FGDC Technical Guidance: Data.gov and The GeoPlatform Metadata Recommendations

Including Guidelines for National Geospatial Data Assets (NGDA)

version
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FEDERAL GEOGRAPHIC DATA COMMITTEE

Federal Geographic Data Committee

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Revision History:

Date	Page	Revision
12/9/2019	n/a	Significant changes and additions made to the prior 2017 publication. Content is updated to ISO 19115-1 metadata standard and combines deprecated documents “Metadata Recommendations Supporting Data Discovery and Use in Data.gov and the Geospatial Platform” and “National Geospatial Data Asset (NGDA) Metadata Guidelines.”

Introduction

Metadata creation and management is a geospatial data management best practice. Metadata records document the *who, what, why, where*, *when*, and *how* of the resource (dataset or service) and provide context for data consumers as to the content, extent, quality, purpose, intended use, and limitations of the resource.

The Federal Geographic Data Committee has long promoted the creation of standardized geospatial metadata and recent legislation such as the Foundations for Evidence-Based Policymaking Act of 2018, the OPEN Government Data Act, and the Geospatial Data Act of 2018 specify critical roles for metadata and outline requirements for the production of metadata by federal agencies.

Documenting geospatial data resources robustly and in accord with national, and preferably international, metadata standards results in metadata records that enhance the ability of the geospatial data to be:

- discovered
- assessed
- accessed
- applied
- archived.

The recommendations that follow are intended to support metadata publishers in developing rich metadata content that will enhance the effectiveness of Data.gov and GeoPlatform.gov search results and the utility of the results within the GeoPlatform. Special attention is given to the use of standardized vocabularies when curating keywords, the incorporation of unique identifiers, and the documentation of geospatial web services in a manner that enhances the user experience by enabling data download, visualization, analysis, and custom map production within the GeoPlatform.

The document includes best practices for creating metadata records to improve the discovery and application of National Geospatial Data Assets (NGDA). The document also serves as a foundation for the companion metadata guidance developed for Project Open Data.

FGDC Endorses ISO Geospatial Metadata Standards

FGDC endorses the use of the International Organization for Standardization (ISO) 19100 series of geospatial metadata standards. In 2011, the FGDC endorsed ISO 19115 and directed agencies to undertake the organizational changes necessary to implement ISO metadata. The FGDC has since endorsed the ISO 19115-1 update to ISO 19115. The FGDC refrained from deprecating the FGDC-authored Content Standard for Digital Geospatial Metadata to give agencies adequate time to complete the transition process. Citing the transition period as overly extended, the 2017 ISO Metadata Summit Summary Report includes a recommendation to "develop plan of action for transition to ISO that considers CSDGM deprecation." This recommendation is in alignment with the Geospatial Data Act and OMB A119 Revised federal policy to *use voluntary consensus standards* [e.g. ISO] *in lieu of government-unique standards* [e.g. CSDGM].

Agencies publishing to Data.gov and GeoPlatform.gov are therefore expected to create metadata using ISO geospatial metadata standards:

- *ISO 19115: Geographic Information – Metadata* content standard and formatted using *ISO/TS 19139:2007: Geographic information -- Metadata -- XML schema*
- *ISO 19115-2:2019 Geographic information -- Metadata -- Part 2: Extensions for acquisition and processing* and formatted using *ISO/TS 19139-2:2012: Geographic information — Metadata — XML schema implementation — Part 2: Extensions for imagery and gridded data*
- *ISO 19115-1:2014 Geographic Information – Metadata – Part 1: Fundamentals – Metadata* content standard and formatted using *ISO/TS 19115-3:2016 Geographic information -- Metadata -- Part 3: XML schema implementation for fundamental concepts*

Note: This guidance is based on the use of ISO 19115-1, the most current ISO geospatial metadata standard. However, Data.gov is not able to ingest 19115-1 metadata records at this time. Therefore, specific guidance for ISO 19115 implementation is included where it differs from 19115-1.

The FGDC metadata website provides many resources to assist agencies in the transition process. Key among these is the *ISO Geospatial Metadata Implementation Model Workflow*.

How to Read This Document

This document provides guidance specific to the creation of metadata intended for publication to Data.gov and the GeoPlatform. The recommendations were developed to improve data discovery and to facilitate the assessment and application of found resources. Metadata producers are encouraged to read the entire document in order and incorporate the recommendations into their own metadata production process.

Readers should be aware of the following document components:

NGDA Guidance Call-out Boxes

Information specific to the publication of FGDC-designated National Geospatial Data Asset (NGDA) resource metadata records is presented in tan call-out boxes. The call-out boxes are included, as needed, at the end of each relevant metadata topic.

CSDGM Guidance Call-out Boxes

Given that some metadata publishers continue to use the FGDC *Content Standard for Digital Geospatial Metadata* (CSDGM), specific guidance is presented in blue call-out boxes when the CSDGM elements, domain, or format significantly differs from ISO 19115-1. The call-out boxes are included, as needed, at the end of each relevant metadata topic.

Reference Section

A Reference Section is provided at the end of the document to provide users additional information about specific topics and to provide links to additional resources. Links to relevant Reference Section topics are provided throughout the document.

XPaths

XPaths are XML expressions that identify the location of the metadata element within the metadata record. Some metadata elements such as identifiers and dates occur in multiple locations throughout the metadata record. XPaths provide a navigable path for locating the element within the metadata section/class with which the element is associated. For example:

MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.date>CI_Date.date

Can be read as 'Within the metadata record (*MD_Metadata*), go to the *Identification* section (*MD_Identification*) to locate the *Citation* (*CI_Citation*) for the resources and provide a *date* (*CI_Date.date*) for the resource.'

Metadata Example Records

ISO and CSDGM metadata records have been developed to illustrate the implementation of these guidelines. The 'exemplar' records provide detailed XML and HTML presentations of the metadata content. Links to the exemplars are provided in the Reference Section.

Metadata Content Best Practices

Write Informative Titles and Abstracts

Titles

A good title is descriptive and distinctive. It provides data consumers a good sense of the resource content and context and enables them to distinguish among similar resources. *Titles* should not try to replace an *Abstract* or *Purpose* statement, but they should strive to relay the *what, when, where* and, if relevant, the *who, why,* and *how* of the resource. For example:

- What feature or feature collection does the resource represent?
- When did the content occur or when was it captured?
- Where is the content located on the earth?
- Who is the authority for the resource?
- Why was the resource created?
- How is the resource formatted?

Title example:
Aquifer Systems and Recharge Potential in Louisiana from Louisiana DEQ source data, Geographic NAD83, Louisiana Oil Spill Coordinator's Office (LOSCO), 1999, [aqrgeog3dpdeq]

NGDA Guidance: Title

To facilitate the identification of NGDA resources, it is important to use the NGDA name published in the NGDA Portfolio. If the dataset title differs from the official, approved NGDA name, the NGDA Dataset Manager must coordinate with the A–16 NGDA Theme Lead and the FGDC (NGDATeam@FGDC.gov) to harmonize the name with the title by:

- changing the NGDA Portfolio name to match the dataset title or
- changing the dataset title to match the NGDA Portfolio name.

In those cases where agency dataset naming conventions or data development processes inhibit the ability to harmonize the dataset title with the NGDA Portfolio name agencies should include the NGDA name as an *Alternate Title* as shown below.

Citation

Title: *Series Information File for the 2018 TIGER/Line Shapefile, Current Census Tract State-based*

Alternate Title: *National Geospatial Data Asset (NGDA) Census Tract*

CSDGM User Note: Title

CSDGM does not provide an *Alternate Title* element nor a repeat of the *Title* element. In cases where the agency is unable to harmonize the title with the NGDA-designated title, NGDA Dataset or Metadata Managers are advised to append the title with the NGDA Portfolio name as shown below.

Citation

Title: *Series Information File for the 2018 TIGER/Line Shapefile, Current Census Tract State-based - National Geospatial Data Asset (NGDA) Census Tract*

Abstracts

A good abstract provides the information necessary for data consumers to assess the relevance of an available data resource to their specific data needs. To meet this objective, the abstract should include:

- a general description of the data resource content and features
- the form of the data resource, e.g. GIS, imagery, database, service, application, etc.
- the purpose for which the data resource was developed
- relevant place names and references
- the time period of the data resource content
- the resolution of the resource
- information about special data characteristics or limitations, e.g. data access limitations, excluded geographies or content, completeness, etc.

Populate Date Elements Using the Correct Format

Date Elements

There are numerous options within the metadata record to record date values. Dates enable machines to improve search results and humans to determine the relevancy and 'fitness for use' of the resource. While information about the date of the resource should be included in titles and abstracts, explicit dates for the following metadata elements are required for data discovery and assessment:

- use ***Citation Date*** to identify the most current date of the resource: *MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.date>CI_Date.date*
- use ***Metadata Date*** to identify the most current date of the metadata record: *MD_Metadata.dateInfo>CI_Date.date*

To clarify the action associated with the date, ISO date elements require a companion *date type code*. The following *date types* are most useful in assessing a resource:

- creation
- publication
- expiry
- lastUpdate
- released
- superseded.

The complete *CI_DateTypeCode* codelist is provided in the Reference Section.

CSDGM User Note: Date Elements

CSDGM date elements do not have an associated *Date Type Code* because they are labeled, and defined, with the specific to the action, e.g. 'Publication Date', Process Date', etc. Provide the CSDGM date elements below.

- use ***Publication Date*** to identify the most current date of the resource *metadata/idinfo/citation/citeinfo/pubdate*
- use ***Metadata Date*** to identify the most current date of the metadata record *metadata>metainfo>metd*

Date Formats

ISO 19115* requires that dates to be specified in ISO 8601 format, for example:

YYYY-MM-DD

If the exact day or month is not known, the convention allows for the use of YYYY-MM and YYYY.

When the specific date is not known, *indeterminatePosition* allows the use of date qualifiers: *before, after, now, and unknown.*

CSDGM User Note: Date Format

CSDGM expects dates to be specified in the form: YYYYMMDD

The convention allows for the use of just the year: YYYY.

However, the 6-letter representation, YYYYMM, e.g. 201112 (December of 2011), must ***not*** be used as it is easily misinterpreted as the incorrect, but still used, YYMMDD form, e.g. 201112 (November 12, 2020).

Indicate the Lifecycle Status of the Resource

All data resources exist within the context of lifecycle management practices, from planning, to creation, through to publication, distribution, archiving, and eventual replacement or obsolescence. Metadata for the resource should accurately indicate the lifecycle status of the resource. By documenting all phases of a

resource status, including when "expired" (deprecated, superseded, invalid, etc.), all distributors and consumers of the metadata can determine and appropriately indicate the true status of the resource.

- use ***Progress Code*** to indicate the lifecycle status of the resource.
  MD_Metadata.identificationInfo>MD_Identification.status>MD_ProgressCode

  The following *progress codes* are recommended for use:

  - planned
  - completed
  - obsolete
  - retired
  - superseded
  - deprecated.

  The complete *MD_ProgressCode* codelist is provided in the Reference Section.

  NGDA User Note: Resource Status

  NGDA resources must be documented with a *progress code*. The documentation of the resource status aligns with the objectives of the NGDA Lifecycle Maturity Assessment.

Populate Unique Identifier Elements Formatted in Accord with IETF/W3C Standards

Unique Identifier Elements

Unique identifiers are character strings associated with a single entity. Identifiers increase the efficiency and accuracy of metadata. ISO metadata provides unique identifiers as options for many ISO metadata elements, especially in citations where they can be used to uniquely identify resources and the metadata record associated with the resource as shown below.

- use ***Citation Identifier*** to uniquely identify the resource
  MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.identifier>MD_Identifier.code
- use ***Metadata Identifier*** to uniquely identify the metadata record associated with the resource
  MD_Metadata.metadataIdentifier>MD_Identifier.code (19115-1)
  MD_Metadata.fileIdentifier (19115).

Identifiers are also used to reduce the unnecessary restatement of parameters for commonly used specifications. For example, the CSDGM standard requires an extensive list of elements to define a single projection, e.g. *scale factor at central meridian, latitude and longitude of central meridian, false easting, false northing*, etc. However, the European Petroleum Survey Group (EPSG), an industry standards organization, has created identifiers for each projection specification that consolidate and codify the parameters. Therefore, if a standard projection is used, without modification, the EPSG code can be provided as the unique and unambiguous ISO *Spatial Reference System Identifier* and the projection parameters are fully referenced rather than explicitly documented.

IETF/W3C Identifier Format

Identifiers are best represented using a Uniform Resources Identifier (URI) - an IETF/W3C standard scheme for treating resource identifiers as globally unique and persistent, even when the resource ceases to exist or becomes unavailable. URIs are used to unambiguously identify an abstract or physical resource (e.g., a place, standard, role, namespace, dataset, or service) and are especially useful when searching for resources or things related to them. Part of a URI defines the namespace of the identifier. For example, the URI "EPSG:4326" is an abbreviated identifier for the EPSG Coordinate Reference System specification described earlier.

For more information about these and other industry best practices, refer to "W3C & OGC Best Practices" in the section of this document.

It is highly recommended to generate globally unique URIs that are either:

- issued by a well-established organization that maintains a registry of identifiers such as the DOI Foundation
  or
- developed within the agency, scoped by the authoritative DNS namespace of the organization and then qualified by other facets of the resource including the type of resource, type of identifier, specification identifier, version number, etc.

Additional information about the production, syntax, and use of URIs is provided in the Reference Section.

Regardless of how URIs are defined, to be useful to machines and trusted by people they should be: 1) universally unique, 2) persistent over time, 3) resolvable on the Web, and 4) carefully managed as part of an integrated data management governance process.

CSDGM User Note: Identifiers

CSDGM does not specify the use of unique identifier values. However, use of URI-encoded identifiers should be incorporated into elements with free text domains when relevant. For example, the unique identifier for a resource can be included within the *Other Citation Details* element of the metadata record *Citation*.

Provide Rich Keywords and Use Controlled Vocabularies

Rich Keywords

Data.gov and the GeoPlatform rely heavily on keywords to identify resources of highest interest to users. Keywords of all types should be provided, as relevant, including:

- theme
- place
- stratum
- temporal
- discipline.

Keywords outline the content and purpose of the resource. Users and machines are best able discern, differentiate, and distinguish the resources when presented with a rich set of accurate keywords. Publishers are encouraged to include a wide variety of keywords bearing in mind that quality is far more important than quantity.

Example:
Listing all 50 U.S. States as keywords is not particularly helpful for humans or machines trying to distinguish whether a dataset is relevant to a specific location. In contrast, listing 'United States of America' as a keyword makes clear that the resource is national in scope.

Publishers are encouraged to consider selecting keywords that uniquely identify the resource. This is especially important when considering theme-related keywords.

Example:
'Coastal' is a very broad term that is applicable to many geospatial data resources. However, terms such as 'dune regeneration', 'beach nourishment', and 'seawall' impart detailed information about the content and purpose of the resource.

When documenting keywords, each keyword must be listed individually and not grouped into a delimited list.

Correct:
Theme Keyword: dune regeneration
Theme Keyword: beach nourishment
Theme Keyword: seawall

Incorrect:
Theme Keyword: dune regeneration, beach nourishment, seawall.

Controlled Vocabularies

Keywords are most effective when drawn from discipline-specific controlled vocabularies such as the *Classification of Wetlands and Deepwater Habitats of the United States* taxonomy, the *Global Change Master Directory (GCMD) Science Keywords*, and the *Global Names Index Service (GNIS)* gazetteer. The use of controlled vocabularies helps to standardize the spelling and definition of the term and therefore improves the relevancy of the search and user assessment results.

When documenting keywords from controlled vocabularies:

- use ***Thesaurus Name*** to provide the title of the controlled vocabulary *MD_Metadata.identificationInfo>MD_Identification.descriptiveKeywords>MD_Keywords.thesaurusName>CI_Citation.title*
- use ***Thesaurus Online Link*** to provide a link, if available, to the controlled vocabulary *MD_Metadata.identificationInfo>MD_Identification.descriptiveKeywords>MD_Keywords.thesaurusName>CI_Citation.onlineResource>CI_OnlineResource.linkage*
- use **Thesaurus Identifier** to provide the unique identifier, if available, for the controlled vocabulary *MD_Metadata.identificationInfo>MD_Identification.descriptiveKeywords>MD_Keywords.thesaurusName>CI_Citation.identifier>MD_Identifier.code.*

If the vocabulary is not published, provide a contact for the vocabulary within the thesaurus *Citation* and encourage the contact to make the vocabulary available online.

Keywords from controlled vocabularies with well-known, authoritative, and complete thesaurus citations are essential for humans and machines to distinguish the best and most appropriate resources to use for a given purpose. A list of commonly used geospatial vocabularies is provided in the Reference Section.

CSDGM User Note: Keywords

ISO metadata requires the selection of one or more *Topic Categories* that best characterize the data or application domain. These are high-level thematic bins used by Data.gov and the GeoPlatform to quickly sort available resources.

To facilitate discovery by ISO *Topic Category*, CSDGM users should include one or more *Topic Categories* (see Reference Section) as a *Theme Keyword* and specify "ISO 19115 Topic Category" as the *Theme Keyword Thesaurus*. The following example illustrates the application of ISO *Topic Categories* to a U.S. Census Metropolitan Statistical Areas dataset.

Keyword:
Theme:
Theme Keyword: Boundary
Theme Keyword: Society
Theme Keyword Thesaurus: *ISO 19115 Topic Category*

NGDA Guidance: Keywords

To facilitate the identification of the data as an NGDA resource and to support the population of the Geospatial Platform NGDA Theme Data Resource pages, include the NGDA-required keywords and keyword thesaurus content specified below.

Keyword:
Theme:
Theme Keyword: NGDA
Theme Keyword: National Geospatial Data Asset
Theme Keyword: *(select one NGDA specified Theme from the list below. Note: Do not include commas or other punctuation as some search engines cannot properly handle punctuation)*
Address Theme
Biodiversity and Ecosystems Theme
Cadastre Theme
Climate and Weather Theme
Cultural Resources Theme
Elevation Theme
Geodetic Control Theme
Geology Theme
Governmental Units and Administrative and Statistical Boundaries Theme
Imagery Theme
Land Use Land Cover Theme
Real Property Theme
Soils Theme
Transportation Theme
Utilities Theme

Water Inland Theme
Water Oceans and Coasts Theme
Theme Keyword Thesaurus: *NGDA Portfolio Themes*

NOTE: Do not include non-NGDA keywords in the *NGDA Portfolio Themes Thesaurus* list of keywords. The thesaurus is limited to the terms above and the inclusion of other terms may render the metadata record invalid for publication to the GeoPlatform.

Include Links to Browse Graphics

Browse or "thumbnail" graphics are especially valuable for the identification of relevant search results. The adage "a picture tells a thousand words" is true in this context and a quick view of the data can often provide sufficient information for a user to discern its appropriateness. Provide the following *Browse Graphic* information to enable Data.gov and the GeoPlatform to display the graphic with the search results.

ISO 19115-1

- use ***Browse Graphic File Name*** to provide the actual file name of the graphic *MD_Metadata.identificationInfo>MD_Identification.graphicOverview>MD_BrowseGraphic.fileName*
- use ***Browse Graphic Linkage*** to provide a link that enables access and display of the graphic *MD_Metadata.identificationInfo>MD_Identification.graphicOverview>MD_BrowseGraphic.linkage.*

ISO 19115

- ISO 19115 does not include a browse graphic linkage element so metadata creators should include the linkage as the ***Browse Graphic File Name*** *MD_Metadata.identificationInfo>MD_Identification.graphicOverview>MD_BrowseGraphic.fileName*

Note: The ***Browse Graphic File Name*** element is designated as a 'character string' data type versus 'URL'. Therefore when providing a URL in this element, it must be encoded in a manner that is compatible for use in XML documents, as shown below:

- encode naked ampersand (&) symbols using the "&" escape sequence. Ampersands cause a lot of problems in XML and should be escaped by using "&" instead of a naked "&".
- URLs cannot contain spaces. URL-encoding normally replaces a space with a plus (+) sign or with the %20 escape sequence.

For example, a URL string such as this:

```
https://tigerweb.geo.census.gov/arcgis/services/TIGERweb/tigerWMS_Current/MapServer/WmsServer?REQUEST=GetMap&SERVICE=WMS&VERSION=1.3.0&LAYERS=Metropolitan Statistical Areas,Metropolitan Statistical Areas Labels,Micropolitan Statistical Areas,Micropolitan Statistical Areas Labels&STYLES=default,default,default,default&FORMAT=image/svg+xml&BGCOLOR=0xFFFFFF&TRANSPARENT=TRUE&CRS=EPSG:4326&BBOX=41.187053,-73.508142,42.88679,-69.858861&WIDTH=891&HEIGHT=751
```

should be encoded for the *MD_BrowseGraphic.fileName* like this:

```
https://tigerweb.geo.census.gov/arcgis/services/TIGERweb/tigerWMS_Current/MapServer/WmsServer?REQUEST=GetMap&amp;SERVICE=WMS&amp;VERSION=1.3.0&amp;LAYERS=Metropolitan%20Statistical%20Areas,Metropolitan%20Statistical%20Areas%20Labels,Micropolitan%20Statistical%20Areas,Micropolitan%20Statistical%20Areas%20Labels&amp;STYLES=default,default,default,default&amp;FORMAT=image/svg+xml&amp;BGCOLOR=0xFFFFFF&amp;TRANSPARENT=TRUE&amp;CRS=EPSG:4326&amp;BBOX=41.187053,-73.508142,42.88679,-69.858861&amp;WIDTH=891&amp;HEIGHT=751</gco:CharacterString>
```

Best Practice: If more than one browse graphic is specified, the first browse graphic listed should be the best representation of the resource. For datasets, this is commonly a small map that illustrates the extent and nature of the content.

Best Practice: To facilitate efficient machine processing and positive user experiences, browse graphic images should be relatively small, for example, no larger than 800x600 pixels (~1MB) and encoded with compression as JPG or PNG format.

CSDGM User Note: Browse Graphics

CSDGM does not specify a linkage element for Browse Graphic. Publishers are encouraged to provide the URL as the *Browse Graphic File Type*.

If referencing a browse graphic file by URL, be sure to encode the URL string according to the rules described above.

Provide Contact Information

Agency Names

Like controlled vocabularies, naming authorities establish consistency in organizational reference. As such, federal agencies should directly and unambiguously follow guidance from those organizations whose mission and authority is to maintain lists of government and affiliated organization identifiers.

OMB agency names are available from *Preparation, Submission, and Execution of the Budget, Circular A-11, Appendix C*.

Multiple *Responsibility.organizationName* elements can be used to include the agency and bureau names as shown below.

Responsibility
Organization Name: Department of the Interior
Responsibilty
Organization Name: United States Geological Survey

Central Point of Contact for the Resource

While there are many opportunities within the ISO metadata record to identify contacts, the inclusion of a *Point of Contact* enables Data.gov and the GeoPlatform to direct users to a single point of inquiry for the resource. To facilitate discovery by ‘organization’ within Data.gov and the GeoPlatform, the *Point of Contact* should be the agency directly responsible for the metadata publication. In addition to designating the publishing agency as the *Point of Contact*, it is important to designate the associated *Responsible Party Role* as ‘publisher’, as shown below.

- use ***Point of Contact*** to identify the agency responsible for publishing the resource
  MD_Metadata.identificationInfo>MD_Identification.pointOfContact>CI_Responsibility.organizationName (ISO 19115-1)
  MD_Metadata.identificationInfo>MD_Identification.pointOfContact>CI_ResponsibleParty.organizationName (ISO 19115)
- use ***Agency Role*** to identify the agency as the publisher of the resource
  MD_Metadata.identificationInfo>MD_Identification.pointOfContact>CI_Responsibility.role = "publisher" (19115-1).
  MD_Metadata.identificationInfo>MD_Identification.pointOfContact> CI_ResponsibleParty.role = "publisher" (19115).

The *CI_RoleCode* codelist is provided in the Reference Section.

Contact Information

In addition to identifying the *Point of Contact* agency responsible for publishing the resource, other contacts (distributor, originator, processor, etc.) and supporting information are needed to guide the data consumer to the contact most relevant to their inquiry.

- Agency units associated with the resource
  ...>CI_Responsibility.organizationName (ISO 19115-1)
  ...>CI_ResponsibleParty.organizationName (ISO 19115)
- Staff positions associated with the resource
  ...>CI_Responsibility.positionName (ISO 19115-1)
  ...> CI_ResponsibleParty.positionName (ISO 19115)
- Agency/unit/position role with regard to the resource
  ...>CI_Responsibility.role (CI_RoleCode) (ISO 19115-1)
  ...>CI_ResponsibleParty.role (CI_RoleCode) (ISO 19115)
- The email address of the contact
  ...>CI_Responsibility.contactInfo>CI_Contact.address>CI_Address.electronicMailAddress (ISO 19115-1)
  ...>CI_ResponsibleParty.contactInfo>CI_Contact.address>CI_Address.electronicMailAddress (ISO 19115)
- The phone number for the contact:
  ...>CI_Responsibility.contactInfo>CI_Contact.phone>CI_Telephone.number (ISO 19115-1)
  ...>CI_ResponsibleParty.contactInfo>CI_Contact.phone>CI_Telephone.number (ISO 19115).

CSDGM User Note: Contact Information

Use the following elements to document contacts associated with the resource:

- ***Point of Contact*** agency responsible for publishing the resource
  metadata>idinfo>ptcontac>cntinfo>cntorgp>cntorg
- **Email address** of the contact
  metadata>idinfo>ptcontac>cntinfo>cntvoice
- **Phone number** for the contact:
  metadata>idinfo>ptcontac>cntinfo>cntemail

Use of XLink for Contact Information

The use of XML Linking Language (XLink) for Contact Information is discouraged. While XLink is a useful method to link externally-referenced information to a metadata record, they present problems for software applications that process or present metadata.

- XLinks don't scale when harvesting and indexing hundreds of thousands of metadata documents. Acessing XLinks and embedding the information into the metadata record ('resolving' the XLinks) causes delays in processing and with some metadata records containing ten or more XLinks, the resulting latency can be significant
- XLinks do not include the informative, and mandatory, *Responsible Party Role Code*
- XLinks in source metadata are often badly constructed and schema-invalid, rendering the XLink and even the entire metadata document not machine processable.

Agencies that utilize XLink in their metadata to reduce duplication of information and/or link to dynamic information, **are encouraged to resolve XLink references**, so that all content is embedded in the metadata record prior to making the record available to Data.gov and GeoPlatform.gov for harvesting.

Provide Direct URLs to Data Download

Data.gov and the GeoPlatform depend on operational, direct links to provide users access to available resources and associated information. The primary mission of Data.gov and the GeoPlatform is to connect users with data.

As such, a direct access URL to the resource is required. Exceptions are understood for collection-level metadata records that include link(s) to an agency/organization maintained resource collection search portal or application.

Provide the direct data download URL and supporting information as listed below:

- Provide the download URL as either:
  MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.onlineResource>CI_OnlineResource.linkage
  or
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.onLine>CI_OnlineResource.linkage
- Provide the download file name as either:
  MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.onlineResource>CI_OnlineResource.name
  or
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.onLine>CI_OnlineResource.name
- Provide a description of the download resource
  MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.onlineResource>CI_OnlineResource.description
  or
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.onLine>CI_OnlineResource.description

- Indicate that the function of the URL is 'download'
  MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.onlineResource> CI_OnlineResource.function = "download"
  or
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.onLine>CI_OnlineResource.function = "download"
- Indicate the format of the download, e.g. ESRI Shapefile, ESRI Smart Data Compression, Triangular Irregular Network, MrSID, JPEG 2000, PDF, ZIP, or other
  MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.onlineResource> CI_OnlineResource.applicationProfile
  or
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.onLine> CI_OnlineResource.applicationProfile.

CSDGM User Note: Data Download

The data download URL should be documented in the *Distribution* section (vs. *Citation.onlineLink*) so that key format information is also captured.

- Provide the download URL as
  Network Address
  Metadata>Distribution>Standard Order Process>Digital Transfer Option>Online Option>Network Address
- Provide the download file name as
  Format Name
  Metadata>Distribution>Standard Order Process>Digital Transfer Information>Format Name
- Provide a description of the download resource as
  Format Information Content
  Metadata>Distribution>Standard Order Process> Digital Form> Digital Transfer Information>Format Information Content
- Indicate that the function of the URL is 'download' using
  Format Specification
  Metadata>Distribution>Standard Order Process>Digital Transfer Information>Format Specification = "download"
- Indicate the format of the download, e.g. ESRI Shapefile, ESRI Smart Data Compression, Triangular Irregular Network, MrSID, JPEG 2000, PDF, ZIP, or other, as
  Format Name
  Metadata>Distribution>Standard Order Process> Digital Form> Digital Transfer Information>Format Name
- Provide the CSDGM mandatory format version information as
  Format Version Name
  Metadata>Distribution>Standard Order Process>Digital Transfer Information>Format Version Name
  or
  Format Version Date
  Metadata>Distribution>Standard Order Process>Digital Transfer Information>Format Version Date

- Provide the CSDGM mandatory statement of cost as Fees
  Metadata>Distribution>Standard Order Process>Fees

Establish and Document Web Services

Establish Web Services for Geospatial Data

Web services play a key role in any open platform experience. GeoPlatform.gov provides this experience in two ways:

- Application services (tools) that run in a browser so users can perform useful tasks
- Web services that a developer integrates into their own application, through standards-based application program interfaces (APIs).

Agencies are expected to establish web services for their geospatial data and to document those services in a manner that enables the GeoPlatform to access and ingest those services.

Fully Document Web Services

ISO metadata allows for the documentation of services as:

- a *Service Identification* within a dataset metadata record
- a *Distribution Method* within a dataset metadata record or
- a stand-alone *Service* (vs dataset) metadata record.

By creating a stand-alone service metadata record, the metadata for datasets hosted by the service, current and future, can be linked to the same service metadata record and information about the service is maintained and updated in a central location.

Most existing metadata creation workflows do not include the creation of stand-alone service metadata records. Organizations are encouraged to incorporate the production of service metadata records into their workflow. Until then, service information should be added to existing dataset metadata records within the Online Resource component of any of the following:

- Data Citation
  MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource
- Distribution Transfer Option
  MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online
- Distribution Distributor
  Metadata.distributionInfo>
  MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.distributorTransferOptions>MD_DigitalTransferOptions.online

Metadata for a web service should include:

1. A name for the service.

   MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.name

or
MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.name
or
Metadata.distributionInfo>MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.distributorTransferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.name.

2. A description that outlines the purpose and content of the service.

   MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.description
   or
   MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.description
   or
   Metadata.distributionInfo>MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.distributorTransferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.description.

3. An *actionable* (i.e., online and consumable) service endpoint URL that provides direct access to the geospatial web service of the specified resource type.

   The URL must enable uniform and reliable access to a dataset as maps and layers via online services that are compliant with the OGC WMS and/or Esri REST API specifications. If there are multiple services for an individual dataset, all the endpoint URLs for map services that host the dataset should be documented.

   Note: Do not include URL encoding, e.g. '&', nor query parameters, e.g. 'request=GetCapabilities', in the web service URL. Only the base URL (everything preceding the "?" parameter delimiter) is needed as long as the 'Application Profile Specification' (described in item 5 below) is designated.

   Correct:
   https://services.agency.gov/arcgis/services/XYZIndex/MapServer/WMSServer
   Incorrect:
   https://services.agency.gov/arcgis/services/XYZIndex/MapServer/WMSServer?request=GetCapabilities&service=WMS

   MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.linkage
   or
   MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.linkage
   or
   Metadata.distributionInfo>MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.distributorTransferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.linkage.

4. A function code identifier of "search" to indicate the online resource is a web service.

   MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.function="search"
   or
   MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.function="search"
   or
   Metadata.distributionInfo>MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.distributorTransferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.function="search"

5. The URI that uniquely identifies the application profile specification associated with the geospatial web service (i.e., the API specification identifier for the web service).

   MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.applicationProfile

   or
   MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOptions.online>CI_OnlineResource.applicationProfile
   or
   Metadata.distributionInfo>MD_Metadata.distributionInfo>MD_Distribution.distributor>MD_Distributor.applicationProfile.

   The following application profiles (i.e.,specification identifiers) for common types of web service APIs are based on the OGC's online resource naming scheme for unique and persistent identifiers:

   OGC Web Map Service (WMS)
   Specification Identifier: **http://opengis.net/spec/wms** – a service compliant with an approved OGC Web Map Service implementation specification, or specific version, e.g., OGC Web Map Service version 1.1: http://opengis.net/spec/wms/1.1

   OGC Web Feature Service (WFS)
   Specification Identifier: **http://opengis.net/spec/wfs** – a service compliant with an approved OGC Web Feature Service implementation specification, or specific version, e.g., OGC Web Feature Service version 1.0: http://opengis.net/spec/wfs/1.0

   OGC Web Coverage Service (WCS)
   Specification Identifier: **http://opengis.net/spec/wcs** – a service compliant with an approved OGC Web Coverage Service implementation specification, or specific version, e.g., OGC Web Coverage Service version 1.0: http://opengis.net/spec/wcs/1.0

   OGC Web Map Tile Service (WMTS)
   Specification Identifier: **http://opengis.net/spec/wmts** – a service compliant with an OGC Web Map Tile Service implementation specification, or specific version, e.g., OGC Web Map Tile Service 1.0.0: http://opengis.net/spec/wmts/1.0.0

OGC Catalog Service (CSW)
Specification Identifier: **http://opengis.net/spec/csw** – a service compliant with an OGC Catalog Service for the Web implementation specification, or specific version, e.g., OGC Catalogue Service Specification 2.0.2: http://opengis.net/spec/csw/2.0.2

OGC Keyhole Markup Language (KML)
Specification Identifier: **http://opengis.net/spec/kml** – a service that produces a document that is compliant with the OGC Keyhole Markup Language specification, or specific version, e.g., OGC Keyhole Markup Language version 2.2: http://opengis.net/spec/kml/2.2

Esri REST Map Service
Specification Identifier**: http://www.geoplatform.gov/spec/esri-map-rest –** a service compliant with the Esri ArcGIS Map Server REST API.

Esri REST Image Service
Specification Identifier**: http://www.geoplatform.gov/spec/esri-image-rest –** a service compliant with the Esri ArcGIS Image Server REST API.

Esri REST Feature Service
Specification Identifier**: http://www.geoplatform.gov/spec/esri-feature-rest –** a service compliant with the Esri ArcGIS Feature Server REST API.

For more information about identities for Esri REST API Specifications, see https://www.geoplatform.gov/spec.

Additional application profiles (specification identifiers) can be added to the geoplatform.gov/spec domain as relevant. Please verify additional identifiers with the GeoPlatform Team (servicedesk@geoplatform.gov) before specifying services not listed above in metadata.

NGDA Guidance: Publish Web Services

NGDA Dataset Managers should establish one or more geospatial web services to serve each NGDA Dataset. The GeoPlatform support team can assist the NGDA Dataset Managers in standing up these services and hosting them free of charge on the GeoPlatform.gov. If interested in this support, please send an email to servicedesk@geoplatform.gov and a member of the team will schedule a time to discuss your needs. The FGDC and GeoPlatform teams are committed to making services for each NGDA discoverable and available.

CSDGM User Note: Publish Web Services

CSDGM does not include an *Application Profile* element. Therefore publishers should provide the application profile specification described above using:

- Format Specification
  Distribution Information > Standard Order Process > Digital Form .> Digital Transfer Information > Format Specification

This is required to identify the online resource as: 1) a web service and 2) a web service that conforms to a published API specification.

Metadata Publication Best Practices

Create and Publish Collection-level Metadata

Collections and series are comprised of data resources that share similar, homogenous content but may vary in terms of content date or geographic extent. Examples include orthoimagery, elevation points, hydrography, and land cover. Collection-level metadata is useful in guiding users toward specific data resources.

Create Collection-level and Collection Member Metadata Records

Create metadata records for both the collection and, as feasible, the members of the collection using the following steps.

1. Create a metadata record for the entire collection (parent) that provides a(n):
   - ***Title*** that references the resource as a collection or series
     MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.title
   - ***Identifier*** that uniquely identifies the data collection
     MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.identifier
   - ***Abstract*** that identifies and describes the resource as a collection or series, e.g. 'This is a collection-level metadata record'
     MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.identifier
   - ***Geographic Extent*** for the complete collection
     MD_Metadata.identificationInfo>MD_Identification.extent>EX_Extent.geographicElement>EX_GeographicExtent.(polygon, bounding box, or identifier)
   - ***Temporal Extent*** for the complete collection
     MD_Metadata.identificationInfo>MD_Identification.extent>EX_Extent.temporalElement>EX_TemporalExtent.extent
   - ***Online Linkage*** to the website that describes the collection and/or provides access to individual collection members
     MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.linkage
   - ***Online Function Code*** that describes the purpose of the *Online Linkage* website above, e.g. 'information', or 'search'
     MD_Metadata.identificationInfo>MD_Identification.citation>CI_Citation.onlineResource>CI_OnlineResource.function ('information', 'search', etc.).

2. Create metadata records for the individual collection members (children) and subset compilations, as feasible. The collection-level metadata can be transformed to an individual record by editing the:
   - ***Title*** that references the resource as a member of a collection or series and indicates the specific geography and/or temporal extent
   - ***Identifier*** that uniquely identifies the collection member

- ***Abstract*** that identifies and describes the resource as a member of the collection of series, e.g. 'This resource is a member of a collection'
- ***Geographic Extent*** and/or ***Temporal Extent*** for the individual member
- ***Online Linkage*** to the website that provides information about or access to individual collection member
- ***Online Function Code*** that describes the purpose of the *Online Linkage* website above, e.g. 'information', or 'search'

In addition, the metadata record for the individual member of a resource collection should document the relationship to the larger collection and include:

- ***Title*** of associated larger collection
  MD_Identification.associatedResource>MD_AssociatedResource.name>CI_Citation.title (ISO 19115-1)
  MD_Identification.aggregationInfo>MD_AggregationInfo.aggregateDataSetName>CI_Citation.title (ISO 19115)
- ***Association*** of the individual member to the larger collection
  MD_Identification.associatedResource>MD_AssociatedResource.associationType>DS_AssociationTypeCode, e.g. 'largerWorkCitation', 'partOfSeamlessDatabase' (ISO 19115-1)
  MD_Identification.aggregationInfo>MD_AggregationInfo.associationType>DS_AssociationTypeCode, e.g. 'largerWorkCitation', 'partOfSeamlessDatabase', 'collectiveTitle', 'series' (ISO 19115)
- ***Identifier*** for the associated larger collection.
  MD_Identification.associatedResource>MD_AssociatedResource.name>CI_Citation.Identifier (ISO 19115-1)
  MD_Identification.aggregationInfo>MD_AggregationInfo.aggregateDataSetIdentifier>CI_Citation.identifier (ISO 19115).

CSDGM User Note: Collection Level Metadata Records

CSDGM users should follow the same steps as above using the elements designated below.

1. Create a metadata record for the entire collection (parent) that provides a(n):
   - ***Title*** that references the resource as a collection or series.
   - ***Abstract*** that identifies and describes the resource as a collection or series, e.g. 'This is a collection-level metadata record'.
   - ***Geographic Extent*** and ***Temporal Extent*** for the complete collection.
   - ***Online Linkage*** to websites that describes the collection.

2. Create metadata records for the individual collection members (children) and subset compilations, as feasible. The collection-level metadata can be transformed to an individual record by editing the:
   - ***Title*** that references the resource as a member of a collection or series and indicates the specific geography and/or temporal extent.
   - ***Abstract*** that identifies and describes the resource as a member of the collection of

series, e.g. 'This resource is a member of a collection'.
- ***Geographic Extent*** and/or ***Temporal Extent*** for the individual member.
- ***Online Linkage*** that provides direct access to the individual member.
- ***Larger Work Citation*** for the collection of which the individual resource is a member.

Publish Collection-level and Collection Member Metadata Records

Once metadata is created for both the collection and the individual collection members, it is important to organize and place the metadata in a manner that enables Data.gov to harvest collection-member metadata and the collection-level metadata without introducing duplicates.

At this time, Data.gov requires publishers to:

1. Place the individual member metadata records in a single WAF *separate from the collection-level metadata record.*
2. Register the WAF that includes the member metadata records as a "WAF Homogeneous Collection" Harvest Source in catalog.data.gov.
3. Create the "WAF Homogeneous Collection," providing agency-specific URLs for the following Harvest Source registration elements:
   - ***URL*** – provide a link to the WAF that contains the member metadata records
   - ***Collection Metadata URL*** – provide a link to the collection-level metadata record.

By organizing and registering collection-level and member metadata records in this manner, Data.gov and the GeoPlatform are able to point users to member metadata records upon discovery of the collection-level metadata record. This greatly facilitates user access to the resource that best meets their information needs.

In the future, Data.gov expects to utilize the metadata record identifiers to connect data resources with collections to which they belong, and a separate harvest folder will no longer be required.

Don't Publish Metadata for Resources Produced by Others

Metadata should be published to Data.gov by the agency that is responsible for the resource. If metadata for the same resource is duplicated, it can result in conflicting information about the resource, confusion about the resource authority, and the unintended use of derived resources. When committing resources to Data.gov, a publisher is asserting that the resources conform to the data quality guidelines of the publishing organization and that they are authors of such data.

If an organization modifies a resource, the *Title*, *Abstract*, and *Lineage* of the metadata record for the modified resource should make clear the modification and attribute both the source of the resource and the authority responsible for the resource.

In some cases, publishers may serve as a metadata clearinghouse for other organizations, such as a federal Enterprise Data Inventory (EDI) or a State metadata catalog. These publishers are encouraged to publish to Data.gov if the metadata records within their catalog are unique and clearly cite the authority responsible for the resource. If the publisher cannot assure that the records are unique, the *Title* and *Abstract* for each metadata record should include the publisher's name, e.g. 'State of Oregon Metadata Clearinghouse – National Hydrography Dataset (NHD)…' to distinguish it from the possible publication of the same resource by another organization.

Reference Section

FGDC Endorsed Geospatial Metadata Standards

- ISO 19115-1:2014 Geographic Information – Metadata – Part 1: Fundamentals – Metadata (https://www.iso.org/standard/53798.html)
  Encoded by
  - ISO/TS 19115-3:2016 Geographic information -- Metadata -- Part 3: XML schema implementation for fundamental concepts (https://www.iso.org/standard/32579.html)
- ISO 19115:2003 Geographic Information – Metadata (https://www.iso.org/standard/26020.html)
  Encoded by
  - ISO/TS 19139:2007: Geographic information -- Metadata -- XML schema (https://www.iso.org/standard/32557.html)
- ISO 19115-2:2009 Geographic information - Metadata - Part 2: Extensions for imagery and gridded data (https://www.iso.org/standard/67039.html)
  Encoded by
  - ISO/TS 19139-2:2012: Geographic information — Metadata — XML schema implementation — Part 2: Extensions for imagery and gridded data (https://www.iso.org/standard/57104.html)
- FGDC-STD-001-1998 Content Standard for Digital Geospatial Metadata (https://www.fgdc.gov/standards/projects/metadata/base-metadata/v2_0698.pdf)
  Encoded by
  - CSGDM XML Schema Document (XSD) (https://www.fgdc.gov/schemas/metadata/)

Federal Geospatial Metadata Guidance Documents, Reports, and Information Resources

- ISO Metadata Summit Summary Report (https://www.fgdc.gov/metadata/events/iso-metadata-summit-2017/iso-metadata-summit-summary-report-20170630.pdf)
- How to Get Your Open Data on Data.gov (https://www.digitalgov.gov/resources/how-to-get-your-open-data-on-data-gov/)
- ISO Metadata Standards (https://www.fgdc.gov/metadata/iso-standards)
- *ISO Geospatial Metadata Implementation Model Workflow* (https://www.fgdc.gov/metadata/iso-implementation-model-workflow)

Federal Geospatial Data Policies and Programs

- Foundations for Evidence-Based Policymaking Act of 2018 (https://www.congress.gov/bill/115th-congress/house-bill/4174/text)
- OPEN Government Data Act (https://www.congress.gov/115/bills/s760/BILLS-115s760is.pdf)
- Geospatial Data Act of 2018 (https://www.fgdc.gov/gda)
- OMB A119 Revised (https://www.whitehouse.gov/wp-content/uploads/2017/11/Circular-119-1.pdf)
- Supplemental Guidance on the Implementation of M-13-13 “Open Data Policy – Managing Information as an Asset (Project Open Data implementation Guide) (https://project-open-data.cio.gov/implementation-guide/)
- Federal Open Data Policy M-13-13 (https://digital.gov/open-data-policy-m-13-13/)
- NGDA Portfolio (https://communities.geoplatform.gov/ngda-portfolio/ngda-portfolio/)
- Federal Register Listing of Agency Names (https://www.federalregister.gov/agencies)
- Preparation, Submission, and Execution of the Budget, Circular A-11, Appendix C: (https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/a11_current_year/app_c.pdf)

Example Metadata Records

Example ISO and CSDGM metadata records, and other metadata-related resources, are provided at: https://www.geoplatform.gov/help/metadata

W3C & OGC Best Practices

- Data on the Web Best Practices (https://www.w3.org/TR/dwbp/)
    a. Best Practice 9: Use persistent URIs as identifiers of datasets (https://www.w3.org/TR/dwbp/#DataIdentifiers)
- Spatial Data on the Web Best Practices, OGC and W3C, 2017, (https://www.w3.org/TR/sdw-bp/)
    a. Best Practice 1: Use globally unique persistent HTTP URIs for Spatial Things (https://www.w3.org/TR/sdw-bp/#bp-identifiers)
- OGC Naming Authority Best Practices (http://www.opengeospatial.org/standards/na). Note specifically, the policy document titled "OGC-NA Name type specification - specification elements"(10-103). The generic scheme for identifying persistent names for online resources (e.g., service type identifiers) follows this pattern: http://{namingAuthority}/spec/{specName}/{version}

Uniform Resource Identifiers (URIs)

Title	Description	URL
DOI Foundation	Not-for-profit membership organization that governs and manages Digital Object Identifier (DOI) services and registration	http://doi.org/
Uniform Resource Identifiers (URI): Generic Syntax	Specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements (1998)	http://www.ietf.org/rfc/rfc2396.txt
URI review procedures	OGC Naming Authority (OGC-NA) process for assigning URIs for OGC resources, such as OGC documents, standards, XML namespaces, ontologies (2013)	https://www.opengeospatial.org/projects/groups/ogcnasc
USGS Data Management DOI	Guidance provided to USGS on use of DOIs	https://www.usgs.gov/products/data-and-tools/data-management/digital-object-identifiers?qt-science_support_page_related_con=0#qt-science_support_page_related_con
Permanent Identifiers for the Web	Provides a secure, permanent URL re-direction service for Web applications. This service is run by the W3C Permanent Identifier Community Group.	https://w3id.org/
Persistent URL (PURL)Service	The PURL service is an initiative of the Internet Archive, a 501(c)(3) non-profit, building a digital library of Internet sites and other cultural artifacts in digital form.	http://purl.org/

Controlled Vocabularies

Controlled Vocabulary	Description	URL
Classification of Wetlands and Deepwater Habitats of the United States (aka Cowardin System)	Wetlands are classified by landscape position, vegetation cover and hydrologic regime. The Cowardin system includes five major wetland types: marine, tidal, lacustrine, palustrine and riverine.	https://www.fws.gov/wetlands/documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States-2013.pdf
Global Change Master Directory (GCMD) Science Keywords	Earth science dataset and service descriptions which cover subject areas within Earth and environmental sciences.	https://gcmd.nasa.gov/search/Keywords.do#keywords
Global Names Index Service (GNIS)	The official names for places, features, and areas in the 50 States, the District of Columbia, the territories, and outlying areas of the United States, including Antarctica. Coordinated with State naming authorities to standardize geographic names.	https://geonames.usgs.gov/apex/f?p=138:1:6351264625746
USGS Thesaurus	The USGS Thesaurus is a controlled vocabulary providing category terms for scientific information products generated The thesaurus is faceted, meaning its top terms delineate general aspects of information resources: by the U.S. Geological Survey.	https://www2.usgs.gov/science/about/
Topographic Feature Vocabularies and Semantics	The TOPO files contain a subset of basic data resources from The National Map to link to other RDF data. The LOD graphs are based on two primary resources: the USGS feature Name, relevant identification codes, and the Open Geospatial Consortium GeoSPARQL ontology.	https://www.usgs.gov/core-science-systems/ngp/cegis/linked-geospatial-data

ISO 19115-1 Codelists

Reference: https://standards.iso.org/iso/19115/resources/Codelists/cat/codelists.html

ISO 19115-1 Date Type Codes (Date element)

Date Type Code	Description
creation	date identifies when the resource was brought into existence
publication	date identifies when the resource was issued
revision	date identifies when the resource was examined or re-examined and improved or amended
adopted	date identifies when resource was adopted
deprecated	date identifies when resource was deprecated
distribution	date identifies when an instance of the resource was distributed
expiry	date identifies when resource expires
inForce	date identifies when resource became in force
lastRevision	date identifies when resource was last reviewed
lastUpdate	date identifies when resource was last updated
nextUpdate	date identifies when resource will be next updated
released	the date that the resource shall be released for public access
superseded	date identifies when resource was superseded or replaced by another resource
unavailable	date identifies when resource became not available or obtainable
validityBegins	time at which the data are considered to become valid. NOTE: There could be quite a delay between creation and validity begins
validityExpires	time at which the data are no longer considered to be valid
creation	date identifies when the resource was brought into existence
publication	date identifies when the resource was issued

ISO 19115-1 Progress Codes (Status element)

Progress Code	Description
completed	has been completed
historicalArchive	stored in an offline storage facility
obsolete	no longer relevant
onGoing	continually being updated
planned	fixed date has been established upon or by which the resource will be created or updated
required	needs to be generated or updated
underDevelopment	currently in the process of being created
final	progress concluded and no changes will be accepted
pending	committed to, but not yet addressed
retired	item is no longer recommended for use. It has not been superseded by another item
superseded	replaced by new
tentative	provisional changes likely before resource becomes final or complete
valid	acceptable under specific conditions
accepted	agreed to by sponsor

Progress Code	Description
notAccepted	rejected by sponsor
withdrawn	removed from consideration
proposed	suggested that development needs to be undertaken
deprecated	resource superseded and will become obsolete, use only for historical purposes

ISO 19115-1 Topic Category Codes (Topic Category element)

Topic Category Code	Description	Examples
farming	rearing of animals and/or cultivation of plants.	agriculture, irrigation, aquaculture, plantations, herding, pests and diseases affecting crops and livestock
biota	flora and/or fauna in natural environment.	wildlife, vegetation, biological sciences, ecology, wilderness, sealife, wetlands, habitat
boundaries	legal land descriptions.	political and administrative boundaries
climatologyMeteorologyAtmosphere	processes and phenomena of the atmosphere.	cloud cover, weather, climate, atmospheric conditions, climate change, precipitation
economy	economic activities, conditions and employment.	production, labor, revenue, commerce, industry, tourism and ecotourism, forestry, fisheries, hunting, exploration and exploitation of resources such as minerals, oil and gas
elevation	height above or below sea level.	altitude, bathymetry, digital elevation models, slope, derived products
environment	environmental resources, protection and conservation.	environmental pollution, waste storage and treatment, environmental impact assessment, monitoring environmental risk, nature reserves, landscape
geoscientificInformation	information pertaining to earth sciences.	geophysical features and processes, geology, minerals, sciences dealing with the composition, structure and origin of the earth s rocks, risks of earthquakes, volcanic activity, landslides, gravity information, soils, permafrost, hydrogeology, erosion
health	health, health services, human ecology, and safety.	disease and illness, factors affecting health, hygiene, substance abuse, mental and physical health, health services
imageryBaseMapsEarthCover	base maps.	land cover, topographic maps, imagery, unclassified images, annotations
intelligenceMilitary	military bases, structures, activities.	barracks, training grounds, military transportation, information collection
inlandWaters	inland water features, drainage systems and their characteristics.	rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, hydrographic charts
location	positional information and services.	addresses, geodetic networks, control points, postal zones and services, place names

Topic Category Code	Description	Examples
oceans	**features and characteristics of salt water bodies (excluding inland waters).**	**tides, tidal waves, coastal information, reefs**
planningCadastre	information used for appropriate actions for future use of the land.	land use maps, zoning maps, cadastral surveys, land ownership
society	characteristics of society and cultures.	settlements, anthropology, archaeology, education, traditional beliefs, manners and customs, demographic data, recreational areas and activities, social impact assessments, crime and justice, census information
structure	man-made construction.	buildings, museums, churches, factories, housing, monuments, shops, towers
transportation	means and aids for conveying persons and/or goods.	roads, airports/airstrips, shipping routes, tunnels, nautical charts, vehicle or vessel location, aeronautical charts, railways
utilitiesCommunication	energy, water and waste systems and communications infrastructure and services.	hydroelectricity, geothermal, solar and nuclear sources of energy, water purification and distribution, sewage collection and disposal, electricity and gas distribution, data communication, telecommunication, radio, communication networks
extraterrestrial	region more than 100 km above the surface of the earth	space, planets
disaster	information related to disasters	site of the disaster, evacuation zone, disaster prevention facility, disaster relief activities

ISO 19115-1 Role Codes (Responsible Party element)

Responsible Party Role Code	Description
author	the individual or organization whose name should appear first in the citation for the resource (for names that come after the first use co-author). while it is possible to have an author and principle investigator be the same individual or organization, author is not the same as nor synonymous with principle investigator. applicable mainly to documents, reports, memos, etc.
custodian	the individual or organization that has accountability and responsibility for the data and ensures appropriate care and maintenance of the resource.
distributor	the organization that is responsible for providing the PARR required access to the data.
originator	the name of the individual or organization who is responsible for the data at the point when the data was first created. applicable for datasets that are an aggregation of two or more datasets or if the dataset is the first instance of the signal having been converted into data.

Responsible Party Role Code	Description
owner	the individual or organization that has ownership of the resource.
pointOfContact	the individual or organization who is responsible for the initial triage of and answering questions related to the resource.
principalInvestigator	the individual or individuals who are the lead researchers for a grant (i.e. head of the laboratory, research group leader, etc.). if there are co-principal investigators then this field will repeat for each principle investigator. while it is possible to have a principal investigator and author be the same individual or organization, principal investigator is not the same nor synonymous with author.
processor	the name of the individual or organization who has processed the data in a manner such that the resource has been modified.
publisher	the individual or organization who prepares and issues the resource.
resourceProvider	the individual or organization that supplies or allocates the resource for another entity.
sponsor	the individual or organization who is providing sponsorship for the resource.
user	the individuals or organizations who are the intended consumers of the resource.
coAuthor	the individual(s) or organization(s) who name(s) should appear after the first name in a citation for the resource (use author to denote the first name in the citation). while it is possible to have a co-author and principal investigator/collaborator be the same individual or organization, co-author is no the same as nor synonymous with principle investigator or collaborator
collaborator	party who assists with the generation of the resource other than the principal investigator
contributor	the individuals or organizations whose contributions deserve recognition in the citation. contributor is mutually exclusive from author, co-author, principal investigator, and collaborator. use ISO MD_Identification credit field to identify individual or organizations that should be given acknowledgement only.
editor	the individual who has made a corrective or editorial change to the resource as part of a systematic revision process.
funder	the individual or organization which has provided all or part of the finances associated with the resource.
mediator	a class of entity that mediates access to the resource and for whom the resource is intended or useful
rightsHolder	the individual or organization who has ownership of the legal right to the resource.
stakeholder	an individual or organization who has an interest in the resource and/or is affected by or affects the actions of the resource