Alberta Biodiversity
Monitoring Institute

www.abmi.ca

Wall-to-Wall Natural Cover Layers and Human Footprint Edge Buffer Layers Version 1.0 - Metadata

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1 Summary

The Alberta Biodiversity Monitoring Institute (ABMI) tracks changes in human footprint (HF) and reports on the status of, and changes in, land use 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 remaining native vegetation to support natural resources management. This document provides metadata related to the 2015 Edge Buffer Layer (Version 1.0) that ABMI created[1] using the 2012 Wall-to-Wall Human Footprint Layer[2]. The layers are continuously being updated, and new versions of this document will be released periodically.

2 Background on the Alberta Biodiversity Monitoring Institute

The ABMI was initiated in 1997 through a broad partnership of industry, government and academia. The ABMI operates a long-term biodiversity monitoring program and is tasked with tracking the status of, and changes to, biodiversity and habitats throughout Alberta. The ABMI provides 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, mites, aquatic invertebrates, vascular plants, lichens, and moss), habitat structures, vegetation and human footprints at 1656 sites spaced systematically on a 20-kilometre grid across the province of Alberta. Each of the 1656 sites is sampled once every 5 years using a set of scientifically reviewed protocols. In addition, vegetation and human footprint data is 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 effects on the environment from multiple industries and human activities.

ABMI's data collection protocols, data sheets, and all data collected to date are available from the Institute's website at www.abmi.ca.

3 Base Data Source

The primary source of data when creating the edge buffer layers was the 2012 Human Footprint Inventory (Version 3.0)[2] - a GIS polygon layer that describes human footprint in Alberta as of December 31, 2012. Polygons in that layer map the location and geographic extent of areas under human use that either have either lost their natural cover (e.g., cities, roads, agricultural land, industrial areas), or whose natural cover is periodically or temporarily replaced by resource extraction activities (e.g., forestry, seismic lines).

4 Sub-setting and processing the 2012 Human Footprint Inventory

[1] ArcGIS Pro and ArcGIS Desktop (ESRI) were used for all steps described in this document.
[2] For details please refer to: Alberta Biodiversity Monitoring Institute. 2015. Human Footprint Inventory for 2012 conditions Version 1.0 - Metadata. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Report available at: abmi.ca.

The 2012 Human Footprint Inventory (referred to as **HF_w2w_2012**) contained information on multiple types of human footprint. This layer was used to create two new edge buffer layers:

1. Edge assuming that all human footprint types were included as footprint, and
2. Edge assuming that all human footprint types except cutlines were included as footprint. Cutlines in the **HF_w2w_2012** layer were derived from the linear Cutline layer in the provincial Base Layer Database. The linear cutlines were buffered with 2 meters post 2005 and 3 meters pre 2005 in the **HF_w2w_2012**. It is defined as: "*A minor roadway/linear clearing (2-10m wide) in which the surface may be exposed soil, rock, and/or low vegetation. Its condition is inferior to that of a truck trail, and usage is light. Cutlines/Trails may include seismic lines, minor pipelines.".*

The above layers were further processed (Sections 4.1 and 4.2) prior to the creation of distance-to-edge buffers.

4.1 Wall-to-Wall Natural Cover Layer With All Human Footprint Types Removed

This layer was created with the following steps:

1. First, the 2012 Human Footprint Inventory (**HF_w2w_2012**) was dissolved to create a new layer having a single category of all human footprint (**HF_w2w_2012_dsv).**

2. A wall-to-wall natural layer (**natural_raw**) containing the areas outside of the **HF_w2w_2012_dsv,** was created by applying the **Erase** command to the Alberta Boundary layer and **HF_w2w_2012_dsv**.

3. Polygon 'slivers' with the following characteristics were removed from the **natural_raw** layer to create the **natural_sliver_removed** layer:
   - polygons with area < 200 m^2,
   - polygons with area between 200-1000 m^2 except those "touching" cutlines,
   - polygons "touching" cutblocks and/or mines that were < 2500 m^2, and
   - linearly-shaped polygons <5000 m^2. These 'linearly-shaped polygons' were defined as polygons with an Area/Length ratio of <6.

4. GIS-created stream corridors within the 2012 Human Footprint Inventory layer were removed from the **natural_sliver_removed** layer. These corridors of native vegetation through human footprint originated when the buffered steam line and hydropoly sublayers were overlaid on the HF polygons; the native vegetation dissected the human footprint types such as pipelines, translines, and roads into segments (as shown in Figure 1). By removing these narrow stream corridors, the native vegetation polygons on each side of the linear disturbance were separated into two different polygons. This process was accomplished using the **Erase** command with the original buffered sub-layers of pipelines, cutlines, transmission lines, railway lines, Paved Road, and Soft Road overlaid on the **natural-sliver_removed** layer.

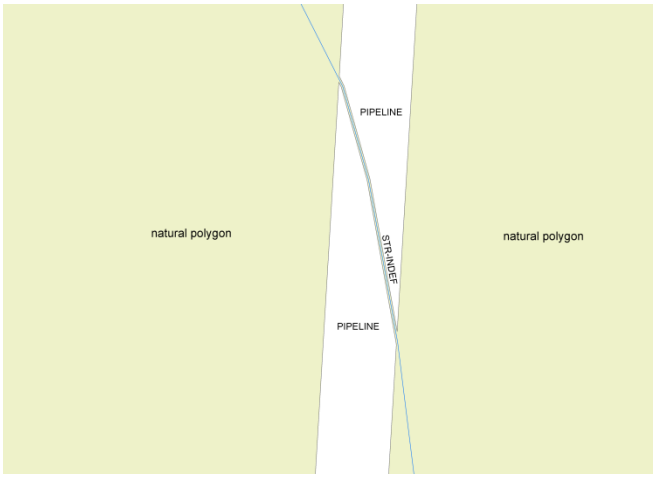

Figure 1: Illustration of the dissection of linear human footprint features (such as a pipeline) by water features such as streams.

5. Artificial corridors between polygons of native vegetation occurred when cutlines had small gaps at their end when adjacent to roads. This resulted in many natural polygons being artificially large because two or more polygons were artificially "joined" along the road margin. To fix this issue, the ends of cutline polygons were "snapped" onto road polygons using following 4 steps:
    a. First, cutlines that were not connected to the buffered roads, but which were within 10 meters of a buffered road, were selected from the original non-buffered linear cutlines layer.
    b. Second, the **Densify** command was used to add vertices onto the selected cutlines (most only had start and end points, which would have prevented accurate snapping to the road described next).
    c. Third, the densified cutlines were extended and snapped into the road with the **Snap** command.
    d. Fourth, the snapped layer was buffered.
    e. Fifth, the buffered cutline layer was overlaid on results from Step 4 to remove the artificial corridors using the **Erase** command.

6. The final wall-to-wall natural cover layer was created by dissolving the layer from Step 5 above. This layer was used in the effective mesh size calculation.

4.2 Wall-to-Wall Natural Cover Layer With All Human Footprint Types (Except Cutlines)

1. In the **HF_w2w_2012** layer, all polygons that were not cutlines were selected (FEATURE_TY <> 'CUTLINE-TRAIL') and saved as a new layer named **HF_w2w_2012_noCutlines.**
2. The layer **HF_w2w_2012_noCutlines** was then processed similar to that for Section 4.1 (Following Steps 1-4, and 6, to create a second natural cover layer). However, because

cutlines were excluded from human footprint in that layer Step 5 in Section 4.1 was not required.

3. Also note that the sliver removal rules in Step 3 of Section 4.1 was replaced as follow:
   - polygons with area < 1000 m^2,
   - Polygons "touching" cutblocks and/or mines and which were <2500 m^2, and
   - Linearly-shaped polygons <5000 m^2. The 'linearly-shaped polygons' were defined as polygons with an Area/Length ratio of <6.

5 Creation of 'Distance to Edge' Buffers

5.1 Wall-to-Wall HF Edge Layer with All Human Footprint Types

From the final wall-to-wall natural cover layer described in Section 4.1, a series of buffers that describe the distance to the edge (0-50m, 50-200, 200-2000m, and >2000m) were created. Steps for this include:

1. **Overlay** the Alberta boundary layer and natural vegetation layers and apply the **Erase** command to create clean layer of human footprint with no slivers. This new layer was named **HF2012_no_slivers**.
2. Create the layer **HF2012_no_slivers_buf50m** from the **HF2012_no_slivers** layer with the **Buffer** command and the linear unit set to 50m.
3. Create the layer **HF2012_no_slivers_buf200m** from the **HF2012_no_slivers** layer with the **Buffer** command and the linear unit set to 200m.
4. Create the **HF2012_no_slivers_buf2000m** layer from the **HF2012_no_slivers** layer with the **Buffer** command and the linear unit set to 2000m.
5. Use the **Update** command to "stamp" **HF2012_no_slivers_buf200m** on **HF2012_no_slivers_buf2000m** to create an intermediate layer with buffer rings of 200 and 2000m.
6. Use the **Update** command to "stamp" **HF2012_no_slivers_buf50m** onto the intermediate layer from Step 5 to create a layer with buffer rings 50m, 200m, and 2000m.
7. Use the **Update** command to "stamp" **HF2012_no_slivers** on the intermediate layer from Step 6 to create the final layer with buffer rings 2000m, 200m, 50m and HF.

The distance to edge for each of the final layer(s) are coded as follows (with definitions in parentheses): 0 (pixel is within HF), 50 (0-50m from HF), 200 (50-200m from HF), and 2000 (200-2000m from HF).

The final layer may be obtained for use from www.abmi.ca.

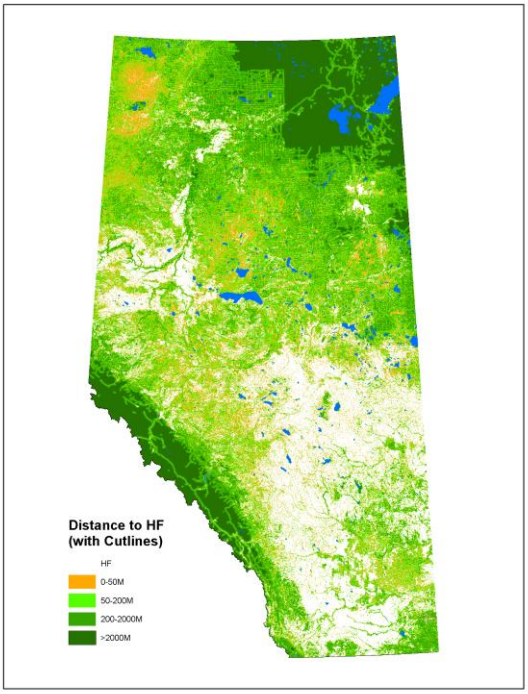

Figure 2: Map of Alberta showing native vegetation in Alberta under 2012 conditions, categorized by distance to human footprint.

5.2 Wall-to-Wall HF Edge Layer without Cutlines

From the final wall-to-wall natural cover layer with cutlines excluded from Human Footprint described in Section 4.2, a series of buffers that describe the distance to the edge (0-50m, 50-200, 200-2000m, and >2000m) were created. Steps and legends are exactly the same as Section 5.1. The final layer may be obtained for use from www.abmi.ca.

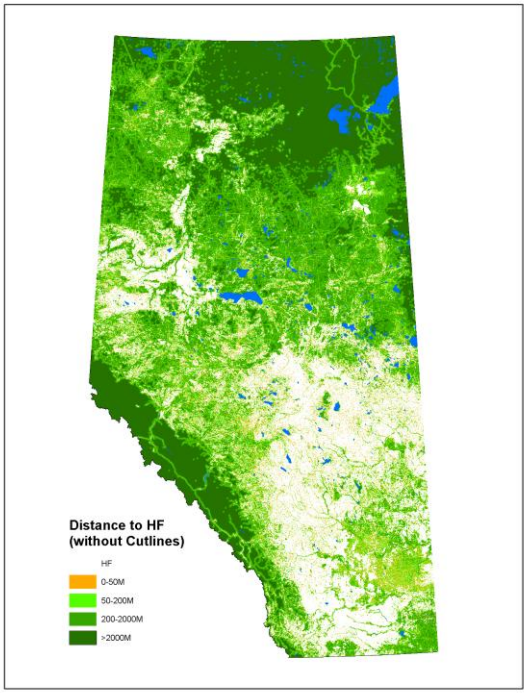

Figure 3: Map of Alberta showing native vegetation in Alberta under 2012 conditions, categorized by distance to human footprint (but excluding cutlines).

5.3 Wall-to-Wall HF Edge Layer for BMF

A layer with human footprint, edge buffers, and interior patches was created for the Alberta Biodiversity Monitoring Framework (BMF) using the 2012 Human Footprint Inventory (Version 3.0). The BMF required one edge buffer in natural open areas, and two edge buffers in natural forested areas. In addition, the edge buffer size varied by human footprint type for natural open (**Error! Reference source not found.**) and natural forested (**Table**) areas.

The processing steps used to create the Edge/Interior layer are illustrated in **Figure 4**. The steps were as follows:

1. First, the 2012 Human Footprint Inventory (**HF_w2w_2012**) was unioned with the **HF2012_no_slivers** layer created in Step 1 of Section 5.1. Any small remaining polygons without an assigned human footprint type in this unioned layer were filled with the human footprint of its neighbouring polygon. The resultant layer was named **W2W Sliver Removed HF 2012** (**Figure 4**).
2. Two buffer layers were created from the **W2W Sliver Removed HF 2012** as in Section 5.1 but using the buffer sizes for different HF types listed in **Error! Reference source not found.** and 2 respectively. One buffer layer included the **HF** plus the two buffer distances based on how far edge effects were expected to occur into the forested habitats (these distances were labeled Edge50, and Edge200, although the actual distance are not always 50 or 200m, see Table 1). The other buffer layer included HF plus one buffer

distances based on how far edge effects were expected to occur into non-forested habitats (these distances were labeled EdgeOpen, see Table 2).

3. From the ABMI Backfilled Vegetation Layer V5, the natural forest patch layer was derived by selecting the HABIT categories representing forested patches; the natural open patch layer was derived by selecting the HABIT not representing forested patches. Note, all polygons in which HABIT indicated "Water" were assigned to the open patch layer except those water polygons derived from the buffered stream lines. The polygons from the buffered stream lines were re-assigned to the vegetation type that existed prior to stamping the buffered steam lines. This process eliminated the artificial narrow open patches (on the forested area) in the open patch layer.
4. The natural forest patch layer and natural open patch layer created in Step 3 were used to clip the 2 buffering ring layers respectively created in Step 2 (**Figure 4**).
5. The final layer (**Figure 5**) was created by merging the two buffer rings layers from natural forest patches and from the natural open patches.

The final layer may be obtained for use from www.abmi.ca.

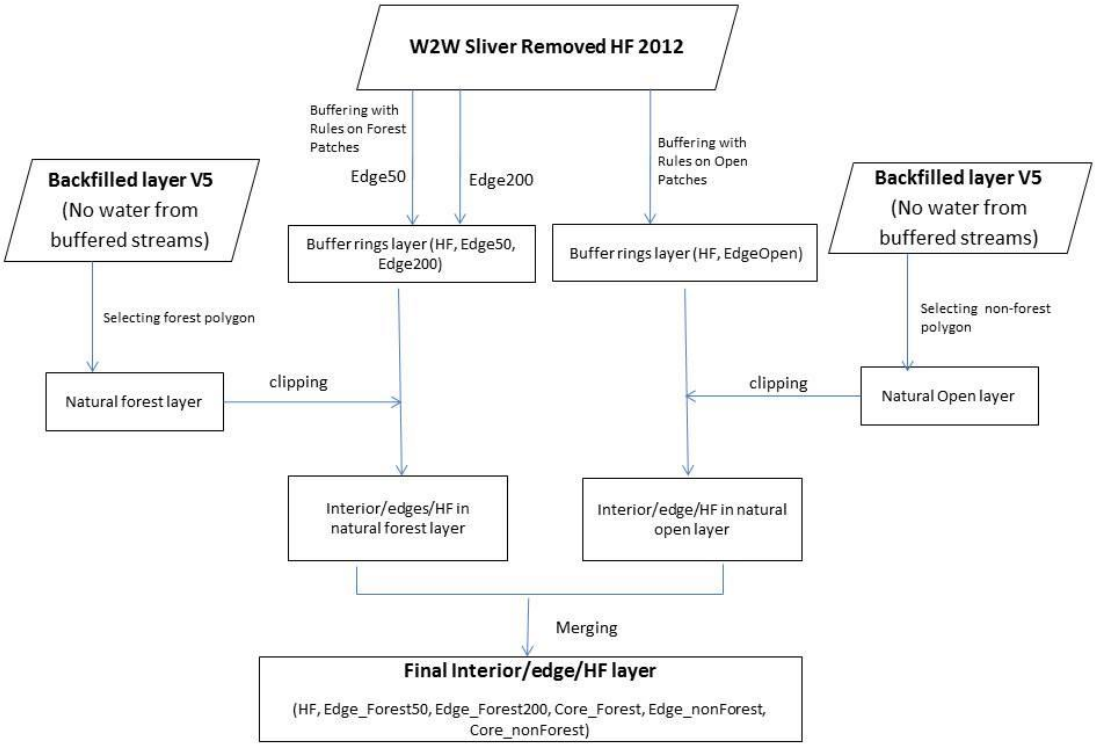

Figure 4: Processing steps used to create the Edge/Interior layer.

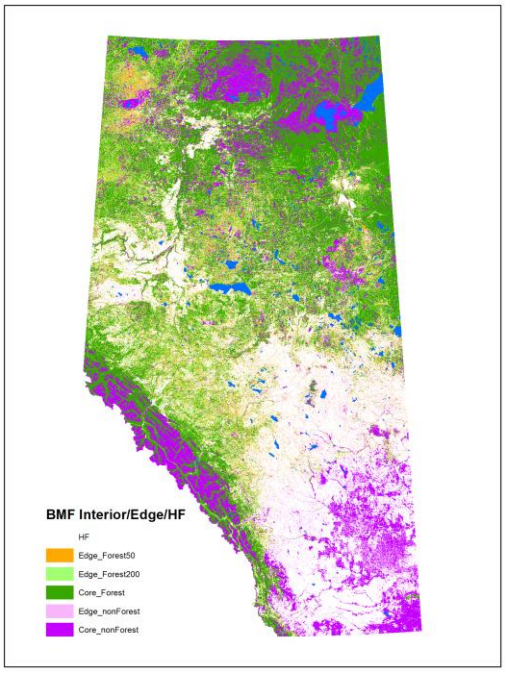

Figure 5: The Biodiversity Monitoring Framework Edge Layer

5.4 Miscellaneous Processing Notes

A variety of procedures were evaluated when creating the above layers and the steps described above were found to be the most efficient. The buffering described in Section 5.1 Steps 2, 3 and 4 and the steps in Section 5.3 were processed as a single piece (i.e., not tiled) in ArcGIS Pro, while all other steps in Section 4 and Section 5 were processed with the 801 National Topographic System (NTS) tiles in ArcGIS desktop. Scripts were developed to handle the case where buffering extended to the neighbouring tiles. On computers where buffering is not doable as a single piece (i.e., when the size of the HF layer is large and the geometries in the HF layer are too complex), all steps can be processed at the tile level.

Table 1: Actual human footprint buffer distances used for the 50m and 200m buffer distances based on human footprint type.

Feature Type	**Age** (years)	**Edge50** (m; one side)	**Edge200** (m; one side)
ACREAGE		50	200
AGRICULTURE_CLEARING		50	200
BORROWPITS		50	200
CANAL-MAJ		50	200
CFO		50	200
CULTIVATION		50	200
CUTBLOCK	0	50	200
CUTBLOCK	1-10	45.4	181.7
CUTBLOCK	11-20	37.1	148.3
CUTBLOCK	21-30	28.8	115
CUTBLOCK	31-40	20.4	81.7
CUTBLOCK	41-50	12.1	48.3
CUTBLOCK	51-60	3.75	15
CUTBLOCK	>60	0	0
CUTLINE-TRAIL		23.75	95
CUTLINE-TRAIL		20	80
DISTURB_VEG		50	200
DUGOUT		50	200
FORD-WINTER-XING		31.25	125
GRVL-SAND-PIT		50	200
IND-HIGH		50	200
IND-LOW		50	200
INTERCHANGE-RAMP		50	200
LAGOON		50	200
MINES		50	200
MINES-DISTURBED-NO-VEG		50	200
MINES-DISTURBED-VEG		50	200
MINES-PITLAKE		50	200
MINES-UNDISTURBED		50	200
OPEN-PIT-MINE		50	200
PIPELINE		50	200
RECREATION		50	200
RESERVOIR		50	200
RESIDENCE_CLEARING		50	200
RLWY-ABANDONED		50	200
RLWY-FORMER		50	200
RLWY-SGL-TRACK		50	200
RLWY-SPUR		50	200
ROAD-GRAVEL-1L		50	200
ROAD-GRAVEL-2L		50	200
ROAD-PAVED-DIV		50	200
ROAD-PAVED-UNDIV-1L		50	200
ROAD-PAVED-UNDIV-2L		50	200
ROAD-PAVED-UNDIV-4L		50	200
ROAD-UNCLASSIFIED		35	140
ROAD-UNIMPROVED		35	140

ROAD-WINTER-ROAD		46.25	185
RURAL_1-5ha		50	200
RURAL_GT_5ha		50	200
RURAL_LESS_1ha		50	200
SOFT_INTERCHANGE-RAMP		50	200
SOFT_RLWY-ABANDONED		50	200
SOFT_RLWY-SGL-TRACK		50	200
SOFT_RLWY-SPUR		50	200
SOFT_ROAD-GRAVEL-1L		50	200
SOFT_ROAD-GRAVEL-2L		50	200
SOFT_ROAD-PAVED-DIV		50	200
SOFT_ROAD-PAVED-UNDIV-1L		50	200
SOFT_ROAD-PAVED-UNDIV-2L		50	200
SUMPS		50	200
TAILING-PILE		50	200
TRAIL-ATV		30	120
TRAIL-ATV-INDEFINITE		30	120
TRANS-LINE		50	200
TRUCK-TRAIL		35	140
URBAN_RESIDENCE		50	200
WELL		50	200
WELL-ABAND		50	200
WELL-GAS		50	200
WELL-GAS-ABAND		50	200
WELL-GAS-CAPPED		50	200
WELL-OIL		50	200
WELL-OIL-ABAND		50	200
WELL-SPOT07		50	200
WELL-WATER		50	200
WELL-WATER-ABAND		50	200

Table 2: Human footprint buffer distances for natural open areas.

Feature Type	Buffer (m; to one side)
ACREAGE	300
AGRICULTURE_CLEARING	300
AIRF-RUNWAY-ACTIVE	200
AIRP-RUNWAY-ACTIVE	200
BORROWPITS	100
CANAL	100
CANAL-MAJ	100
CANAL-MAJ-REP-PRI	100
CFO	300
CULTIVATION	300
CUTBLOCK	20
CUTLINE-TRAIL	0
DISTURB_VEG	300
DUGOUT	100
FORD-WINTER-XING	50
GRVL-SAND-PIT	100
IND-HIGH	300
IND-LOW	100
INTERCHANGE-RAMP	200
LAGOON	100
LANDFILL	300
MINES	300
MINES-DISTURBED-NO-VEG	300
MINES-DISTURBED-VEG	100
MINES-PITLAKE	300
MINES-UNDISTURBED	100
OPEN-PIT-MINE	300
PEAT	300
PIPELINE	20
PIPELINE-INTERSECTION	20
RECREATION	300
RESERVOIR	100
RESIDENCE_CLEARING	300
RLWY-ABANDONED	50
RLWY-DBL-TRACK	100
RLWY-FORMER	50
RLWY-INTERSECTION	100
RLWY-MLT-TRACK	100
RLWY-SGL-TRACK	100
RLWY-SPUR	100
ROAD-GRAVEL-1L	50
ROAD-GRAVEL-2L	50
ROAD-INTERSECTION	200

Feature Type	Buffer (m; to one side)
ROAD-PAVED-DIV	200
ROAD-PAVED-UNDIV-1L	100
ROAD-PAVED-UNDIV-2L	100
ROAD-PAVED-UNDIV-4L	100
ROAD-UNCLASSIFIED	50
ROAD-UNIMPROVED	50
ROAD-WINTER-ROAD	50
RURAL_1-5ha	300
RURAL_GT_5ha	300
RURAL_LESS_1ha	300
SOFT_INTERCHANGE-RAMP	0
SOFT_RLWY-ABANDONED	0
SOFT_RLWY-DBL-TRACK	0
SOFT_RLWY-MLT-TRACK	0
SOFT_RLWY-SGL-TRACK	0
SOFT_RLWY-SPUR	0
SOFT_ROAD-GRAVEL-1L	0
SOFT_ROAD-GRAVEL-2L	0
SOFT_ROAD-PAVED-DIV	0
SOFT_ROAD-PAVED-UNDIV-1L	0
SOFT_ROAD-PAVED-UNDIV-2L	0
SOFT_ROAD-PAVED-UNDIV-4L	0
SUMPS	100
TAILING-PILE	300
TRAIL-ATV	50
TRAIL-ATV-INDEFINITE	50
TRANS-LINE	20
TRUCK-TRAIL	50
URBAN_RESIDENCE	300
VEG-SURFACE-OVERLAP	0
WELL	100
WELL_MODEL_FOREST	100
WELL-ABAND	50
WELL-CBM	100
WELL-GAS	100
WELL-GAS-ABAND	50
WELL-GAS-CAPPED	50
WELL-OIL	100
WELL-OIL-ABAND	50
WELL-SPOT07	100
WELL-WATER	50
WELL-WATER-ABAND	50
WINDMILLS	100