Alberta Biodiversity
Monitoring Institute

www.abmi.ca

2000 Alberta Backfilled Wall-to-Wall Land Cover
Version 2.5 - Metadata

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1 SUMMARY

The Alberta Biodiversity Monitoring Institute (ABMI) tracks changes in biodiversity across the province of Alberta. One of the goals of the Institute is to provide credible and understandable information on the amount and location of multiple vegetation types to support natural resources management.

This document provides metadata related to the Backfilled 2000 Wall-to-Wall Land Cover Layer (Version 2.5) created by ABMI. This GIS polygon layer includes information on five main landscape characteristics:

1. Land cover Class,
2. Percentage of Pine,
3. Uplands and Lowlands,
4. Year of Origin (age), and
5. Soil Type

Using GIS data originally created for a wall-to-wall land cover layer for the province of Alberta as of December 31, 2000, human footprint was removed and the land cover that was predicted to be present in the absence of human footprint was used to create this backfilled land cover layer.

2 BACKGROUND ON THE ALBERTA BIODIVERSITY MONITORING INSTITUTE

The ABMI was initiated in 1997 through a broad partnership of industry, government and academia. ABMI is tasked with tracking status and change to biodiversity at local, regional and provincial scales, and providing relevant and objective information to policy makers, scientists and the general public.

The Institute collects information on thousands of terrestrial and aquatic species (mammals, birds, fish, mites, aquatic invertebrates, vascular plants, lichens, and moss), habitat structures, and human footprints at 1656 sites spaced systematically on a 20-kilometre grid across the entire province. The ABMI design strives to sample each of the 1656 sites every 5 years using a set of scientifically reviewed protocols. In addition, human footprint data are compiled across the province and summarized on an ongoing basis. This standardized data collection is designed to reduce duplication and increase cost efficiency for provincial and regional monitoring commitments, and to provide managers with better understanding of cumulative impacts on the environment from multiple industries and human activities.

3 BASE LAYER

The primary source of data was the Alberta Wall-to-Wall Land Cover Polygon vector layer created by the ABMI Remote Sensing Group that described the land cover conditions in Alberta as of 2000[1].

[1] The base layer filename is ABMIw2wLCV2000 (Version 2.1) and may be download from http://abmi.ca.

The overall thematic accuracy of the base layer (estimated using extensive validation datasets) was 75% when eleven land cover classes were defined (see Appendix A for classes and definitions).

3.1 2010 Human Footprint Layer

The ABMI has created a GIS polygon layer that contains all human footprints in Alberta up to December 31, 2010. Human footprint refers to the areas of Alberta that have lost their natural vegetation cover (permanently or temporarily) due to human activities (e.g., cities, roads, agricultural land, industrial areas, forestry, seismic lines, or surface mining). This layer was a) used during the backfilling processes described in Section 5, and b) was added to the backfilled layer such that human footprint codes were added to the land cover class (FEATURE_TY; Section 9) where appropriate.

4 CREATION OF BACKFILLED LAYER

To create the backfilled layer, the GIS data in the ABMIw2wLCV2000 base layer was modified to:

1) Replace (or 'backfill') the vegetation classified as "shrubland" and "grassland" in cutblocks with the expected pre-disturbance vegetation type (i.e., the forest type expected to be present prior to harvest).
2) Replace linear features (e.g., roads, rail line, pipelines, transmission lines seismic lines, etc.) with the vegetation type that was adjacent to them.
3) Replace human developed polygons (e.g., cities, mines, industrial sites, agriculture, etc.) with the vegetation type that was expected to be present prior to disturbance.
4) Improve the overall quality of water polygons[2].
5) Add supplementary information to the backfilled layer's attribute table, including:
    i. Distinguishing upland and lowland areas (WET),
    ii. Percentage of pine (PCT_P), and
    iii. Polygon year of origin (ORIGIN_YEAR),
    iv. Soil type for Grassland and Parkland Natural Regions.

The backfilled layer containing the supplemental information is referred to as the '*2000 Alberta Backfilled Wall-to-Wall Land Cover (Version 2.5)*'. The following sections describe in detail the various procedures and sources of information used in the creation of this layer.

5 REMOVAL OF HUMAN FOOTPRINT ('BACKFILLING')

5.1 Backfilling Cutblocks

Cutblock polygons in the ABMIw2wLCV2000 were usually coded as shrubland or grassland. Cutblocks in ABMIw2wLCV2000 were identified by overlying with the 2010 ABMI Human Footprint layer. Vegetation with these cutblock polygons was replaced (i.e., 'backfilled') with vegetation polygons from the ABMIw2wLCV2000 layer according to the rule-set illustrated in Figure 1. In general terms, if the cutblock polygon had a harvestable forest class within 50m of

[2] The Alberta base features layer contained higher resolution data on water polygon features.

the cutblock boundary, it was backfilled with the dominant forest class in the neighbouring 50m buffer. Otherwise, it is backfilled with the dominant harvestable forest class in the Natural Subregion.

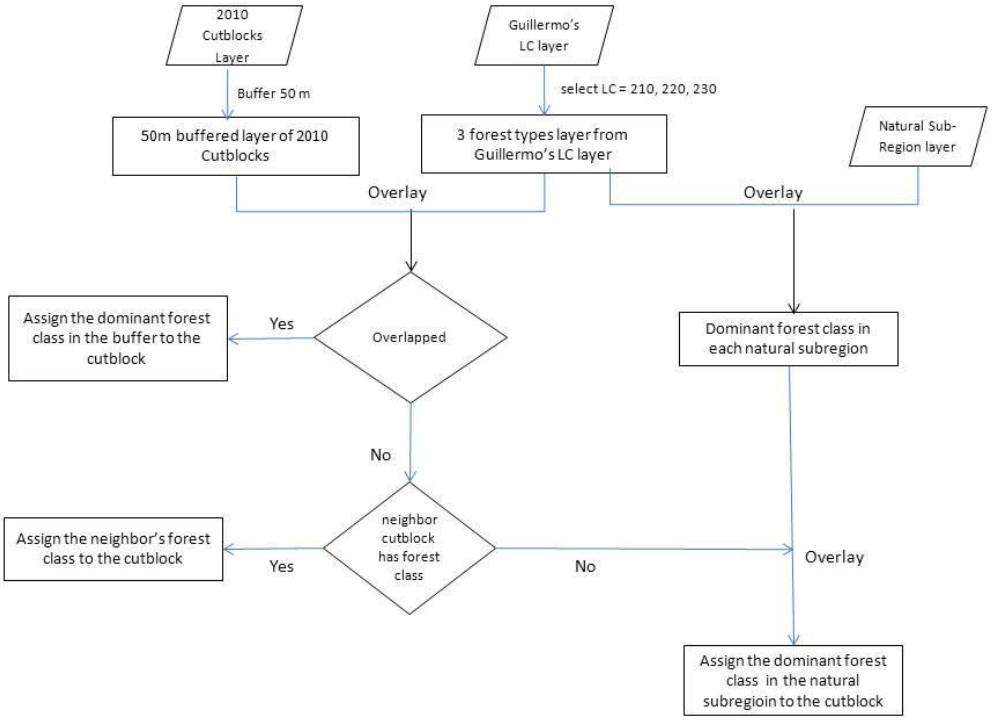

Figure 1: Flow chart illustrating the rule set used in backfilling polygons identified as forest harvest operations with pre-harvest vegetation conditions.

5.2 Backfilling Linear Features

The base layer (ABMIw2wLCV2000) contained a human footprint category[3] that included linear (road and rail, etc.). The linear features were identified by applying a 60m inside buffer and a threshold with Area/Length ration <60. These polygons were backfilled based on the type of vegetation in the neighbouring polygons (Figure 2).

[3] Referred to as 'Class 34 - Developed' in the vegetation layer.

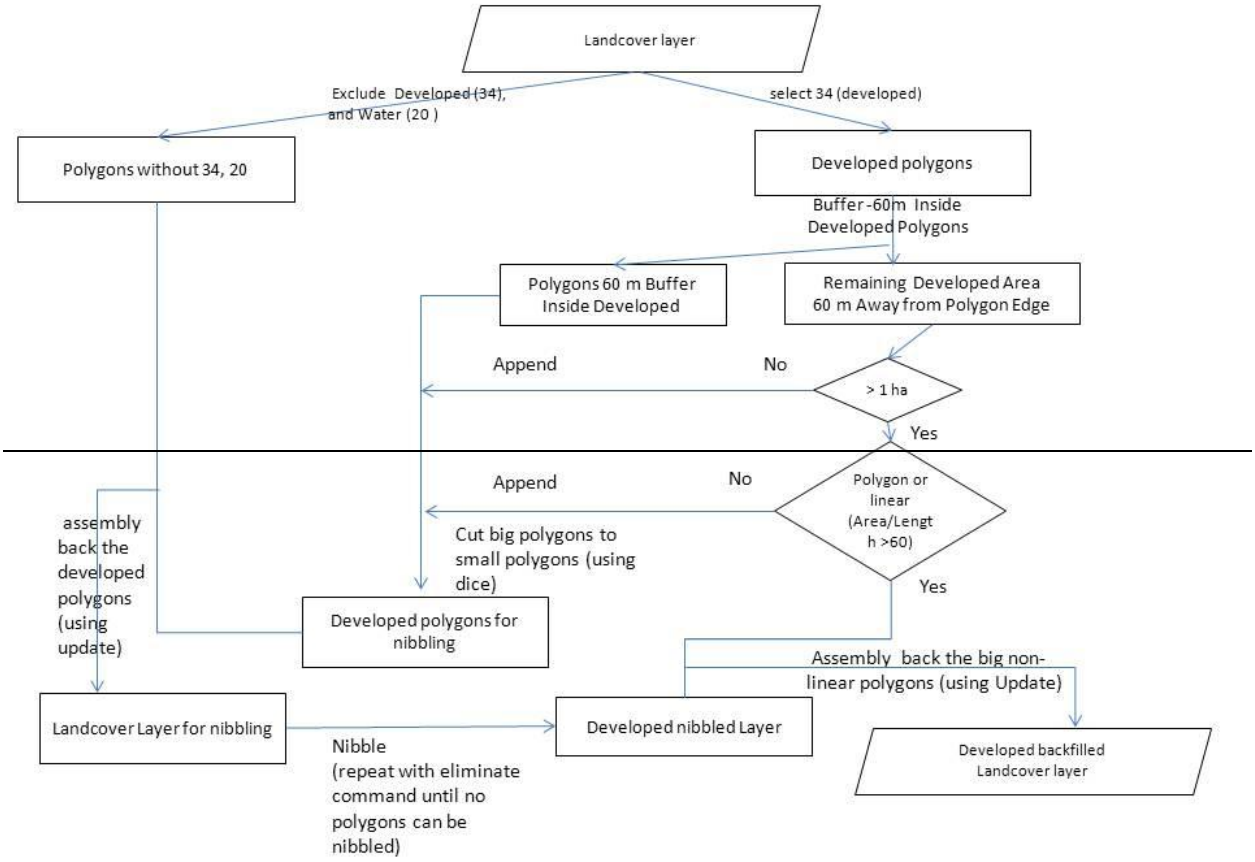

Figure 2: Flow chart illustrating the rule set used in backfilling polygons identified as linear (roads and rails, etc.) with pre-disturbance vegetation conditions.

5.3 Mines and Industrial Areas

Mines and industrial areas were identified with the 2010 ABMI Human Footprint layer (Version 1.1) and were backfilled with the vegetation that was expected to exist prior to disturbance. To do so, the 2010 mines and industries polygons were overlaid with the ABMIw2wLCV2000 layer. All mines and industrial features were replaced based on the vegetation present in the Phase 1 Alberta Vegetation Inventory layer (AVI, also known as the Broad Inventory layer, originally produced as a hardcopy map in 1957). To ensure compatibility among the ABMIw2wLCV2000 and Phase 1 classes, a rule set was developed to convert the Phase 1 classes into the ABMIw2wLCV2000 land cover classes (Table 1). The dominant forest type for the Natural Subregion was used for polygons outside the Phase 1 coverage area.

Table 1: Land cover classes and descriptions for the Phase 1 AVI inventory layer and the ABMIw2wLCV2000 layers. The Phase 1 inventory codes were converted to the corresponding ABMIw2wLCV2000 code during the creation of the backfilled layer.

Phase 1 Class	Phase 1 Class Description	ABMIw2wLCV2000 Land Cover Class	ABMIw2wLCV2000 Land Cover Class Definition
10	Agriculture and other improved lands		
14	Barren above timberline	32	Rock/Rubble
7	Burns - 1941 to 1957 inclusive	220	Broadleaf Forest
2	Coniferous stands over 60" height	210	Coniferous Forest
1	Coniferous stands up to 60" height	210	Coniferous Forest
6	Deciduous stands over 60" height	220	Broadleaf Forest
5	Deciduous stands up to 60" height	220	Broadleaf Forest
15	Indian Reserves		
16	Lakes and Rivers		
4	Mixedwood stands over 60" height	230	Mixed Forest
3	Mixedwood stands up to 60" height	230	Mixed Forest
11	Muskeg and Marsh	210	Coniferous Forest
17	National Park		
9	Old burn - productive and non-productive	230	Mixed Forest
8	Old burn and brush land	230	Mixed Forest
12	Rock barren	32	Rock/Rubble

5.4 Exposed Land

The 'Exposed Land' land cover class (Land Cover Class 33; Appendix A) within the ABMIw2wLCV2000 vegetation layer was backfilled with vegetation data from in order of precedence: a) neighbouring polygons and b) the Phase 1 inventory layer, c) no backfilling. First, the exposed land polygons were over-layed with i) the 2010 mines and industries layer, ii) 2010 cutblock layer with a 50m buffer, and iii) the fire layer (see Section 7.4.2) with a 100m buffer.

The 'Exposed Land' polygons falling within the buffered cutblock layer were assigned the backfilled vegetation type of that cutblock.

Exposed polygons falling inside the a) buffered mine and industries polygons and b) buffered fire polygons, were assigned the vegetation types from the Phase 1 inventory layer which were subsequently converted according to Table 1.

Other exposed land polygons (most of these were <1 ha) were backfilled according to the following criteria:

1. If the polygon was <100m from a 2010 human footprint polygon, then data from the Phase 1 inventory layer were used for backfilling. In Grassland and Parkland regions Phase 1 inventory was not available, and same procedures as cultivation in grassland and parkland regions was used (see Section 5.5).
2. If the polygon was within the Rocky Mountain Natural Region, and within 500m of a Rock/Rubble polygon, then it was classified as 'Rock/Rubble'

3. If the polygon was within the Canadian Shield Natural Region it was not recoded and remained 'Exposed'.
4. If the polygon was within a riparian area, as determined by the DEM-derived riparian layer, it was not reclassified and remained 'Exposed'.

5.5 Cultivated and Developed Areas Outside of Human Footprint Layer

Developed or cultivated areas that were identified within the ABMIw2wLCV2000 vegetation layer but outside human footprint within the 2010 Human Footprint layer were backfilled according to the following rule set.

1. Cultivated areas within the Boreal, Shield, Foothills, and Rocky Mountain Natural Region were backfilled using Alberta Vegetation Inventory (AVI). If there were no data for a particular polygon (i.e., the ABMIw2wLCV2000 and AVI layers did not overlap), then the dominant land cover type for that Natural Subregion was used (conversion rules are given in Table 2).

Table 2: Rule set used to convert land cover types for Natural Subregions into land cover types for the backfilled layer.

Vegetation Type	Rule set
Coniferous Forest	Stands where the combined coniferous species ≥ 80%
Deciduous Forest	Stands where the combined deciduous species ≥ 80%
Mixedwood Forest	Stands where the combined deciduous species > 20%, and combined conifer species > 20%
Shrubland	Non-Forested Land (NFL) Classifier = Open Shrub (SO) or Closed Shrub (SC)
Grassland	Non-Forested Land (NFL) Classifier = Herbaceous Grassland (HG), Herbaceous Forbs (HF), or Bryophytes and lichens (BR)

2. Cultivated areas within the Parkland and Grassland Natural Regions, the following GIS layers were used for backfilling (in order of precedence)[4]:
    i. Grassland Vegetation Inventory (GVI). Data from the GVI layer were converted to ABMIw2wLCV2000 land cover classes by:
        1. Calculating the area-weighted sum of PCT_TREES, PCT_SHRUBS, PCT_GRASS_OR_HERBACEOUS of each polygon. The field PCT_OF_POLYGON was used as the weights in the summation process.
        2. Following the summation process, the dominant GVI vegetation class was converted to a ABMIw2wLCV2000 land cover class as:

[4] The GVI, CPVI, and NPVI layers' metadata can be downloaded from: http://srd.alberta.ca/MapsPhotosPublications/Maps/ResourceDataProductCatalogue/ForestVegetationInventories.aspx

a. GRASS_OR_HERBACEOUS = Grassland,
b. SHRUBS = Shrubland, and
c. TREES = Broadleaf Forest.

ii. Central Parkland Vegetation Inventory (CPVI). Data from the GEN_CLASS field within the CPVI layer was converted to the ABMIw2wLCV2000 land cover types as follows:
   a. N_Conif = 'Coniferous Forest',
   b. N_Decid = 'Broadleaf Forest', and
   c. N_Grass = 'Grassland'.

iii. Native Prairie Vegetation Inventory (NPVI; 1/4 section grid). Areas classified as 'TREED' in the NPVI layer were reclassified as 'Broadleaf Forest'. For other vegetation classes, backfilling and conversions of vegetation types differed according to Natural Region:
   1. For polygons within the Grassland Natural Region, if the sum of GRAMINOID + WETLAND + RIPARIAN areas was dominant over other vegetation types, then those polygons were reclassified as 'Grassland". If SHRUB was dominant, then the polygon was reclassified as 'Shrubland'.
   2. For polygons within the Parkland Natural Region, if the sum of SHRUB + WETLAND + RIPARIAN areas was dominant over other vegetation types, then those polygons were reclassified as 'Shrubland'. If GRAMINOID was the dominant vegetation type, then the polygon was reclassified as 'Grassland'.

iv. ABMIw2wLCV2000. If no information was available from the three data sources above (i.e., GVI, CPVI, or NPVI) then the dominant natural land cover class for that Natural Subregion was used.

6 OPEN WATER BOUNDARIES

Polygons in the ABMIw2wLCV2000 layer that indicated areas of open water were replaced with more detailed polygons obtained from the Government of Alberta Base Layers for hydropoly and stream lines.

The hydropoly layer contained polygons of multiple feature types (see Table 3), not all of which were relevant to updating open water boundaries. Therefore, the ABMIw2wLCV2000 layer was updated in the following manner:

1. First, feature types indicating islands ('ISLAND-LAKE', 'ISLAND-RECUR', and 'ISLAND-RIV') and wetlands ('WETLAND') were removed.
2. Second, the stream line layer was buffered according to Table 4.
3. Third, the remaining open water feature types were added ("stamped") on the buffered stream line layer and the combined layer assigned the feature class for water (Class 20; Appendix A).

4. Fourth, these polygons were added ("stamped") onto the ABMIw2wLCV2000 vegetation layer.
5. Finally, all water class polygons from the original ABMIw2wLCV2000 layer (i.e., pre-modification) that fell outside of the new open water boundaries (i.e., from the Government of Alberta Base Layer Database) were re-coded as Shrub (Class 50; Appendix A).

Table 3: List of feature types (FEATURE_TY) contained within the Government of Alberta hydropoly layer, and whether they were used to update the boundaries of open water areas in the backfilled layer.

Feature Type	Used to Update Open Water Boundaries?
CANAL-MAJ	Yes
DUGOUT	Yes
ICEFIELD	Yes
ISLAND-LAKE	No
ISLAND-RECUR	No
ISLAND-RIV	No
LAGOON	Yes
LAKE-PER	Yes
LAKE-RECUR	Yes
OXBOW-PER	Yes
OXBOW-RECUR	Yes
QUARRY	Yes
RESERVOIR	Yes
RIV-MAJ	Yes
WETLAND	No

Table 4: Buffer sizes (m) used in the combined open water and stream line layer added to the ABMIw2wLCV2000 layer to improve the accuracy of open water boundaries.

Feature Type	**Buffer size to each side (m)**
AQUEDUCT	1
CANAL	1
DITCH	1
ICEFIELD-REP-PRI	1
OXBOW-RECUR	1
STR-RECUR	1
CANAL-MAJ-REP-SEC	2
OXBOW-PER	2
RIV-MAJ-REP-SEC	2
SPILLWAY	2
CANAL-MAJ-REP-PRI	3

LAKE-REP-PRI	3
RIV-MAJ-REP-PRI	3
FLOW-ARB-DEM	0.5
FLOW-ARB-MANUAL	0.5
STR-INDEF	0.5
STR-PER	1.5

7 DATA ADDITIONS

Additional data were added to the attribute table for each polygon to increase its usefulness as a vegetation map of Alberta. The supplementary data included information on the percentage of pine, delineating upland and lowland areas, polygon year of origin (age), and soil type.

7.1 Pine (PCT_P)

Information regarding the location of pine throughout Alberta was obtained from two main sources:

1. Extended AVI layer (AVIE, provided by AESRD in August, 2012), and
2. Alberta Ground Cover Characterization (AGCC, provided by the Earth Observation Systems Laboratory[5] at the University of Alberta).

Data from the AVIE layer were preferentially used in areas where it was available. Pine information in AVIE cutblocks were also backfilled. Data from the AGCC layer were used in areas outside of the AVIE boundary.

7.1.1 Processing the AVIE layer

1. Polygons in the AVIE layer in which PCT_P was >0 were selected.
2. Cutblock polygons identified in the AVIE were first backfilled into one of the four vegetation types (Pine, Other conifers, Deciduous, Mixed) using the same procedure as in Section 4.1.1. The cutblocks with backfilled types as Pine were selected. The PCT_P value was coded as 9 (i.e., corresponding to a polygon comprised of 90% pine).
3. The layer created by Step 1 was 'stamped' onto the layer in Step 2.

7.1.2 Processing the AGCC layer

1. A new pine layer was created by selecting AGCC polygons coded as either '52' or '152'.
2. The boundaries of the AVIE polygon layer was used to clip the AGCC pine layer created in step 1 above to generate a new raster layer. This new layer, therefore, was limited to pine data for areas beyond the AVIE boundary.
3. The clipped AGCC layer was converted from raster format to a vector layer.
4. Polygons >0.5 ha were selected from Step 3.
5. The layer in step 4 was clipped with Grassland and Parkland Natural Region boundaries to ensure no pine from AGCC layer occurred within those Regions.

[5] http://www.eosl.eas.ualberta.ca/index.html

7.1.3 Combining layers

The pine sub-layers from Sections 7.1.1 (AVIE) and 7.1.2 (AGCC) above were combined as a single layer representing the location of pine throughout the Province.

The data values[6] include 1-10, 52, and 152. Values 1-10 indicates the percentage of pine canopy cover from 10 to 100% respectively from AVIE (where 1 = 10%, 2 = 20%, …, and 10 = 100%). Values of '52' and '152' are from the AGCC layer; '52' refers to 'Closed Pine' and '152' refers to 'Open Pine' areas.

7.2 Uplands and Lowlands (WET)

A new sub-layer was created from multiple data sources (Table 5) to describe the location of uplands and lowlands throughout Alberta. This new wetland information was added as a new field (WET) in the attribute table of the ABMIw2wLCV2000 vegetation layer. The general approach was to identify wetlands throughout the province. By default, all other areas (i.e., non-wetlands) were blank.

Table 5: Source layers (listed in order of overlay) used in the creation of the wetlands sub-layer. Note that the DEM-Derived riparian data were coarse and included some upland habitat; it was used only when no other data were available.

Order	Source layer	Data Extraction Rule Set	Attribute Names
1	Hydropoly water	All data	See Table 3
2	Stream Lines (buffered layer)	All data	See Table 4
3	AVI water	NWL, NWF, and NWR	AVI_water
4	GVI water	Type 5 >=80%	GVI_water
5	CPVI water	Water type from the attribute table	CPVI_water
6	Hydropoly_wetland	All data	Hydro_wetland
7	Alberta CWCS Merged Wetland Inventory	All data	Marsh, Open Water, Bog, Fen, Swamp
8	AVI	See Section 7.2.4	AVI_wet
9	GVI	(type 1-5 >=60% or type 5 <80%)	GVI_wet
10	CPVI wetland	Wetland type from attribute table	CPVI_wet
11	DEM_Derived riparian	All data	DEM_rip

A description of each data source listed in Table 5, along with the steps involved in data processing and extraction, is described below.

7.2.1 Hydropoly Layer

The hydropoly layer was derived from the SRD Base Layer Database. Two sub-layers were derived from this layer by querying polygon feature types ('FEATURE_TY' in the attribute table):

[6] Data for pine are contained within the PCT_P field of the backfilled layer.

1. The ‘Hydropoly_water’ sub-layer (Figure 3) was created by removing all polygons that indicated either a) islands (i.e., FEATURE_TY = 'ISLAND-LAKE', 'ISLAND-RECUR', 'ISLAND-RIV') or b) wetlands (i.e., FEATURE_TY = ‘WETLAND’).
2. The ‘Hydropoly_wetland’ sub-layer (Figure 4) was created by extracting all wetland polygons (i.e., FEATURE_TY = ‘WETLAND’).

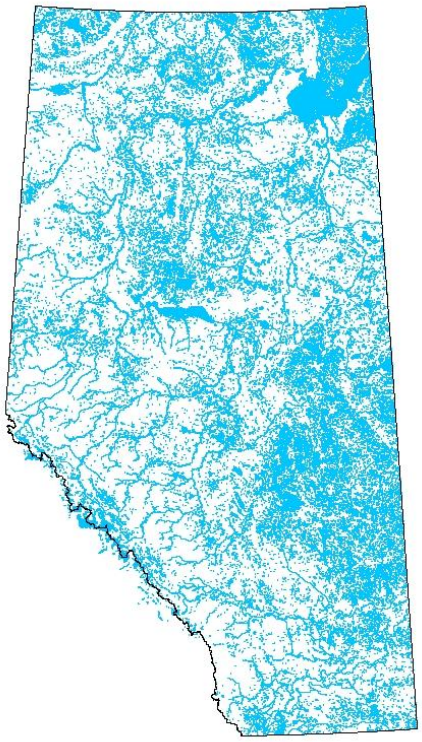

Figure 3: Distribution of water features contained within the Hydropoly_water sublayer.

Figure 4: Distribution of wetlands contained within the Hydropoly_wetland sub-layer.

7.2.2 Stream Line Layer

The Stream Line layer was created from the SRD Base Layer Database by extracting the feature types listed in Table 4. The initial polyline format was converted to a polygon format by adding buffers to each line; width of each buffer varied by feature type (Table 4).

7.2.3 Alberta CWCS Merged Wetland Inventory

The Alberta CWCS Merged Wetland Inventory[7] (Figure 5) is a polygon layer with five classes of wetland defined according to the Canadian Wetland Classification System (CWCS)[8]. The five classes are 1) marsh, 2) open water, 3) bog, 4) fen, and 5) swamp.

This layer contained data from four sources:

1. Ducks Unlimited Canada (DUC)-Boreal Enhanced Wetland Classification System (EWC). The minimum mapping unit was 1 ha.
2. Landsat-Canadian Wetland Classification System (CWCS). The minimum mapping unit was 1 ha.

[7] The layer and associated metadata may be downloaded from: http://srd.alberta.ca/MapsPhotosPublications/Maps/ResourceDataProductCatalogue/Biophysical.aspx

[8] National Wetlands Working Group. 1997. The Canadian Wetland Classification System, 2nd Edition. Warner, B.G. and C.D.A. Rubec (eds.), Wetlands Research Centre, University of Waterloo, Waterloo, ON, Canada. 68 p.

3. SPOT (Systeme Pour l'Observation de la Terre) Grassland Vegetation Inventory (GVI) Lentic Classification. The minimum mapping unit was 0.04 ha.
4. High resolution (1:15,000 to 1:30,000 scale) air photography. The minimum mapping unit was 0.02 ha.

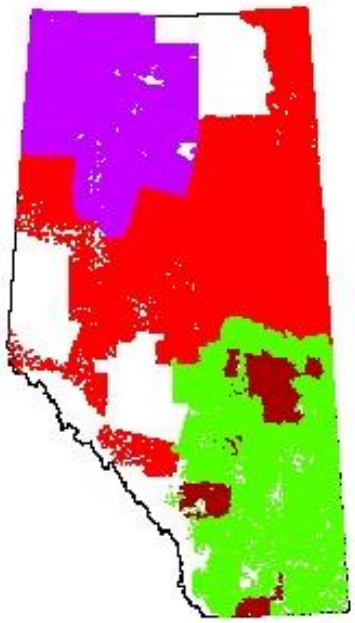

Figure 5: Distribution of wetlands contained within the Alberta CWCS Merged Wetland Inventory layer. Colors represent individual sources of data (purple: Landsat-CWCS, red: DUC-EWC, green: SPOT-GVI, dark brown – High-Resolution, and white: no data).

7.2.4 Alberta Vegetation Inventory (AVI)

Wetland information was extracted from the AVI layer (Figure 6) by creating two sub-layers that were then recombined.

The first sub-layer was created by selecting polygons in which:

1. The Timber Productivity Rating was classified as 'Unproductive' (i.e., TPR = U), and
2. The Moisture Regime was classified as either Wet or Aquatic. (i.e., MOIST_REM = 'w' or 'a').

The second sub-layer was created by selecting polygons in which the sum of pct was at least 70% of the following four species: Black spruce (Sb), tamarack (Lt), Alpine larch (La), and Western larch (Lw).

The first AVI sub-layer described above was then used to update the second sub-layer to remove any overlaps.

Figure 6: Extent of the Alberta Vegetation Inventory (AVI) coverage within Alberta.

7.2.5 Grassland Vegetation Inventory (GVI)

Wetland information was extracted from the GVI layer (Figure 7) by selecting polygons where the percentage of lentic site types (i.e., Site Types 1-5; Table 6) was greater than or equal to 60% of the total polygon area.

Table 6: Site type numbers, definitions, and codes used to extract wetland polygons from the Grassland Vegetation Inventory layer.

Site Type	Definition	Code
1	Lentic Temporary	LenT
2	Lentic Seasonal	LenS
3	Lentic Alkali	LenA
4	Lentic Semi-Permanent to Permanent	LenSP
5	Lentic Open Water	LenW

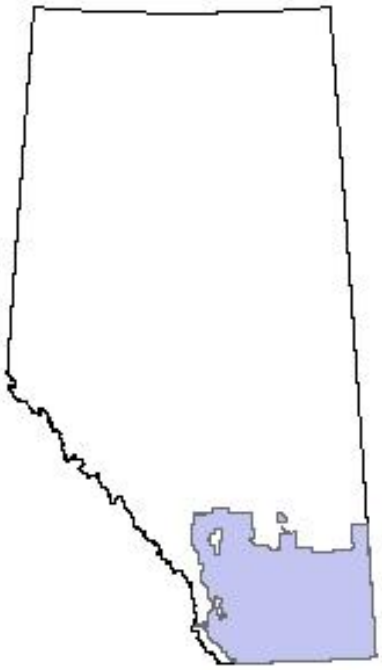

Figure 7: Extent of the Grassland Vegetation Inventory (GVI) in Alberta.

7.2.6 Digital Elevation Model (DEM) Derived Riparian Layer

This polygon layer identifies potential riparian areas associated with lotic features such as steams and rivers. The polygons were generated from the slopes derived from the Base Features Derived Partially Filled Hydrologically Corrected Digital Elevation Model grid using satellite imagery to determine thresholds for the floodplains.

The extent of this layer includes all of Alberta and was developed by Caslys Consulting Ltd. under contract to Alberta Sustainable Resource Development, Government of Alberta. Merging and cleanup procedures were performed by Alison Fraser at the Resource Information Management Branch.

The DEM-derived wetland information was used only for areas where the Alberta CWCS Merged Wetland Inventory or the Hydropoly_wetlands were not mapped. (see next section)

7.3 Mapped Area for Alberta CWCS Merged Wetland Inventory layer and ArcHydro_wetland layer (AENV_HYDROPOLY_WETLAND)

A sublayer was created to identify areas having wetlands but these areas were not mapped either in the Alberta CWCS Merged Wetland Inventory (called AENV wetland layer here) or in the Hydropoly_wetlands. Therefore, in these areas, it was necessary to use the DEM derived riparian information (See Section 7.2.6: Digital Elevation Model (DEM) Derived Riparian Layer*)*.

This unmapped area was identified by using the Hydropoly_wetland and AENV wetland layers. The AENV wetland layer and Hydropoly_wetland layer were overlaid with a layer containing the boundaries of Alberta township quarter-sections. All quarter-sections that did not contain any wetlands were selected and dissolved. Areas with 5 or more contiguous quarter sections were coded as "Not_mapped" in the "AENV_Hydropoly_wetland" field in the attribute table.

7.4 Date of Origin (ORIGIN_YEAR)

A sub-layer was created that described the year of polygon origin throughout Alberta. This information was added to the ABMIw2wLCV2000 layer as two new fields (ORIGIN_YEAR, ORIGIN_TYPE).

The sub-layer was derived from two primary data sources:

1. Extended AVI Layer[9] (AVIE), and
2. SRD Historical Wildfire Data Layer[10].

The 'year of origin' information for the backfilled Cutblocks (see Section 5.1: Backfilling Cutblocks*)* was also derived and added to this sub-layer. The processing steps for the AVIE and Wildfire data are described below.

7.4.1 AVIE Processing Steps

The AVIE layer was processed as follows (Figure 8):

1. First, the fields ORIGIN_TYPE and ORIGIN_YEAR were added to the attribute table.
2. Second, AVIE polygons in which the stand condition met the following criteria:
    a. defined as burned (MOD1 = 'BU'), and
    b. the loss of crown closure was ≥76% (MOD1_EXT = 4 or 5), and
    c. the year of burn column has value (MOD1_YR >0) were selected.

    For these polygons, the ORIGIN_TYPE was recorded as "AVI_BURN" and the value of ORIGIN_YEAR was copied from MOD1_YR.

3. Third, polygons where ORIGIN > 0 were selected. For these polygons, the ORIGIN_TYPE was recorded as "AVI_ORIGIN", and the value of the ORIGIN_YEAR was copied from "ORIGIN".
4. Finally, the layer created in Step 2 was "stamped"[11] onto the layer created in Step 3.

[9] The AVIE layer was provided by Bev Wilson from AESRD (August, 2012).
[10] Downloadable from: http://www.srd.alberta.ca/Wildfire/WildfireStatus/HistoricalWildfireInformation/SpatialWildfireData.aspx.
[11] The layers were combined using the 'Update' command in ArcGIS.

7.4.2 SRD Historical Wildfire Data Layer Processing Steps

This layer was originally organized into eight layers according to decade (e.g., layers for 1931-1939, 1940-1949, etc.). A combined layer was created according to the following processing steps:

1. First, the ORIGIN_YEAR and ORIGIN_TYPE fields were added to the attribute table of each individual layer. For each layer, the ORIGIN_TYPE was coded as "SRD_FIRE" and the value of ORIGIN_YEAR was copied from the field YEAR.
2. Next, the 1931-1939 layer was "stamped" by the 1940-1949 layer[12].
3. The resultant combined layer of 1931-1949 from Step 2 (above) was "stamped" by the 1950-1959 layer from Step 1.
4. The general process in 2) and 3) above was repeated with each combined layer being stamped (updated) by the layer from the following decade. This process ended when the 1930-1999 combined layer was stamped by the 2000-2009 layer.

[12] The layers were combined using the 'Update' command in ArcGIS.

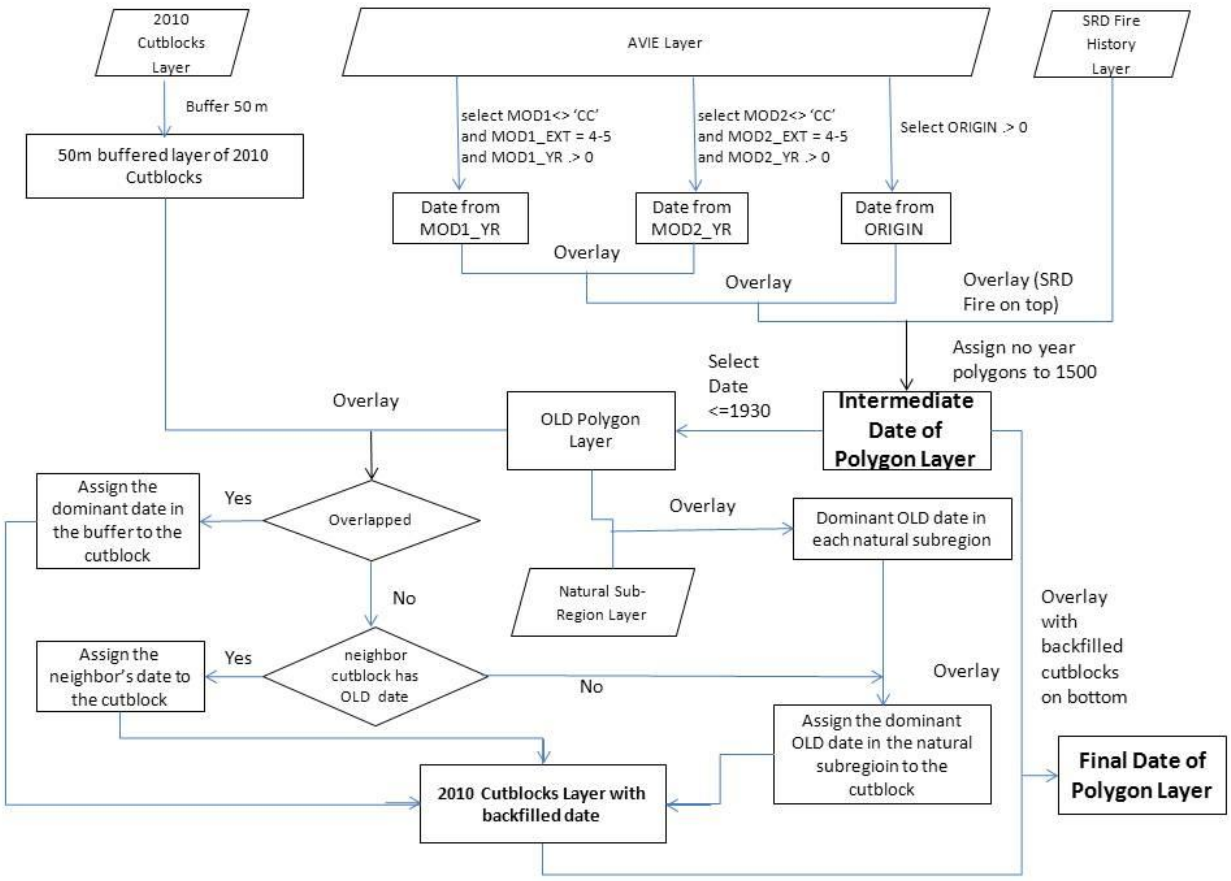

Figure 8: Flow chart illustrating the rule set and processing steps used to assign origin year to 1) the 2010 cutblocks, and 2) the backfilled layer.

The year of origin information derived from Fire (Section 7.4.2) was stamped on the origin information derived from AVIE (Section 7.4.1). See Figure 8 for detailed illustration of the rule set and processing steps.

7.5 Soil Type

A new sub-layer was created that described the soil type for polygons in the Grassland and Parkland Natural Regions. The soil type data was critical for backfilling vegetation into cultivated and developed areas. Overall, there were six wetland and eighteen natural upland GVI site types (24 types in total; see Appendix B).

Soil type information was combined from two sources (Figure 9):

1. A geodatabase[13] that provided detailed soil type information across eleven map units, each with a single layer. These 11 maps were cleaned and merged into a single layer.

[13] The geodatabase ("GVI_sitetypes_from_soils.gdb") was provided by O. Castelli from SRD in Lethbridge, AB.

2. The Agricultural Region of Alberta Soil Inventory Database (AGRASID 30)[14]. The soil types in the areas outside of the boundaries of the detailed soil information (#1 above) were derived from this AGRASID layer[15].

The layers from source 1 and source 2 were merged into a final soil type layer.

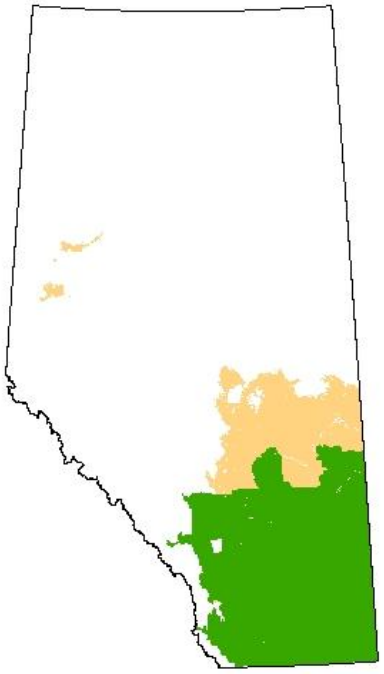

Figure 9: Extent of soil type information derived from 1) the SRD geodatabase 'GVI_sitetypes_from_soils.gdb' (green) and 2) AGRASID layers (brown).

8 COMBINATION OF SUB-LAYERS

The five new GIS sub-layers created in Section 7 were combined with the original vegetation layer described in Sections 3[16] , 5 and 6. Within the attribute table (Figure 10), the field 'LC_class' records the vegetation classes. The land cover classes in this table were the same as the original layer (see Appendix A).

[14] Downloaded from: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag3252?opendocument
[15] The derivation of GVI-compatible site types from the AGRASID layer was done by Ron McNeil, LandWise Inc.
[16] The layers were combined using the 'Union' command in ArcGIS.

OBJECTID *	Shape *	WET	AENV_HYDROPOLY_WETLAND	ABMI_ECOSITE	ORIGIN_YEAR	ORIGIN_TYPE	PCT_P	LC_Class	Shape_Length	Shape_Area
29969	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	220	3605.880044	33126.225608
29970	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	220	808.889936	1.538852
29971	Polygon	DEM_rip	Not_mapped		1930	AVI_ORIGIN	0	210	735.885184	4903.087806
29972	Polygon	DEM_rip	Not_mapped		1930	AVI_ORIGIN	0	220	699.416148	4435.237864
29973	Polygon	DEM_rip	Not_mapped		1950	AVI_ORIGIN	0	220	707.827082	1.165476
29974	Polygon	DEM_rip	Not_mapped		1950	AVI_ORIGIN	0	220	944.678159	3231.266724
29975	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	210	453.997839	1.331395
29976	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	210	1136.509876	1.074177
29977	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	210	2442.991675	25013.932844
29978	Polygon	DEM_rip	Not_mapped		1870	AVI_ORIGIN	0	220	193.243831	1039.118818
29979	Polygon	DEM_rip	Not_mapped		1950	AVI_ORIGIN	0	220	428.240938	5732.349539
29980	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	220	5595.624132	9.362337
29981	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	50	477.49956	3286.5899
29982	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	50	832.245604	5857.331206
29983	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	50	2137.451071	18055.252307
29984	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	220	15176.123458	128837.76278
29985	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	220	1074.051541	2.253114
29986	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	50	1145.922657	2.095739
29987	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	220	1930.497022	4.251398
29988	Polygon	DEM_rip	Not_mapped		1981	SRD_FIRE	0	220	1275.051156	2.224839

Figure 10: Attribute table of the backfilled vegetation layer.

The backfilled layer is available two formats: 1) a single layer that spans all of Alberta, and 2) a tiled version.

8.1 Attribute Table Definitions

ORIGIN_YEAR

Definition: Year of last known disturbance in which vegetation age would have been reset to zero.

Values: Integers between 1500 and 2000. The values '1500' refers to areas that did not have information on the year of last disturbance and were assumed to be undisturbed in recent history.

ORIGIN_TYPE

Definition: Data source for ORIGIN_YEAR field.

Values: Categorical values. Acceptable values are: AVI_BURN, AVI_ORIGIN, CUTBLOCK, SRD_FIRE

PCT_P

Definition: Percentage of pine; based on canopy cover, .

Values: Integers include 1-10, 52, and 152. Values 1-10 indicates the percentage of pine in increments of 10% (where 1 = 10%, 2 = 20%, …, and 10 = 100%). Values of '52' and '152' refer to 'Closed Pine' and 'Open Pine' areas, respectively.

WET

Definition: Indicates upland or lowland conditions.

Values: Categorical values. See Table 5.

AENV_HYDROPOLY_WETLAND

Definition: Areas having wetlands but these areas were not mapped either in the Alberta CWCS Merged Wetland Inventory or in the Hydropoly_wetlands

Values: Not_mapped.

ABMI_ECOSITE

Definition: Soil type based on GVI, detailed soil information and AGRASID data.
Values: Categorical; see Appendix B

LC_Class

Definition: Backfilled land cover classes
Values: Categorical; see Appendix A.

9 ADDITION OF 2010 HUMAN FOOTPRINT LAYER

The ABMI 2010 Human Footprint (Version 1.1) was "stamped' on the backfilled layer created in Section 8[17]. The attribute table of this layer (Figure 11) is the same as for the backfilled layer with the exception that the field 'FEATURE_TY' records both the vegetation and 2010 Human Footprint types.

OBJECTID *	Shape *	WET	AENV_HYDROPOLY_WETLAND	ABMI_ECOSITE	ORIGIN_YEAR	ORIGIN_TYPE	PCT_P	FEATURE_TY	Shape_Length	Shape_Area
1	Polygon	UPLAN		BIO	1500		0	50	50.473631	0.035039
2	Polygon	UPLAN		BIO	1500		0	110	280.639921	0.198295
3	Polygon	UPLAN		BIO	1500		0	110	67.457532	0.064096
4	Polygon	UPLAN		BIO	1500		0	110	8.758824	0.005297
5	Polygon	UPLAN		LenW	1500		0	50	9.608825	0.006968
6	Polygon	UPLAN		BIO	1500		0	110	116.527332	0.047176
7	Polygon	UPLAN		LenW	1500		0	50	10.696208	0.007724
8	Polygon	UPLAN		Lo	1500		0	110	0.260238	0.000196
9	Polygon	UPLAN		LenW	1500		0	110	34.52597	0.022863
10	Polygon	UPLAN		LenA	1500		0	110	8.529514	0.005918
11	Polygon	UPLAN	Not_mapped	BIO	1500		0	110	1859.224159	2.58579
12	Polygon	UPLAN	Not_mapped	BIO	1500		0	110	17.976133	0.034044
13	Polygon	UPLAN	Not_mapped	BIO	1500		0	110	1253.447595	1.102184
14	Polygon	UPLAN		BIO	1500		0	110	0.154018	0.00013
15	Polygon	UPLAN		BIO	1500		0	110	1.797932	0.003026
16	Polygon	UPLAN		BIO	1500		0	110	1080.470972	1.030014
17	Polygon	UPLAN		BIO	1500		0	33	1.664764	0.00171
18	Polygon	UPLAN		BIO	1500		0	110	1956.337768	2.614242
19	Polygon	UPLAN		BIO	1500		0	110	3419.739393	3.737117
20	Polygon	UPLAN		Lo	1500		0	110	28.922974	0.028601

Figure 11: Attribute table of the backfilled vegetation layer combined with the 2010 human footprint stamped on top.

The backfilled layer with the added 2010 human footprint is available two formats: 1) a single layer that spans all of Alberta, and 2) a tiled version.

[17] The ArcGIS commend 'Update' was used in this step.

10 APPENDIX A: LAND COVER CLASS DEFINITIONS

Land cover class numbers, names, and definitions for the base (ABMIw2wLCV2000; see Section 3), and backfilled layers:

Land Cover Class #	Name	Description	Base Layer	Backfilled Layer
20	Water	Lakes, lagoons, rivers, canals, and artificial water bodies. Shallow open water is included in this category, unless there is more than 20% vegetation cover, in which case it belongs to the relevant vegetated class.	Yes	Yes
31	Snow & Ice	Areas permanently covered by snow or ice, including glaciers.	Yes	Yes
32	Rock & Rubble	Bedrock, rubble, talus, blockfield, lava beds, or other natural impervious surfaces.	Yes	Yes
33	Exposed Land	Bare soil (barren, non-agricultural), river sediments and cutbanks, pond or lake sediments, reservoir margins, beaches, landings, fresh (less than 1yr) cutblocks, recently burned areas, mudflat sediments, surface mining, or other non-vegetated (less than 10% trees, or less than 20% shrub/herb) surfaces.	Yes	Yes
34	Developed	Urban and built-up areas (including industrial sites), impervious artificial surfaces (e.g. airport runaways), railways and roads. Acreages and farmsteads are included in this class. Oil and gas well pads are included in this class if connected to a road and not abandoned or under reclamation. Urban terrain under development is included in this class, even if the land is exposed. Urban green areas are excluded of this class if larger than 2 ha and if they have less than 2 buildings per hectare.	Yes	Yes (Only backfilled linear HF, and those outside of HF2010 layer bound)
50	Shrubland	At least 20% ground cover which is at least one-third shrub (shrub: a woody plant not considered a tree), with no or little presence of trees (less than10% crown closure). Examples of plants belonging to this class in Alberta are alder, willow, juniper, and sagebrush. Shrubby fens and other non-treed woody wetlands, usually associated with floodplains and the shores of lakes and streams, belong to this class. NB. A dense patch of regenerating young trees is still considered forest and not shrub, no matter that the trees are still small.	Yes	Yes

110	Grassland	Predominantly native grasses and other non-woody vegetation (e.g., forbs) with a minimum of 20% ground cover. May include some shrub cover (but less than a third of the vegetated area) or a few trees (but the tree cover cannot exceed 10%). Land used for range with native unimproved grasses (a.k.a. rough pasture) is included in this class. Alpine meadows fall into this class. Marshes and other non-woody wetlands with at least 20% vegetation cover (sedges, cattails, or moss) belong to this class. NB. A forestry cutblock harvested more than year ago that contains seedlings, but where the latter cover less than 10% of the area of the cutblock, belongs to this class. If the cutblock had no successful regeneration and was covered by more than 20% shrubs, then it would belong to the 'shrubland' class.	Yes	Yes
120	Agriculture	Annually cultivated crops, tame pastures (fields planted or sown with non-native grasses/legumes where livestock is directly grazing on them in the summer), forage crops (same as the previous, but instead of grazed, cut for hay) and woody perennial crops (fruit orchards and vineyards). Bare agricultural (i.e., tilled) soil belongs to this class and not to 'exposed land'.	Yes	Yes (only those outside of HF 2010 layer bound are backfilled)
210	Coniferous Forest	Treed areas with at least a 10% ground cover of trees (a.k.a. crown closure), where coniferous trees (spruce, pine, fir, larch) are 75% or more of the crown closure. Young plantations or regenerating cutblocks of conifer trees belong to this class no matter that the trees are less than 5 m tall, providing crown closure has reached 10%. Treed wetlands (e.g., black spruce bogs and fens) are included in this class providing they are conifer dominated and crown closure exceeds 10%.	Yes	Yes
220	Broadleaf Forest	Treed areas with at least a 10% ground cover of trees, where broadleaf trees (trembling aspen, balsam poplar, white birch) are 75% or more of the crown closure. Young plantations or regenerating cutblocks of broadleaf trees belong to this class no matter that the trees are less than 5 m tall, providing crown closure has reached 10%. Treed swamps along river floodplains and other treed wetlands are included in this class providing they are broadleaf dominated and crown closure exceeds 10%.	Yes	Yes
230	Mixed Forest	Treed areas with at least a 10% ground cover of trees, where neither coniferous nor broadleaf trees account for 75% or more of crown closure.	Yes	Yes

11 APPENDIX B: SOIL TYPES FROM GVI

Primary Class	Land Sub-Class	Site Type	Description	ABMI Code
Open Water	Lentic	Standing water	Permanent open standing-water with no emergent vegetation, generally larger than 1.0 ha and >15 cm deep.	LenW
	Lotic	River	Open water of rivers, generally rivers wider than 20 m.	LtcR
Native / Natural Lentic	Lentic	Temporary	Water present <3 weeks (dry by July) <15 cm deep.	LenT
		Seasonal	Water usually present >3 weeks (usually dry by July) >15 cm deep.	LenS
		Alkali	Water present >3 weeks and >15 cm deep	LenA
		Semi-Permanent to Permanent	Throughout the year except during periods of extreme drought (present in autumn in 70% of the years); often occurs adjacent to LenW; includes the march zones; water is generally >15 cm deep; if open water is present it is smaller than 1.0 ha	LenSP
Native / Natural Lotic	Lotic	Coniferous	Coniferous trees with a combined canopy cover of greater than 25%.	LtcC
		Deciduous	Deciduous trees with a combined canopy cover of greater than 25%.	LtcD
		Shrub	Shrubs have a combined cover of at least 10%.	LtcS
		Herbaceous	Herbaceous species (including sedges) have a combined cover of at least 5%.	LtcH
Native / Natural Grassland	Grassland	Subirrigated	Water table is close to surface during growing season, but rarely above. Does not have a defined depressional edge.	Sb
		Overflow	Areas subject to water spreading and sheet flow. Typically on gentle inclines or terraces above the frequent flood zone. For locations where flood frequency is less than once every ten years.	Ov
		Clayey	Clayey-textured soils including silty clay, sandy clay, clay, and heavy clay. Generally >40% clay.	Cy
		Loamy	Includes loam, silt loam, silt, clay loam, sandy clay loam, and silty clay loam.	Lo
		Sandy	Sandy-loam-textured soils.	Sy
		Limy	Eroded or immature soils with free lime ($CaCO_3$) at the soil surface. Soil pH generally >7.5.	Li
		Sand	Loamy sand and sand soils, and not with a duned surface.	Sa
		Blowouts/ Solonetzic Order	Areas with Solonetzic (hardpan) soils. The surface may or may not have eroded pits.	BlO
		Choppy Sandhills	Loamy sand and sand soils with a duned land surface.	CS
		Thin Breaks	Areas with bedrock at or near the soil surface. Amount of vegetation is intermediate between Limy and Badlands. TB may include thin, eroded or immature soils on gentle to steep slopes.	TB
		Shallow to Gravel	Soil with 20 to 50 cm of a sandy or loamy surface overlying a gravel or cobble- rich substrate.	SwG
		Saline Lowland	Areas with negligible vegetation due to electrical conductivity (salts) and/or sodium adsorption ratio limitations.	SL
		Gravel	Dominated by gravels or cobbles (>50% coarse fragments). May be covered by a mantle <20 cm thick with some gravels.	Gr
		Badlands/ Bedrock	Nearly barren or barren lands, with exposures of soft rock, hard rock, or surficial geology. Includes steep valley walls.	BdL