instantiated. UML notation for this to show the name in italics.

e) <<Package>> cluster of logically related components, containing sub-packages.

f) <<Leaf>> package that contains definitions, without any sub-packages.

B.2.3 Attribute

An attribute represents a characteristic common to the objects of a class. An attribute is specified by a text string that can be parsed into elements that describe the properties of the attribute:

visibility name [multiplicity]: type-expression = initial-value

where**:**

visibility may be public (indicated by "+") or private (indicated by "-").

name is a character string. The attribute name shall include no blank spaces and shall begin with a lower case letter. Individual words in the name, following the first word, shall begin with upper case letters. Attribute names are unique within a class, but not throughout the entire data dictionary of this standard. Attribute names are made unique, within an application, by the combination of the class and attribute names (example: GUB_Dataset.Name).

multiplicity specifies the number of values that an instance of a class may have for a given attribute.

type-expression identifies the data type of the attribute.

initial value specifies the default value for the attribute.

B.2.4 Constraint

A constraint specifies a semantic condition or restriction. A constraint may be written using any formal notation, or a natural language. A constraint is shown as a text string in braces ({ }). It is placed near the element to which it applies. If the notation for an element is a text string (such as an attribute), the constraint string may follow the element text string in braces. A constraint included as an element in a list applies to all subsequent elements in the list, down to the next constraint element or the end of the list.

B.2.5 Note

A note contains textual information. It is shown as a rectangle with a “bent corner” in the upper right corner, attached to zero or more model elements by a dashed line. Notes may be used to contain comments or constraints.

B.3 UML Associations

B.3.1 Association

An association (see Figure B.2) is a semantic relationship between classes that specifies connections between their instances.

An association is drawn as a solid line connecting class rectangles. An association may have a name, represented as a character string placed near the line, but not close to either end.

An association is assumed to be two-way. The end of an association may be adorned with information pertinent to the class at that end, including multiplicity and role name.

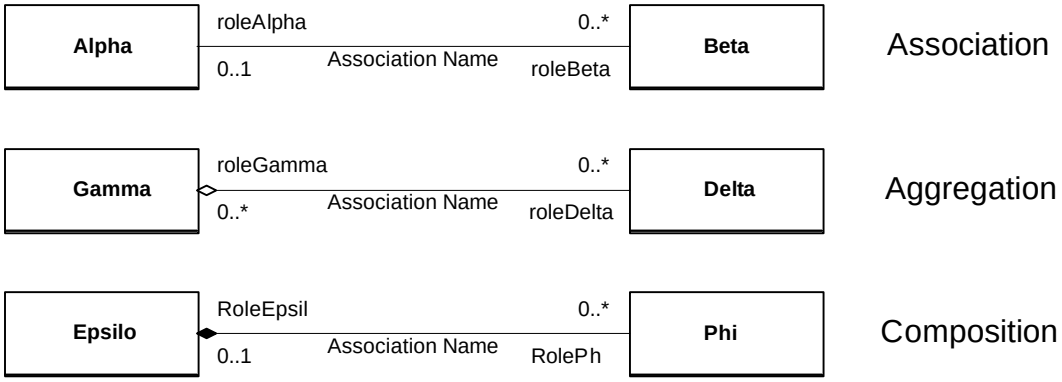

Figure B.2 — UML Associations

B.3.1.1 Role Name

A role name adorning an association end specifies behavior of the class at that end with respect to the class at the other end of the association. In Figure B.2, roleAlpha describes the role that the class named Alpha has with respect to the class named Beta.

A role name is represented as a Character String. A role name shall include no blank spaces and shall begin with a lower case letter. Individual words in the name, following the first word, shall begin with upper case letters. Role names are preceded by “Role name:” or to distinguish them from other elements.

B.3.1.2 Multiplicity

Multiplicity specifies the number of instances of a class that may be associated with a class at the other end of the association. The values shown in Figure B.2 have the following meanings:

zero or one instance of Alpha may be associated with one instance of Beta,
zero or more instances of Beta may be associated with one instance of Alpha,

zero or more instances of Gamma may be associated with one instance of Delta,
zero or more instances of Delta may be associated with one instance of Gamma,

zero or one instance of Epsilon may be associated with one instance of Phi,
zero or more instances of Phi may be associated with one instance of Epsilon.

B.3.1.3 Roles

If an association is navigable in a particular direction, the model shall supply a “role name” that is appropriate for the role of the target object in relation to the source object. Thus in a two-way association, two role names will be supplied.

Figure B.3 represents how role names and cardinalities are expressed in UML diagrams. The role name “r1”’ is Class1’s relationship to Class2. The role name “r2” is Class2’s relationship to Class1. The cardinalities show that “zero or many” Class1s are related to “exactly one” Class2.

Figure B.3 also shows how derived classes will be expressed. The diagram indicates that Class1 is a derived class of Class2. Any attributes and aggregates of Class1 are also derived from Class2.

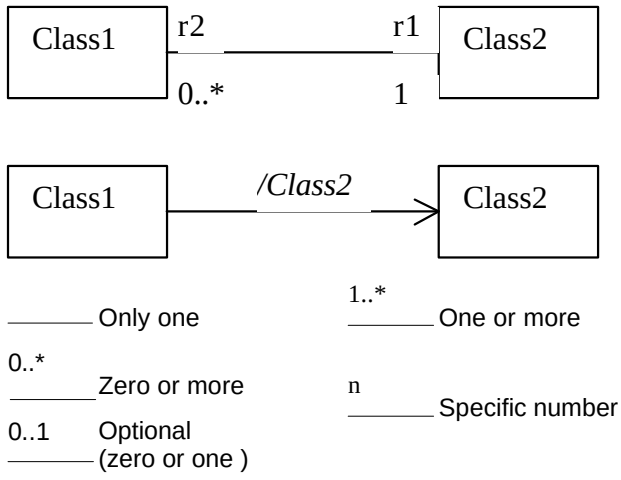

Figure B. 3 — UML roles

B.3.2 Aggregation

An aggregation is an association in which one class (the containee) is a component of the other class (the container). The members of an aggregation can exist independently of the aggregation, and can be members of more than one aggregation.

An open diamond on an association end indicates that the class at that end of the association is the container, that is, an aggregate of instances of the class at the other end.

B.3.3 Composition

A composition is an association in which the class at one end of the association (the container) is composed of instances of the class at the other end (the containee). Members of a composite

cannot exist independently of the composite class, nor can they be members of more than one composite class. If the composite class is deleted, then all of its members are deleted as well.

A closed diamond on an association end indicates that the class at that end of the association is the container, that is, a composite of instances of the class at the other end.

B.4 Generalization

A generalization is a relationship between a superclass and the subclasses that may be substituted for it. The super-class is the generalized class, while the subclasses are specified classes. In Figure B.4, Alpha is the superclass, while Beta and gamma are the subclasses.

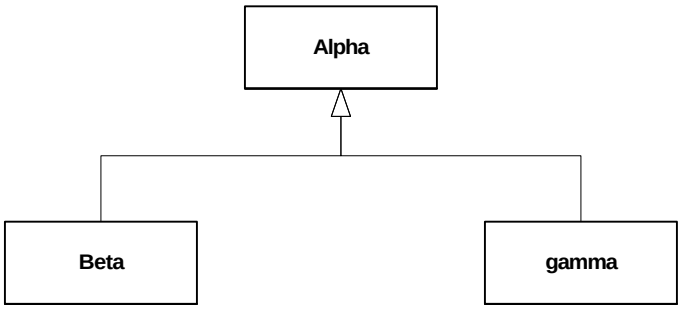

Figure B.4— UML Generalization

ISO 19501 defines generalization as a taxonomic relationship between a more general element and a more specific element. The more specific element is fully consistent with the more general element and contains additional information. An instance of the more specific element may be used where the more general element is allowed. Generalization is shown as a solid-line path from the child (the more specific element, such as a subclass) to the parent (the more general element, such as a superclass), with a hollow triangle at the end of the path where it meets the more general element.

B.5 Instantiation / Dependency

TBSL

Annex C: Data Dictionary of Metadata Elements

Row Number	Name	Definition	Obligation / Condition	Maximum occurrence	Data type	Domain
1	dataset title	name by which the cited resource is known	M	1	CharacterString	Free text
2	dataset reference date	reference date for the cited resource	M	*	Class	CI_Date.date.Date CI_Date.CI_DateTypeCode
3	dataset abstract	brief narrative summary of the content of the resource(s)	M	1	CharacterString	Free text
4	metadata point of contact	party responsible for the metadata information	M	*	Class	CI_ResponsibleParty. individualName (CharacterString) OR organisationName (CharacterString) OR positionName (CharacterString) CI_ResponsibleParty.role.CI_RoleCode
5	metadata date stamp	date that the metadata was created	M	1	Class	Date
6	dataset language	language(s) used within the dataset	M	*	Other	ISO 639-2 code
7	dataset topic category	main theme(s) of the dataset	M	*	Class	MD_TopicCategoryCode
8	geographic location (bounding box)	geographic position of the dataset NOTE This is only an approximate reference so specifying the coordinate reference system is unnecessary	M	*	Class	EX_Extent.geographicElement.EX_GeographicBoundingBox. westBoundLongitude eastBoundLongitude sorthBoundLatitude nouthBoundLatitude
9	dataset character set	full name of the character coding standard used for the dataset	C	*	Class	MD_CharacterSetCode

Row Number	Name	Definition	Obligation / Condition	Maximum occurrence	Data type	Domain
10	metadata language	language used for documenting metadata	C	1	Other	ISO 639-2 code
11	metadata character set	full name of the character coding standard used for the metadata set	C	1	Class	MD_CharacterSetCode
12	metadata standard name	name of the metadata standard (including profile name) used	M	1	CharacterString	Free text
13	metadata standard version	version (profile) of the metadata standard used	M	1	CharacterString	Free text
14	spatial representation type	method used to spatially represent geographic information	O	*	Class	MD_SpatialRepresentationTypeCode
15	distribution format	description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel	O	*	Class	MD_Format.name MD_Format.version
16	dataset point of contact	identification of, and means of communication with, person(s) and organization(s) associated with the resource(s)	O	*	Class	CI_ResponsibleParty. individualName (CharacterString) OR organisationName (CharacterString) OR positionName (CharacterString) CI_ResponsibleParty.role.CI_RoleCode
17	lineage	information about the events or source data used in constructing the data specified by the scope or lack of knowledge about lineage	O	1	CharacterString	Free text
18	online resource	information about on-line sources from which the dataset, can be obtained	O	1	Class	CI_OnlineResource.linkage

Row Number	Name	Definition	Obligation / Condition	Maximum occurrence	Data type	Domain
19	reference system	description of the spatial and temporal reference systems used in the dataset	O	*	Class	MD_ReferenceSystem.referenceSystemIdentifier.RS_Identifier.code (CharacterString)
20	dataset spatial resolution	factor which provides a general understanding of the density of spatial data in the dataset	O	*	Class	MD_Resolution. equivalentScale.MD_RepresentativeFraction.denominator (Integer) OR distance (Distance)
21	metadata file identifier	unique identifier for this metadata file	O	1	CharacterString	Free text
22	additional extent (vertical)	extent information including the vertical extent of the dataset	O	*		EX_VerticalExtent. minimumValue (Real) maximumValue (Real) UnitOfMeasure (UomLength)
23	additional extent (temporal)	extent information about temporal extent of the dataset	M	*	Class	EX_Extent.temporalElement. EX_TemporalExtent.extent.TM_Primitive
24	dataset purpose	summary of the intentions with which the resource(s) was developed	M	1	CharacterString	Free text
25	dataset progress	status of the resource(s)	M	*	Class	MD_ProgressCode
26	dataset maintenance and update frequency	frequency with which changes and additions are made to the resource after the initial resource is completed	M	1	Class	MD_MaintenanceFrequencyCode
27	access constraints	access constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the resource or metadata	M	*	CharacterString	Free text

Row Number	Name	Definition	Obligation / Condition	Maximum occurrence	Data type	Domain
28	use constraints	constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations or warnings on using the resource or metadata	M	*	CharacterString	Free text
29	keywords	commonly used word(s) or formalized word(s) or phrase(s) used to describe the subject NOTE: thematic keywords are required by the FGDC CSDGM v2	M	*	CharacterString	Free text
30	dataset originator	party who created the resource	M	*	Class	CI_ResponsibleParty. individualName (CharacterString) OR organisationName (CharacterString) OR positionName (CharacterString) CI_ResponsibleParty.role.CI_ RoleCode
31	currentness reference	basis on which the time period of content information is determined (FDGC definition)	M	1	Class	EX_Extent.description