

# ***ISO 19131 – Land Use 1990, 2000, 2010 Data Product Specifications***

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Revision: A

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# 1 OVERVIEW

## 1.1 Informal description

The 1990, 2000 and 2010 Land Use (LU) maps cover all areas of Canada south of 60°N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and consist of: Forest, Water, Cropland, Grassland, Settlement and Otherland (barren land, ice, rock and unclassified). These maps were developed in response to a need for explicit, high-accuracy, high-resolution land use data to meet AAFC's commitments in international reporting, especially for the annual National Inventory Report (NIR) to the United Nations Framework Convention on Climate Change (UNFCCC), the Agri-Environmental program of the Organization for Economic Co-operation and Development (OECD) and the FAOSTAT component of the Food and Agriculture Organization of the United Nations (FAO).

The LU maps were prepared using existing source data, including a variety of land cover (LC) and crop maps and various topographic layers such as Buildings and Structures, Hydrography, Industrial and Commercial Areas, Transportation and Wetlands from the CanVec program of Natural Resources Canada (NRCan). All available source data was carefully co-registered and a series of 'rules' were developed in order to generate a LU class for each year for each of 6.7 billion pixels. The rules followed the principle of "preponderance of evidence" and were developed using logic, class accuracies of the various products and expert knowledge. Examples of rules are: "If 3 input products indicate forest and 2 indicate water, then the output is forest", or "If one input with an accuracy of 85% indicates settlement and another with accuracy of 82% indicates water, then the output is settlement". The use of a variety of input products covering the time period from 1990 to 2012 also enabled the development of 'logical' rules such as "settlement does not disappear". The development of a LU map based on IPCC classes also necessitated the elimination of the input LC class "shrubland" as that is not considered a use. "Shrubland" was converted to other classes (primarily forest or grassland) on the basis of other inputs, location and proximity. A "discrepancy resolution" procedure based on the same and additional rules was developed and applied at each pixel to "v0.9" of the 3 maps in order to resolve incidents of temporal discrepancy, such as a pixel being classified as water in 1990, forest in 2000 and water in 2010. Finally, accuracy assessment was conducted using 7138, 7219, and 4063 randomly selected points for 1990, 2000 and 2010 respectively.

## 1.2 Data product specifications – Metadata

This section provides metadata about the creation of this data product specification

Dataset title:	Land Use 1990, 2000 and 2010 (LU1990, LU2000, LU2010)
Dataset reference date:	2015-01-01
Dataset responsible party:	Agriculture and Agri-Food Canada
Dataset language:	English, French
Dataset topic category:	; Land Use

## 1.3 Terms and Definitions

Feature: map depiction of a real-world phenomenon

Attribute: characteristic of a feature

Class: a set of objects that share the same attributes, operations, methods, relationships, and semantics;

Object: entity with a well-defined boundary and identity that encapsulates state and behaviour (an instance of a class);

#### 1.4 Abbreviations

AAFC	Agriculture and Agri-Food Canada
LU	Land Use
LC	Land Cover
CanVec	"Canada Vectors"; a digital cartographic product in vector format

## 2 SPECIFICATION SCOPE

This data specification has only one scope, the general scope.

NOTE: The term 'specification scope' originates from the International Standard ISO19131. 'Specification scope' does not express the purpose for the creation of a data specification or the potential use of data, but identifies partitions of the data specification where specific requirements apply.

## 3 DATA PRODUCT IDENTIFICATION

### 3.1 Data series identification

Title	Land Use 1990, 2000 & 2010
Alternate Title	None
Abstract	The 1990, 2000 and 2010 Land Use (LU) maps cover all areas of Canada south of 60°N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and consist of: Forest, Water, Cropland, Grassland, Settlement and Otherland.
Purpose	The 1990, 2000 and 2010 Land Use (LU) maps were developed in response to a need for explicit, high-accuracy, high-resolution land use data to meet AAFC's commitments in international reporting, especially for the annual National Inventory Report (NIR) to the United Nations Framework Convention on Climate Change (UNFCCC), the Agri-Environmental program of the Organization for Economic Co-operation and Development (OECD) and the FAOSTAT component of the Food and Agriculture Organization of the United Nations (FAO)
Topic Category	Land Use
Spatial Representation Type	Grid
Spatial Resolution	30 meters
Geographic Description	Canada UTM Zones 9 -22 South of 60 Degrees North
Supplemental Information	None

Constraints	Data are subject to the Government of Canada Open Data Licence Agreement available at <a href="http://www.data.gc.ca">www.data.gc.ca</a> .
Keywords	Thesaurus: Government of Canada Core Subject Thesaurus ( <a href="http://www.thesaurus.gc.ca/recherche-search/thes-eng.html">http://www.thesaurus.gc.ca/recherche-search/thes-eng.html</a> ) Date: February 1, 2000 Keywords: Land Use, Agriculture, Environment, Forestry
Scope Identification	Series

### 3.2 Data product specification

#### 3.2.1 Land Use 1990

Title	Land Use 1990
Alternate Title	LU1990
Abstract	The 1990 Land Use (LU) map covers all areas of Canada south of 60°N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and consist of: Forest, Water, Cropland, Grassland, Settlement and Otherland.
Purpose	The 1990 Land Use (LU) map was developed in response to a need for explicit, high-accuracy, high-resolution land use data to meet AAFC's commitments in international reporting.
Topic Category	Land Use
Spatial Representation Type	Grid
Spatial Resolution	30 meters
Geographic Description	Canada UTM Zones 9 -22 South of 60 Degrees North
Supplemental Information	Accuracy assessment. See section 6.5
Constraints	Data are subject to the Government of Canada Open Data Licence Agreement available at <a href="http://www.data.gc.ca">www.data.gc.ca</a> .
Keywords	Thesaurus: Government of Canada Core Subject Thesaurus ( <a href="http://www.thesaurus.gc.ca/recherchearch/thes-eng.html">http://www.thesaurus.gc.ca/recherchearch/thes-eng.html</a> ) Date: February 1, 2000 Keywords: Land Use, Agriculture, Environment, Forestry
Scope Identification	Dataset

#### 3.2.2 Land Use 2000

Title	Land Use 2000
Alternate Title	LU2000
Abstract	The 2000 Land Use (LU) map covers all areas of Canada south of 60°N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and consist of: Forest, Water, Cropland,

	Grassland, Settlement and Otherland.
Purpose	The 2000 Land Use (LU) map was developed in response to a need for explicit, high-accuracy, high-resolution land use data to meet AAFC's commitments in international reporting.
Topic Category	Land Use
Spatial Representation Type	Grid
Spatial Resolution	30 meters
Geographic Description	Canada UTM Zones 9 -22 South of 60 Degrees North
Supplemental Information	Accuracy assessment. See section 6.5
Constraints	Data are subject to the Government of Canada Open Data Licence Agreement available at <a href="http://www.data.gc.ca">www.data.gc.ca</a> .
Keywords	Thesaurus: Government of Canada Core Subject Thesaurus ( <a href="http://www.thesaurus.gc.ca/recherche-search/thes-eng.html">http://www.thesaurus.gc.ca/recherche-search/thes-eng.html</a> ) Date: February 1, 2000 Keywords: Land Use, Agriculture, Environment, Forestry
Scope Identification	Dataset

### 3.2.3 Land Use 2010

Title	Land Use 2010
Alternate Title	LU2010
Abstract	The 2010 Land Use (LU) map covers all areas of Canada south of 60°N at a spatial resolution of 30 metres. The LU classes follow the protocol of the Intergovernmental Panel on Climate Change (IPCC) and consist of: Forest, Water, Cropland, Grassland, Settlement and Otherland.
Purpose	The 2010 Land Use (LU) map was developed in response to a need for explicit, high-accuracy, high-resolution land use data to meet AAFC's commitments in international reporting.
Topic Category	Land Use
Spatial Representation Type	Grid
Spatial Resolution	30 meters
Geographic Description	Canada UTM Zones 9 -22 South of 60 Degrees North
Supplemental Information	Accuracy assessment. See section 6.5
Constraints	Data are subject to the Government of Canada Open Data Licence Agreement available at <a href="http://www.data.gc.ca">www.data.gc.ca</a> .
Keywords	Thesaurus: Government of Canada Core Subject Thesaurus ( <a href="http://www.thesaurus.gc.ca/recherche-search/thes-eng.html">http://www.thesaurus.gc.ca/recherche-search/thes-eng.html</a> ) Date: February 1, 2000 Keywords: Land Use, Agriculture, Environment, Forestry
Scope Identification	Dataset

## 4 DATA STRUCTURE AND SCOPE

### 4.1 Feature-based application schema

Not applicable

### 4.2 Feature Catalogue

Title	Land Use 1990, 2000 & 2010
Scope	Series
Version Number	1
Version Data	January 1, 2015
Producer	Agriculture and Agri-Food Canada

Note: System-generated attributes (for example, OBJECTID, Shape, Shape Length and Area) are not defined in the feature catalog.

### 4.3 Feature Attributes

#### 4.3.1 Class (Value)

Name	Class( Value)		
Definition			
Aliases			
Producer	AAFC		
Value Data Type	Integer		
Value Domain Type	1 (enumerated)		
Value Domain			
Feature Attribute Value	Label	Code	Definition
	Unclassified	11	Areas not classified due to clouds
	Settlement	21	Built-up and urban
	Roads	25	Primary, secondary and tertiary
	Water	31	Natural and human-made
	Forest	41	Treed areas >1 ha in size
	Forest Wetland	42	Wetland with forest cover
	Trees	45	Treed areas <1 ha in size
	Treed Wetland	46	Wetland with tree cover
	Cropland	51	Annual and perennial
	Grassland Managed	61	Natural grass and shrubs used for cattle grazing
	Grassland Unmanaged	62	Natural grass and shrubs with no apparent use (forest openings, alpine meadows, tundra, etc.)
	Wetland	71	Undifferentiated wetland
	Wetland Shrub	73	Wetland with shrub cover
	Wetland Herb	74	Wetland with grass cover
Other land	91	Rock, beaches, ice, barren land	

## 5 REFERENCE SYSTEMS

### 5.1 Spatial Reference System

#### 5.1.1 UTM Datasets

Horizontal coordinate reference system: WGS 84

**Map projection:** UTM zone 10N; EPSG:32610, UTM zone 11N; EPSG:32611, UTM zone 12N; EPSG:32612, UTM zone 13N; EPSG:32613, UTM zone 14N; EPSG:32614, UTM zone 15N; EPSG:32615, UTM zone 16N; EPSG:32616, UTM zone 17N; EPSG:32617, UTM zone 18N; EPSG:32618, UTM zone 19N; EPSG:32619, UTM zone 20N; EPSG:32620

### 5.1.2 Web Mapping Application

**Horizontal coordinate reference system:** WGS 84

**Map projection:** Web Mercator Auxiliary Sphere; EPSG: 3857

### 5.2 Temporal Reference System

Gregorian calendar

## 6 DATA QUALITY

### 6.1 Completeness

DQ_Scope	All information represents landuse in Canada, south of 60 <sup>0</sup> N latitude.
DQ_Element	1 - Completeness
DQ_Subelement	1 - Commission
DQ_Measure	
DQ_MeasureDesc	Pass-Fail
DQ_MeasureID	
DQ_EvalMethod	
DQ_EvalMethodType	2 - external
DQ_EvalMethodDesc	All pixels fall within the borders of Canada, south of 60 <sup>0</sup> N latitude.
DQ_Result	
DQ_ValueType	1 - Boolean
DQ_Value	TRUE
DQ_ValueUnit	NA
DQ_Date	31-Jan-15
DQ_ConformanceLevel	Zero commissions in dataset
Dataset Parameters	X records in dataset.
Quality Result Meaning	Dataset passes.

### 6.2 Logical Consistency

Measure not defined at this time

### 6.3 Positional Accuracy

Measure not defined at this time

Not tested

### 6.4 Temporal Accuracy

DQ_Scope	1990 Geocover Product.	2000 Geocover Product.	2010 Geocover Product.
DQ_Element	4 – Temporal accuracy	4 – Temporal accuracy	4 – Temporal accuracy
DQ_Subelement	2– Temporal consistency	2– Temporal consistency	2– Temporal consistency
DQ_Measure			
DQ_MeasureDesc	Pass-Fail	Pass-Fail	Pass-Fail
DQ_MeasureID			
DQ_EvalMethod			
DQ_EvalMethodType	1 - external	1 - external	1 - external
DQ_EvalMethodDesc	Imagery utilized covers years 1988 through 1994	Imagery utilized covers years 1998 through 2002	Imagery utilized covers years 2009 through 2012
DQ_Result			
DQ_ValueType	1 - Boolean	1 - Boolean	1 - Boolean
DQ_Value	TRUE	TRUE	TRUE
DQ_ValueUnit	NA	NA	NA
DQ_Date	31-Jan-15	31-Jan-15	31-Jan-15
DQ_ConformanceLevel	Dataset conforms to expectations.	Dataset conforms to expectations.	Dataset conforms to expectations.
Dataset Parameters	X records in dataset.	X records in dataset.	X records in dataset.
Quality Result Meaning	Dataset passes.	Dataset passes.	Dataset passes.

## 6.5 Classification Accuracy

The following confusion matrices were compiled through comparison of each map with randomly generated points at which ground-truth information for the appropriate year was collected through field survey or visual aerial photo or high-resolution satellite image interpretation. The overall accuracy was estimated at 84.0%, 87.1% and 92.7% for 1990, 2000 and 2010 respectively. Since some locations can legitimately be both Wetland and Forest and others can be both Water and Wetland, overall accuracies improve to 89.1%, 90.6% and 94.7% for 1990, 2000 and 2010 respectively if misclassifications between those classes are not considered errors. The greatest amount of misclassification occurs between Otherland and Forest, Grassland and Forest, Cropland and Forest and Wetland and Forest. The majority of error occurs with boundary pixels.

### LU1990

Ground-Truth ↓	← Map →							Total	Users accuracy
	Forest	Water	Cropland	Settlement	Wetland	Otherland	Grassland		
Forest	2781	32	56	23	113	11	12	3028	91.8%
Water	25	1372	6	2	9	1	3	1418	96.8%
Cropland	103	3	524	37	26	5	35	733	71.5%
Settlement	4	0	18	190	5	0	0	217	87.6%
Wetland	172	74	40	9	859	17	9	1180	72.8%
Otherland	87	8	5	8	30	91	13	242	37.6%
Grassland	78	7	26	1	29	2	177	320	55.3%
<b>Total</b>	<b>3250</b>	<b>1496</b>	<b>675</b>	<b>270</b>	<b>1071</b>	<b>127</b>	<b>249</b>	<b>7138</b>	

Producers accuracy      85.6%      91.7%      77.6%      70.4%      80.2%      71.7%      71.1%  
**Overall accuracy =      84.0%**  
**K<sub>nat</sub> (Kappa) =          78.0%**

**LU2000**

Ground-Truth ↓	← Map →							Total	Users accuracy
	Forest	Water	Cropland	Settlement	Wetland	Otherland	Grassland		
Forest	2870	28	48	19	85	8	13	3071	93.5%
Water	18	1181	6	3	8	1	2	1219	96.9%
Cropland	84	27	1004	25	36	0	45	1221	82.2%
Settlement	3	0	15	217	5	0	0	240	90.4%
Wetland	109	55	35	1	776	17	7	1000	77.6%
Otherland	60	6	3	4	27	75	11	186	40.3%
Grassland	61	5	27	0	23	2	164	282	58.2%
<b>Total</b>	<b>3205</b>	<b>1302</b>	<b>1138</b>	<b>269</b>	<b>960</b>	<b>103</b>	<b>242</b>	<b>7219</b>	

Producers accuracy      89.5%      90.7%      88.2%      80.7%      80.8%      72.8%      67.8%  
**Overall accuracy =      87.1%**  
**K<sub>nat</sub> (Kappa) =          82.4%**

**LU2010**

Ground-Truth ↓	← Map →							Total	Users accuracy
	Forest	Water	Cropland	Settlement	Wetland	Otherland	Grassland		
Forest	1719	12	20	5	24	7	8	1795	95.8%
Water	8	839	1	0	3	1	0	852	98.5%
Cropland	12	3	429	5	3	1	7	460	93.3%
Settlement	3	0	0	50	2	2	0	57	87.7%
Wetland	43	14	2	0	464	19	5	547	84.8%
Otherland	41	3	0	0	3	182	4	233	78.1%
Grassland	16	0	18	0	1	2	82	119	68.9%
<b>Total</b>	<b>1842</b>	<b>871</b>	<b>470</b>	<b>60</b>	<b>500</b>	<b>214</b>	<b>106</b>	<b>4063</b>	

Producers accuracy      93.3%      96.3%      91.3%      83.3%      92.8%      85.0%      77.4%  
**Overall accuracy =      92.7%**  
**K<sub>nat</sub> (Kappa) =          89.8%**

## 6.6 Lineage statement

### 6.6.1 Land Use 1990

Lineage Statement	Derived from: <ul style="list-style-type: none"> <li>- Land Cover for Agricultural regions of Canada, c.2000</li> <li>- Circa1990 Geocover</li> <li>- Canadian Forest Service (CFS): Earth Observation for Sustainable Development of Forests Land Cover, c.2000</li> <li>- Rasterized CanVec base features</li> <li>- Southern Ontario Land Resource Information System (2000-2002), v 1.2</li> <li>- AAFC (AESB/EOS) Prairie Grassland Extents, c.2010</li> <li>- National Road Network (NRN) Roads</li> </ul>
Scope	Dataset (Land Use 1990)

### 6.6.2 Land Use 2000

Lineage Statement	Derived from: <ul style="list-style-type: none"> <li>- Land Cover for Agricultural regions of Canada, c.2000</li> <li>- Circa1990 Geocover</li> <li>- Canadian Forest Service (CFS): Earth Observation for Sustainable Development of Forests Land Cover, c.2000</li> <li>- Rasterized CanVec base features</li> <li>- Southern Ontario Land Resource Information System (2000-2002), v 1.2</li> <li>- AAFC (AESB/EOS) Prairie Grassland Extents, c.2010</li> <li>- National Road Network (NRN) Roads</li> </ul>
Scope	Dataset (Land Use 2000)

### 6.6.3 Land Use 2010

Lineage Statement	Derived from: <ul style="list-style-type: none"> <li>- AAFC Crop Inventory 2011, 2012, 2013</li> <li>- Land Cover for Agricultural regions of Canada, c.2000</li> <li>- Canadian Forest Service (CFS): Earth Observation for Sustainable Development of Forests Land Cover, c.2000</li> <li>- Rasterized CanVec base features</li> <li>- National Road Network (NRN) Roads</li> </ul>
Scope	Dataset (Land Use 2010)

## **7 DATA CAPTURE**

All available source data except 1990 Geocover is publicly available from various websites. Geocover was accessed under a 'sole-use' agreement with Environment Canada.

## **8 DATA MAINTENANCE**

Frequency: Irregular

## **9 PORTRAYAL**

## 10 DATA PRODUCT DELIVERY

*TIF*

*format name: Tag Interleaved File:*

*version: 6.0*

*specification: GeoTIFF is format extension for storing georeference and geocoding information in a TIFF 6.0 compliant raster file by tying a raster image to a known model space or map projection.*

*languages: eng*

*character set: utf8*

## 11 METADATA

The metadata requirements follow the Government of Canada's Treasury Board Standard on Geospatial Data (ISO19115)