

## LAND USE/LAND COVER CODES

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### I. PURPOSE

Maps of land use and land cover are fundamental tools for natural resource management and planning. These land use/cover codes provide a standard system by which units of land can be categorized. Land use/cover maps serve to:

- assess the area and distribution of individual land use/cover categories (such as cropland and pasture, code 21)
- show the diversity of the landscape
- contrast the land diversity of different regions
- monitor changes in land use and/or cover over time

The VGIS Land Use/Land Cover Codes have been developed to:

- provide compatibility with existing USGS codes,
- provide codes tailored to Vermont's landscape,
- permit land coding at a various resolutions (local, regional and state),
- avoid and clarify redundant classifications which depend on interpretation.

### II. LAND USE AND LAND COVER

GIS provides new tools for mapping the landscape. Although land use and land cover are quite different, they are frequently lumped together on a single map. Land use and land cover, however, are very different ways of looking at the land:

- Land Cover:*
- The vegetative, barren, liquid or artificial (human-made) material covering the land.
  - Land cover can be interpreted from aerial photographs or satellite imagery with varying degrees of accuracy.

- Land Use:*
- The actual use of the land by its human inhabitants.
  - Land use may at times be based on property boundaries (as in a municipal park), but the actual use of the land will not necessarily correspond to land ownership.

In a GIS it is feasible to view land use and land cover in a combined data layer, or as separate data layers. Some individual land categories will be developed as GIS data layers completely separate from land use/cover mapping. For example, surface waters and wetlands, both components of a land cover map, are being developed as separate data

layers. A land use/cover mapping project should make use of existing data layers when possible.

Land use is the actual human activity for which the land is used, which may differ from the promoted use of the land. For example, zoning is generally not considered a land use since an area with "three acre zoning" may actually have much less than one unit per three acres. The delineation of residential areas may be particularly tricky. Mappers should be systematic in their methods, which should be well documented to enable proper interpretation of their maps in the future. Documentation might include language such as: "Land use and cover were photo-interpreted from 1:5000 orthophotos. Residential areas were delineated at the boundaries between homesteads (including yards or gardens) and the surrounding woods and fields. The density of residential single family/duplex areas (code 113) was determined by assigning a number of homes to residential area polygons, and computing the number of units per acre."

**III. THE CODING HIERARCHY**

VGIS Land Use/Land Cover Codes are an expansion of USGS land categories developed by Anderson and others (1976) for use with remotely sensed images. The codes are organized into four hierarchical levels. At the top of the hierarchy, first level includes:

1. Urban and built-up land
2. Agricultural land
3. Brush or transitional between open and forest
4. Forest
5. Water
6. Wetlands
7. Barren land
8. Tundra
9. Permanent snow and ice (no known examples in Vermont)

Each sub-level contains at most 9 categories (1 through 9). Level one has the lowest resolution, or detail of the landscape, while level four has the highest resolution. For example, a permanent pasture would be coded as follows at each of the four levels:

<u>Level</u>	<u>Code</u>	<u>Category</u>	<u>Resolution</u>
1	2	Agricultural land	Low
2	21	Cropland and Pasture	
3	212	Hay/rotation/permanent pasture	
4	2123	Permanent pasture	High

The USGS level 1 and level 2 codes were used for the VGIS codes with these changes:

- Rangeland (3) was changed to Brush or Transitional Between Open and Forested, since there are no real rangelands in Vermont,
- a Mixed Herbaceous and Shrub/Brush code (33) was added,
- level 2 codes were added for Tundra (8).

#### IV. RESOLVING CONFLICTS BETWEEN CODES

For some land units, more than one code will be possible. *The recommended rule for resolving conflicts is to use the code that comes first in the numbering sequence.* This rule is meant to be used for a combined land use/land cover map. For example, a grove of maples used for producing maple syrup may be considered either a Sugarbush (code 225) or as Northern Hardwoods, Sugar Maple (code 4121). In this case, the lower code (225) would be used. Likewise, a campground with mixed woods would be coded as Campground (1936) instead of as a Mixed Coniferous-Broadleaf Forest (43), because 1936 precedes 43 in the numbering sequence.

Only levels 1 and 2 (Urban/built-up and Agricultural land) emphasize land use, while levels 3 to 9 are almost exclusively land cover categories. If the rule above is used to resolve coding conflicts, the resulting map will emphasize land use over land cover. Land cover can be emphasized by selecting the code that is *higher* in the numbering sequence when conflicts occur. Whichever method is used, it should be followed systematically and clearly documented.

#### V. USE OF THE CODES

Mappers will choose how to use the codes to best suit their needs. Maps can be made in which:

- only land use is coded
- only land cover is coded
- a single code is used to for mixed land use/land cover
- separate land use and land cover codes are assigned to each unit of land (thus to each GIS polygon)
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It will not always be feasible to code land for land use only, because remote areas often will not have appropriate land use codes. Land use maps will generally be restricted to developed areas when using these codes. More extensive land use coding schemes exist, however, and can be provided by VCGI.

If land use and land cover are separately coded, it is likely that some boundaries will be shared between land use and land cover maps. The following ARC/Info polygon attribute table (PAT) items are recommended for a combined land use/land cover GIS map:

<u>Item</u>	<u>Type</u>	<u>Width</u>	<u>For</u>
LUSEyy	I	4	Land use only
LCOVERyy	I	4	Land cover only
LULCyy	I	4	Combined land use/land cover

"yy" refers to the year of interpretation, so that LCOVER90 would be the land cover interpreted for 1990. All item types are I (integer).

**VI. LAND USE/LAND COVER CODES**

**1 URBAN AND BUILT-UP LAND**

11 RESIDENTIAL

111 Multi-family, medium to high rise apartments & condominiums (3 or more stories)

- 1111 more than 50 units/acre
- 1112 36 to 50 units/acre
- 1113 21 to 35 units/acre
- 1114 10 to 21 units/acre
- 1115 1 to 10 units/acre

112 Multi-family, low rise apartments and town houses, but not duplexes; (1 or 2 stories)

- 1121 more than 18 units/acre
- 1122 12 to 18 units/acre
- 1123 8 to 12 units/acre
- 1124 less than 8 units/acre

113 Single family/duplex

- 1131 more than 8 units/acre
- 1132 5 to 8 units/acre
- 1133 3 to 4 units/acre
- 1134 1 to 2 units/acre
- 1135 less than 1 unit/acre

114 Mobile home parks

- 1141 more than 9 units/acre (legal Vermont maximum of 9 units/acre)
- 1142 6 to 9 units/acre
- 1143 2 to 5 units/acre
- 1144 less than 2 units/acre

115 Group and transient quarters

- 1151 Rooming and boarding houses
- 1152 Shelters
- 1153 Residence halls and dormitories
- 1154 Retirement homes and orphanages
- 1155 Religious quarters
- 1156 Residential hotels
- 1157 Fraternities/sororities
- 1159 Other group & transient quarters

119 Other residential

**VI. LAND USE/LAND  
COVER CODES  
(continued)**

**1 URBAN AND BUILT-UP LAND (continued)**

12 COMMERCIAL, SERVICES AND INSTITUTIONAL

- 121 Commercial retail
  - 1211 Building materials, hardware and farm equipment
  - 1212 General merchandise/department store
  - 1213 Food/groceries
  - 1214 Automotive, marine craft, aircraft and accessories/dealers
  - 1215 Furniture, home furnishings and equipment
  - 1216 Eating and drinking (restaurants)
  - 1217 Gasoline/petroleum
  - 1218 Farm stand
  - 1219 Other (Not elsewhere)
- 122 Commercial wholesale
  - 1221 Food/sundries/beverages
  - 1222 Agricultural products/supplies
  - 1223 Lumber/hardware/building supplies/paper
  - 1224 Industrial product/chemical/petroleum
  - 1225 Motor vehicles/parts/supplies
  - 1229 Other
- 123 Services
  - 1231 Banking
  - 1232 Personal services
  - 1233 Professional services
  - 1234 Self-storage
  - 1235 Day care
  - 1236 Contract construction services
  - 1237 Automotive services/car washes
  - 1238 Agricultural sales/services
  - 1239 Other services
- 124 Lodging
  - 1241 Hotel/motel
  - 1242 Bed and breakfast
  - 1249 Other lodging
- 125 Government
  - 1251 Correctional
  - 1252 Military
  - 1253 Courthouse
  - 1254 Postal service
  - 1255 Administrative offices
  - 1256 Emergency services
  - 1257 Public works

**1 URBAN AND BUILT-UP LAND (continued)**

**VI. LAND USE/LAND  
COVER CODES  
(continued)**

12 COMMERCIAL, SERVICES AND INSTITUTIONAL (continued)

1259 Other government

126 Institutional

1261 Religious

1262 Hospital

1263 Medical clinics

1264 Nursing

1265 Social organizations/associations

1269 Other institutional

127 Educational

1271 Preschool

1272 Elementary

1273 Middle

1274 High school

1275 College/university

1276 Vocational/trade

1279 Other educational

128 Indoor cultural/public assembly

1281 Museum

1282 Theatre

1283 Amusement

1284 Sport

128 Indoor cultural/public assembly (continued)

1289 Other indoor cultural assembly

129 Other commercial, services and institutional

13 INDUSTRIAL

131 Primary metal production

132 Petrochemicals

133 Primary wood processing and paper mills

134 Stone, clay, glass

135 Metal & non metal fabrication

136 Food processing

137 Mining

1371 Hard rock

1372 Quarry

1373 Sand/gravel

1379 Other mining

138 Home/cottage industries

139 Other industrial

**1 URBAN AND BUILT-UP LAND (continued)**

**VI. LAND USE/LAND  
COVER CODES  
(continued)**

- 14 TRANSPORTATION, COMMUNICATION AND UTILITIES
  - 141 Air transportation
    - 1411 Commercial
    - 1412 Non-commercial
    - 1413 Heliports
    - 1419 Other air transportation
  - 142 Rail transportation
    - 1421 Rail yard
    - 1422 Station or terminal
    - 1423 Active rail line
    - 1424 Inactive rail line
    - 1429 Other rail transportation
  - 143 Water transportation
    - 1431 Port facilities
    - 1439 Other water transportation
  - 144 Road transportation
    - 1441 Limited & controlled highway right-of-way
    - 1442 Road right-of-way
    - 1443 Truck terminal
    - 1444 Bus terminal
    - 1445 Park/ride lot
    - 1446 Parking structure/lot
    - 1449 Other road transportation
  - 145 Communication
    - 1451 Radio station
    - 1452 Telecommunications facilities
    - 1453 Television station
    - 1454 Transmitters/towers
    - 1459 Other communication
  - 146 Electric, gas and other utilities
    - 1461 Electric transmission lines
    - 1462 Electric power generation facilities
    - 1463 Gas or oil pipeline (natural, propane or other)
    - 1464 Gas or oil storage facilities
    - 1469 Other utilities
  - 147 Water & wastewater utilities
    - 1471 Water treatment plant
    - 1472 Aqueduct
    - 1473 Water storage tanks
    - 1474 Wastewater treatment
    - 1475 Interceptors
    - 1479 Other water/wastewater utilities

**1 URBAN AND BUILT-UP LAND (continued)**

**VI. LAND USE/LAND  
COVER CODES  
(continued)**

- 14 TRANSPORTATION, COMMUNICATION AND UTILITIES (Continued)
  - 148 Solid waste utilities
    - 1481 Active landfills
    - 1482 Inactive dump sites
    - 1483 Recycling/transfer stations
    - 1484 Incinerator
    - 1485 Composting facility
    - 1486 Sludge processing facility
    - 1487 Hazardous waste collection/processing facility
    - 1488 Junkyards
    - 1489 Other solid waste facilities
  - 149 Other communication, utilities
  
- 15 INDUSTRIAL AND COMMERCIAL COMPLEXES
  - 151 Industrial park
  - 152 Office park
  - 153 Shopping center/mall
  - 159 Other industrial/commercial complexes
  
- 16 MIXED (areas where level 2 uses are mixed with no one use predominating)
  - 161 Multiple stories, residential in upper stories only
    - 1621 Commercial lower level
    - 1622 Services lower level
    - 1623 Mixed commercial/services lower level
    - 1629 Other mixed uses in lower level
  - 169 Other mixed level 2 uses
  
- 17 OUTDOOR AND OTHER URBAN AND BUILT-UP LAND
  - 171 Outdoor cultural
    - 1711 Botanical gardens and arboretums
    - 1712 Zoos
    - 1719 Other outdoor cultural
  - 172 Outdoor public assembly
    - 1721 Amphitheaters
    - 1722 Drive-in movies
    - 1723 Stadiums
    - 1724 Racetracks
    - 1725 Fairgrounds
    - 1726 Amusement parks
    - 1729 Other outdoor public assembly
  - 173 Outdoor recreation
    - 1731 Playground or play field

**VI. LAND USE/LAND  
COVER CODES  
(continued)**

**1 URBAN AND BUILT-UP LAND (continued)**

- 1732 Sports areas
- 1733 Water recreation/marina/launch
- 1734 Ski area
- 1735 Golf course
- 1736 Campground
- 1737 Parks and recreation
- 1739 Other outdoor recreation
- 174 Cemeteries
- 179 Other outdoor urban, built-up and developed

**2 AGRICULTURAL LAND**

**21 CROPLAND AND PASTURE**

**211 Row crops (not including orchards and berries, code 22)**

- 2111 Corn (land cover includes silage corn)
- 2112 Silage (corn or grasses)
- 2113 Potatoes
- 2114 Soybeans
- 2115 Alfalfa
- 2118 Other root crops
- 2119 Other non-root crops

**212 Hay/rotation/permanent pasture**

- 2121 Hay
- 2122 Rotation pasture
- 2123 Permanent pasture
- 2124 Idle agricultural land; use level 3 for land cover
- 2129 Other pasture

**213 Grains (not including row crops)**

- 2131 Wheat
- 2132 Oats
- 2133 Sorghum
- 2134 Barley
- 2139 Other grains (not including row crops)

**22 ORCHARDS, BUSH FRUITS, VINEYARDS AND ORNAMENTAL  
HORTICULTURE**

**221 Tree fruits, regularly spaced (planted)**

- 2211 Apples
- 2212 Pears
- 2219 Other tree fruits

**222 Bush and vine fruits (in rows)**

- 2221 Strawberries
- 2222 Raspberries

- 2223 Blueberries
- 2224 Grapes
- 2229 Other bush and vine fruits
- 223 Ornamental horticulture & nurseries (floriculture, etc.)
- 224 Tree farms
  - 2241 Christmas tree farms
  - 2242 Other coniferous trees
  - 2243 Deciduous trees
  - 2249 Other tree farms
- 225 Sugarbush
- 229 Other orchards, etc.

**23 CONFINED FEEDING OPERATIONS**

- 231 Livestock
  - 2311 Beef
  - 2312 Dairy
  - 2313 Swine
  - 2314 Lamb
  - 2319 Other livestock
- 232 Poultry
  - 2321 Chickens
  - 2322 Turkeys
  - 2329 Other
- 233 Pisciculture
  - 2331 Aquaculture
  - 2332 Fish hatchery
- 239 Other confined feeding operations

**24 OTHER AGRICULTURAL LAND**

- 241 Farmsteads
- 242 Greenhouses and mushroom houses
- 243 Stables & racetracks (non-commercial training areas)
- 244 Sod
- 249 Other

**3 BRUSH OR TRANSITIONAL BETWEEN OPEN AND FORESTED**

- 31 HERBACEOUS, NON-WOODY VEGETATION
- 32 SHRUB/BRUSH
- 33 MIXED HERBACEOUS AND SHRUB/BRUSH
- 34 RECENTLY LOGGED, PARTIAL CANOPY (UP TO 25%)
- 35 RECENTLY CLEAR CUT

**4 FOREST** ([nn] = Society of American Foresters type number)

## 41 BROADLEAF FOREST (generally deciduous)

## 411 Boreal hardwoods

- 4111 Aspen [16]
- 4112 Pin cherry [17]
- 4113 Paper birch [18]
- 4119 Other boreal hardwoods

## 412 Northern hardwoods

- 4121 Sugar maple [27]
- 4122 Sugar maple/Beech/Birch [25]
- 4123 Sugar maple/Basswood [26]
- 4124 Black cherry/Maple [28]
- 4125 Beech/Sugar maple [60]
- 4126 Red maple [28]
- 4129 Other northern hardwoods

## 413 Upland oaks

- 4131 Chestnut oak [44]
- 4132 White oak/Black oak/Northern red oak [52]
- 4133 White oak [53]
- 4134 Black oak [110]
- 4135 Northern red oak [55]
- 4136 Northern pin oak [14]
- 4139 Other upland oaks

## 414 Other hardwoods

- 4141 Gray birch/Red maple [19]
- 4142 Black ash/Elm/Red maple [39]
- 4143 Hawthorn [104]

## 42 CONIFEROUS FOREST (generally evergreen)

## 421 Boreal conifers

- 4211 Jack pine [1]
- 4212 Balsam fir [5]
- 4213 Black spruce [12]
- 4214 Black spruce/Tamarack [13]
- 4215 White spruce [107]
- 4216 Tamarack [38]
- 4219 Other boreal conifers

## 422 Spruce-fir types

- 4221 Red spruce [32]
- 4222 Red spruce/Balsam fir [33]
- 4223 Red spruce/Fraser fir [34]
- 4224 Northern white cedar [37]
- 4229 Other spruce-fir types

## 423 Pine and hemlock

- 4231 Red pine [15]
- 4232 White pine [21]
- 4233 White pine/Hemlock [22]
- 4234 Eastern hemlock [23]
- 4235 Eastern red cedar [46]
- 4239 Other pine and hemlock

43 MIXED CONIFEROUS-BROADLEAF FOREST

- 431 Mixed spruce-fir types
  - 4311 Red spruce/Yellow birch [30]
  - 4312 Red spruce/Sugar maple/Beech [31]
  - 4313 Paper birch/Red spruce/Balsam fir [35]
- 432 Mixed pine/hemlock types
  - 4321 White pine/Red oak/Red maple [20]
  - 4322 White pine/Chestnut oak [51]
  - 4323 Hemlock/Yellow birch [24]

**5 WATER** (see 143 for transportation uses and 233 for agricultural uses)

51 RIVERS, CANALS AND OTHER WATERWAYS

- 511 Canal
- 512 River or Stream
- 519 Other waterways

52 LAKES AND PONDS

53 RESERVOIRS (and other artificial water surfaces)

54 BAYS/ESTUARIES

61 FORESTED WETLAND

- 651 Broad-leaved deciduous
- 652 Needle-leaved deciduous
- 653 Broad-leaved evergreen
- 654 Needle-leaved evergreen
- 655 Dead

62 NON-FORESTED WETLAND

- 621 Aquatic bed
  - 6211 Algal
  - 6212 Aquatic moss

- 6213 Rooted vascular
- 6214 Floating
- 622 Moss-lichen
  - 6221 Moss dominant (bogs and fens)
  - 6222 Lichens dominant
- 623 Emergent wetland
  - 6231 Wet meadow
  - 6232 Shallow marsh
  - 6233 Deep marsh
- 624 Scrub-shrub wetland
  - 6241 Broad-leaved deciduous
  - 6242 Needle-leaved deciduous
  - 6243 Broad-leaved evergreen
  - 6244 Needle-leaved evergreen
  - 6245 Dead

## 7 BARREN LAND

### 71 SALT FLATS

### 72 BEACHES AND RIVER BANKS

- 721 Sand beach
- 722 Gravel beach
- 723 River banks
- 729 Other beaches/riverbanks

### 73 SANDY AREAS (NON-BEACHES)

- 731 Sand dunes
- 732 Sand pits
- 739 Other sandy areas

### 74 BARE/EXPOSED ROCK

- 741 Rock knobs
- 742 Escarpments/Cliffs
- 743 Shoreline rock outcrop
- 744 Riverbank rock outcrop
- 749 Other bare/exposed rock

### 75 STRIP MINE/QUARRY OR GRAVEL PIT

### 79 OTHER BARREN LANDS

## 8 TUNDRA

81 SHRUB AND BRUSH

82 HERBACEOUS

83 BARE GROUND

84 WET

85 MIXED

**9 PERMANENT SNOW & ICE** (no known examples in Vermont)