



Oregon Land Cover Standard

Version 1

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Draft Oregon Land Cover Data Standard

1.0 Introduction

Under the direction of the Oregon Geographic Information Council (OGIC), the Oregon Framework Implementation Team has delegated the development of a Land Cover Framework Implementation Plan and a prototype Land Cover Data Standard to the Framework Implementation Team Land Cover Subcommittee (LU-LC FIT). The Land Use – Land Cover Framework is a collection spatially referenced digital representations of broadly defined and not well integrated feature sets for Oregon. The Land Cover Framework Theme currently comprises (in no particular order): land use land cover – general; public land management / stewardship; recreation sites; historic sites; cemeteries; archaeological sites; and land use. Zoning for both non-UGB lands and for all lands has recently been moved to the Administrative Boundaries FIT, while ecoregions and vegetation have been moved to the Bio-FIT. Since vegetation has significant correlations with land cover classifications and standards, aspects of the vegetation theme will be considered here, although the vegetation standards and related standards (wetlands) are not part of this effort.

This document, the Oregon Land Use Data Standard, describes the first iterative component of a strategy to develop statewide framework land cover data, to assist with environmental benchmarks and natural resource agency policy analysis.

1.1 Mission and Goals of Standard

The Oregon Land Cover Data Standard will provide a consistent and maintainable structure for Land Cover data producers and users, which will help to ensure the compatibility of datasets within the same framework feature set and between other framework feature sets and themes. Specifically, the data standard will assist agencies responsible for the creation, maintenance, and distribution of land cover datasets by reducing the costs of data sharing, data development, and data maintenance. It will also help to ensure that land cover attribution is as up-to-date as possible.

The goal of the Land Cover Data Standard for Oregon is to ensure that Land Cover data applications are able to acquire data from disparate sources, use and display the results in an appropriate manner for the required need, and rely on local data-maintaining resources to assure that the most current dataset is available for all applications.

1.2 Relationship to Existing Standards

The Federal Geographic Data Committee (FGDC) has prepared a draft document entitled, *The Earth Cover Classification Standard*, which serves as a basis for the Oregon standard. All geospatial datasets developed under the Oregon Land Cover Data Standard must adhere to the Oregon Metadata Standard. (See this document for an introduction to the Oregon metadata standard: http://www.oregon.gov/DAS/IRMD/GEO/standards/docs/Metadata_Opportunity.pdf.)

1.3 Description of Standard

The Oregon Land Cover Data Standard describes the essential elements and data structure necessary to adequately describe, produce, and use land cover data in Oregon (in support of Oregon mandates). It is primarily concerned with a core set of geospatial information focused on

the need for standard representations that can be the source of evaluations of change and economic outputs from natural resources in Oregon. Unlike other states, Oregon has chosen to separate the concepts and standards for Land Use with those from Land Cover, and a separate and distinct Land Use standard may be adopted. Therefore, the categories of land cover defined primarily by land use types will be minimized in this standard. For the purposes of this standard, land cover is defined as a summary of the vegetation or material covering the land as seen from directly above. For definitions of general terms, see Appendix A. For land cover definitions, see Appendix B.

1.4 Applicability and Intended Use of Standard

For Oregon geospatial data, this standard is applicable to the feature set(s) that represent land cover. To distinguish between Land Use and to assure any developed land use datasets can be integrated into the land cover database, the characteristic set of upper level land use categories from the Land Use data standard are included in the content standard.

The intended use of this standard has three key components. First, it will enable data users to understand how land cover datasets were produced locally, how the locally produced and maintained datasets can be assembled into regional and statewide data collections, and which uses the producers deemed appropriate for the dataset. Second, it will guide accurate documentation of land cover datasets that are produced for and in Oregon. And third, it will facilitate the discussion of additional geospatial data standards surrounding the attributes that more detailed land use and vegetation standards optionally provide.

In general, the majority of land use datasets are raster, with the scale most frequently determined by the scale of the imagery used. This limits the ability to select standard scales for creating datasets. However, recommended scales based on the majority of standard products are recommended.

1.5 Standard Development Procedures

The Oregon Framework Implementation Team (Oregon FIT) has created a Land Use – Land Cover framework implementation team (LU-LC FIT), comprised of representatives from federal, state, regional, and local governmental agencies and universities. This team worked virtually to create this standard. A draft was produced as a straw man for review at the June 28, 2006 Forum workshop. Subsequently, the standard was revised and published for review and comment beginning July 2006 and ending at the 8th GIS Standards Forum in December 2006. Presentation and approval for endorsement occurred at the forum. The resulting proposed classification and coding scheme is contained in Appendix B. It is based on and designed to be compatible with existing, widely used classification schemes contained in Appendix C.

1.6 Maintenance of Standard

The Oregon Land Cover Data Standard will be revised as needed. Revisions can be initiated by members of the standards process or through comments from the community working on the creation or refinement of the Land Cover dataset. It is anticipated that as land cover data are collected at higher spatial accuracies, as geospatial applications mature, and as technology for capturing that higher resolution data improves, the standard will need to be updated. The update process could refine the range of attributes considered to be minimal or the quality of attributes

in the existing standard. The Institute for Natural Resources at OSU will be the horizontal integrator for this theme and will keep this standard current.

2.0 Body of the Standard

2.1 Scope and Content of the Standard

While many of the standards developed are primarily for data exchange, this standard is focused equally on data development and data exchange. This is because the Land Cover data tends to change fairly dramatically with the development of new satellite and computer technologies, and because there are not as many localized land covers developed. Therefore, this standard is focused first on data development, and secondly on data exchange. The short-term objective of the Oregon Land Cover Data Standard is to provide for publicly available, statewide land cover raster data at a 30-meter-pixel scale.

The initial assumption is that the standard Framework land cover data is raster. Vector data in Oregon would certainly be part of the standard for the vegetation and other related Framework datasets (wetlands, riparian, existing, historic and potential vegetation) and possibly the Land Use Data Standard. These related datasets would likely have a horizontal spatial accuracy of +/- 40 feet or better at a 95% confidence level, which is the USGS National Map Accuracy Standard for the 7.5 minute quadrangle map series, but not for land cover.

The content is focused on the essential data and metadata elements required for the individual (locally maintained) datasets, as well as the centralized (regional and/or statewide) datasets.

2.2 Need for the Standard

Many state, federal and local agencies depend on land cover maps to determine the effectiveness of their planning activities and to determine how the landscape is changing. Currently, the lack of a standard prevents integration of locally collected data with the coarser scale regional and national datasets. The exchange of this valuable information will be greatly simplified through the adoption of a minimal data specification and content standards.

2.3 Participation in Standards Development

The development of extensive standards for land cover-related geospatial data has not been undertaken anywhere. In 1976, Anderson (Anderson et al. 1976) developed a broad scale land use / land cover standard classification, which has been and continues to be widely used in spite of the rapid expansion of higher resolution data available today. Oregon's Land Cover Data Standard, and the process by which it will be updated and enhanced, is open to all agencies concerned with the development, maintenance, and application of land cover data to the resolution of land cover-related business functions. As with all Oregon Framework standards, public review of and comment on the Oregon Land Cover Data Standard is encouraged. An outline of Oregon's process for the development and extension of geospatial data standards can be found at http://www.gis.state.or.us/coord/standards/Standards_Development_Effort.pdf.

Participation in the LU-LC FIT has been fairly limited, although it does span the spectrum of governmental agencies in Oregon. Currently, LU-LC FIT is led by the Institute for Natural Resources at Oregon State University. Important time and resource commitments from the

Department of Administrative Services, DLCD, the City of Eugene, the University of Oregon's InfoGraphics Lab and other University of Oregon faculty, and the faculty at Oregon State University have allowed this to be developed. We have also had participation by the Sanborn Corporation and other non-governmental groups.

2.4 Integration with Other Standards

The Oregon Land Cover Data Standard follows the same format as other Oregon Framework standards. The specifics of the standard are intimately related to the land use dataset, and the methodology for integrating these standards needs to be determined when the Land Use Data Standard is completed. The standard for the vegetation datasets will need to be integrated also. The state of Oregon, through their Bioscience Framework Implementation Team, is establishing separate vegetation and wetland mapping data standards, which should integrate into and be informed by the land cover Framework database.

2.5 Technical and Operation Context

2.5.1 Data Environment

The data environment for this standard is the raster model. The Oregon Statewide Framework Land Cover data will be an ESRI 30-meter GRID.

2.5.2 Reference Systems

Three coordinate reference systems are typically used within Oregon: the Oregon State Plane system (divided into State Plane North and State Plane South along the county boundaries near 44 degrees north latitude), Universal Transverse Mercator (divided into UTM Zone 10 and UTM Zone 11 along the meridian at 120 degrees west longitude), and Oregon Lambert. For more details see <http://egov.oregon.gov/DAS/IRMD/GEO/coordination/projections/projections.shtml>. Oregon Lambert is preferred. The horizontal integrator will assemble and distribute Framework datasets in Oregon Lambert. The reference system and datum must be clearly documented in the metadata accompanying the dataset and a projection defined.

2.5.3 Integration of Themes

The primary Framework elements supported by the Land Cover Data Standard are land cover and vegetation. Information on rule sets for integrating information for these elements into the land cover standard will be developed when the framework vegetation and wetland standards are adopted.

2.5.4 Encoding

Encoding translates user formats into standard formats. These are not an issue for Land Cover raster data.

2.5.5 Resolution

The resolution of any land cover dataset will vary according to data capture methods and the applications that those data must support. However, this standard recommends a set of resolutions which will meet most needs and are reflected in current technology and based on an assessment of common needs.

These include:

| Mapping Scale | Pixel Size |
|--------------------------------|-------------------|
| Statewide and regional mapping | 30 m |
| Basin and ecoregion mapping | 10 m |
| Watershed or county mapping | 4 m |
| Local or site mapping | 0.5 m |

Minimum mapping units (MMU) are often applied to land use raster datasets to address random pixel clutter, especially at finer resolutions. MMUs are not appropriate at the 1-km grid scale. Adopting a standard MMU for each of the three smaller scales listed above has the potential to simplify integration of local and regional maps. Some recommended MMUs are:

| Mapping Scale | MMU |
|--------------------------------|------------|
| Statewide and regional mapping | 2 ha |
| Basin and ecoregion mapping | 1 ha |
| Watershed or county mapping | 0.5 ha |
| Local or site mapping | 0.09 ha |

Minimum mapping units could be pixel size or aggregated to 0.5 hectare (0.5 ha = 5.555 30m pixels). Alternately, four pixels aggregated would create a 0.36 ha MMU, while 9 pixels create a 0.81 ha MMU. The 0.5 ha proposal keeps the standard MMU somewhat independent of the pixel resolution used. The need for higher resolution vegetation data has been identified in relation to Oregon Progress Board environmental benchmarks, and similarly, higher resolution land use data is clearly needed by Metro, many local governments, and the Department of Land Conservation and Development (DLCD). The Oregon Land Use FIT has clearly identified the need to improve the scale of statewide mapping satellite imagery from 30- to 10-meter resolution, although this cannot become the standard until new satellite data is available and affordable statewide. It is not clear that higher resolution (0.5-meter or 1-meter or 4-meter pixel) land cover data is needed, although it is clearly desired in some locations. It is also not clear whether these higher resolution imagery datasets would lead to the FIT adopting a MMU smaller than 0.5 ha for this dataset.

2.5.6 Accuracy

As with resolution, the intention of the standard is to support varying levels of positional and attribute accuracy. However, it is essential to the success of the data standard that all aspects of the data be completely documented (either at the feature or dataset level). Spatial products which conform to the National Map Accuracy Standard should be used for source material in digital data capture if available and suitable (<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/index.html>).

The minimal positional accuracy for vector data reflects the National Map Accuracy Standard for the 1:24,000 USGS quadrangle series (+/- 40 feet for 95% of well-known features). The Proposed Land Cover Standard (Earth Cover Standard) has no recommended map accuracy standards. However, since the NAIP imagery is intended to be the basis for fine scale mapping in Oregon, the positional accuracy of +/- 17 meters (55.8 ft) would be the recommended finest level. The national standard for 1:24,000 data with a 0.5 mm error distance is 12 m (39.4 ft).

2.5.7 Edge Matching

This standard is intended to support seamless datasets across Oregon. Similar datasets from adjacent states and adjacent mapping areas using the same reference system should merge without gaps. This will be facilitated by extending the mapped area by 2-10 kilometers beyond the project area or administrative boundary. The horizontal steward, in concert with the custodial stewards of the adjacent mapped areas, will resolve any classification or mapping issues within the overlapping area.

2.5.8 Feature Identifier

Feature identifiers are not relevant for raster datasets. If at some time, polygon data is included in this standard, feature identifiers for polygons will be determined.

2.5.9 Attributes

Attributes are any of the additional information that is collected and shared in relation to the land cover class, applied to each raster cell. See Section 3 for the specification of minimal and optional characteristics for land covers.

2.5.10 Transactional Updating

Transactional updating processes are being explored for the Oregon Land Cover Database.

2.5.11 Records Management

Unlike many other datasets, the assumption is that land cover datasets will consist of a limited sets of distinct editions. Past versions of the Oregon Land Cover data will be trackable through the relational database management system hosted by the OSU Libraries, as part of the Oregon Explorer Digital Natural Resources Library. Archived datasets will be made available through the Oregon University System.

2.5.12 Metadata

The Oregon Land Cover data standard follows the Oregon Core Metadata Standard for geospatial data. Metadata detailing the characteristics and quality of submitted land cover data must be provided. Stewards should make every effort to meet the more rigorous standards of the Federal Metadata Content Standard where feasible. Metadata must provide sufficient information to allow the user to determine whether it is appropriate for the intended purpose, as well as telling the user how to access the data.

3.0 Data Characteristics

The data characteristics specified below are subject to revision based on the implementation of the Land Use or Land Cover statewide mapping effort.

3.1 Minimum Graphic Data Elements

None specified at this time.

3.2 Minimum Attribute or Non-graphic Data Elements

None specified at this time.

3.3 Optional Graphic, Attribute or Non-graphic Data Elements

None specified at this time.

3.4 Raster Object Information (from FGDC Content Standard)

These are the types and numbers of raster spatial objects in the dataset.

Type: compound

Short Name: rastinfo

3.4.1 Raster Object Type

Raster spatial objects used to locate zero-, two-, or three-dimensional locations in the dataset.

Type: text

Domain: (With the exception of "voxel," the domain is from "Spatial Data Concepts," which is chapter 2 of part 1 in Department of Commerce, 1992, Spatial Data Transfer Standard (SDTS) (Federal Information Processing Standard 173): Washington, Department of Commerce, National Institute of Standards and Technology): "Point" "Pixel" "Grid Cell" "Voxel"

Short Name: rasttype

3.4.2 Row Count

The maximum number of raster objects along the ordinate (y) axis. For use with rectangular raster objects.

Type: Integer

Domain: Row Count > 0

Short Name: rowcount

3.4.3 Column Count

The maximum number of raster objects along the abscissa (x) axis. For use with rectangular raster objects.

Type: Integer

Domain: Column Count > 0

Short Name: colcount

3.4.4 Vertical Count

The maximum number of raster objects along the vertical (z) axis. For use with rectangular volumetric raster objects (voxels).

Type: Integer

Domain: Depth Count > 0

Short Name: vrtcount

3.4.5 Coordinate Resolution

Coordinate resolution information is encoded in section 4. For raster data recorded in geographic (longitude-latitude) coordinates, use "Latitude Resolution" (4.1.1.1) and "Longitude Resolution"(4.1.1.2). For planar (x-y) coordinates, use "Abscissa Resolution" (4.1.2.4.2.1) and "Ordinate Resolution" (4.1.2.4.2.2). For other (local) systems, include resolution information in "Local Description" (4.1.3.1). The resolution of vertical measurements should be provided in "Altitude Resolution" (4.2.1.2) for altitudes or elevations and "Depth Resolution" (4.2.2.2) for depths.

Appendix A. Definition of Terms

(Selected extractions from Parts 0 and 5 of the Geographic Information Framework Data Content Standard)

| <u>Term</u> | <u>Definition</u> |
|----------------------------|---|
| Accuracy | <p>Absolute - A measure of the location of features on a map compared to their true position on the face of the earth.</p> <p>Relative - A measure of the accuracy of individual features on a map when compared to other features on the same map.</p> |
| Areal | Two-dimensional. |
| Attribute | Attributes are the characteristics of features . |
| Boundary | Set that represents the limit of a feature . |
| Custodial Steward | Agency or organization responsible for specific tasks relating to maintaining certain geospatial data. |
| Feature | Abstraction (point, line or polygon) of a real world phenomenon stored within geospatial software. |
| Feature Delineation | Criteria or rules for defining the limits of a feature and how it will be represented geometrically in a dataset. |
| FGDC | Federal Geographic Data Committee |
| GNIS | Geographic Names Information System. The official repository of geographic names in the United States, managed by US Geological Survey. |
| Geospatial Software | Mapping software with analytical capabilities. |
| Horizontal Steward | The agency or organization responsible for assembling and providing access to a statewide dataset of a particular type . |
| Line | A feature built of vectors connecting at least two points. |

| | |
|---------------------------------|---|
| Maintenance Relationship | Relative dependency between two or more geographic areas for maintaining common boundary or area information. |
| Metadata | Data about data. |
| NSDI | National Spatial Data Infrastructure. The effort of the FGDC to create and implement a shared data collection and maintenance resource for geospatial datasets. |
| Polygon | Bounded surface for which the interior configuration is not directly specified |
| Raster | One or more overlapping layers for the same grid or digital image. |
| Raster Object | One or more images and/or grids, each grid or image representing a layer, such that corresponding grid cells and/or pixels between layers are congruent and registered. |
| Resolution | The minimum difference between two independently measured or computed values which can be distinguished by measurement or analytical method being considered or used. |
| Spatial Relationship | Relative spatial location of a geographic area in terms of one or more geographic areas. |
| Type | Class of real world occurrences with common characteristics. |
| Unique Identifier | Every feature is assigned an identifier that is unique to it. |
| Vertical Steward | The agency or organization responsible for assuring that a dataset of a particular type can be used with other Framework elements. |

Appendix B. Oregon Land Use Classification and Coding Scheme

- 100. Water and Perennial Snow/Ice
 - 110. Open Water
 - 111. Reservoirs
 - 112. Lakes and Ponds
 - 113. Bays and Estuaries
 - 114. Rivers and Streams
 - 120. Perennial Ice/Snow
- 200. Developed, non-agriculture
 - 210. Recreation (Developed Open Space)
 - 211. Open Space / Parks – Non-Native Forested
 - 212. Open Space / Parks – Native Forested –(park understory)
 - 213. Open Space Parks, lawns (Golf Course, ballparks, mowed areas)
 - 214. Developed campgrounds
 - 220. Low Density Residential
 - 221. Residential Low Density Forested
 - 222. Residential Low Density Non-forested
 - 230. Developed, Medium Intensity
 - 240. Urban and Industrial (Developed High Intensity) (includes paved roads)
- 300. Barren or Non-Vegetated
 - 310. Barren Land
 - 311. Playa or salt flat
 - 312. Rock or Lava
 - 313. Ash or Badland
 - 314. Dune
 - 320. Unconsolidated Shore
 - 321. Beach
 - 322. Rocky Shoreline
 - 360. Burn
 - 370. Mines, Industrial barrens, unpaved roads (disturbed, permeable surfaces)
- 400. Forest
 - 410. Deciduous Forest
 - 411. Mature
 - 415. Developing
 - 420. Evergreen Forest
 - 421. Large Coniferous Forest
 - 422. Medium Coniferous Forest
 - 423. Small Coniferous Forest
 - 424. Broadleaf Evergreen Mature
 - 425. Broadleaf Evergreen Developing
 - 426. Mixed Broadleaf-Coniferous Mature
 - 427. Mixed Broadleaf-Coniferous Developing
 - 430. Mixed Forest
 - 440. Transitional Forest (< 5 years)

- 500. Shrubland
 - 510. Dwarf shrubland (< 0.5 m, probably not in Oregon)
 - 520. Short (0.5 – 2 m)
 - 530. Tall Shrubland (>2 m)
 - 540. Shrub Steppe
 - 550. Wooded Steppe (shrub savanna)
- 600. Non-Natural Woody
 - 610. High Structure Agriculture
 - 881. Orchards
 - 882. Berries/Vineyards/Hops
 - 883. Christmas trees
 - 884. Nurseries
 - 620. Non-native or exotic invasive forest or shrubland
- 700. Grasslands – Herbaceous Upland
 - 710. Perennial Grasslands/Herbaceous
 - 720. Annual Grasslands/Herbaceous (exotic, invasive)
 - 730. Wooded grassland (savanna)
- 800. Agriculture (Planted/Cultivated)
 - 810. Pasture/Hay
 - 811. Irrigated Pasture/Hay
 - 812. Irrigated Alfalfa
 - 813. Dryland Alfalfa
 - 814. Other non-irrigated pasture
 - 820. Cultivated Crops
 - 821. Row Crops
 - 822. Mint
 - 823. Sugar beets
 - 824. Potatoes
 - 825. Onions
 - 830. Grains
 - 840. Fallow
 - 850. Grass seed
- 900. Wetlands
 - 910. Woody Wetlands
 - 911. Palustrine Forested Wetland
 - 912. Palustrine Exotic or Invasive Forested Wetland
 - 913. Palustrine Scrub/Shrub Wetland
 - 914. Palustrine Shrub/Scrub Exotic or Invasive Wetlands
 - 915. Estuarine Forested Wetland
 - 920. Emergent Herbaceous Freshwater Wetlands
 - 921. Invasive or Exotic Dominated Herbaceous Freshwater Wetlands
 - 930. Estuarine, Intertidal and Marine Vegetation

Oregon Land Use Classification Definitions

100. Water and Perennial Snow/Ice - All areas of open water or permanent ice/snow cover.

110. Open Water - All areas of open water, generally with less than 25% cover of vegetation or soil.

111. Reservoirs – Man made open water bodies with regular boundaries, usually on stream and river networks.

112. Lakes and Ponds – Lakes, ponds and other natural water bodies.

113. Bays and Estuaries – Coastal, non oceanic water bodies.

114. Rivers and Streams – Open water, part of a stream or river network.

120. Perennial Ice/Snow - All areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.

200. Developed, non-agriculture - Areas characterized by a high percentage (30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc).

210. Recreation (Developed Open Space) - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses or horticultural shrubs and tree plantings. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

211. Open Space / Parks – Non-Native Forested

212. Open Space / Parks – Native Forested – (park understory)

213. Open Space Parks, lawns (Golf Course, ballparks, mowed areas) -Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

214. Developed campgrounds – Areas with a mix of natural habitats and developed (paved or gravel) campsites, with > 40% cover of lawns, gravel, or packed dirt from development.

220. Low Density Residential - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

221. Residential Low Density Forested – Low density residential areas with > 25% of total forest cover.

222. Residential Low Density Non-forested – Low density residential areas with < 25% of total forest cover.

230. Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

240. Urban and Industrial (Developed High Intensity) (includes paved roads) - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.

300. Barren or Non-Vegetated - Areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

310. Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

311. Playa or salt flat – Barren areas of white, alkaline material, usually from closed basin evaporation area.

312. Rock or Lava – Exposed rock, lava flows, mountain massif.

313. Ash or Badland – Barren ash deposits or badlands, usually with less than 15% total vegetative cover.

314. Dune – Sandy deposits, usually with less than 15% total vegetative cover.

320. Unconsolidated Shore - Unconsolidated material such as silt, sand, or gravel that is subject to inundation and redistribution due to the action of water. Characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms representing this class.

321. Beach - Unconsolidated sand, or gravel that is subject to inundation and redistribution due to the action of water. Lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Found along oceans and very large water bodies.

322. Rocky Shoreline – Ocean shores with unconsolidated rocks and boulders.

360. Burn – Unvegetated areas recently burned, where no vegetation is remaining.

370. Mines, Industrial barrens - log yards, strip mines, gravel pits, yarding and landing areas and other accumulations of earthen material, created by industry. Generally, vegetation accounts for less than 15% of total cover. Also includes roads and linear surfaces that are not paved, including gravel and dirt roads, parking lots, and cleared or treated powerlines.

400. Forested Upland - Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover.

410. Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

- 411. Mature Deciduous Forest** – Deciduous forest with large trees or trees > 40 years old or with mean stand diameter > 50 cm (20 inches).
- 412. Developing Deciduous Forest** – Deciduous forest with small trees or trees < 40 years old or with mean stand diameter < 50 cm (20 inches).
- 420. Evergreen Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
- 421. Large Coniferous Forest** – Areas with more than 75% needle leaved trees, representing giant or mature conditions (over 80 years old or mean stand diameter > 80 cm (32 inches)).
- 422. Medium Coniferous Forest** – Areas with more than 75% needle leaved trees, representing moderate or mid seral conditions (between 40 - 80 years old or mean stand diameter between 50 – 80 cm (20 – 50 inches)).
- 423. Small Coniferous Forest** – Areas with more than 75% needle leaved trees representing young or early seral conditions (any forest < 40 years old or with mean stand diameter < 50 cm (20 inches)).
- 424. Broadleaf Evergreen Mature** – Areas with more than 75% broadleaf evergreen trees representing mature conditions (over 60 years old or mean stand diameter > 50 cm (20 inches)).
- 425. Broadleaf Evergreen Developing** – Areas with more than 75% broadleaf evergreen trees representing early seral or young conditions (< 60 years old or with mean stand diameter < 50 cm (20 inches)).
- 426. Mixed Broadleaf-Coniferous Mature** – Areas with neither broadleaf evergreen trees or needle leaved trees with more than 75% cover, representing mature conditions (over 60 years old or mean stand diameter > 50 cm (20 inches)).
- 427. Mixed Broadleaf-Coniferous Developing** – Areas with Areas with neither broadleaf evergreen trees or needle leaved trees with more than 75% cover, representing early seral or young conditions (< 60 years old or with mean stand diameter < 50 cm (20 inches)).
- 430. Mixed Forest** – Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
- 440. Transitional Forest** – Young, recently established mixed forest < 5 years).
- 500. Shrubland** - Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.
- 510. Dwarf Shrubland (Dwarf Scrub)** – Areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation. NLCD maps this type in Alaska only.

520. Short Shrubland (Shrub/Scrub) – Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.

530. Tall Shrubland – Areas dominated by shrubs >2 m; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation.

540. Shrub Steppe – Shrublands characterized by natural or semi-natural shrub and grassland mixed vegetation, with shrub cover between 5 and 25%, and the majority of ground cover dominated by graminoids.

550. Wooded Steppe (shrub savanna) – Shrub steppe with between 5-25% cover of woody species taller than 5 meters tall.

600. Non-Natural Woody – Areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25-100 percent of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.

610. High Structure Agriculture – Orchards, nurseries, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.

881. Orchards – Orchards and nuts, self supporting large or small trees

882. Berries/Vineyards/Hops – Berries, vineyards and hops, usually with artificial support.

883. Christmas trees – Christmas tree farms

884. Nurseries – Nursery operations.

620. Non-native or exotic invasive forest or shrubland – Shrublands and forests dominated by non-native, exotic shrubs or trees, with > 25% shrub + tree cover.

700. Herbaceous Upland – Upland areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover.

710. Perennial Grassland/Herbaceous – Areas dominated by perennial graminoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

720. Annual Grasslands/Herbaceous – Areas dominated by annual or herbaceous annual vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing. In Oregon, these are entirely dominated by introduced, exotic species.

730. Wooded grassland (savanna) – Upland areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover, but with 5-25% cover of woody species taller than 5 meters, and with shrub (woody species < 5 meters tall) cover less than 5%.

800. Agriculture (Planted/Cultivated) – Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained

in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.

810. Pasture/Hay – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

811. Irrigated Pasture/Hay – Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation. Includes clover mixes.

812. Irrigated Alfalfa – Irrigated areas used for the production of alfalfa.

813. Dryland Alfalfa – Non-irrigated areas used for the production of alfalfa.

814. Other non-irrigated pasture – Areas of planted grasses, legumes or mixtures for the production of hay or livestock grazing.

820. Cultivated Crops – Areas used for the production of annual crops, such as corn, vegetables, and potatoes. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled, except for fallow lands.

821. Row Crops – Areas used for the production of annual vegetable row crops. Crop vegetation accounts for greater than 50% of total vegetation.

822. Mint – Mint fields

823. Sugar beets – Areas used for the production of sugar beets.

824. Potatoes – Areas used for the production of potatoes.

825. Onions – Areas used for the production of onions, garlic and related crops.

830. Grains (small grains) – Non-irrigated grain production (wheat, barley, rye).

840. Fallow – Areas used for the production of crops that do not exhibit visible vegetation as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.

850. Grass seed – Grass seed production areas.

900. Wetlands – Areas where soil or substrate is periodically saturated with or covered with water.

910. Woody Wetlands – Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

911. Palustrine Forested Wetland – Includes all tidal and non-tidal wetlands dominated by trees (woody vegetation greater than or equal to 5 meters in height) and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

912. Palustrine Exotic or Invasive Forested Wetlands – Includes all tidal and non-tidal wetlands dominated by non-native, exotic or invasive, non native trees (woody vegetation greater than or equal to 5 meters in height) and all such wetlands that occur in tidal areas

in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

913. Palustrine Scrub/Shrub Wetland – Includes all tidal and non-tidal wetlands dominated by shrubs (woody vegetation less than 5 meters in height), and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs or trees that are small or stunted due to environmental conditions.

914. Palustrine Scrub/Shrub Exotic Wetland – Includes all tidal and non-tidal wetlands dominated by exotic or invasive, non-native shrubs (woody vegetation less than 5 meters in height), and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs or trees that are small or stunted due to environmental conditions.

915. Estuarine Forested Wetland – Includes all tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

920. Emergent Herbaceous Freshwater Wetlands – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

921. Invasive or Exotic Emergent Herbaceous Freshwater Wetlands – Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

930. Estuarine, Intertidal and Marine Vegetation – Includes all tidal wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

Appendix C. Other Content Standards for Land Cover Mapping

Proposal for an **Earth Cover Classification Standard** – September 13, 1999

Type of Standard Proposed: A uniform earth cover classification standard that classifies earth surface features.

Submitting Organization: Earth Cover Working Group (ECWG), Co-chaired by the United States Department of Commerce (USDoC) National Oceanic and Atmospheric Administration (NOAA) and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

Point of Contact: Dorsey Worthy, NOAA C-CAP, 2234 S. Hobson Ave, Charleston, SC, 29405-2413; [(843) 740-1234] or E-Mail= Dorsey.Worthy@noaa.gov
George Cross, USDA NRCS, 5601 Sunnyside Ave., Beltsville, MD. 20705-5475
[(301) 504-2280] or E-Mail=George.Cross@usda.gov

Objectives: The purpose of the Earth Cover Classification Standard (ECCS) is to facilitate the production and exchange of earth cover digital data. The standard will define common terminology and will be applicable over extensive areas and at a range of scales. Application of the ECCS will be repeatable and consistent and will be compatible, where possible, with other earth cover/land cover classification systems.

Scope: The ECCS will identify the classification categories for earth cover data. The ECCS categories will encompass 100% of the earth's surface and, in orientation, will look down upon the earth. The ECWG will coordinate with the Federal Geographic Data Committee (FGDC) Subcommittees to refine the categories. Vegetation, water, snow, ice, human constructions, bare soil, sand and exposed rocks qualify as cover surfaces. Land use classifications will NOT be developed. Detailed identification will not be developed for cover categories such as vegetation, soil, transportation, wetlands and cultural features because they are being addressed by other FGDC subcommittees or are already provided by the FGDC's "Vegetation Classification standard."

Justification/Benefits: This standard is to meet the FGDC responsibility under E.O. 12906, dated April 13, 1994 and OMB Circular(s) A-16 and A-119. There is no current national FGDC approved ECCS. An ECCS provides common terminology and definition for earth cover. By not addressing interpretations such as land use, the ECCS will be more flexible, simpler to use, and to understand. Another benefit will be an increase in the efficiency of using earth cover data as users share experience involving applications. At some point in time, the FGDC will develop a land use standard, and it is expected by the ECWG that the ECCS will be a necessary building block in that land use standard.

Development Approach: The Earth Cover Working Group was established on February 13, 1996, by the FGDC Coordination Group. The ECWG will formulate the ECCS by beginning with the work of the FGDC Vegetative Subcommittee and will incorporate material as appropriate from other FGDC subcommittees.

Non-vegetated areas of the globe, such as rocky or permanently snow or ice covered land, will have earth cover categories developed. Cover categories for areas covered by water or ice, irregardless of depth, will also be accommodated, as appropriate in the ECCS. It is expected that the FGDC accuracy standards will be incorporated in the ECCS.

Related Standards: The proposed ECCS will utilize the FGDC's "Vegetation Classification Standard." It is also expected that the completed Wetlands Classification Standard will integrate with the ECCS. The ECCS should also be part of the foundation for land use studies. While the ECCS will utilize the Vegetative Classification Standard, there may be a need for either one to be revised.

There also are other, earlier, classification systems, such as Andersen, et.al.(1976) that combine land use and earth cover. The ECCS intends to be as compatible with these early systems as possible but will not incorporate land use terminology. At some point in time, the FGDC will develop a land use standard, and the ECWG expects that the ECCS will be a necessary building block in that land use standard.

Development and Completion Schedule:

- A. Develop draft Earth Cover Classification Standard. October 1999
- B. Develop a comment procedure for the ECCS. November 1999
- C. Revise ECCS as a result of comments received. February 2000
- D. Operate test pilots of the revised ECCS. Spring 2000
- E. Incorporate changes revealed by pilot tests. May 2000
- F. Submit revised Standard to the FGDC Standard's June 2000 Committee.

Resources Required: The ECCS is being developed using existing staffing and funding from the ECWG membership and the FGDC.

Potential Participants: To date the ECWG has consulted with a variety of government agencies and organizations in the development of this classification scheme. The principal organizations that have been involved since beginning of the ECWG are United States Geological Service, NOAA, NRCS, Defense Department's Corp of Engineers, Bureau of the Census, and the Department of the Interior. The ECWG will continue to solicit involvement and input from other Federal agencies, that should be involved, and from State, Local and private groups as the standard moves through the formal FGDC process.

Other Targeted Authorization Bodies: This proposed standard is not currently targeted for consideration by any other authorizing bodies, such as American National Standards Institute. As a classification standard, it is expected that this proposed standard will follow the FGDC approving process.

Anderson Coding and Classification System (modified by EPA)

Description:

Abstract: This is land use/land cover digital data collected by USGS and converted to ARC/INFO by the EPA. This data is useful for environmental assessment of land use patterns with respect to water quality analysis, growth management, and other types of environmental impact assessment. Use may be limited due to currency.

Land use and land cover data LU/LC collected by the USGS NMD is useful for environmental assessment of land use patterns with respect to water quality analysis, growth management, and other types of environmental impact assessment.

Data are meant to be used by quadrangle, or among adjacent quadrangles where temporally contiguous. Can be used in any geographic application where intermediate scale land use data are appropriate and the dates are representative.

The most common mapping system, described here, is the land use and land cover data. Land use was mapped and coded using the Anderson classification system (Anderson others, 1976) which is a hierarchical system of general (level 1) to more specific (level 2) characterization. Some agencies have taken this to a level 3 classification -- but this has not been done in the GIRAS series.

The salient attribute managed for this polygon dataset in the polygon attribute table (PAT) is the column named LUCODE containing the Anderson level 2 classification. The first digit represents the level one value and the second digit (ones place) represents the subdivision of the level 1 or level 2 value.

The Anderson land use codes are:

- 1 Urban or built-up land
- 11 Residential
- 12 Commercial and services
- 13 Industrial
- 14 Transportation, communication, utilities
- 15 Industrial and commercial complexes
- 16 Mixed urban or built-up land
- 17 Other urban or built-up land
- 2 Agricultural land
- 21 Cropland and pasture
- 22 Orchards, groves, vineyards, nurseries, and ornamental horticultural
- 23 Confined feeding operations
- 24 Other agricultural land
- 3 Rangeland
- 31 Herbaceous rangeland
- 32 Shrub and brush rangeland
- 33 Mixed rangeland
- 4 Forest land
- 41 Deciduous forest land
- 42 Evergreen forest land
- 43 Mixed forest land

- 5 Water
- 51 Streams and canals
- 52 Lakes
- 53 Reservoirs
- 54 Bays and estuaries
- 6 Wetland
- 61 Forested wetland
- 62 Nonforested wetland
- 7 Barren land
- 71 Dry salt flats
- 72 Beaches
- 73 Sandy areas not beaches
- 74 Bare exposed rock
- 75 Strip mines, quarries, gravel pits
- 76 Transitional areas
- 8 Tundra
- 81 Shrub and brush tundra
- 82 Herbaceous tundra
- 83 Bare ground
- 84 Wet tundra
- 85 Mixed tundra
- 9 Perennial snow or ice
- 91 Perennial snowfields
- 92 Glaciers

Purpose: To convert the GIRAS data into EPA's standard Geographic Information System (GIS) called ARC/INFO software from ESRI.

Supplemental Information: Intended use of data: This data layer is intended to be used with ARC/INFO Geographic Information System (GIS) applications.

References Cited:

James R. Anderson, Ernest E. Hardy, John T. Roach, and Richard E. Witmer. 1976. A Land Use and Land Cover Classification System for Use with Remote Sensor Data. USGS Professional Paper 964, Reston, Virginia.
<ftp://www-nmd.usgs.gov/pub/ti/LULC/lulcpp964>

Limitations of Data: Conterminous United States.

USGS National Land Cover Dataset (NLCD)

Content Citation

Content Title:

U.S.G.S. National Land Cover Dataset (NLCD)

Content Type:

planning, and cadastral, Agricultural Data, Soils and Vegetation. Land Use Data, land-use land-cover, landcover, Live data and maps

Publisher:

U.S. Geological Survey U.S. Geological Survey Sioux Falls, SD

Publication Date:

20010704

Content Description

Content Summary:

The USGS, in cooperation with the USEPA, has produced a land cover dataset for the conterminous US, based on Landsat Thematic Mapper imagery (circa 1992) and supplemental data. The National Land Cover Dataset (NLCD) contains 21 categories of land cover information.

Content Purpose:

The National Land Cover Dataset is suitable for a variety of State and regional applications, including landscape analysis, land management, and modeling nutrient and pesticide runoff. The NLCD are intended for regional scale analysis (approximately 1:100,000).

Supplemental Information:

For more information on the USGS National Land Cover Dataset and the National Land Cover Characterization Program: <http://edcwww.cr.usgs.gov/programs/lccp/>

Time Period of Content

Beginning Date:

2001-07-04

Content Status

Progress:

Completed

Update Frequency:

unknown

Spatial Domain

West Coordinate:

-124.5114991

East Coordinate:

-67.2337154

North Coordinate:

49.0021688

South Coordinate:

25.4404855

Coverage Area:

48 Conterminous United States

Content Keywords

Theme Keywords:

planning, and cadastral, Agricultural Data, Soils and Vegetation, Land Use Data, land-use land-cover landcover

Spatial Data Information

Data Projection:

Latitude/Longitude

- 11 Open Water
- 12 Perennial Ice/Snow
- 21 Low-Intensity Residential
- 22 High-Intensity Residential
- 23 Commercial/Industrial/Transportation
- 31 Bare Rock/Sand/Clay
- 32 Quarries/Strip Mines/Gravel Pits
- 33 Transitional
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Shrubland
- 61 Orchards/Vineyards/Other
- 71 Grasslands/Herbaceous
- 81 Pasture/Hay
- 82 Row Crops
- 83 Small Grains
- 84 Fallow
- 85 Urban/Recreational Grasses
- 91 Woody Wetlands
- 92 Emergent Herbaceous Wetlands

Definitions for US Land Cover Dataset Categories: <http://www.epa.gov/mrlc/definitions.html>

Appendix D. Referenced Documents and Web Links

- Anderson, James R., Ernest E. Hardy, John T. Roach, and Richard E. Witmer. 1976. *A Land Use and Land Cover Classification System for Use with Remote Sensor Data*. USGS Professional Paper 964, Reston, Virginia. www-nmd.usgs.gov/pub/ti/LULC/lulcpp964
- Federal Geographic Data Committee. 1997. *National Vegetation Classification Standard*. NVC endorsed as standard by FGDC 1997-1998.
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/index_html
- Federal Geographic Data Committee. 2001. *Revisions to the National Standards for the Physiognomic Levels of Vegetation Classification in the United States*. Standard proposed by the FGDC Vegetation Subcommittee.
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/physiognomic-levels/index_html
- Oregon Natural Heritage Program. 2003. *Oregon Natural Heritage Plan*. Department of State Lands, Salem. 167 pp. http://oregonstate.edu/ornhic/ornh_plan.pdf
- Environmental Systems Resource Institute. *ESRI shapefile technical description: An ESRI white paper (July 1998)* - <http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>.
- US Geological Survey. National Map Accuracy Standard -
<http://rockyweb.cr.usgs.gov/nmpstds/acrodcs/nmas/NMAS647.PDF>.
- US Geological Survey. Geographic Names Information System (GNIS) -
<http://geonames.usgs.gov>.
- Oregon Geographic Information Council. *Oregon Metadata Standard*. Proposed adoption of FGDC metadata standard as standard for Oregon.
http://egov.oregon.gov/DAS/IRMD/GEO/standards/docs/Metadata_Opportunity.pdf