The Human Footprint Inventory Enhanced (HFIe) for the Oil Sands Monitoring Region (OSM) 2018

Table of Contents

Overview

1. Summary

This dataset represents the Human Footprint Inventory Enhanced (HFIe) for the Oil Sands Monitoring Region (OSM) - HFIeOSM2018. The HFIeOSM2018 maps human footprint features across the entire OSM region. The dataset is intended to aid human footprint and land use inquiries.

2. Description

The ABMI uses existing available datasets (Alberta Base Features, Inventories, Road/Railway Networks, etc.) as the starting point for this product. The dataset is then further updated using SPOT6 satellite imagery to interpret anthropogenic disturbances on the land surface. Thematic mapping or image interpretation requires professional judgment, skill, knowledge and expertise to create the human footprint dataset in a very complex land use environment. It is expected that the final dataset has an element of thematic accuracy. The list of expected thematic accuracies depending on data source is available in the Appendix of this document.

The 2018 SPOT6 mosaic contains approximately 21% of imagery acquired in 2017, therefore this dataset represents circa 2018 human footprint updates. Figure 1 and Figure 2 display spatial distribution of satellite imagery coverage for 2018 and 2017 and spatial distribution of circa 2018 Human Footprint, respectively.

Representative human footprint polygons were delineated for 117 feature types, which were organized into 20 final sublayers.

3. Credits

In addition to the human footprint features, data originating from open sources and created by the ABMI, this dataset includes human footprint data collected and created by the Alberta Human Footprint Monitoring Program and the Alberta Biodiversity Monitoring Institute, and support from members of the Oil Sands Monitoring program.

4. Acknowledgments

In 2014 the Alberta Biodiversity Monitoring Institute (ABMI) initiated work to create a group of organizations to collaborate in the development of human footprint information in a program called the Alberta Human Footprint Monitoring Program (AHFMP), a collaboration initiative

between the Government of Alberta, the Alberta Biodiversity Monitoring Institute (ABMI), and non-governmental organizations. The intent was to bring the expertise and resources of various government and non-government organizations to create a common database of human footprint data. The AHFMP governance and organization structure are designed to promote relevancy, accessibility, and transparency of human footprint information. The AHFMP organization structure includes two Steering Committees (Data Steering Committee and Stakeholder Steering Committee) and a Technical Committee. The Technical Committee is directly involved in the assembling of the enhanced sub-layers (i.e., Roads, Railways, and Well Sites) and includes members from the GoA and the ABMI. Few of the sublayers used in the public version of the Human Footprint Inventory, e.g., the enhanced sub-layers for Roads, Railways, Well Sites, and Pipelines sub-layers were obtained from the Government of Alberta through the AHFMP.

In fall of 2019 the ABMI, AHFMP members, and members of the Oil Sands Monitoring (OSM) program initiated a working group to create Human Footprint Inventory enhanced for the Oil Sands Region. The 2018 HFIe enhancements include, when and where available, improved attribution on age and sector type value, which adds information about origin of human footprint creation. In addition to sector type value, light radiance value was derived from the nighttime data from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) and applied to the well sites, industrial and residential feature types. Normalized Difference Vegetation Index (NDVI) was derived using optical Sentinel 2 data from the Copernicus Programme to provide information on the status of vegetated cover in the human footprint features across the OSM.

5. Human Footprint Definition

The ABMI defines Human Footprint (HF) as:

- the temporary or permanent transformation of native ecosystems to support residential, recreational or industrial land uses.
- under this definition, HF includes the geographic extent of areas under human use that either have lost their natural cover for extended periods of time (**alienating HF**; e.g., cities, roads, agricultural land, and surface mines) or whose natural cover is periodically reset to earlier successional conditions by industrial activities (**successional HF**; e.g., forest harvest areas and seismic lines).

IMPORTANT: This dataset does not account for succession or reclamation of human footprint. It is a cumulative record of human disturbances resulting from direct, mechanical activity. The disturbances are in various states of recovery (natural and human-influenced) and the interpretation of whether a disturbance is still considered a footprint is left to the discretion of the user and their specific requirements.

- Successional HF is treated the same as alienating HF despite the vegetation recovery that almost certainly will have occurred since the development. Any GIS analysis or subsequent interpretation that does not account for succession or reclamation of alienating/successional HF should be done with caution.

Physical Footprint

Definition adopted from AHFMP (Source: AHFMP_Footprint Data Manual.docx):

For the purposes of the AHFMP, this includes any direct physical modifications, temporary or permanent, that humans make to the surface of private, public, or specified (i.e., allocated through Legislation) lands. This includes the pressure (boundary), and state (attributes) of the modifications including what type of activity (well pad, road, etc.) caused the disturbance. The boundary represents the original extent of the disturbance even if the full extent is not visible.

In some situations, the extent of the disturbance was assumed based on operational requirements to construct the feature. For example, the full extent of a well pad in native grasslands is not always visible. The extent of the original disturbance is estimated based on

disposition boundaries or buffering to allow for the potential disturbance resulting from the equipment used in the construction of the well pad.

6. Contact Information

If you have questions or concerns about the data, please contact:

Geospatial Centre

Alberta Biodiversity Monitoring Institute

CW 405 Biological Sciences Centre

University of Alberta

Edmonton, Alberta, Canada, T6G 2E9

Email: abmiinfo@ualberta.ca

7. Keywords

Alberta, OSM, anthropogenic, human footprint, reservoirs, borrow pits, sumps, dugouts, lagoons, roads, rails, canals, mines, industrial, oil and gas well pads, landfills, recreation, wind generation facilities, transmission lines, CFO, residential, cultivation, harvested areas, pipelines, seismic lines, disturbed vegetation, sector, light, radiance, Normalized Difference Vegetation Index (NDVI),

8. Citation

ABMI Human Footprint Inventory enhanced (HFIe) for the Oil Sands Region: *Wall-to-Wall Human Footprint Inventory enhanced for the Oil Sands Region*. 2018. Edmonton, AB: Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, March 2020.

9. Use Limitations

9.1 Proprietary Sourced Data

This dataset contains data originating from proprietary sources, which has subsequently been enhanced through active visual interpretation and computer processing. The Proprietary Sourced Data shall not be used or reproduced in whole or in part or in any form. By accessing the Proprietary Sourced Data, you agree to indemnify and hold harmless the ABMI and the ABMI's subsidiaries, affiliates, related parties, officers, directors, employees, agents, independent contractors, advertisers, partners, and co-branders, from any and all actions, proceedings, claims, demands, liabilities, losses, damages, and expenses which may be brought against or suffered by the ABMI or which it may sustain, pay or incur, arising or resulting from your violation of this clause.

The Proprietary Sourced Data is provided on an "As Is" and "As Available" basis and the ABMI does not guarantee that the Proprietary Sourced Data will be suitable for your purposes or requirements. The ABMI further states that the Proprietary Sourced Data is subject to change, and the ABMI gives no guarantee that the content is complete, accurate, error or virus free, or up to date. The ABMI disclaims all warranties, conditions, and other terms of any kind, whether express or implied, whether in contract, tort (including liability for negligence) or otherwise, including, but not limited to any implied term of satisfactory quality, fitness for a particular purpose, and any standard of reasonable care and skill.

9.2 Open Sourced Data

This dataset contains data originating from open sources, which has subsequently been enhanced through active visual interpretation and computer processing. The Open Sourced Data may be reproduced in whole or in part and in any form for educational, data collection or non-profit purposes without special permission from the ABMI provided acknowledgement of the source is made. No use of the Open Sourced Data may be made for resale without prior permission in writing from the ABMI.

By accessing the Open Sourced Data, you agree to indemnify and hold harmless the ABMI and the ABMI's subsidiaries, affiliates, related parties, officers, directors, employees, agents, independent contractors, advertisers, partners, co-branders, and Open Sourced Data sources from any and all actions, proceedings, claims, demands, liabilities, losses, damages, and expenses which may be brought against or suffered by the ABMI or which it may sustain, pay or incur, arising or resulting from your violation of this clause.

The Open Sourced Data is provided on an "As Is" and "As Available" basis and the ABMI does not guarantee that the Open Sourced Data will be suitable for your purposes or requirements. The ABMI further states that the Open Sourced Data is subject to change, and the ABMI gives no guarantee that the content is complete, accurate, error or virus free, or up to date. The ABMI disclaims all warranties, conditions, and other terms of any kind, whether express or implied, whether in contract, tort (including liability for negligence) or otherwise, including, but not limited to any implied term of satisfactory quality, fitness for a particular purpose, and any standard of reasonable care and skill.

9.3 Exclusive ABMI Sourced Data

This dataset contains data created by the ABMI through active visual interpretation and computer processing. The ABMI Sourced Data may be reproduced in whole or in part and in any form for educational, data collection or non-profit purposes without special permission from the ABMI provided acknowledgement of the source is made. No use of the ABMI Sourced Data may be made for resale without prior permission in writing from the ABMI.

By accessing the ABMI Sourced Data, you agree to indemnify and hold harmless the ABMI and the ABMI's subsidiaries, affiliates, related parties, officers, directors, employees, agents, independent contractors, advertisers, partners, and co-branders, from any and all actions, proceedings, claims, demands, liabilities, losses, damages, and expenses which may be brought against or suffered by the ABMI or which it may sustain, pay or incur, arising or resulting from your violation of this clause.

The ABMI Sourced Data is provided on an "As Is" and "As Available" basis and the ABMI does not guarantee that the ABMI Sourced Data will be suitable for your purposes or requirements. The ABMI further states that the ABMI Sourced Data is subject to change, and the ABMI gives no guarantee that the content is complete, accurate, error or virus free, or up to date. The ABMI disclaims all warranties, conditions, and other terms of any kind, whether express or implied, whether in contract, tort (including liability for negligence) or otherwise, including, but not limited to any implied term of satisfactory quality, fitness for a particular purpose, and any standard of reasonable care and skill.

IMPORTANT:

- SEISMIC LINES currently available in the ABMI's HFIeOSM2018 are not the complete representation of the seismic lines existing on the land surface. Low impact seismic lines might be missing from this dataset due to low detectability on SPOT imagery and due to the number of features that go beyond current capabilities of heads up digitization on the provincial scale HF dataset. The ABMI's sampling scale HF dataset (3x7 km) within OSM boundaries should be used for a more detailed representation of this sub-layer within sampling sites (dimensions: 3 km by 7km; distributed in 20 km by 20 km spacing grid).
- New CULTIVATION features created by heads-up digitization ([SOURCE] attribute is either 'ABMI15', 'ABMI16', 'ABMI17' or 'ABMI18' were attributed based on visual interpretation of SPOT6 satellite natural color composite mosaics. HFIeOSM dataset has not included a reattribution of existing HFI_2014 cultivation Feature Types to status of circa 2018.
- HARVEST-AREAS might accidently include areas that have been cleared for another purpose than timber harvesting (i.e., agricultural use, residential, mine and industrial areas expansion.)
- HARVEST-AREAS [YEAR] value is the best estimation of year when the area was harvested. It has been determined by:
    - heads up digitization for years 2014 to 2018,
    - combination of source data values and remote sensing analysis for years 1985 to 2013,
    - and source data based for years prior to 1985.
- PIPELINES dataset is an estimate of the high-pressure pipelines in the province and is not suitable for locating pipelines on the ground. The data will also contain some low-pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The

pipeline verge estimates the extent of the direct physical disturbance of the pipeline corridor whether it is visible or not on available imagery.

- LINEAR FEATURES dataset should be used as a supporting dataset to polygonal representation of HF features available in HFIeOSM2018. There are areas where human footprint is captured in polygon layers (HFIeOSM2018 and Sublayers) but is still missing in the Linear Features (Polylines).

- Available attribute values of the LINEAR FEATURES dataset are limited. Polygon layers (HFIeOSM and Sublayers) should be used for geographic extent and more complete thematic information (i.e., available attribution, including source of the data).

Data Product Specification

10. Spatial Resolution

Dataset's scale denominator: 30,000

11. Processing Environment

Microsoft Windows 10 ; Esri ArcGIS 10.7.1

Extents

This dataset comprises visually interpreted human footprint in Alberta circa 2018.

Geographical Extent

West Longitude: -117.91

East Longitude: -110.00

South Latitude: 53.54

North Latitude: 57.99

12. Resource Maintenance

Resource Maintenance updates frequency: as needed

13. Spatial Reference

NAD_1983_10TM_AEP_Forest

WKID: 3400 Authority: EPSG

Projection: Transverse Mercator

False Easting: 500000.0

False Northing: 0.0

Central Meridian: -115.0

Scale Factor: 0.9992

Latitude of Origin: 0.0

Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_North_American_1983

Angular Unit: Degree (0.0174532925199433)

Prime Meridian: Greenwich (0.0)

Datum: D_North_American_1983

Spheroid: GRS_1980

Semi-major Axis: 6378137.0

Semi-minor Axis: 6356752.314140356

Inverse Flattening: 298.257222101

14. Lineage

The ABMI's HFIeOSM was built using open sourced, proprietary, historical, and remotely sensed data. Remotely sensed data were used for visual interpretation and heads-up digitization of human footprint features. Assessment analysis was conducted to identify new and missing features, which were then digitized and added to the dataset. This dataset is comprised of 20 unique Human Footprint categories, i.e., sublayers. This dataset is representative of the visual interpretation of anthropogenic disturbances on the Alberta landscape as seen from SPOT6 (circa 2018) satellite imagery mosaic.

Human Footprint Inventory Integrated Dataset

The **HFIeOSM2018** Feature Dataset, is a product of multiple sub-layers that have been merged into a single layer. Each sub-layer is listed in the chapter "Sublayers", including a detailed description of the layer contents, the data source, modifications made by the ABMI.

The order of precedence applied during creation of the final HFI dataset, i.e., merging process of the sub-layers is provided in Table 1.

Table 1. The order of precedence applied during creation of the final HFI dataset, i.e., merging process of the sub-layers.

Order of Precedence	Sub-layer
1	Reservoirs
2	Borrow Pits, Sumps, Dugouts and Lagoons
3	Non-Vegetated Impermeable Surfaces (Roads)
4	Rail Lines Hard Surface
5	Canals
6	Vegetated Surfaces of Roads, Trails and Railways
7	Mine Sites
8	Industrial Sites
9	Well Sites (Energy) ACTIVE
10	Landfill
11	Other Vegetated Facilities and Recreation
12	Wind Generation Facility*
13	Transmission Lines
14	CFO and other High Density Livestock
15	Urban and Rural Residential
16	Well Sites (Energy) ABANDONED
17	Cultivation
18	Cut Blocks
19	Pipelines
20	Seismic Lines

*Wind Generation Facility features not present in OSM region

Human Footprint Inventory Enhanced (HFIe) Dataset

The **HFIeOSM** Dataset contains additional information about:

- the origin of each human footprint:
    - industry that created human footprint - [SECTOR],
    - year of the origin - [YEAR],
- the state of human footprint:
    - Normalized Difference Vegetation Index - [NDVI],
    - Day/Night Band (DNB) Radiance [VIIRS_DNB].

Sublayers

01 RESERVOIRS

Feature type: RESERVOIR

Definition:

An artificial lake or storage pond resulting from human made dam.

A body of water created by excavation or the man-made damming of a river or stream.

Interpretation Elements and Rules:

SIZE:

Different sizes: ranging from the small ones created by damming small streams for a purpose of watering livestock to large water bodies of hydro dams.

SHAPE:

Dam structure (straight or hyperbolic wall) must be visible on reservoirs created on streams and rivers. Sides of the water body are given by topology of the terrain.

Storage pond reservoirs shape is given by engineers to fulfill specific needs. There is no front wall but all sides of storage pond are artificially created.

SHADOW: no shadow

COLOR: may depend on water depth, but usually in gradients of blue and brown

TEXTURE: fine

ASSOCIATED RELATIONSHIP or CONTEXT:

Dams must be in valleys of streams and rivers.

Storm water storage ponds are located nearby residential areas.

Irrigation storage ponds are located nearby agriculture along with irrigation structures – canals, pumps.

02 BORROW PITS, SUMPS, DUGOUTS and LAGOONS (BPSDL)

Feature type: LAGOON

Definition:

An artificial holding or treatment ponds for agricultural or municipal wastewater. Human made water and sewage lagoons used for municipal purposes.

Interpretation Elements and Rules:

SIZE:

Smaller to medium sized water bodies.

SHAPE:

Usually rectangular or square shape structure, occasionally might be triangular or other shape – following terrain topography and engineering design. Structural walls are usually elevated above surrounding terrain.

SHADOW: Shadow might be visible as lagoons are usually elevated above surrounding terrain.

COLOR: may depend on water depth, but usually in gradients of blue and brown

TEXTURE: fine

ASSOCIATED RELATIONSHIP or CONTEXT:

Lagoons are municipal structures built as part of water treatment facilities, so they are usually located nearby residential areas and within industrial zones.

Many times there are more than two lagoons build by each other creating a cluster of water bodies.

Feature type: SUMP

Definition:

An artificial holding or treatment pond for industrial wastewater.

Drilling waste storage system – holding of drilling waste on well sites or remotely.

Either earthen excavation (in clayey soils) or sumps lined with a synthetic liner.

Source:

The same as "LAGOON"

Interpretation Elements and Rules:

SIZE:

Smaller to medium size water bodies.

SHAPE:

Usually rectangular or square shape structure, occasionally might be triangular or other shape – following terrain topography and engineering design. Structural walls might be elevated above surrounding terrain for lined sump.

SHADOW: Shadow might be visible if sump walls are elevated above surrounding terrain.

COLOR: may depend on water depth, but usually in gradients of blue and brown

TEXTURE: fine

ASSOCIATED RELATIONSHIP or CONTEXT:

Sumps are industrial structures built as part of water treatment process, so they are usually located nearby industrial sites and well pads.

There is usually a single drilling waste storage structure build for a single well pad/industrial site.

Feature types:

FEATURE_TY	Feature Description
BORROWPITS	Includes pits dug to build forestry and well-site roads. They are usually associated with a road or another structure.
BORROWPIT-DRY	Includes pits dug to build forestry and well-site roads. They are usually associated with a road or another structure. No presence of water.
BORROWPIT-WET	Includes pits dug to build forestry and well-site roads. They are usually associated with a road or another structure. Presence of water confirmed by visual interpretation.
RIS-BORROWPITS	Identifies any area disturbed for the purpose of extraction of aggregate materials including gravel pits in oil sand mines area only.

Definition:

Excavation outside of the road right-of-way, made solely for the purpose of removing or proving borrow material for the construction of the sub-base for a specific roadway project. It includes any other associated infrastructure such as access roads. (*ALBERTA TRANSPORTAITON; GUIDE TO RECLAIMING BORROW EXCAVATIONS – 2013 Edition*).

Interpretation Elements and Rules:

SIZE:

Usually smaller excavation, quite often smaller than 1 ha.

SHAPE:

Rectangular or square shape structure, occasionally might be triangular or other shape – following terrain topography and engineering design.

SHADOW: no shadows

COLOR: Depends whether they are dry or filled with water. Brown/Grey/Blue

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Always located along roadways.

Feature types: DUGOUT

Definition:

Small water storage excavations collecting water that occurs either as a runoff from summer rains or as a surplus of surface water that occurs during snowmelt in the spring. *(Alberta Agriculture and Rural Development, QUALITY FARM DUGOUTS).*

Interpretation Elements and Rules:

SIZE:

Usually smaller excavation quite often smaller than 1 ha.

SHAPE:

Rectangular, square or elliptical shape structure.

SHADOW: no shadows

COLOR: Depends whether they are dry or filled with water. Brown/Grey/Blue

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Usually located along pastures, farms and agriculture areas.

03 ROADS

Feature types:

FEATURE_TY	Feature Description
AIRP-RUNWAY	An active landing facility for aircraft, usually associated with paved and lighted runways, an operating control tower, and services for aircraft and passengers.
INTERCHANGE-RAMP	A series of roadways (ramps) constructed to permit access to and from intersecting paved roads. These ramps are usually at different levels, and form an overpass / underpass.
RIS-AIRP-RUNWAY	Identifies operator owned landing facility for airplanes and related transportation in oil sand mines area only.
RIS-ROAD	Identifies roads that are not specifically part of other disturbed features in oil sand mines area only.
ROAD-GRAVEL-1L	A roadway surfaced with gravel and constituted as a main access route. The road surface is about 6 metres in width, and the road clearing is about 20 metres or greater in width. The surface, ditches, bridges and intersections are in good condition.
ROAD-GRAVEL-2L	A roadway surfaced with gravel and constituted as a main access route. The road surface is 7 metres or greater in width, and the road clearing is 30 metres or greater in width. The surface, ditches, bridges and intersections are in good condition.
ROAD-PAVED-1L	A roadway, paved with asphalt or concrete, consisting of one (1) lane.
ROAD-PAVED-2L	A major roadway, which is paved with asphalt or concrete, and consists of two (2) roadbeds separated by a median. Each road bed usually consists of two (2) or more lanes.
ROAD-PAVED-3L	A major roadway, which is paved with asphalt or concrete, and consists of 3 roadbeds separated by a median.
ROAD-PAVED-4L	A major roadway, which is paved with asphalt or concrete, and consists of 4 roadbeds separated by a median.
ROAD-PAVED-5L	A major roadway, which is paved with asphalt or concrete, and consists of 5 roadbeds separated by a median.
ROAD-PAVED-6L	A major roadway, which is paved with asphalt or concrete, and consists of 6 roadbeds separated by a median.
ROAD-PAVED-7L	A major roadway, which is paved with asphalt or concrete, and consists of 7 roadbeds separated by a median.
ROAD-PAVED-DIV	A major roadway, which is paved with asphalt or concrete, and consists of two (2) roadbeds separated by a median. Each road bed usually consists of two (2) or more lanes.
ROAD-PAVED-UNDIV-1L	A roadway, paved with asphalt or concrete, consisting of one (1) lane, and usually found servicing rural acreages that are close to large urban centres.
ROAD-PAVED-UNDIV-2L	A roadway, paved with asphalt or concrete, and consisting of two (2) adjacent lanes, with no median to separate them.
ROAD-PAVED-UNDIV-4L	A roadway, paved with asphalt or concrete, and consisting of four (4) adjacent lanes, with no median to separate them.
ROAD-UNCLASSIFIED	A temporary coding for an unknown class of road, which will be updated after a field check or verification. (Source: road_album_2.ppt)

ROAD-UNIMPROVED	A roadway surfaced with dirt and constituted as a minor access route. The road surface is up to 7 metres in width, and the road clearing is up to 20 metres in width. The surface and ditches are poorly maintained, and the bridges are narrow.
ROAD-UNPAVED-1L	A roadway surfaced with dirt and constituted as a minor access route.
ROAD-UNPAVED-2L	A roadway surfaced with dirt and constituted as a minor access route.
ROAD-WINTER	A clearing that is vehicular accessible in winter only.
ROAD-WINTER-ACCESS	A clearing that is vehicular accessible in winter only. A roadway surfaced with dirt or low vegetation and constituted as a minor access route. The road clearing is 8 metres or greater in width.
TRUCK-TRAIL	A roadway surfaced with dirt or low vegetation and constituted as a minor access route. The road clearing is 6 metres or greater in width. Streams are generally forded, and ditches are few.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

04 RAILWAY LINES – HARD SURFACE

Feature types:

FEATURE_TY	Feature Description
RLWY-ABANDONED	An abandoned road or track for trains, consisting of parallel steel rails, supported on wooden crossbeams that is no longer in use.
RLWY-DBL-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden crossbeams. The Double track consists of two parallel sets of tracks.
RLWY-MLT-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden crossbeams. A multiple track railway consists of many parallel sets of tracks.
RLWY-SGL-TRACK	A road or track for trains, consisting of parallel steel rails, supported on wooden crossbeams. The single track consists of one parallel sets of tracks.
RLWY-SPUR	A short length of railway leading off a main line, to a dead end. Spur lines usually lead to a commercial/industrial site, or may be used as a turnaround along a rail line.

05 CANALS

Feature type: CANAL

Definition:

A man-made watercourse built to convey water for irrigation. An irrigation canal is larger than a ditch, with reinforced banks that are usually well maintained.

A man-made drainage network channels built to prepare wetland areas for anthropogenic land use.

Interpretation Elements and Rules:

SIZE:

Linear feature usually up to 40 meters in width with reinforced banks that are usually well maintained.

SHAPE: Linear.

SHADOW: no shadows

COLOR: Depends whether they are dry or filled with water. Brown/Grey/Blue

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Located along irrigated cultivation fields.

06 VEGETATED SURFACES of ROADS, TRAILS and RAILWAYS

Feature types:

FEATURE_TY	Feature Description
VEGETATED-EDGE-ROADS	Disturbed vegetation alongside road edges
VEGETATED-EDGE-RAILWAYS	Disturbed vegetation alongside railway edges.

Definition:

Disturbed vegetation alongside road edges and railway edges including ditches.

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

Interpretation Elements and Rules:

SIZE:

Linear feature - various width.

SHAPE:

Linear.

SHADOW: no shadows

COLOR: shades of green,

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Usually located along roads and railways.

07 MINE SITES

Feature types:

FEATURE_TY	Feature Description
GRVL-SAND-PIT	An area of surface disturbance for the purpose of extracting sand and/or gravel consistently open and/or expanding over multiple years, usually close to lakes or rivers.
MINES-COAL	Heavy industry use with bare and/or vegetated ground and low human density for the purpose of coal mining.
MINES-OILSANDS	Heavy industry use with bare and/or vegetated ground and low human density for the purpose of oil sands mining.
MINES-PITLAKE	Areas of ground that were surface water is collected into the existing mine pit usually after mining activity is finished.
OPEN-PIT-MINE	An area of surface disturbance for the purpose of mining (with the exception of sand and/or gravel), consistently open and/or expanding over multiple years, usually close to lakes or rivers.
PEAT	An area of surface disturbance for the purpose of mining peat, consistently open and/or expanding over multiple years, usually in bogs or fens.
RIS-DRAINAGE	Identifies surface disturbance for the purpose of managing surface water features.
RIS-MINES-OILSANDS	Identifies areas where overburden removal has commenced for the purposes of preparing an area for open pit mining and all mine pit features.
RIS-OILSANDS-RMS	Identifies reclamation material stockpiles (RMS). Each RMS may have several material types and corresponding volumes.
RIS-OVERBURDEN-DUMP	Includes all areas where overburden and interburden is placed out-of-pit or in-pit for disposal.
RIS-RECLAIM-READY	Identifies areas where landform construction has been completed and the site is ready for clean cap, subsoil and surface soil placement. This definition is consistent with that used for annual reporting which identifies land "no longer required for mine or plant purposes and available for reclamation but where reclamation activities have not yet commenced.
RIS-RECLAIMED-CERTIFIED	Identifies polygons of reclaimed areas which have received a reclamation certificate.
RIS-RECLAIMED-PERMANENT	Identifies polygons which meet the definition of permanent reclamation - land is considered permanently reclaimed when landform construction and contouring, clean material placement (as required), reclamation material placement and revegetation has taken place.
RIS-RECLAIMED-TEMP	Identifies polygons which meet the definition of temporary reclamation – areas being managed where vegetation has been seeded, planted, or ingressed, where there is an expectation that future disturbance may occur at that location. This does not include cleared areas (planned for future disturbance) that have naturally revegetated through ingress.
RIS-SOIL-REPLACED	Identifies areas which have had subsoil or topsoil placed and which have not been revegetated.

RIS-SOIL-SALVAGED	Identifies areas where soil salvage is occurring but where overburden removal has not commenced.
RIS-TAILING-POND	Identifies all areas associated with tailings including toe berms, dykes, beaches, ponds and drying areas.
RIS-WASTE	Identifies all areas associated with waste and by-product storage on-site.
RIS-WINDROW	Includes areas where a line of reclamation material (soil or vegetation) is heaped up by a machine.
TAILING-PILE	An area used to store waste materials produced in mining processes.
TAILING-POND	Body of water on/in close proximity to an oil sands mine comprised of acids, benzene, hydrocarbons, residual bitumen, fine silts, and water.

Note: "RIS" features were imported from Reclamation Information System (GoA) based on Cross-reference table (Table 2.)

Table 2. Reclamation Information System (GoA) Cross-reference table

RIS		ABMI HFI 2014	
LANDCOVER	FEATURE_TY	FEATURE_TY	Sublayer
	Cleared other industry	RIS-CLEARING-UNKNOWN	08 Industrials
CLEARED	<null>	RIS-CLEARING-UNKNOWN	08 Industrials
	Oil sands cleared	RIS-CLEARING-UNKNOWN	08 Industrials
	Aerodrome	AIRP-RUNWAY-ACTIVE	03 Roads
	Borrow pit	RIS-BORROWPITS	02 Borrow Pits, Sumps, Dugouts, Lagoons
	Camp housing	RIS-CAMP-INDUSTRIAL	08 Industrials
	Disturbed other industry	RIS-FACILITY-UNKNOWN	08 Industrials
	Disturbed unclassified	RIS-FACILITY-UNKNOWN	08 Industrials
	Drainage	RIS-DRAINAGE	07 Mines
DISTURBED	<null>	RIS-FACILITY-UNKNOWN	08 Industrials
	Mine pit	RIS-MINES-OILSANDS	07 Mines
	Operations	RIS-FACILITY-OPERATIONS	08 Industrials
	Other	RIS-FACILITY-UNKNOWN	08 Industrials
	Overburden dump	RIS-OVERBURDEN-DUMP	07 Mines
	Pipeline	RIS-PIPELINE	19 Pipelines
	Plant site	RIS-PLANT	08 Industrials
	Powerline	RIS-TRANSMISSION-LINE	13 Transmission Lines

	Ready to reclaim	RIS-RECLAIM-READY	07 Mines
	Reclamation material stockpile (RMS)	RIS-OILSANDS-RMS	07 Mines
	River water intake structure	RIS-RESERVOIR	01 Reservoir
	Road	RIS-ROAD	03 Roads
	Soil placed	RIS-SOIL-REPLACED	07 Mines
	Soil salvaged	RIS-SOIL-SALVAGED	07 Mines
	Tailings	RIS-TAILING-POND	07 Mines
	Tank farm	RIS-TANK-FARM	08 Industrials
	Utilities	RIS-UTILITIES	08 Industrials
	Waste	RIS-WASTE	07 Mines
	Wellsite	RIS-WELL	09 Well Sites Active
	Windrow	RIS-WINDROW	07 Mines
RECLAIMED	Certified	RIS-RECLAIMED-CERTIFIED	07 Mines
	<null>	RIS-RECLAIMED-UNKNOWN	07 Mines
	Permanent	RIS-RECLAIMED-PERMANENT	07 Mines
	Temporary	RIS-RECLAIMED-TEMP	07 Mines
	Temporary (dam safety)	RIS-RECLAIMED-TEMP	07 Mines

08 INDUSTRIAL SITES

Feature types:

FEATURE_TY	Feature Description
CAMP-INDUSTRIAL	Buildings used for temporary residence by employees on or in close proximity to an industrial activity such as mining, forestry, or oil and gas activities.
CLEARING-UNKNOWN	A human-made clearing with unknown purposes and contains no visible buildings, fences or equipment.
CLEARING-WELLPAD-UNCONFIRMED	Roughly square in shape clearing, roughly 90-120 meters wide (approximately 1 ha). Not confirmed as a well pad by available reference sources.
FACILITY-OTHER	Industrial facility characterized by large non-residential buildings most often surrounded by concrete for parking purposes. The purpose of the facility is not disclosed.
FACILITY-UNKNOWN	Industrial facility characterized by large non-residential buildings most often surrounded by concrete for parking purposes. The purpose of the facility is unknown.
MILL	Intense industrial & commercial development for the purpose of pulp or paper production.
MISC-OIL-GAS-FACILITY	Industrial facility used for the purpose of oil and gas. BATTERY SITE, COMPRESSOR SITE, FLARE STACK, METER STATION SITE, VALVE SITE
OIL-GAS-PLANT	Industrial facility used for oil production. RAFINERIES, PLANTS, FACTORIES
RIS-CAMP-INDUSTRIAL	Identifies area disturbed for the purposes of housing camp workers.
RIS-CLEARING-UNKNOWN	Identifies all areas where vegetation has been removed for the purposes of preparing the land for drainage, soil removal, overburden removal, mining, etc. but where soil has been left mostly intact and relatively undisturbed. May include any or all of: tree removal, shrub removal, and/or grubbing (stump removal). Identifies areas cleared for by other industry and not for the purposes of forest harvesting or for oil sands development.
RIS-FACILITY-OPERATIONS	Designated for areas which are not part of the plant site, e.g., may include laydown areas not integrated with the main plant site(s), tailings lines, water lines, compressor station, buildings away from the main plant site, flare stack, communications tower.
RIS-FACILITY-UNKNOWN	Identifies areas where the reclamation liability associated for the disturbance is currently held by another industry operator.
RIS-PLANT	Includes areas associated with extraction, processing, upgrader. Plant sites may be multiple non-contiguous polygons.
RIS-TANK-FARM	Identifies areas where products of extraction or upgrading are stored. Product stored for on-site use can be identified under plant site or operations.
RIS-UTILITIES	Identifies areas specifically disturbed for the purposes of utilities (power generation).
URBAN-INDUSTRIAL	An industrial facility within the boundary of an urban residence.

Note: "RIS" features were imported from Reclamation Information System (GoA) based on

Cross-reference table (Table 2.)

09 WELL SITES ACTIVE

Feature types:

FEATURE_TY	Feature Description
RIS-WELL	Identifies areas disturbed for the purpose of establishing exploration, production or disposal wells.
WELL-BIT	Well site - ground cleared for a bitumen well pad.
WELL-CASED	Well site - ground cleared and well cased.
WELL-CLEARED-DRILLED	Well site - confirmation of drilling and the boundary outline are provided by reference sources.
WELL-CLEARED-NOT-CONFIRMED	Well site - confirmation of the boundary outline are not provided by reference sources.
WELL-CLEARED-NOT-DRILLED	Well site - confirmation of the boundary outline are provided by reference sources.
WELL-DRILLED-OTHER	Well site - confirmation of drilling are provided by reference sources.
WELL-GAS	Well site - ground cleared for a gas well pad.
WELL-OIL	Well site - ground cleared for an oil well pad.
WELL-OTHER	Well site - clearing, purpose is unknown.

Note: "RIS" features were imported from Reclamation Information System (GoA) based on Cross-reference table (Table 2.)

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Well Pad Procedures for 2014 Footprint.pdf

AHFMP - Well Pad User Guide 2014 Footprint.pdf

10 LANDFILL

Feature types:

FEATURE_TY	Feature Description
LANDFILL	Larger area of raised land, indicating buried garbage. Some landfills have evidence of surface revegetation and garbage dispersed throughout designated extent. They may also have large perimeter berms or fences.
TRANSFER_STATION	Smaller area of land, less than one hectare, usually fenced with a U-shaped road and two entry ways. Used primarily for garbage drop-off and located close to municipalities or present in rural areas.

Interpretation Elements and Rules:

SIZE:

Various sizes, often larger polygons of landfills than transfer stations.

SHAPE:

Often rectangular or square shape structure.

SHADOW: no shadows

COLOR: various colours

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Usually located in proximity of residential areas.

11 OTHER VEGETATED FACILITIES and RECREATION

Feature types:

FEATURE_TY	Feature Description
CAMPGROUND	Disturbed vegetation with frequently changing facilities of RVs and tents used for overnight stay. Most often comprised of several individual clearings surrounded by vegetation and gravel or concrete roads connecting clearings.
GOLFCOURSE	Large recreational area comprised of a series of grass patches surrounded by trees.
GREENSPACE	Greenspace used for recreation within a residential area including parks, schools, school yards and sport fields.
RECREATION	Urban/rural greenspace and recreation that does not fit into other categories (e.g. grave yards, baseball diamonds, parks, shelterbelts, ski hills, clearings from old industrial activity that is now vegetated). This layer was also used to identify green-space features that do not fit into other categories such as storage areas and parking lots.
RUNWAY	Vegetated runway.
SURROUNDING-VEG	Disturbed vegetation surrounding an airport runways, highway ramps and other industrial features.

Interpretation Elements and Rules:

SIZE:

Various sizes, often larger polygons of landfills than transfer stations.

SHAPE:

Often rectangular or square shape structure.

SHADOW: no shadows

COLOR: various colours

TEXTURE: fine / coarser

ASSOCIATED RELATIONSHIP or CONTEXT:

Usually located in proximity of residential areas.

13 TRANSMISSION LINES

Feature types:

FEATURE_TY	Feature Description
TRANSMISSION-LINE	A utility corridor >10 m wide with poles, towers and lines for transmitting high voltage electricity (voltage greater than 69 kV).
RIS-TRANSMISSION-LINE	Include the right of way area designated for the power line.

Interpretation Elements and Rules:

SHAPE: Linear shape – corridor in landscape. Tower structure visible.

WIDTH:

Buffered to 19 m - each side from the centerline (38 m in total width of the corridor) for AHFMP and BASEFE features.

Buffered to measured width for ABMI14, ABMI15, ABMI16, ABMI17 features.

SHADOW: tower shadows

COLOR: shades of green or brown/grey depending on vegetation cover of the corridor

TEXTURE: usually finer texture as a result even vegetation on the corridor

ASSOCIATED RELATIONSHIP or CONTEXT:

Corridor connects energy users with energy providers.

14 CFO and HIGH DENSITY LIVESTOCK

Feature type: CFO

Interpretation Elements and Rules:

SIZE: Various sizes.

SHAPE: Often regular shape.

SHADOW: shadows of building and facilities associated with CFO

COLOR: various colours

TEXTURE: usually coarser texture

ASSOCIATED RELATIONSHIP or CONTEXT:

Usually in proximity of farm fields, residential or industrial features.

15 URBAN and RURAL RESIDENTIAL

Feature type: COUNTRY-RESIDENCE

Definition:

Country-residential developments with density of 10 - 100 buildings per quarter section.

Interpretation Elements and Rules:

SIZE:

Minimum size of the polygon should be 0.4 Ha (1 Acre) in case one country-residential property

creates an acreage polygon. More often – multiple country-residential developments are

captured into one polygon therefore maximum size of polygon is not limited.

SHAPE:

Multi-vertices polygons, where boundaries follow property lines, fences, clearings of country-

residential development.

SHADOW: no shadow

COLOR: no unique color

TEXTURE: no unique texture

ASSOCIATED RELATIONSHIP or CONTEXT:

Country residential areas are often grouped together with road system as a backbone of such residential development.

Feature type: RURAL-RESIDENCE

Definition:

Rural-residential developments with density of less than 10 buildings per quarter section.

Interpretation Elements and Rules:

SIZE:

Various sizes. Usually one polygon per one rural residence.

SHAPE:

Multi-vertices polygons, where boundaries follow property lines, fences, clearings of rural-residential development.

SHADOW: no shadow

COLOR: no unique color

TEXTURE: no unique texture

ASSOCIATED RELATIONSHIP or CONTEXT:

Rural residences are often isolated by other human footprint types (cultivation) or native landscape (lodges). They are connected to the other areas by access road.

Feature type: URBAN-RESIDENCE

Definition:

Residential areas in cities, towns, villages, hamlets and ribbon developments. Areas that are dominated by dwellings.

Interpretation Elements and Rules:

SIZE:

Various sizes. Usually one polygon per many urban residences.

SHAPE:

Multi-vertices polygons, where boundaries follow property lines, fences, clearings of urban -

residential development.

SHADOW: no shadow

COLOR: no unique color

TEXTURE: no unique texture

ASSOCIATED RELATIONSHIP or CONTEXT:

Urban residences are often surrounded by other human footprint types (recreational –

GREENSPACE, industrial – URBAN-INDUSTRIAL).

Feature type: RESIDENCE_CLEARING

Definition:

Areas cleared for building developments that do not yet have any buildings.

Interpretation Elements and Rules:

SIZE:

Various sizes. Usually one polygon per one residence clearing.

SHAPE:

Multi-vertices polygons, where boundaries follow property lines, fences, clearings of residential

development.

SHADOW: no shadow

COLOR: no unique color

TEXTURE: no unique texture

ASSOCIATED RELATIONSHIP or CONTEXT:

Residence clearings are often in vicinity of existing urban residences.

16 WELL SITES ABANDONED
Feature type: WELL- ABAND

Definition: Ground cleared for an oil/gas well pad where the well is currently abandoned.

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Well Pad Procedures for 2014 Footprint.pdf

AHFMP - Well Pad User Guide 2014 Footprint.pdf

17 CULTIVATION
Feature type: CROP

Definition:

Cultivated cropland or cropland planted with annual crop species, including farmlands that are in cultivation rotation.

Cropland includes: **small grains** (wheat, barley, oats and mixed grains), **oilseeds** (canola, flax), **specialty crops** (peas, lentils), **row crops** (potatoes, sugar beets, corn, vegetables).

Fallow describes areas used for the production of the crops that do not exhibit visible vegetation as the result of being cultivated.

Interpretation Elements and Rules:

SIZE: Variable size from smaller fields, usually next to a rural residential area, up to very large polygons covering multiple townships.

SHAPE: Often rectangular, square or multi-vertex shape with distinct round corners as a result of active cultivation by agricultural equipment and machinery.

Circular shape for irrigated crop fields.

SHADOW: no shadows

COLOR: Variable - depending on type of the cropland and imagery acquisition date.

TEXTURE: Consistent smooth, fine texture for cropland / coarser texture for fallow.

STRUCTURE: Often visible tillage lines as a result of active cultivation by agricultural equipment (field cultivator, disk and plow).

ASSOCIATED RELATIONSHIP or CONTEXT: No evidence of grazing as livestock are restricted from these fields during the growing season.

Feature type: TAME_PASTURE

Definition:

Lands where the soil has been disturbed and planted to perennial grass species used primarily for grazing livestock.

Tame pasture represents areas of grasses, legumes or grass-legume mixtures planted for livestock grazing or hay collection.

Interpretation Elements and Rules:

SIZE: Variable size from smaller fields, usually next to a rural residential area, up to very large polygons covering multiple townships.

SHAPE: Often rectangular, square or multi-vertex shape with distinct round corners as a result of active cultivation by agricultural equipment and machinery.

Circular shape for irrigated hay fields.

SHADOW: no shadows

COLOR: Variable - depending on the type of the pasture (grazing/hay) and imagery acquisition date.

TEXTURE: Coarser texture comparing to the crop.

STRUCTURE: Often visible hay collection lines or hay bales.

ASSOCIATED RELATIONSHIP or CONTEXT: Evidence of grazing by livestock – trails, dugouts.

Feature type: ROUGH_PASTURE

Definition:

Lands where the forest and/or shrubs have been removed so that native or introduced grasses can flourish for the grazing of livestock.

This pastureland has not been irrigated or fertilized and the soil has not been disturbed to improve productivity.

Interpretation Elements and Rules:

SIZE: Variable.

SHAPE: Variable

SHADOW: no shadows

COLOR: Usually shades of green - depending on imagery acquisition date.

TEXTURE: Coarser texture for new clearings, smoother for old ones.

STRUCTURE: There might be remains of cleared wood/shrub lands on new clearings– wood piles, timber.

ASSOCIATED RELATIONSHIP or CONTEXT: Usually still surrounded by forest or wooded/shrubby remains. Quite often nearby existing farmland and crop/tame pasture fields.

Feature type: CULTIVATION_ABANDONED

Definition:

Agricultural land that has been formally seeded and tilled, but no evidence of present day production use. Landscape appears to have a heterogeneous mix of vegetation and closely resembles natural cover.

Feature type: FRUIT-VEGETABLES

Definition:

AAFC 2014 Crop Types: Vegetables, Tomatoes, Potatoes, Sugar beets, Other Vegetables, Fruits, Berries, Blueberry, Cranberry, Other Berry, Orchards, Other Fruits, Herbs.

 HFI_2014 dataset cultivation Feature Types were based on AAFC 2014 classification (*ISO 19131 AAFC Annual Crop Inventory, Agriculture and Agri-food Canada, 2014).* AAFC 2014 classification crop types were overlaid onto HFI_2014 polygons and area coverage of individual AAFC crop type within HFI polygon was computed. Cross-referencing all cultivation polygons to Crop Type values based on AAFC 2014 classification is displayed in Table 3.

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP_Cultivation_User_Guide_Footprint_HFI_2014FTv2.pdf

AHFMP_Cultivation_User_Guide_HFI_2014.pdf

Details about AAFC 2014 processes are available in document:

ISO 19131_AAFC_Annual_Crop_Inventory_Data_Product_Specifications.pdf

IMPORTANT:

New cultivation features created by heads-up digitization ([SOURCE] either 'ABMI15', 'ABMI16', 'ABMI17'' 'ABMI18') were attributed based on visual interpretation of SPOT6 satellite natural color composite mosaics. Current HFIeOSM2018 dataset has not included a reattribution of existing HFI_2014 cultivation Feature Types to status of circa 2018.

Table 3. "AAFC2014=>ABMI_HFI2014" cross reference table.

AAFC		ABMI [proposed]
Code	Label	Feature_Ty
10	Cloud	NA
20	Water	HYDRO
30	Exposed Land and Barren	NATIVE-NATURAL
34	Urban and Developed	Residential-Industrial
35	Greenhouses	NA
50	Shrubland	NATIVE-NATURAL
80	Wetland	WETLAND
110	Grassland	NATIVE-NATURAL
120	Agriculture	CROP
122	Pasture and Forages	TAME-PASTURE
130	Too Wet to be Seeded	CROP-WETLAND
131	Fallow	CROP
132	Cereals	CROP
133	Barley	CROP
134	Other Grains	CROP
135	Millet	CROP
136	Oats	CROP
137	Rye	CROP
138	Spelt	CROP
139	Triticale	CROP
140	Wheat	CROP

141	Switchgrass	TAME-PASTURE
145	Winter Wheat	CROP
146	Spring Wheat	CROP
147	Corn	CROP
148	Tobacco	CROP
149	Ginseng	AGRICULTURE-OTHER
150	Oilseeds	CROP
151	Borage	CROP
152	Camelina	CROP
153	Canola and Rapeseed	CROP
154	Flaxseed	CROP
155	Mustard	CROP
156	Safflower	CROP
157	Sunflower	CROP
158	Soybeans	CROP
160	Pulses	CROP
AAFC		**ABMI [proposed]**
Code	**Label**	**Feature_Ty**
162	Peas	CROP
167	Beans	CROP
174	Lentils	CROP
175	Vegetables	FRUIT-VEGETABLES
176	Tomatoes	FRUIT-VEGETABLES
177	Potatoes	FRUIT-VEGETABLES
178	Sugarbeets	FRUIT-VEGETABLES
179	Other Vegetables	FRUIT-VEGETABLES
180	Fruits	FRUIT-VEGETABLES
181	Berries	FRUIT-VEGETABLES
182	Blueberry	FRUIT-VEGETABLES
183	Cranberry	FRUIT-VEGETABLES
185	Other Berry	FRUIT-VEGETABLES
188	Orchards	FRUIT-VEGETABLES
189	Other Fruits	FRUIT-VEGETABLES
190	Vineyards	AGRICULTURE-OTHER
191	Hops	AGRICULTURE-OTHER
192	Sod	AGRICULTURE-OTHER
193	Herbs	FRUIT-VEGETABLES
194	Nursery	AGRICULTURE-OTHER
195	Buckwheat	CROP
196	Canaryseed	CROP
197	Hemp	CROP

198	Vetch	TAME-PASTURE
199	Other Crops	AGRICULTURE-OTHER
200	Forest	NATIVE-NATURAL
210	Coniferous	NATIVE-NATURAL
220	Broadleaf	NATIVE-NATURAL
230	Mixedwood	NATIVE-NATURAL

18 FOREST HARVEST AREAS

Feature type: HARVEST-AREA

Definition:

Areas where forestry operations have occurred (clear-cut, selective harvest, salvage logging, etc.).

IMPORTANT:

- HARVEST-AREAS might accidently include areas that have been cleared for another purpose then timber harvesting (i.e. agricultural use, residential, mine and industrial areas expansion.)
- HARVEST-AREAS [YEAR] value is the best estimation of year when area was harvested. It has been determined by:
  - heads up digitization for years 2014 to 2018,
  - combination of source data values and remote sensing analysis for years 1985 to 2013,
  - source data based for years prior to 1985.

Interpretation Elements and Rules:

SIZE: Variable.

SHAPE: Variable

SHADOW: no shadows

COLOR: Usually shades of green - depending on imagery acquisition date.

TEXTURE: Coarser texture for new clearings, smoother for old ones.

STRUCTURE: There might be remains of cleared wood/shrub lands on new clearings– wood piles, timber.

ASSOCIATED RELATIONSHIP or CONTEXT: Usually still surrounded by forest or wooded/shrubby remains.

19 PIPELINES

Feature types: PIPELINE

Definition:

A line of underground and over ground pipes, of substantial length and capacity, used for the conveyance of petrochemicals.

The physical clearing that contains underground and above-ground high pressure pipelines. These clearings may contain one or multiple pipelines.

Data Source: The Pipeline Verge feature class was created by the Geographic Science Team (GScT) of Alberta Environment and Parks for the Alberta Human Footprint Monitoring Program (AHFMP). The data is used to monitor the total area of pipeline corridors in the province of Alberta. The data is an ESTIMATE of the high-pressure pipelines in the province and is not suitable for locating pipelines on the ground. The data will also contain some low-pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The pipeline verge estimates the extent of the direct physical disturbance of the pipeline corridor whether it is visible or not on imagery. The verges was derived from the Digitally Integrated Dispositions (DIDs), Rural Cadastral pipeline right of ways and from manual digitizing using SPOT imagery. Some verges were also buffered using the estimated pipeline centre lines within the pipeline centre line feature class. The Alberta Energy Regulator (AER) pipeline dataset was used as reference to locate the pipeline corridors. The data was designed specifically for monitoring human footprint and may not be suitable for some cartographic purposes.

Data created by Alberta Human Footprint Monitoring Program (AHFMP) was consequently modified by ABMI. Digitized pipelines interpreted from satellite imagery (year 2017) were added to source dataset to create final HFI sublayer that represents estimated status of pipelines up to year 2017.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Pipeline Procedures Manual for 2016 Footprint - Ver 3.pdf

AHFMP - Pipeline User Guide for 2016 Footprint - Ver 2.pdf

Interpretation Elements and Rules:

SIZE: Variable.

SHAPE: Variable

SHADOW: no shadows

COLOR: shades of green or brown/grey depending on vegetation cover of the corridor

TEXTURE: usually finer texture as a result even vegetation on the corridor

ASSOCIATED RELATIONSHIP or CONTEXT:

Corridor connects energy users with energy providers.

IMPORTANT:

- PIPELINES might include corridor that contain pipelines built for another purpose than the conveyance of petrochemicals, e.g. municipal water.

20 SEISMIC LINES

Feature types:

FEATURE_TY	Feature Description
LOW-IMPACT-SEISMIC	A polygon feature class derived from a 1.5-meter buffer (3 meter total width) of a pre-low-impact-seismic centerline.
CONVENTIONAL-SEISMIC	A polygon feature class derived from a 3-meter buffer (6 meter total width) of a pre-low-impact-seismic centerline.
TRAIL	A polygon feature class derived from a 2-meter buffer (4 meter total width) of a pre-low-impact-seismic centerline.

Buffered to:

TRAIL = 2m half width (**4m full width**)

CONVENTIONAL-SEISMIC = 3m half width (**6m full width**)

LOW-IMPACT-SEISMIC = 1.5m half width (**3m full width**)

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Seismic User Guide 2014 Footprint Ver3.docx

Disclaimer:

- Seismic lines currently available in the ABMI's HFIeOSM2018 are not complete representation of the seismic lines existing on the land surface. The ABMI's sampling scale HF dataset (3x7km) should be used for a more detailed representation of this sub-layer.
- [YEAR] value is the best estimation of year when seismic line was created. It has been determined by visual interpretation based on available aerial/satellite imagery. It is less accurate for the years prior to year 2005 (the first year with higher spatial resolution mosaic available for the entire province of Alberta).

LINEAR FEATURES

This dataset consists of digital representations of linear features, centerlines (Geometry Type: Polylines) within the HFI2017 dataset, including:

1. pipelines,
2. roads,
3. railways,
4. transmission lines,
5. seismic lines.

Disclaimer:

Linear Features dataset should be used as a supporting dataset to polygonal representation of HF features available in HFIeOSM2018. There are areas where human footprint is captured in polygon layers (HFIeOSM2018 and Sublayers) but is still missing in the Linear Features (Polylines).

Available attribute values of the Linear Features dataset are limited. Polygon layers (HFIeOSM2018 and Sublayers) should be used for geographic extent and more complete thematic information (i.e., available attribution, including source of the data).

ROAD

Feature Class: **o03_RoadsCenterlines_HFIeOSM2018**

Feature type list:

'AIRP-RUNWAY' 'FORD-WINTER-XING' 'INTERCHANGE-RAMP' 'RIS-ROAD' 'ROAD' 'ROAD-GRAVEL-1L' 'ROAD-GRAVEL-2L' 'ROAD-PAVED-1L' 'ROAD-PAVED-2L' 'ROAD-PAVED-3L' 'ROAD-PAVED-4L' 'ROAD-PAVED-5L' 'ROAD-PAVED-6L' 'ROAD-PAVED-7L' 'ROAD-PAVED-DIV' 'ROAD-

PAVED-UNDIV-1L' 'ROAD-PAVED-UNDIV-2L' 'ROAD-PAVED-UNDIV-4L' 'ROAD-UNCLASSIFIED'
'ROAD-UNIMPROVED' 'ROAD-UNPAVED-1L' 'ROAD-UNPAVED-2L' 'ROAD-WINTER-ACCESS'
'ROAD-WINTER-ROAD' 'TRAIL-ATV' 'TRUCK-TRAIL'

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Road Processing 2014 Footprint.pdf

AHFMP - Road User Guide 2014 Footprint.pdf

RAILWAY

Feature Class: **o04_RailwaysCenterlines_HFIeOSM2018**

Feature type list:

'RLWY' 'RLWY-ABANDONED' 'RLWY-DBL-TRACK' 'RLWY-MLT-TRACK' 'RLWY-SGL-TRACK' 'RLWY-
SPUR'

TRANSMISSION LINES

Feature Class: **o13_TransmissionLineCenterlines_HFIeOSM2018**

Feature type list:

'TRANSMISSION-LINE'

PIPELINE

Feature Class: **o19_PipelineCenterlines_HFIeOSM2018**

Feature type list:

'PIPELINE'

The Pipeline Centre Line feature class was created by the Geographic Science Team (GScT) of Alberta Environment and Parks for the Alberta Human Footprint Monitoring Program (AHFMP). The data is used to monitor the linear density of pipeline corridors in the province of Alberta. The data is an estimate of the high-pressure pipelines in the province and is not suitable for locating pipelines on the ground. The data will also contain some low-pressure pipelines. A pipeline corridor is defined by the AHFMP as any linear disturbance created for the purpose of constructing and maintaining pipelines. The center line represents the linear distance of the corridor and a single center line is placed in the corridor regardless of the number of pipelines in that corridor. The data was derived from the Digitally Integrated Dispositions (DIDs), Rural Cadastral pipeline right of ways and SPOT imagery using a combination of raster processing and manual digitizing. The Alberta Energy Regulator (AER) pipeline dataset was used as reference to

locate the pipeline corridors. The data was designed specifically for monitoring human footprint and may not be suitable for some cartographic purposes.

Data created by Alberta Human Footprint Monitoring Program (AHFMP) was consequently modified by ABMI. Digitized pipelines interpreted from satellite imagery (year 2017) were added to source dataset to create final HFI sublayer that represents estimated status of pipelines up to year 2017.

Details of AHFMP processing steps and user guide are included in these documents:

AHFMP - Pipeline Procedures Manual for 2016 Footprint - Ver 3.pdf

AHFMP - Pipeline User Guide for 2016 Footprint - Ver 2.pdf

SEISMIC LINES

Feature Class: **o20_SeismicCenterlines_HFIeOSM2018**

Feature type list:

'LOW-IMPACT-SEISMIC' CONVENTIONAL-SEISMIC' 'TRAIL'

Details of AHFMP processing steps and User Guide are included in these documents:

AHFMP - Seismic User Guide 2014 Footprint Ver3.docx

Sections

AGRICULTURE

Land disturbed for agricultural purposes such as crop and tame pasture.

FORESTRY

Disturbances related to the harvesting of timber.

BITUMEN_MINING_SURFACE

Bitumen is a low-grade of crude oil which is composed of complex, heavy hydrocarbons with a high viscosity. Mining Surface is an area defined by the AER (Alberta Energy Regulator) where the recovery of this resource is accomplished by removing overburden to physically access the resource.

MINING_SURFACE_OTHER

Mining sites unrelated to oil and gas. i.e. coal, peat, gravel, etc.

BITUMEN_INSITU

Bitumen is a low-grade of crude oil which is composed of complex, heavy hydrocarbons with a high viscosity and will not flow to a well. In-situ meaning (in the original place) requires a enhanced recovery methods such as SAGD (steam assisted gravity drainage) to recover the resource. The AER designated three areas in the province Cold Lake, Peace River and Athabasca as oil sands areas where this recovery method is employed. These designated oil sands areas do not include the AER designated surface mining area.

OIL_GAS_CONVENTIONAL

Conventional oil and gas refers to petroleum, or crude oil, and raw natural gas extracted from the ground by the natural pressure from the wells and pumping operations and do not require enhance recovery methods.

ENERGY/INDUSTRIAL_OTHER

Industrial or energy disturbances unrelated to oil and gas.

MUNICIPAL_INDUSTRIAL

Industry related to municipal services or within the municipal boundary.

MUNICIPAL_RESIDENTIAL

All residential areas.

MUNICIPAL_RECREATIONAL

Recreational areas within a municipal boundary.

ENERGY_TRANSMISSION

Disturbances related to the transportation of oil and gas products through pipelines to and from facilities and the transmission of electrical energy through power lines from power generating sources such as power plants, windmills, etc. to the consumers.

TRANSPORTATION_MAJOR

A roadway, which is paved with asphalt or concrete or surfaced with gravel and constituted as a main access route.

TRANSPORTATION_MINOR

A roadway surfaced with dirt or low vegetation and constituted as a minor access route.

RECREATIONAL/OTHER

Recreational facilities located outside a municipal boundary.

ANTHROPOGENIC_WATER

Man made water features.

UNKNOWN

Any feature too ambiguous to assign a specific sector.

OIL_GAS_BITUMEN_UNKNOWN

Infrastructure in close proximity to and maybe related to Bitumen/oil and gas that is not obvious.

Day/Night Band (DNB) Radiance

Data source: The National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce.

Credits: Image and Data processing by NOAA's National Geophysical Data Center. DMSP data collected by the US Air Force Weather Agency.

Download source: https://www.ngdc.noaa.gov/eog/viirs/download_dnb_composites.html

Data description:

Produced by the Earth Observations Group, Nighttime data from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) was used to create the version 1 suite of average radiance composite images. The products cover the globe from 75N latitude to 65S. The products are produced in 15 arc-second geographic grids and are made available in geotiff format as a set of 6 tiles. Version 1 does not screen out lights from aurora, fires, boats and other temporal lights. Data for these images are composited monthly and can therefore have discrepancies in the quality of data due to cloud cover and solar illumination.

Downloaded files contain floating point radiance values with units in nanoWatts/cm2/sr. The original DNB radiance values have been multiplied by 1E9. This was done to alleviate issues some software packages were having with the very small numbers in the original units.

Processing steps:

1. Data download, review, selection, clip to OSA boundary

Monthly DNB radiance average - composite raster files for year 2018, were downloaded from:

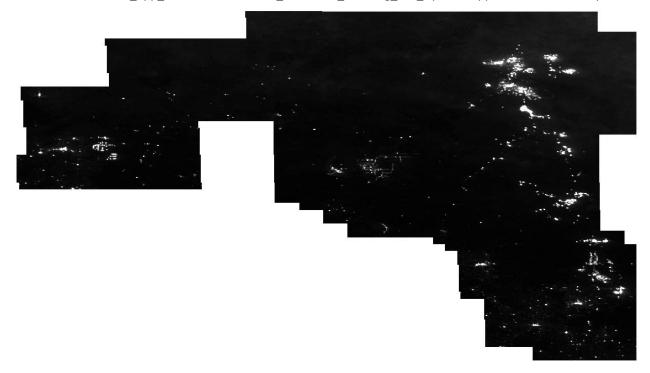https://www.ngdc.noaa.gov/eog/viirs/download_dnb_composites.html

January 2018; "SVDNB_npp_20180101-
20180131_75N180W_vcmslcfg_v10_c201805221252.avg_rade9h.tif":

Downloaded data were clipped to OSM region boundaries and reviewed for quality and noise evaluation. Data from February 2018 and March 2018 were selected as source of DNB value based on the review.

February 2018; "SVDNB_npp_20180201-20180228_75N180W_vcmslcfg_v10_clp.tif"; clipped to OSA boundary:

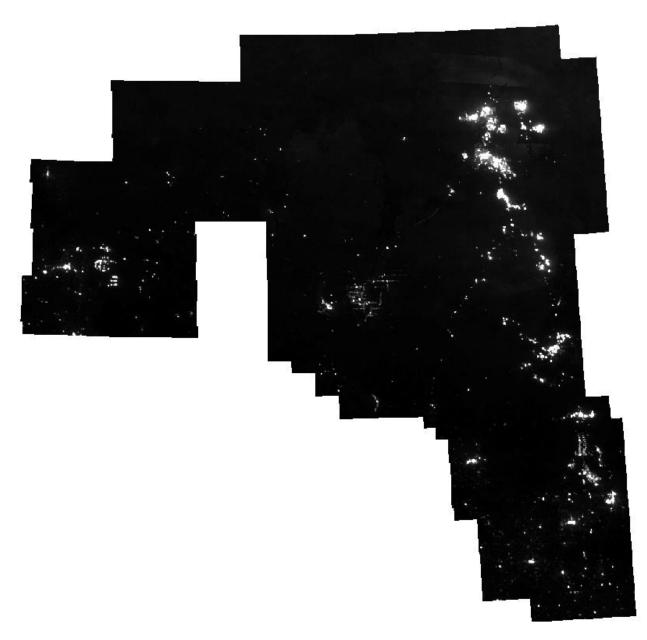March 2018; "SVDNB_npp_20180301-20180331_75N180W_vcmslcfg_v10_clp.tif"; clipped to OSA boundary:

2. Reprojection, February/March mean value raster creation

Clipped raster files (March DNB, February DNB) were used to calculate average value for these two months:

```
("SVDNB_npp_20180201-20180228_75N180W_vcmslcfg_v10_clp@1" + "SVDNB_npp_20180301-
20180331_75N180W_vcmslcfg_v10_clp@1") / 2
```

The result DNB radiance values were saved into a new raster, the raster was subsequently reprojected to NAD83 10TM Forest coordinate system. The spatial resolution of the reprojected raster file is 250m (GSD). The final raster file is part of HFIeOSM2018 ESRI geodatabase - "SVDNB_npp_201802_201803_vcmslcfg_v10_OSA_10TMf".

Raster values (DNB radiance) were assigned to human footprint features by using "Zonal statistics" algorithm in QGIS software suite. This algorithm calculates statistics of a raster layer for each feature of an overlapping polygon vector layer. Mean value of DNB radiance was assign to [VIIRS_DNB_mean] attribute of particular human footprint feature.

Example of DNB radiance value stored in [VIIRS_DNB_mean] attribute of Wellsite Active:

Normalized Difference Vegetation Index (NDVI)

Data source: European Space Agency (ESA); The Copernicus Sentinel-2 mission; https://sentinel.esa.int/web/sentinel/missions/sentinel-2

Credits: European Space Agency (ESA); EO Ground Segment and Mission Operations Department; EO Common Services Section; Via Galileo Galilei; 00044 Frascati (Rome); Italy

Download source: https://code.earthengine.google.com/

Data description:

SENTINEL-2 is a European wide-swath, high-resolution, multi-spectral imaging mission. The full mission specification of the twin satellites flying in the same orbit but phased at 180°, is designed to give a high revisit frequency of 5 days at the Equator.

SENTINEL-2 carries an optical instrument payload that samples 13 spectral bands: four bands at 10 m, six bands at 20 m and three bands at 60 m spatial resolution. The orbital swath width is 290 km.

SENTINEL-2 Radiometric Resolutions

The 13 spectral bands of Sentinel-2 range from the Visible (VNIR) and Near Infra-Red (NIR) to the Short Wave Infra-Red (SWIR):

4 x 10 metre Bands: the three classical RGB bands ((Blue (~493nm), Green (560nm), and Red (~665nm)) and a Near Infra-Red (~833nm) band;

6 x 20 metre Bands: 4 narrow Bands in the VNIR vegetation red edge spectral domain (~704nm,~740nm, ~783nm and ~865nm) and 2 wider SWIR bands (~1610nm and ~2190nm) for applications such as snow/ice/cloud detection, or vegetation moisture stress assessment;

3 x 60 metre Bands mainly focused towards cloud screening and atmospheric correction (~443nm for aerosols and ~945nm for water vapour) and cirrus detection (~1374nm).

Radiometric resolution is the capacity of the instrument to distinguish differences in light intensity or reflectance. The greater the radiometric resolution, the more accurate the sensed image will be.

Radiometric resolution is routinely expressed as a bit number, typically in the range of 8 to 16 bits. The radiometric resolution of the MSI instrument is 12 bit, enabling the image to be acquired over a range of 0 to 4095 potential light intensity values. The radiometric accuracy is less than 5% (goal 3%). Radiometric resolution is also dependent upon the Signal to Noise Ratio (SNR) of the detector.

Processing steps:

The Google Earth Engine was used to create NDVI raster file for vegetation period of year 2018 ('2018-06-01', '2018-09-30'):

var S2_2018 = ee.ImageCollection('COPERNICUS/S2')
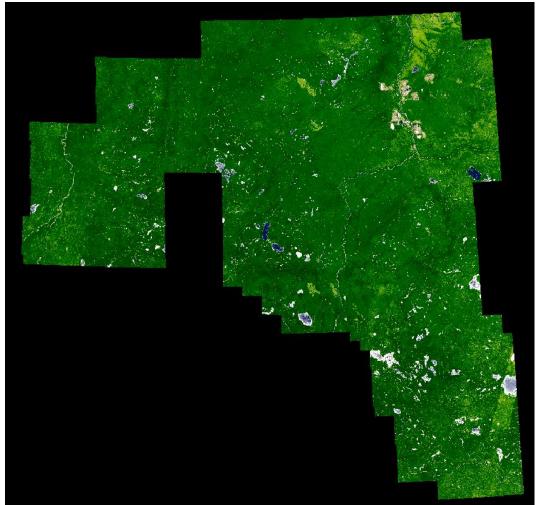
.filterDate('2018-06-01', '2018-09-30')

Normalized Difference function, processing median value of Red (~665nm)) and a Near Infra-Red (~833nm) bands, was used to create NDVI raster file:

var ndvi2018 = S2_2018.normalizedDifference(['B8','B4'])

NDVI normalizes green leaf scattering in the Near Infra-red wavelength and chlorophyll absorption in the red wavelength.

Values description: The value range of an NDVI is -1 to 1. Negative values of NDVI (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) generally correspond to barren areas of rock, sand, or snow. Low, positive values represent shrub and grassland (approximately 0.2 to 0.4), while high values indicate temperate and tropical rainforests (values approaching 1). Source: https://www.sentinel-hub.com/eoproducts/ndvi-normalized-difference-vegetation-index

NDVI raster file; "NDVI_2018_06to09_OSA_10TMf.tif":

Raster values (NDVI) were assigned to human footprint features by using "Zonal statistics" algorithm in QGIS software suite. This algorithm calculates statistics of a raster layer for each feature of an overlapping polygon vector layer.

These statistic values were calculated:

- Count [NDVI_count] - number of pixels overlaid by human footprint feature,
- Mean [NDVI_mean] – mean value of pixels overlaid by human footprint feature,
- Min [NDVI_min] – minimum value of pixel overlaid by human footprint feature,
- Max [NDVI_max] – maximum value of pixel overlaid by human footprint feature,
- Range [NDVI_range] difference between Max value and Min value.

Example of NDVI values stored in [NDVI_*] attributes of Wellsite Active:

Appendix
Attribute List

Sublayer	attributes						
	FEATURE_TY	SOURCE	YEAR	SECTOR	VIIRS_DNB	NDVI	HFI_ID
01 Reservoirs	☑	☑	1984 2014	☑	☒	☑	☑
02 Borrow Pits, Sumps, Dugouts and Lagoons	☑	☑	NULL 1950 2018	☑	☑	☑	☑
03 Non-Vegetated Impermeable Surfaces (Roads)	☑	☑	NULL 1884 2018	☑	☒	☒	☑
04 Rail Lines Hard Surface	☑	☑	NULL 2015 2014	☑	☒	☒	☑
05 Canals	☑	☑	NULL 1999 2015	☑	☒	☒	☑
06 Vegetated Surfaces of Roads, Trails and Railways	☑	☑	NULL 1884 2018	☑	☒	☒	☑
07 Mine Sites	☑	☑	NULL 1950 2018	☑	☑	☑	☑
08 Industrial Sites	☑	☑	NULL 1950 2018	☑	☑	☑	☑
09 Well Sites ACTIVE	☑	☑	NULL 1897 2018	☑	☑	☑	☑
10 Landfill	☑	☑	1984 2018	☑	☑	☑	☑
11 Other Vegetated Surface	☑	☑	NULL 1980 2018	☑	☒	☒	☑
12 Wind Generation Facility	NA	NA	NA	NA	NA	NA	NA
13 Transmission Lines	☑	☑	NULL 1988 2018	☑	☒	☒	☑
14 CFO and other High Density Livestock	☑	☑	1980 2018	☑	☑	☑	☑
15 Urban and Rural Residential	☑	☑	NULL 1980 2018	☑	☑	☒	☑
16 Well Sites ABANDONED	☑	☑	1908 2018	☑	☑	☑	☑
17 Cultivation	☑	☑	NULL 1937 2018	☑	☒	☒	☑
18 Harvest Areas	☑	☑	1940 2018	☑	☒	☒	☑
19 Pipelines	☑	☑	NULL 1910 2018	☑	☒	☒	☑
20 Seismic Lines	☑	☑	NULL 1980 2018	☑	☒	☒	☑

Mandatory Fields:

"FEATURE_TY"

      category of human footprint

 "SOURCE"

      source of feature in the dataset

Values:

'ABMI' – data updated by ABMI prior to HFI_2014 update,

'ABMI00' – data updated by ABMI during HFI_2000 update,

'ABMI14' – data updated by ABMI during HFI_2014 update,

'ABMI15' – data updated by ABMI during HFI_2015 update,

'ABMI16' – data updated by ABMI during HFI_2016 update,

'ABMI17' – data updated by ABMI during HFI_2017 update,

'ABMI18' – data updated by ABMI during HFI_2018 update,

'ABMI37' – data updated by ABMI during temporal human footprint on sample scale update,

'AHFMP'– data updated by Alberta Human Footprint Mapping Program

'AVIE' – data derived from the Alberta Vegetation Inventory obtained from the Government of Alberta

'AVI' – data derived from the Alberta Vegetation Inventory obtained from the Government of Alberta

'BASEFE' – data obtained from the Government of Alberta under the Open Data License. Data source: http://www.altalis.com/products/base/20k_base_features.html,

'GVI' – data derived from the Grassland Vegetation Inventory obtained from the Government of Alberta

'GVIed' – data derived from the Grassland Vegetation Inventory obtained from the Government of Alberta updated by ABMI

'PLVI' – data derived from the Primary Land and Vegetation Inventory obtained from the Government of Alberta

'PLVIed' – data derived from the Primary Land and Vegetation Inventory obtained from the Government of Alberta updated by ABMI,

'RIS' – Reclamation Information System *(RIS)* data obtained from the Government of Alberta, Alberta Environment and Parks

'SRDSPT' – Special Areas data obtained from the Government of Alberta, Alberta Environment and Parks

'SPAREA' – Special Areas data obtained from the Government of Alberta, Alberta Environment and Parks

"YEAR"

[YEAR] attribute contains a value of "year of origin". This value is either introduced to HFI dataset from other sources (along with original features) or it is being attributed by ABMI processes. When feature is updated by ABMI, [YEAR] value is updated based on available imagery in ABMI mosaic catalogue – years of 1949-1951, 1999-2003, and 2004 to 2018.

Google Earth Timelapse was used as a reference tool for year of origin determination of some features.

Year value has not been determined for all polygons. The ABMI is constantly updating human footprint inventory dataset including filling in year values. It is expected that next release of HFI dataset will contain more human footprint features with known year of origin than the current version.

"HFI_ID"

Unique identifier used for additional analysis
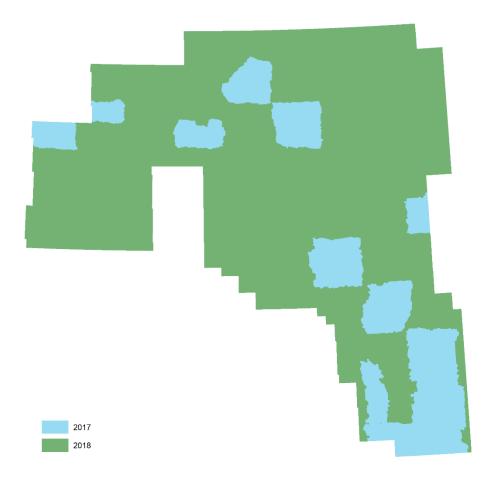
Optional fields:

"NAME"

"BNDRY_SOURCE"

Figure 1: Spatial distribution of satellite imagery available for 2018 SPOT6 mosaic
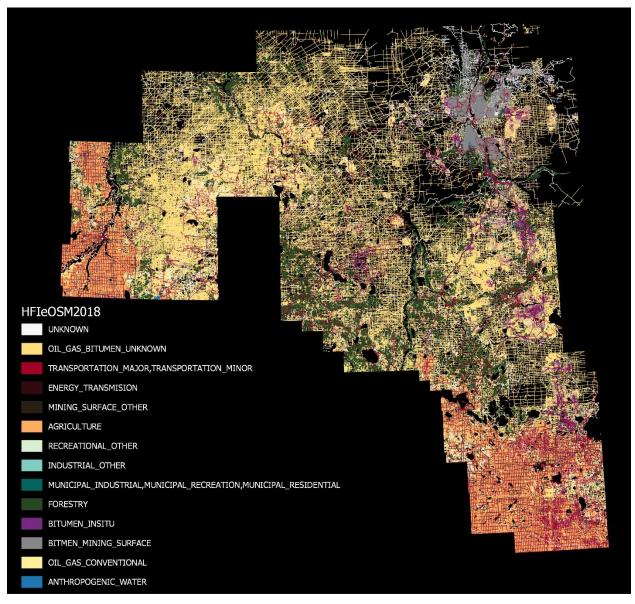
Figure 2: Spatial distribution of 2018 Human Footprint features

Data References

Title	Association Type	Location/Reference
Alberta Vegetation Inventory (AVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Grassland Vegetation Inventory (GVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project

		(AHFMP), https://open.alberta.ca/opendata/ahfmp
Primary Land and Vegetation Inventory (PLVI)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Alberta Human Footprint Mapping Project (AHFMP)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Reclamation Information System (RIS)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Government of Alberta (SRDSPT)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Digitally Integrated Dispositions (DIDs)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Alberta Vegetation Inventory Enhanced (AVIE)	Source	Government of Alberta, 2016. Data provided by Alberta Human Footprint Mapping Project (AHFMP), https://open.alberta.ca/opendata/ahfmp
Special Areas (SPAREA)	Source	The Special Areas; specialareas.ab.ca
Land Use Classification in the Special Areas of Alberta	Source	Publication No. 731; technical Bulletin No.39; Issued: February. 1942
SPOT6, 2014	Source	Ministry of Alberta Environment and Parks, 2019. *Air, Biodiversity and Policy Integration Branch, Policy and Planning Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2010 to 2017.* [Edmonton, AB: Alberta Environment and Parks, 2019].
SPOT6, 2017	Source	Ministry of Alberta Environment and Parks, 2019. *Air, Biodiversity and Policy Integration Branch, Policy and Planning Division, Provincial coverage of pan sharpened and multispectral SPOT6, years 2010 to 2017.* [Edmonton, AB: Alberta Environment and Parks, 2019].
Valtus Orthophoto Mosaic	Reference	Alberta Environment and Parks, 2016. *Informatics Branch*
IRS Satellite	Reference	Alberta Environment and Parks, 2016. *Informatics Branch*
Base Features (BASEFE)	Source	Government of Alberta, 2016. Open Data License, Retrieved from

		http://www.altalis.com/products/base/20k_base_features.html
Google Maps	Reference	https://maps.google.ca
Google Earth Timelapse	Reference	https://earthengine.google.com/timelapse/
Alberta Recycling Management Authority	Reference	http://www.albertarecycling.ca/collection-site-search-results
City of Calgary	Source	https://data.calgary.ca/Base-Maps/Land-Use-Polygons/gbpb-ymc5/about
Alberta Environment and Sustainable Resource Development	Reference	Alberta Environment and Sustainable Resource Development, 2016. *Informatics Branch, 1.5 m Colour SPOT 6 Mosaic.* Retrieved from http://environment.alberta.ca/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2010. *Valtus Imagery*. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2011. *Valtus Imagery*. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2012. *Valtus Imagery*. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, 2013. *Valtus Imagery*. Retrieved from http://www.valtus.com/
Valtus Imagery Services	Reference	Valtus Imagery Services, n.d. *Valtus Imagery*. Retrieved from http://www.valtus.com/
Quality Farm Dugouts (3rd Edition)	Reference	http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex15866
Alberta Vegetation Inventory Standards and Data Model Documents	Reference	https://www.agriculture.alberta.ca/app21/forestrypage?cat1=Vegetation%20Inventory%20Standards
Grassland Vegetation Inventory Standards	Reference	https://geodiscover.alberta.ca/geoportal/catalog/search/resource/details.page?uuid=%7BD3AB9031-8EC0-4589-9335-C1E50AE05992%7D
Primary Land and Vegetation Inventory Standards	Reference	https://geodiscover.alberta.ca/geoportal/catalog/search/resource/details.page?uuid=%7BF640CD9D-C232-481D-9CFF-7A7B66E51E49%7D
road_album_2.ppt	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)

Alberta Transportation Guide to Reclaiming Borrow Excavations – 2013 Edition	Reference	www.transportation.alberta.ca/Content/docType245/Production/borrowguide.pdf
AHFMP_Footprint Data Manual.docx	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP),
AHFMP - Road Processing 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP),
AHFMP - Well Pad User Guide 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP - Well Pad Procedures for 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP - Well Pad User Guide 2014 Footprint.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP_Cultivation_User_Guide_Footprint_HFI_2014 FTv2.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AHFMP_Cultivation_User_Guide_HFI_2014.pdf	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
ISO 19131_AAFC_Annual_Crop_Inventory_Data_Product_Specifications.pdf	Reference	Agriculture and Agri-Food Canada (AAFC); AAFC Crop Inventory, 2014
AHFMP - Seismic User Guide 2014 Footprint Ver3.docx	Reference	Government of Alberta document, provided by Alberta Human Footprint Mapping Project (AHFMP)
AAFC Annual Crop Inventory Data	Source	http://www.agr.gc.ca/atlas/data_donnees/agr/annualCropInventory/tif/

SENTINEL - 2	Reference	European Space Agency (ESA); The Copernicus Sentinel-2 mission; https://sentinel.esa.int/web/sentinel/missions/sentinel-2
Visible Infrared Imaging Radiometer Suite (VIIRS)	Reference	Image and Data processing by NOAA's National Geophysical Data Center. DMSP data collected by the US Air Force Weather Agency.

Thematic Accuracy

SOURCE	Collection	Source Category	Accuracy [%]
External	Inventories	AVI - Photo Interpretation Audit	≥ 90%
		GVI	≥ 65%
		PLVI	≥ 90%

Spatial (Horizontal) Accuracy

SOURCE	Collection	Source Category	Accuracy [+-m]
External	Base features	1:20 000 Provincial Digital Mapping Program	5
		Alberta 1:50 000 Access Mapping	50
		GPS field data	25
		IRS-1C/1D imagery	25
		NTDB data	100
		Federal hydrography	100
		Orthophoto imagery	10
		Aerial photography	10
		SRD regional investigation	25
		Ikonos imagery	10
		Derived from supplementary data	25
		SPOT imagery	2.5
	Inventories	Alberta Vegetation Inventory	20
		GVI upland	5
		GVI wetland	2
		PLVI	5
	Cadastral	Cadastral urban	0.15
		Cadastral rural	3
ABMI	ABMI	Heads-up digitization SPOT "green zone"	10 – 20
Buffer	Buffer	Calculated RMSE per feature type	