Vegetation Resources Inventory

Cranbrook TSA – Project Implementation Plan for Re-Inventory

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Section 1 - Introduction

Background Information

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO) has identified a need to complete a new inventory in the Cranbrook Timber Supply Area (TSA). The new inventory will be conducted using a combination of two methodologies:

1) Traditional photo interpretation following the Vegetation Resources Inventory (VRI) Phase 1 methodology (where LiDAR will be used to inform some of the interpretive work, such as tree height and crown cover); and
2) LiDAR Enhanced Forest Inventory (LEFI) (where photo interpretation is done on a small subset of the photos and combined with LiDAR data to model the entire new inventory).

The plan is to complete this inventory by March 2020, and to have it available by January 2021. This document details the planning necessary for the project to commence.

The mountain pine beetle (MPB) has had a noticeable impact on the forest cover in the Cranbrook TSA. This, in combination with the overall vintage of the current inventory (1988), means the new inventory will provide much needed current information on (among other things) species composition, the spatial distribution of live and dead stands, and an estimate of the amount of dead volume in the TSA.

First Nations and stakeholders were invited to attend a re-inventory planning meeting on June 27, 2017 at the government offices in Cranbrook for an introduction to the project and to provide input regarding their needs and objectives. First Nations, stakeholders, and government entities with representatives at the meeting included:

- 2 forest licencees
- 1 BC Timber Sales staff
- 6 FLNRO staff
- (no local First Nations attended)

A complete list of contact persons and attendees is available in Appendix A: First Nation and Stakeholders Meeting Attendance.

Document Objectives

This VRI Project Implementation Plan (VPIP) is a working document that states the critical reasons and objectives for carrying out a new inventory in the Cranbrook TSA. It includes details on the area to be inventoried, issues with the current inventory, objectives, and key steps required to be carried out for a successful completion of both the Phase 1 (photo interpretation) and LEFI projects. Necessarily, this VPIP primarily describes the higher-level details of the projects, whereas the finer details and specifics will be contained within the respective contract documents.

Overview of the VRI Phase 1 Process

The VRI provides a strategic inventory (as opposed to an operational inventory) at the management unit level (e.g., District, TSA or TFL) designed to answer two basic questions: where is the resource, and how much is there? The VRI consists of two phases: air photo interpretation (Phase 1) and ground sampling (Phase 2). These phases may be undertaken in combination or, in certain situations, individually.

Phase 1 involves acquisition of new photos, delineation of new polygons, and estimation of polygon attributes, with the final product being the corporate inventory. Phase 2 involves a network of forest growth monitoring plots established across the target unit, supplemented by ground sampling a random subset of the new polygons. This serves to verify the level of confidence in the Phase 1 inventory, and to provide detailed information on stand characteristics (such as tree size distribution and condition) that is not available from the Phase 1 inventory.

The individual stages of a VRI Phase 1 project include the following:

- Image acquisition: Images used for VRI photo interpretation projects must be less than five years old. The photos for this project were acquired in the summer of 2016.
- Historical data source transfer: The existing data sources in the project area are evaluated and captured digitally if they are deemed to be useful for the current project.
- Delineation: New linework is delineated on the images. Polygon delineation is based on the B.C. Land Cover Classification Scheme (BCLCS). This land classification scheme includes both vegetated and non-vegetated cover classes. Polygons identified by the land classification scheme are further divided into similar vegetated or non-vegetated polygons based on mensurational attributes (species, age, height and crown closure) and/or ecological attributes where appropriate.
- Fieldwork: A series of calibration points are established for use by the interpreters. These calibration points are a combination of air calls via helicopter, and ground calls. The calibration program allows the interpreters to gain some familiarity with the project area, and the data acts as reference points while attributing neighbouring polygons.
- Attribute estimation: All delineated polygons are assigned attributes which describe the vegetative or non-vegetative characteristics of the polygon. A complete description of the attributes described is available in the *VRI Photo Interpretation Procedures*.

More details regarding the VRI process and the VRI procedures and standards are available at the Forest Analysis and Inventory Branch (FAIB) website:

> https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/photo-interpretation.

For this re-inventory, LiDAR data, where available, will be used to augment the Phase 1 photo interpreted inventory. LiDAR-based attributes for height will be generated and provided back to the Phase 1 contractor prior to the attribution stage, to be used as a starting point for species and/or layer heights (but to be adjusted as necessary by the photo interpreter). These LiDAR-based attributes will likely be as follows:

- a single percentile height (e.g., 90th percentile height) for each Phase 1 delineated polygon, along with the standard deviation;
- a canopy cover for each Phase 1 delineated polygon; and
- a rasterized canopy height model (CHM).

Overview of the LEFI Process

LiDAR is a system that can provide highly accurate 3-dimentional characterization of terrain, forest canopy, sub-canopy, and vegetation. Various forest stand attributes that can be modeled using LiDAR data and the LEFI process include stand height, density, crown closure, basal area, diameter, volume, and biomass, among others.

The LEFI process involves many steps, but the essence of it all is to combine calculated metrics from a massive data point cloud with ground plot data in order to generate predictive models that then generate the attribution across the rasterized project area, which is then amalgamated into polygons. A more step-by-step outline follows:

- Acquisition: Fly to acquire the raw LiDAR data, pre-process and QA it, to produce a normalized and classified point cloud.
- Processing: Convert the point cloud to .laz format, retile and buffer it, remove duplicates, create a digital elevation model (DEM) and CHM, and generate raster metrics and plot metrics.
- Segmentation: Segment the project area land base into like areas (with a minimum size of 2 ha) using the CHM, and cut in existing treed VRI attributes to each segment.
- Sampling design and selection: Stratify the current VRI (by leading species, BEC, height, and volume), and use that stratification scheme intersected with the road network to perform a weighted (by strata proportion) systematic selection of sample plots. Verify and adjust the plot locations for acceptability with the help of orthophotos, LANDSAT imagery, and Google Earth.
- Ground sampling and modeling: Collect ground data on the sample plots, compile the data, and combine with the plot metrics to produce statistical models. Run the models on the raster metrics to produce the rasterized predicted attribution.
- Photo sampling: Complete traditional photo interpretation (including air and ground calls) on a systematic selection of segments, but using the LiDAR predicted values for height, basal area, crown cover, and density.
- Enhancement: Processing through evaluation and amalgamation (i.e., "nearest neighbour" analysis) of individual raster cells, in combination with the ground and photo sampling data, leads to the final predicted polygons and attribution.

Cranbrook TSA "Target Area" Landbase

In recent years, VRI Phase 1 projects have typically been conducted for entire TSAs or Districts. The primary benefit of this is generating a consistent inventory product (both in qualities and vintage) to be used in timber supply analyses. This project is no exception. The full re-inventory ("target") area contains all of the Cranbrook TSA (except for a fraction of mapsheet 82J004), and it extends beyond the north TSA boundary to incorporate adjacent areas of the Invermere TSA (Figure 1). This reflects the recent practice of completing Phase 1 inventory projects using square edge boundaries (such as mapsheets) where logical. The Invermere TSA inventory is from 1988. The project area stops in the east, south, and west along the provincial, national, and TSA boundaries, respectively. The Kootenay Lake TSA inventory to the west of the Cranbrook TSA is from 2006, and will not be updated. The exception to this is to update the partial polygons in the Kootenay Lake inventory along the Kootenay Lake-Cranbrook TSA boundary, thus eliminating the need for edge-tying (for reference, this is referred to as a "wiggle" boundary).

The portion of the full re-inventory area that will apply to the LEFI project is the one large contiguous block of LiDAR labeled as "AI LiDAR 2010" (the east block) (Note that all tables in this section represent data based specifically on the project area, which does not exactly match the area of the Cranbrook TSA (for the reasons discussed above) (Table 2). Also note that the summary tables and maps do not include mapsheets 82F097, 82F098, or 82F099, or the area from the Kootenay Lake TSA "wiggle" boundary, as this combined area (~ 26,871 ha, or 1.7 FMEs) was added late to the project area.

, Figure 2). The Phase 1 project will encompass all re-inventory areas outside of this LiDAR block, but also including mapsheets 82G005 and 82G015. This overlap of two mapsheets will allow a direct comparison to be made between the inventories resulting from the two methodologies.

Note that all tables in this section represent data based specifically on the project area, which does not exactly match the area of the Cranbrook TSA (for the reasons discussed above) (Table 2). Also note that the summary tables and maps do not include mapsheets 82F097, 82F098, or 82F099, or the area from the Kootenay Lake TSA "wiggle" boundary, as this combined area (~ 26,871 ha, or 1.7 FMEs) was added late to the project area.

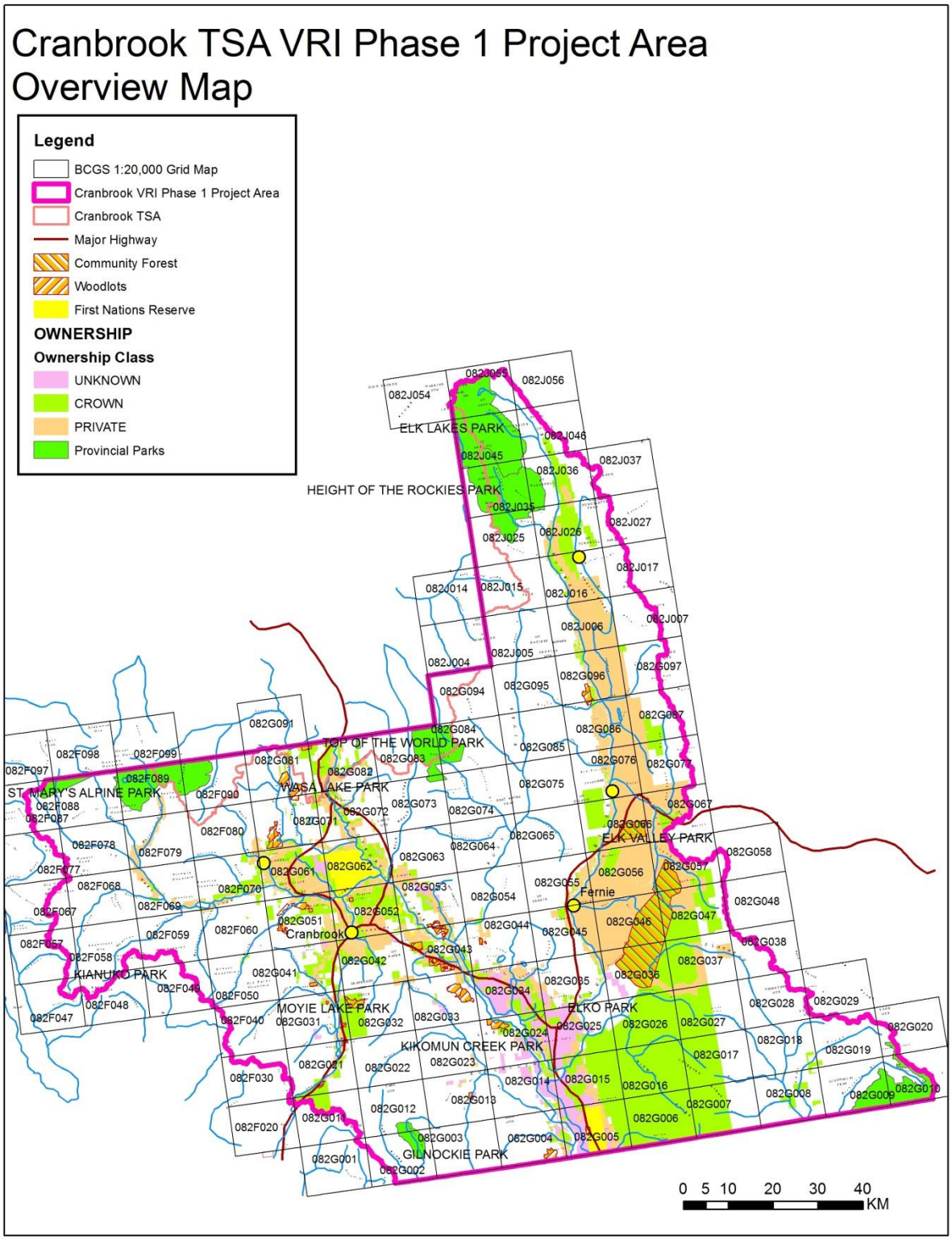


Figure 1. Overview of the Cranbrook re-inventory project area.

Table 1. Phase 1 and LiDAR areas within the Cranbrook re-inventory project area.

Project/Contract Areas	Area (ha)	% of Project Area
Project Area	1,550,655	100.0%
Phase 1 Project Area	944,417	60.9%
AI LiDAR 2010 (East Block)	639,719	41.3%
Subtotal	***1,584,136***	***102.2%***
AI LiDAR 2010 (West Block)*	43,134	2.8%
BCTS LiDAR 2016 Blocks**	546,197	35.2%
Total	***2,173,468***	***140.2%***

* Shown for reference only - not included in LEFI project

** Shown for reference only - not included in LEFI project (except where overlap exists)

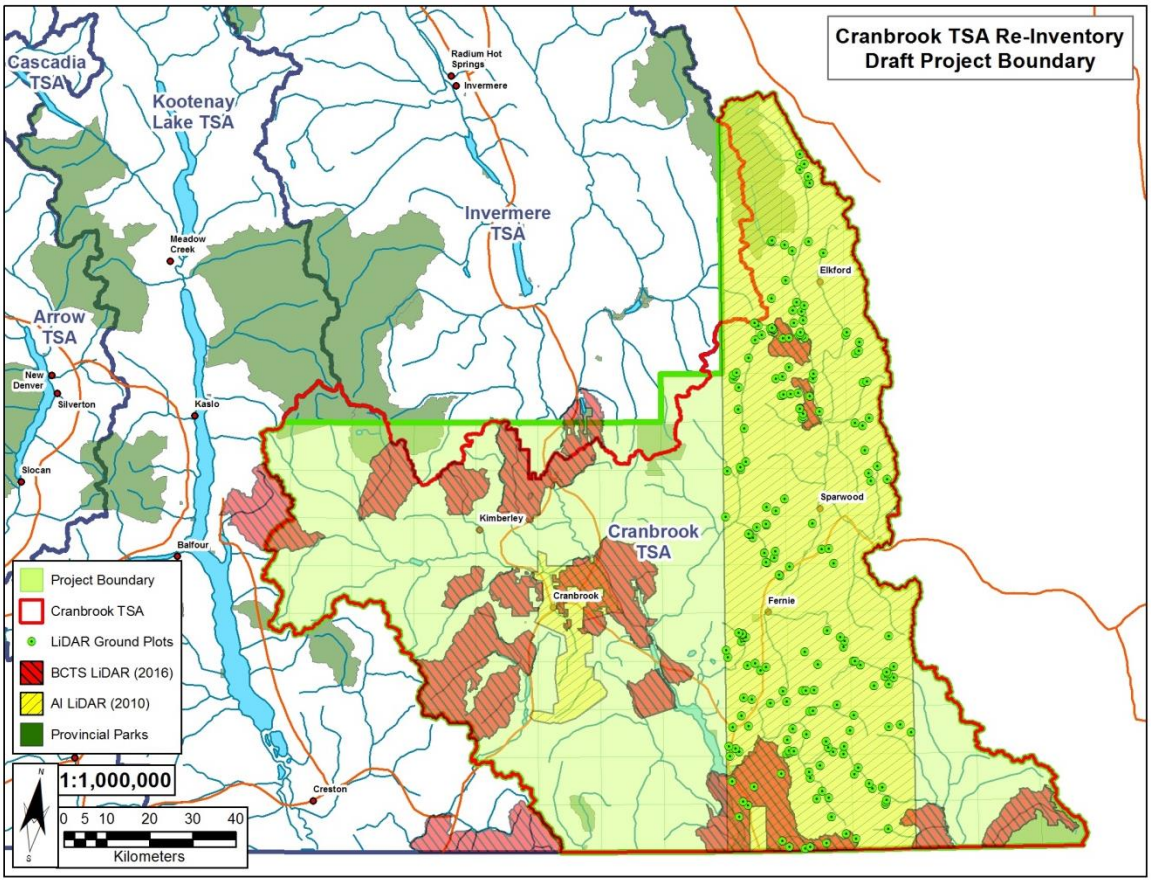


Figure 2. LiDAR blocks and LiDAR calibration ground samples in the Cranbrook re-inventory project area.

Table 2. TSA breakdown for the Cranbrook re-inventory project area.

Timber Supply Areas	Area (ha)	% of Project Area
Cranbrook TSA	1,469,224	94.7%
Invermere TSA	81,431	5.3%
Total	***1,550,655***	***100.0%***

The Cranbrook TSA is located in the very southeast corner of BC and covers approximately 1.48 million hectares. The project area is 1,550,655 ha. Approximately 21% of the entire project area is classed as private land, provincial parks, community forests, Indian reserves, and woodlots (Table 3, Figure 1). According to the most recent TSR document[1], of the total TSA area, ~782,000 ha (~53%) are productive forest under Crown ownership (described as the Crown forest management land base [CFMLB]), with ~352,000 ha (approximately half the CFMLB, or a quarter of the overall TSA) comprising the current timber harvesting land base (THLB).

Table 3. Land classification in the Cranbrook re-inventory project area.

Land Classification (Legal)	Area (ha)	% of Project Area
Project Area	1,550,655	100.0%
Private Land	180,609	11.6%
Provincial Parks	100,866	6.5%
Community Forest Agreements	20,227	1.3%
Indian Reserves	12,288	0.8%
Woodlots	9,993	0.6%
Netdown Subtotal	***323,984***	***20.9%***
Net Area Total	***1,226,671***	***79.1%***

The major population centers in the Cranbrook TSA are Cranbrook, Kimberley, Fernie, Sparwood, and Elkford, with a total population in the TSA of ~46,000. Smaller rural communities exist along the highway networks.[1]

The Cranbrook TSA is located within the "Ktunaxa Traditional Territory", which covers approximately 70,000 square kilometres in southeastern BC. The Ktunaxa Nation Council (KNC) represents five communities within BC, and they are:[2]

- Akisq'nuk First Nation (formally Columbia Lake Band) located near Windermere,
- St. Mary's Community located near Cranbrook,
- Tobacco Plains Community located near Grasmere,
- Lower Kootenay Community located near Creston, and
- Shuswap Community located near Invermere.

The Shuswap Community Leadership have recently joined the Shuswap Nation Tribal Council (SNTC), which is comprised of many First Nation located in the North Okanagan and Shuswap regions.[2]

The Ktunaxa Kinbasket Treaty Council (KKTC), which is affiliated with the KNC, is negotiating a comprehensive Treaty with the Provincial and Federal Governments within the Ktunaxa Traditional Territory.[2]

[1] Cranbrook Timber Supply Area Rationale for Allowable Annual Cut (AAC) Determination. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development. August 24, 2017. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/cranbrook_tsa_rationale_2017.pdf.

[2] Cranbrook Timber Supply Area Vegetation Resources Inventory Strategic Inventory Plan. Tembec. May8, 2008.

Three major physiographic regions characterize the varied terrain of the Cranbrook TSA: the Rocky Mountains in the east, the Purcell Mountains in the west, and the Rocky Mountain Trench in the central region. The trench varies in width from 5 km in the north to 27 km near Cranbrook. The western side of the trench features irregular, comparatively low foothills gradually rising until they merge with the extremely rugged backbone of the Purcell Mountains. In contrast, the eastern side of the trench is characterized by an abrupt rise and continuous wall of mountains broken only by tributary valleys.[1]

The forests of the Cranbrook TSA include a wide variety of species, with lodgepole pine being the dominant species. Douglas-fir, spruce, and balsam are also very common, with larch, other pines, deciduous, cedar, and hemlock rounding out the mix. (Table 4, Figure 3). The recent MPB outbreak peeked in the Cranbrook TSA between 2004 and 2008 and has largely run its course at this time.[1] Thus, both the MPB and pine tree populations should be mostly stabilized within the project area.

Table 4. Leading species in the Cranbrook re-inventory project area.

Leading Species	Area (ha)	% of Project Area	% of Treed Area
Lodgepole (PL, PLC, PLI)	355,770	22.9%	35.1%
Fir (FD, FDI)	173,114	11.2%	17.1%
Spruce (S, SE, SX, SXW)	152,926	9.9%	15.1%
Balsam (B, BL)	146,016	9.4%	14.4%
Larch (L, LA, LT, LW)	98,665	6.4%	9.7%
Other Pine (PA, PW, PY)	59,922	3.9%	5.9%
Deciduous (AC, ACT, AT, E, EP)	21,005	1.4%	2.1%
Cedar (CW, Y)	3,777	0.2%	0.4%
Hemlock (H, HW)	2,661	0.2%	0.3%
Total	***1,013,856***	***65.4%***	***100.0%***
Area with no leading species:	***536,799***	***34.6%***	

The Cranbrook TSA is located in the interior dry-belt of the province, and the project area contains 6 biogeoclimatic ecosystem classification (BEC) zones (Table 5, Figure 4).[3] The distribution of these zones is determined primarily by elevation as opposed to any specific geographic extents. And while the most abundant zone for the overall project area is the Engelmann spruce – sub-alpine fir (ESSF), the montane spruce (MS) is the most prevalent within the THLB.[2]

Table 5. Biogeoclimatic zones in the Cranbrook re-inventory project area.

Biogeoclimatic Zones	Area (ha)	% of Project Area
Engelmann Spruce - Subalpine Fir (ESSF)	840,406	54.2%
Montane Spruce (MS)	261,838	16.9%
Interior Cedar Hemlock (ICH)	166,298	10.7%
Interior Douglas-fir (IDF)	157,707	10.2%
Ponderosa Pine (PP)	90,566	5.8%
Interior Mountain-heather Alpine (IMA)	33,841	2.2%
Total	***1,550,655***	***100.0%***

[3] There is an imminent BEC update pending that covers the project area. Among other adjustments to the existing BEC classification, the entire PP zone will be rolled into the IDF zone. The contact is Deb MacKillop.

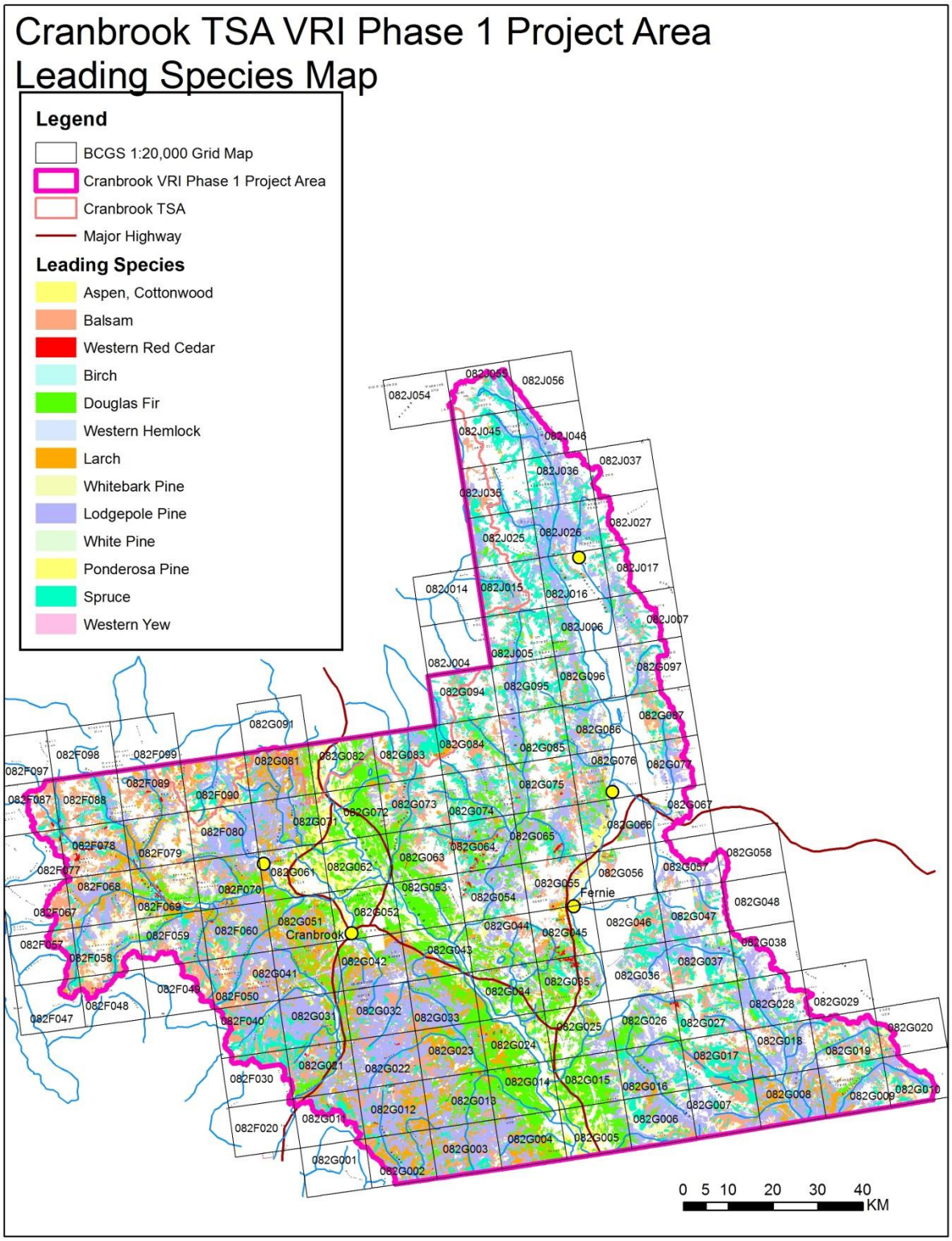


Figure 3. Leading species in the Cranbrook re-inventory project area.

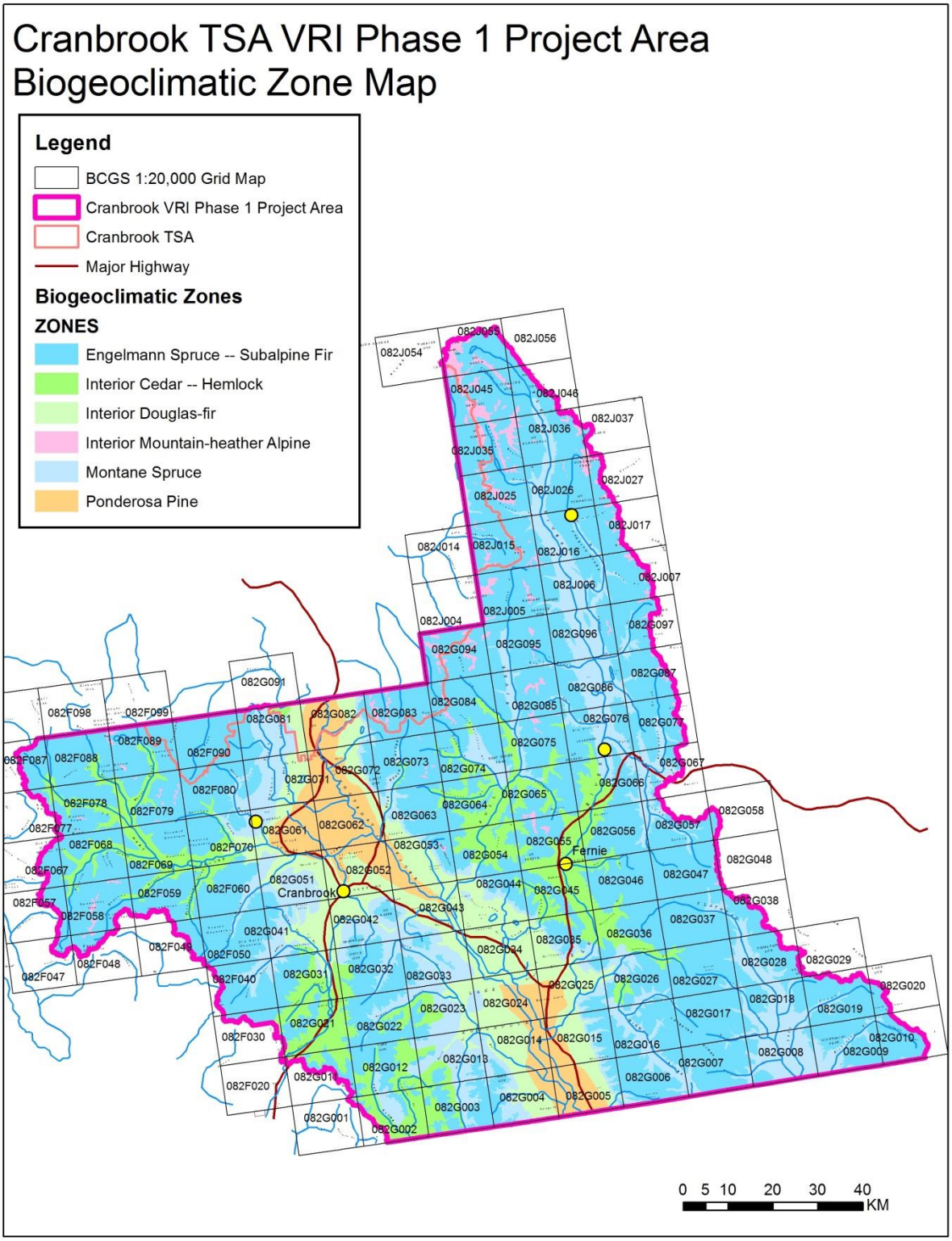


Figure 4. Biogeoclimatic zones in the Cranbrook re-inventory project area.

State of the Current Inventory

The current forest cover inventory for the Cranbrook TSA was completed in 1992 based on air-photo interpretation using 1988 photos (Figure 5).[2] Thus, the forest cover attributes for the vast majority of the project area conform to the older (pre-VRI) FIP inventory standard (F-records). The small remainder of the area is comprised of either newer VRI polygons (V-records), or RESULTS-based polygons (I-records) (Figure 6). The I-records are generated via annual updates for depletions, regeneration, and free-growing declarations sourced from the RESULTS (REporting Silviculture Updates and Land status Tracking System) database since the last major re-inventory.

Depletion and regeneration updates to the inventory from the RESULTS database are current to August 2016. Free-growing updates are current to 2015. The provided inventory file will include these updates and be projected to 2016. Another provided file will include spatial updates for all fire disturbances with fire intensity attributes, up to and including the 2017 fires.

The area previously covered by TFL 13 (37,000 ha) was not part of the 1992 re-inventory. The forest cover inventory for this area was completed in 1981 using 1963 photography for the timber-typing. Ground sampling was for mature strata only and immature types were poorly sampled.[2]

There have been a couple of inventory sampling programs within the Cranbrook TSA since the last re-inventory. First, an inventory audit was conducted on the TSA in 1997. The audit compared the inventory volumes of mature natural stands to field results. The audit showed natural stand volume on the operable land base was 4.2% lower than the predicted inventory volumes. This difference is not deemed to be statistically significant. In general, the inventory audit results show that the volume estimates for the Cranbrook TSA are statistically acceptable.

Second, in the fall of 2007, preliminary sampling was conducted in the NDT4 types to review a potential volume issue. Fire Maintained NDT4 areas are located in the hot, dry Rocky Mountain Trench area of the TSA and are composed generally of Douglas-fir/ponderosa pine leading stands (these areas make up the open forest and open range timber supply analysis units as well as the NDT 4 managed forest stands). 52 samples were randomly located in the IDF-PP BEC zone in the Cranbrook TSA. 3 plots were established at each location and data was collected to estimate gross volume. Data was compiled to 12.5cm utilization and results indicate that gross volume in the inventory is not overestimated in these types. Gross volume on the ground was approximately 10% higher than in the inventory. Results should be viewed with caution as sampling errors were high. Approximately 60 VRI ground samples would be required in the IDF-PP type to achieve a 15% sampling error.

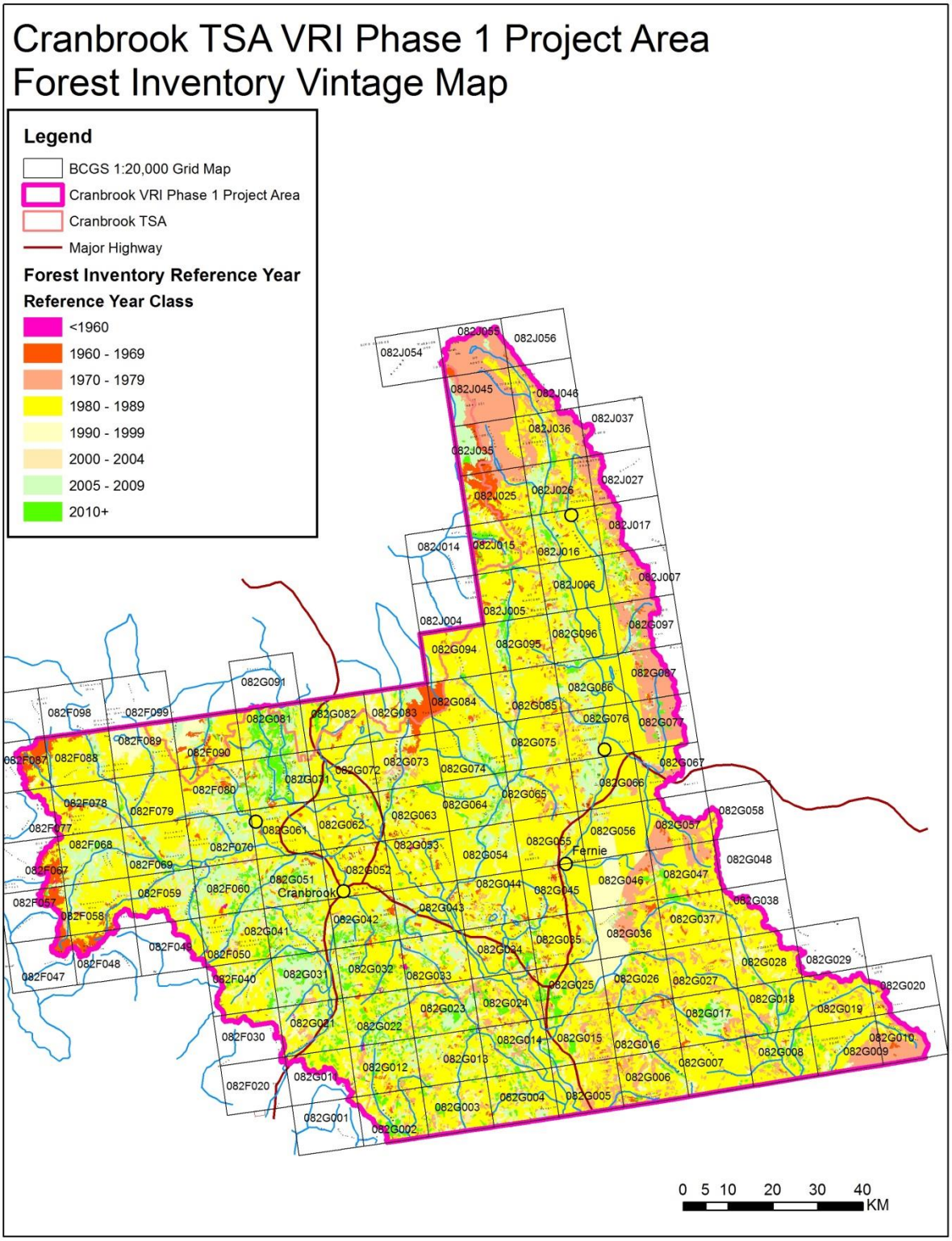


Figure 5. Inventory vintage (reference year) for the Cranbrook re-inventory project area.

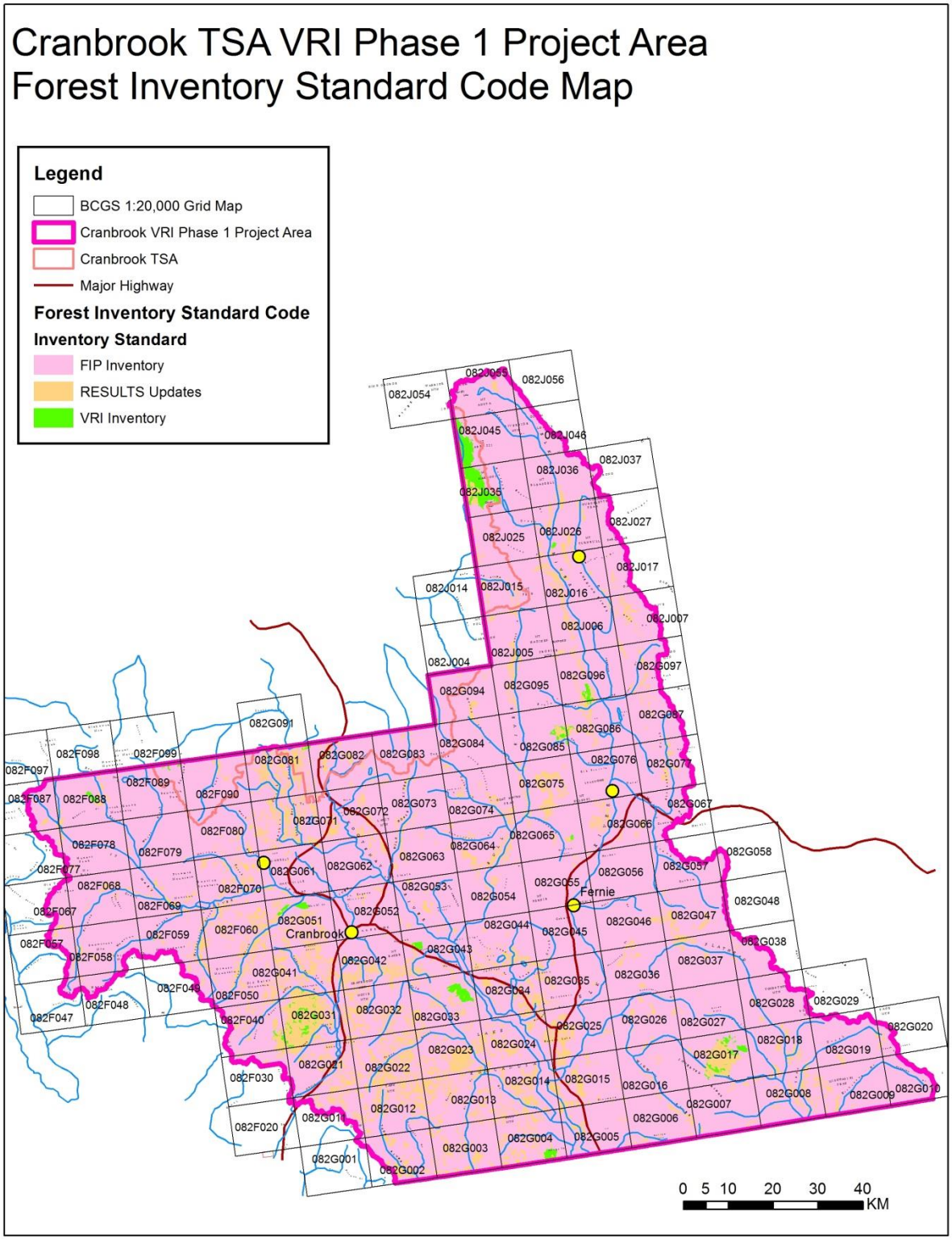


Figure 6. Inventory standard for the Cranbrook re-inventory project area.

Section 2 - Photo Interpretation and LEFI Plan

Project Objectives

The overriding objective of this re-inventory project is to produce a new photo interpreted inventory to account for the accumulated change in the Cranbrook TSA since the last re-inventory for this project area. This change is attributable to such things as annual harvesting and planting, MPB mortality, salvage harvesting, wildfires, and realized differences between modelled growth since the last re-inventory and actual growth on the land base.

The new inventory will provide much needed current information on the spatial distribution of live and dead stands, update species compositions to reflect MPB mortality and harvesting, and provide an estimate of the amount of dead volume in the project area. It will also be conducted to the VRI standard, so it will include the full suite of variables, which are not available in the current inventory. One of the key outcomes of the project is to acquire improved inventory information in order to better inform mid-term timber supply analyses.

A secondary objective of this project is to incorporate LiDAR data into the inventory, in both a direct and indirect way (i.e, generation of an inventory directly from LiDAR models vs. simply informing individual photo interpreted values such as height). The LiDAR data, beyond the inventory itself, will also provide opportunity for various enhanced analyses as determined and conducted by any end-user.

Project Area

The entire Cranbrook re-inventory project area (Figure 1) will be re-inventoried, including all private land, Indian reserves, parks, protected areas, community forests, and woodlots.

The total project area is 1,550,655 ha covering 119 individual BCGS 1:20,000 full and partial mapsheets. For Contractor planning purposes, this equates to 96.4 full mapsheet equivalents (FMEs) based on 16,048 ha/FME (Appendix B - Table 11).

The Phase 1 project, including the two mapsheets that overlap the LEFI project area, covers 944,390 ha[4] (74 individual mapsheets or 58.7 FMEs) (Appendix B - Table 12), while the LEFI project includes 638,750 ha (47 mapsheets representing 39.7 FMEs) (Appendix B - Table 13).

First Nation & Stakeholder-Identified Issues

Several issues with the current inventory are known and/or were identified at the First Nation and stakeholder meeting that should be taken into account, where practicable, when planning and implementing the project:

1. Non-merchantable forest types (balsam IU):
    - The current inventory for balsam IU stands is poor.
    - Need to know what is in these stands, how much volume there is, and when they can be harvested.

[4] Including mapsheets 82F097, 82F098, and 82F099, as well as the area from the Kootenay Lake TSA due to the "wiggle" boundary, the actual total area for the Phase 1 project is 971,261 ha, or 60.4 FMEs.

- This is identified in the most recent AAC determination rational document[1], noting that improved inventory of these stands is needed so they can be appropriately harvested and rehabilitated in order to ensure a sustainable future AAC.

2. Non-merchantable forest types (whitebark pine):
    - Effort needs to be made to identify stands where whitebark pine grows in order to minimize its incidental harvest.
    - There has been some mortality of whitebark pine noted on the landscape, which should be captured in a new inventory.
    - This is also noted in the AAC determination rational document[1] as needing attention.

3. Roads, trails, and landings:
    - Improved road inventory data is needed for use in the next timber supply analysis.
    - This is also noted in the AAC determination rational document[1] as needing attention.

4. NDT 4 stand type volumes:
    - Cruise volumes have typically been as little as half the volume indicated in the inventory within this stand type (primarily the IDF and PP BEC zones).
    - Improved delineation and attribution of these areas may help reduce the differences.

5. RESULTS multi-layer data:
    - There is an abundance of multi-layered regenerating stands in Cranbrook.
    - Utilizing all available tree layers from RESULTS will improve opening attributes.

6. Spruce bark beetle:
    - Although the mountain pine beetle has now been reduced to near-endemic levels within the Cranbrook TSA, and Douglas-fir bark beetles are also at endemic levels, spruce bark beetle is increasing.
    - It is beginning to spread into the Cranbrook TSA (especially into the Elk Valley) from the Palliser River area.
    - Care should be taken to identify dead spruce where possible.

7. Taper equations:
    - It has been noted that there are some issues with the taper equations, particularly within the IDF and PP BEC zones and for high elevation balsam.
    - Although difficult to address directly with photo interpretation, an NVAF program may be able to improve the taper equations.

Many other issues were described within the Cranbrook TSA VRI Strategic Implementation Plan from 2008 (section 2.4),[2] some of which may still apply, although they were not mentioned in either the First Nation and stakeholder meeting, nor in the most recent AAC determination rational document.

Aerial Photography

Digital frame camera imagery of the project area was acquired to GeoBC photo standards and specifications in the summer of 2016. Flight lines were oriented in an east/west direction and captured at 25 cm GSD (ground sampling distance), approximately a 1:15,000 scale. Softcopy image sets will be available as 4-band 8-bit RGBnIr JPEG compressed TIF. This will allow for natural colour display of imagery as well as colour infrared display using the same image file and softcopy setup.

It is hoped that the use of the infrared display may make it easier for photo interpreters to identify live vs. dead trees. It may also be able to help identify the presence of understory vegetation.

Generated supporting products include an ISSD Z\I stereo project file in UTM projection, 10 m DEM in USGS DEM format in UTM projection, 30 cm colour and infrared ortho photos, and a photo index shape file with image names. No hardcopy set of the digital photos is being produced.

Historical Data Sources

Data sources are used as calibration points for improving the quality of air photo interpretation. Existing data sources include air calls, ground calls, permanent and temporary samples and observations distributed across the project area during previous inventories.

An estimated 16,929 air and ground calls have been established in the project area since the first forest inventory project there (Table 6). An unknown number of the established data sources will have been destroyed over the years through harvesting, fires, and other disturbances. The actual number of data sources still available will be determined at the data source transfer stage.

Table 6. Historical calibration points in the Cranbrook re-inventory project area.

Year	FIP Air Calls (X)	FIP Ground Calls (XG)	VRI Air Calls (18)	VRI Ground Calls (17)
Pre 1970	2,829	6,442		
1970 - 1979	1,953	1,889		
1980 - 1989	23	3,070		
1990 - 1999	853	1,471		
2000 - 2009		12		87
2010 - 2017				
Total	***5,658***	***11,184***	***0***	***87***

All data sources that were available in the last re-inventory project are recorded on the earlier document photos[5]. A digital spatial location of these points will be made available to the Contractor in a shape file. All data sources will be reviewed by the Contractor to determine if they are still relevant before they are used. Those that are still relevant to a new inventory on the 2016 imagery will be transferred to a digital format provided by the Ministry.

[5] At the time of this writing, the historical photos have not been located.

Situations that would justify removal of existing data sources include a major disturbance (such as a large fire, harvesting or insect/disease damage), large stand structure changes, or as defined in the contract document. Data sources in MPB-impacted stands will have to be examined closely to determine how relevant they are.

Any data can be used as a calibration data source so long as it has X and Y coordinates. Permanent sample plots, cruise plots, timber recce information, terrestrial ecosystem mapping (TEM), predictive ecosystem mapping (PEM), and SIBEC plots are examples of other data that can be used. However, this data would first need to be obtained and then assembled into a format that the Contractor could easily use.

Polygon Delineation

Polygon delineation is to be completed to VRI standards. Any deviation from these standards must be agreed to by the Ministry Project Manager.

The *VRI Photo Interpretation Procedures* now contain detailed procedures for dealing with dead stands and stands with significant amounts of dead trees resulting in a "dead" ("D") tree layer.

The boundaries for delineation at the north of the project area will be the straight-edged mapsheets. In the east, delineation will coincide with the provincial boundary. In the south along the Canadian-US border, delineation will follow the physical "cut" across the landscape. Although this landscape feature does not always exactly line up with the 49th parallel or the mapsheet boundaries, it is the functional and legal border, and as such is the true limit of our provincial inventory. Finally, in the west along the Cranbrook-Kootenay Lake TSA boundary, the delineation will extend into the Kootenay Lake TSA to cover any "partial" polygons that include the TSA boundary (this is the "wiggle" boundary). This will eliminate the need to do any edge-tying.

Integrating RESULTS Information

The integration of the RESULTS spatial files and tree attribute data will be completed at the delineation and attribution stages of the project. The Contractor is required to incorporate RESULTS information for all non-free growing openings as it exists in the database. For free growing openings, photo interpreters may re-delineate and/or re-attribute the polygons if they do not agree with the RESULTS information. However, if the free growing survey information is recent, the data is typically accepted as is.

A PGDB file for the RESULTS openings found within the project area (Table 7, Figure 7) and the associated tree attributes will be provided to the bidders attending a mandatory project viewing session.

Table 7. Summary of RESULTS database openings for the Cranbrook re-inventory project area.

RESULTS Data	Area (ha)	% of Project Area	# of Openings
RESULTS Free Growing (# of Openings)	69,510	4.5%	4,290
RESULTS Depletion/Regen (# of Openings)	94,248	6.1%	4,514
Total	***163,758***	***10.6%***	***8,804****

* # of Openings has been updated (from the original data summary in August 2017), increasing from 5,612 openings, but the Area and % of Project Area columns have not been updated, and still pertain to the 5,612 openings.

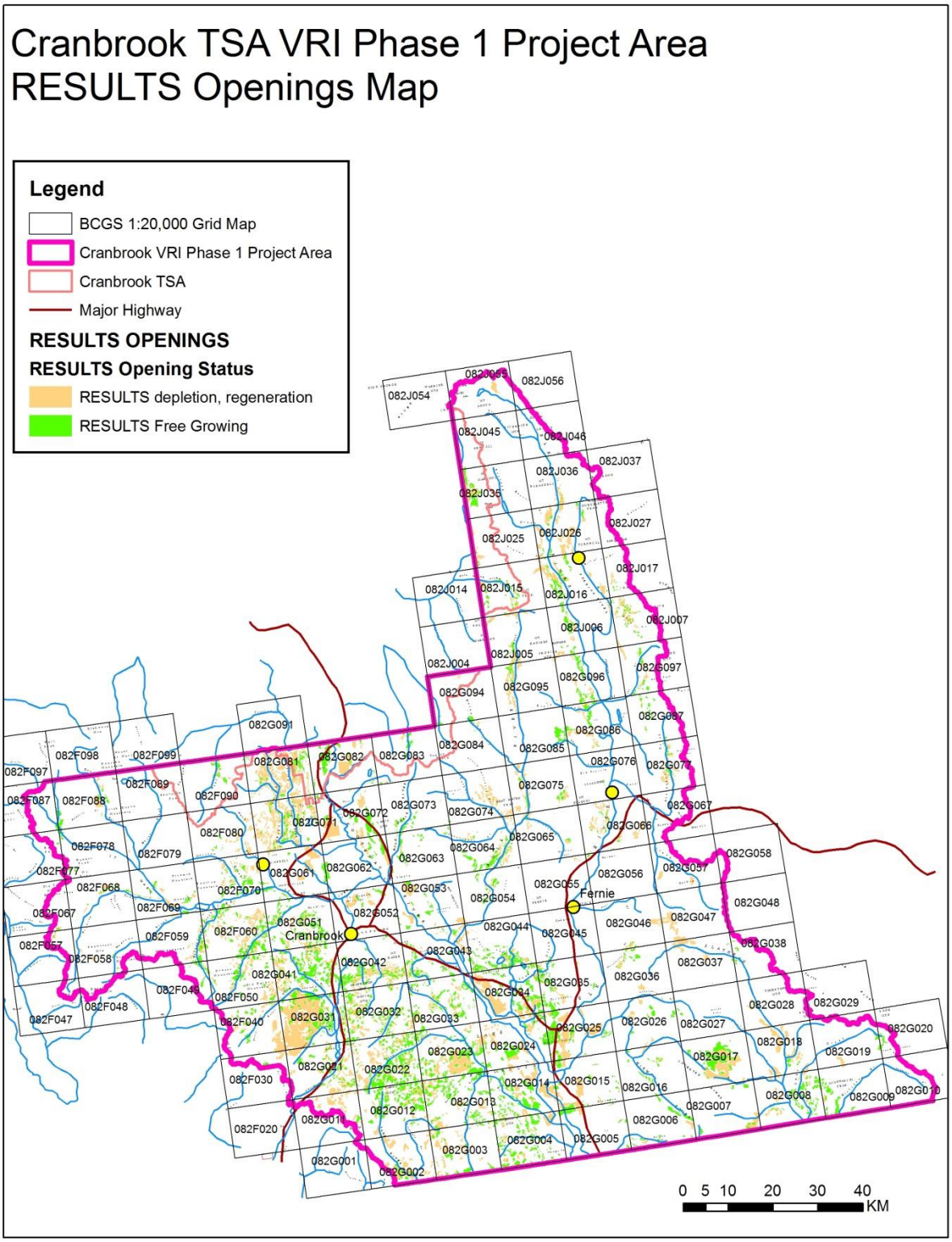


Figure 7. RESULTS polygons in the Cranbrook re-inventory project area.

Free growing updates and depletion/regeneration updates for the project area newer than the last updates (~4,290 and 4,514, respectively) are under a current contract using the 2016 SPOT imagery. A data cut of the production database for these updates will be provided to the Phase 1contractor in VRIMS format (as well as a shape file with spatial and attribute information, and a point file with attribute information). These contracted updates will have already passed QA via the integration process, so they could in theory be copy-pasted from the production database cut into the new working Phase 1 inventory layer without significant review.

Some openings found on the air photos won't be found in the RESULTS data cut. Attribution of harvested areas that are not identified in the RESULTS spatial files will be completed in accordance with the Photo Interpretation Guidelines for Integrating RESULTS Information.

New Data Sources

The fieldwork program calls for the establishment of air and ground calls to provide photo interpreters with actual ground data to use as calibration points. The current standard for distribution of calibration points is a minimum of 10 ground calls and 20 air calls per FME. Actual minimums for this project are still to be determined.

The ground call types will be a combination of 1-point and 3-point calls. The type of ground call established in each polygon is based on the species complexity as described in the *VRI Photo Interpretation Field Calibration Procedures*. The typical ratio of 1-point to 3-point ground calls in the Cranbrook TSA would be approximately 3:7.

An additional tool that will be utilized is ground *observations*. For these, the field crew collects a subset of the full suite of ground call attributes in a quick "observation" without establishing a formal plot (typically in transit between ground calls). Minimum data collection for an observation includes species composition, height, and UTM coordinates. On average, there should be 10 ground observations per FME (in addition to the 20 air and 10 ground calls).

The exact ratios of air calls to ground calls, and 1-point to 3-point ground call types will be determined before the project starts. This determination will be based on recommendations from other recent VRI Phase 1 projects and by reviewing the new aerial images.

Prior to the initiation of a field calibration program, a Field Calibration Plan is to be submitted to the Ministry Project Manager for approval. Documentation within this sampling plan must include a map of the project area indicating the general location and distribution of the calibration points.

As part of the deliverables, the Ministry requires a complete set of any new data sources be provided in a digital format determined by the Ministry, including the geographical locations (UTM coordinates) of these data sources as well as the complete set of field attribute data collected.

Attribute Estimation

This project will be undertaken in softcopy (digital photogrammetric) format.

Photogrammetric tree heights will be taken where suitable at the discretion of the photo interpreter. The LEFI project will also provide the appropriate percentile height for each polygon (with standard deviation) as well as the CHM. The intent is to use these attributes to better inform the photo interpreted height for leading and second species and multiple layers, if present. The LiDAR-provided canopy cover should also help with attributing crown closure.

To some extent, the MPB infestation has caused significant change to the forested landscape in the Cranbrook TSA. The focus for the attribute estimation will be on getting accurate descriptions of the live component of the forest. This includes the residual component remaining in the overstory and,

where visible, the understory. Note that understory can typically only be interpreted when crown closure of the overstory is very low and the understory trees are large enough to be resolved on the photos.

All polygon descriptions will be carried out to the standards of the most current version of the *VRI Photo Interpretation Procedures*. This now includes the capture of attributes on the "dead" ("D") layer for any polygons with more than 100 dead stems per ha.

Mapping

The Ministry has developed a format and database standards for the submission and storage of spatial and attribute data for VRI photo interpretation. All new projects must be completed to this standard and submitted to the Ministry Project Manager as per the delivery schedule.

The Contractor will adhere to the most current version of the *VRIMS Personal Geodatabase Structure and Use* and the *VRIMS Vegetation Cover Polygon Validation Rules* published by the Forest Analysis and Inventory Branch.

Section 3 - Project Implementation

Project Pre-Work Meeting

A project pre-work meeting is mandatory. The purpose of this meeting is to bring together the Ministry Project Manager, VRI Phase 1/LiDAR Contractor, FLNRO representatives and Quality Assurance personnel prior to project start-up. This meeting will ensure that an efficient communication network is established, identify individuals responsible for all aspects of the project, allow discussion of any issues before project work commences, and establish timelines for deliverables and data flow. Minor changes to the contract to complete the project activities may be identified at this meeting.

A project pre-work checklist, signed off by all parties attending, will organize and guide the meeting.

Scheduling

The Phase 1 project will progress over just more than two fiscal years commencing at the very end of 2017/18 (Table 8). 2017/18 will be delineation work only (~10 FMEs), starting in the very west of the project area. Work will proceed from west to east, with ~30 FMEs being completed in 2018/19, and the remaining 30 FMEs being completed by the end of 2019/20. The complete new inventory will be available in January 2021. This schedule may change in order to meet the Ministry's needs. Field calibration is to coincide with subsequent attribution of associated blocks.

The LEFI project will be completed mostly in house, with the product ready to provide the previously specified LiDAR attributes to the Contractor prior to attribution beginning.

Table 8. Proposed coarse project schedule for the Cranbrook re-inventory project.

Calendar Year	Fiscal Year	Fiscal Quarter	Prime Activity	Data Available
2017	2016/17	Q4 (Jan - Mar)	Planning	
	2017/18	Q1 (Apr - Jun)	VPIP	
		Q2 (Jul - Sep)	VPIP	
		Q3 (Oct - Dec)	VPIP Contract Dev.	
2018		Q4 (Jan - Mar)	Contract Award Delineation	
	2018/19	Q1 (Apr - Jun)	Delineation	2010 LiDAR
		Q2 (Jul - Sep)	Field Calibration	
		Q3 (Oct - Dec)	Attribution	
2019		Q4 (Jan - Mar)	Attribution	
	2019/20	Q1 (Apr - Jun)	Delineation	
		Q2 (Jul - Sep)	Field Calibration	
		Q3 (Oct - Dec)	Attribution	
2020		Q4 (Jan - Mar)	Attribution	Year 1 (50%)
	2019/20	Q1 (Apr - Jun)		
		Q2 (Jul - Sep)		
		Q3 (Oct - Dec)		
2021		Q4 (Jan - Mar)		Year 2 (50%)

A delivery schedule outlining progressive delivery of products will be set by the Ministry, in consultation with the Contractor, for each fiscal. The format of the delivery schedule will be agreed to at the project pre-work meeting.

Project Manager

The Ministry Project Manager for the Cranbrook TSA Phase 1 VRI project (and the LEFI project, if LiDAR work is not conducted in house) will be determined at the start of the project(s). Responsibilities include the following: coordinating the project; monitoring and communicating project progress with the local stakeholders; ensuring all contractors are qualified and certified; overseeing photo-interpretation (or LiDAR) activities; ensuring quality assurance is complete and delivered at each stage; and assisting in coordinating technical expertise where required.

Personnel

All VRI photo interpretation work must be completed by or directly supervised by a VRI Certified Photo Interpreter. At least one third of the photo interpreters working on the project must be certified for VRI photo interpretation. All uncertified photo interpreters are to be directly supervised by a Certified Photo Interpreter working on that project. There is a limit of 4 photo interpreters approved to work on the project at any one time; this would help maintain consistency across the project.

Personnel requirement for the LEFI project, if completed by a contractor, will be specified in the contract for that project.

Quality Assurance

An independent third-party quality assurance (QA) will be completed on all stages of the project (historical data source transfer, delineation, calibration fieldwork, and attribution) in accordance with the *VRI Photo Interpretation Quality Assurance Procedures and Standards*. The QA Contractor will receive the same LiDAR data for use in QA as the VRI Contractor receives.

QA for digital map production will be conducted by the Ministry. Contractors will utilize "VEGCAP for Contractors" validation software to perform QA on data files.

All QA findings and re-work instructions are communicated to the VRI Contractor by the Ministry Project Manager.

All LEFI-based work would be reviewed and assessed in house by qualified Ministry personnel.

Deliverables

The VRI Phase 1 project deliverables for each stage of the Phase 1 project are outlined in the *VRI Photo Interpretation Procedures* and the *VRI Field Calibration Procedures for Photo Interpretation*.

The deliverables schedule will be determined by the Ministry, in consultation with the Contractor, at the start of the project. Deliverables are required to be spread out evenly across the entire term of the contract. Deliverables required in a particular fiscal year must be submitted by the end of February to provide sufficient time for completion of independent third-party QA and Ministry in-house GIS QA.

If the LEFI work is conducted by a contractor, the deliverables schedule would again be determined by the Ministry, in consultation with the Contractor, at the start of that project.

Submission of all final deliverables will be signed-off by a qualified ABCFP registered Forest Professional.

Roles & Responsibilities

MFLNRO

The Ministry Project Manager is the point of contact for the Ministry and provides overall communication of project activities with contractors and Rocky Mountain District staff and stakeholders.

VRI Contractor

The VRI Contractor works with the Ministry Project Manager to ensure the planning, coordination and execution of project activities are consistent with the VPIP and contract requirements.

VRI QA Contractor

The VRI QA Contractor works with the VRI Contractor and Ministry Project Manager to ensure that Quality Assurance reporting meets the VRI prescribed standards.

LiDAR Contractor

If utilized, the LiDAR Contractor works with the Ministry Project Manager to ensure the planning, coordination and execution of project activities are consistent with the VPIP and contract requirements.

References for Inventory Standards and Procedures

All work will be carried out in accordance with the following British Columbia Government specifications, current at the time of contract signing.

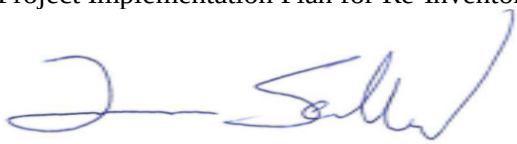
- *Vegetation Resources Inventory Photo Interpretation Procedures*
- *Vegetation Resources Inventory Photo Interpretation Quality Assurance Procedures and Standards*
- *Vegetation Resources Inventory Field Calibration Procedures for Photo Interpretation*
- *Photo Interpretation Guidelines for Integrating RESULTS Information* (contained within the *VRI Photo Interpretation Procedures, Appendix A*)
- *Vegetation Resources Inventory – The B.C. Land Cover Classification Scheme and addendum*
- *VRIMS Personal Geodatabase Structure and Use*
- *VRIMS Vegetation Cover Polygon Validation Rules*
- *Vegetation Resources Inventory – Preparing a Project Implementation Plan for Photo Interpretation, Appendix D*

All contract work related to LiDAR data processing would be carried out in accordance with specifications as detailed in that contract.

Project Sign-Off Sheet

Cranbrook Timber Supply Area Vegetation Resources Inventory
Project Implementation Plan for Re-Inventory

I have reviewed and approved the Cranbrook Timber Supply Area Vegetation Resources Inventory Project Implementation Plan for Re-Inventory.



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Tim Salkeld Date: March 3, 2020
Manager, Forest Inventory Section
Forest Analysis and Inventory Branch
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Appendix A: First Nation and Stakeholders Meeting Attendance

Table 9. Invitations sent to First Nations, and attendees present, for the First Nation and stakeholder meeting regarding initiation of the Cranbrook TSA re-inventory, held at 205 Industrial Rd, Cranbrook, June 27, 2017.

Affiliation	Contact(s)	Attendee(s)
Ktunaxa Nation Council	Cathy Conroy Kerri Garner	<none>
Shuswap Indian Band	info@shuswapband.net	<none>

Table 10. Invitations sent to forest licencees and other stakeholders, and attendees present, for the First Nation and stakeholder meeting regarding initiation of the Cranbrook TSA re-inventory, held at 205 Industrial Rd, Cranbrook, June 27, 2017.

Affiliation*	Contact(s)	Attendee(s)
Canfor	Grant Neville	Grant Neville Terry Lazaruk (phone)
Galloway Lumber	Bud Nelson Randy Byford	<none>
BC Timber Sales	Steve Knowles	Carolyn Beurskens
FLNRO	Local staff	Taye Ayele Mike Daigle Tim Davis Scott Hicks Steve Jablanczy Lyn Konowalyk

Appendix B: Project Mapsheet Area & Land Cover Summary

Table 11. Area and land cover summary for mapsheets included in the overall Cranbrook re-inventory project area.

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082F020	72	0.00	5	1	1
082F030	3,472	0.22	128	386	
082F040	14,058	0.87	544	1,264	9
082F047	1,437	0.09	18	114	
082F048	2,858	0.18	84	175	
082F049	3,833	0.24	511	512	
082F050	16,118	1.0	398	1,079	11
082F057	3,874	0.24		95	25
082F058	14,706	0.91	668	584	6
082F059	14,196	0.88	696	1,211	8
082F060	16,096	1.0	266	2,425	
082F067	4,132	0.26	138	190	5
082F068	16,014	1.0	780	675	21
082F069	16,064	1.0	1,145	1,575	76
082F070	16,064	1.0	548	1,469	43
082F077	1,675	0.10	91	279	
082F078	15,867	1.0	812	632	
082F079	16,031	1.0	1,326	1,209	116
082F080	16,031	1.0	642	1,741	54
082F087	6,008	0.37	499	396	2
082F088	15,998	1.0	607	1,771	
082F089	15,998	1.0	742	569	
082F090	15,998	1.0	605	439	26
082F097***					
082F098***					
082F099***					
082G001	272	0.02			
082G002	13,230	0.82	169	34	13
082G003	16,182	1.0	476	1,581	15
082G004	16,255	1.0	196	2,031	18
082G005**	16,259	1.0	333	2,781	73
082G006	16,235	1.0	2,262	4,245	9

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G007	16,160	1.0	3,749	1,140	112
082G008	16,089	1.0	650	4,251	132
082G009	16,150	1.0	644	2,596	241
082G010	8,891	0.55	87	1,088	5
082G011	6,680	0.42	49	571	
082G012	16,226	1.0	199	678	4
082G013	16,226	1.0	377	1,298	27
082G014	16,226	1.0	342	2,830	7
082G015**	16,226	1.0	1,120	2,377	32
082G016	16,226	1.0	1,939	2,460	47
082G017	16,226	1.0	642	921	6
082G018	16,226	1.0	1,098	2,651	119
082G019	14,529	0.90	1,204	2,304	8
082G020	2,243	0.14	29	1,534	2
082G021	16,159	1.0	500	108	3
082G022	16,194	1.0	488	2,015	1
082G023	16,194	1.0	87	2,557	22
082G024	16,194	1.0	175	2,289	41
082G025	16,194	1.0	816	3,874	24
082G026	16,194	1.0	1,184	5,510	15
082G027	16,194	1.0	1,919	786	43
082G028	14,609	0.91	3,046	3,771	17
082G029	322	0.02	2	1,979	
082G031	16,161	1.0	206	1	41
082G032	16,161	1.0	251	4,281	11
082G033	16,161	1.0	233	1,585	62
082G034	16,161	1.0	115	1,446	628
082G035	16,161	1.0	798	5,343	174
082G036	16,161	1.0	2,536	1,542	357
082G037	16,161	1.0	1,414	2,163	251
082G038	6,914	0.43	1,459	1,956	41
082G041	16,129	1.0	345	1,160	131
082G042	16,129	1.0	225	2,822	381
082G043	16,129	1.0	496	2,134	226
082G044	16,129	1.0	1,377	4,976	365

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G045	16,129	1.0	929	3,444	207
082G046	16,129	1.0	1,176	1,134	
082G047	16,091	1.0	2,413	1,115	85
082G048	220	0.01		2,302	
082G051	16,096	1.0	324	2,197	59
082G052	16,096	1.0	168	3,355	169
082G053	16,096	1.0	647	3,651	45
082G054	16,096	1.0	1,175	1,137	27
082G055	16,096	1.0	536	959	136
082G056	16,096	1.0	296	669	14
082G057	11,140	0.69	1,472	1,059	51
082G058	1,069	0.07		5,540	
082G061	16,064	1.0	101	4,494	245
082G062	16,064	1.0	338	1,449	309
082G063	16,064	1.0	707	2,086	29
082G064	16,064	1.0	1,062	762	541
082G065	16,064	1.0	1,182	941	33
082G066	16,064	1.0	651	357	
082G067	8,815	0.55	326	2,961	82
082G071	16,031	1.0	357	3,946	71
082G072	16,031	1.0	650	1,329	26
082G073	16,031	1.0	906	2,823	9
082G074	16,031	1.0	1,246	745	34
082G075	16,031	1.0	932	652	66
082G076	16,031	1.0	680	865	145
082G077	12,694	0.79	893	1,956	
082G081	15,998	1.0	804	5,195	44
082G082	15,998	1.0	743	702	8
082G083	15,998	1.0	180	1,045	9
082G084	15,998	1.0	772	588	6
082G085	15,998	1.0	483	2,233	
082G086	15,998	1.0	493	349	253
082G087	11,172	0.69	323	70	
082G091	114	0.01	32	2,098	
082G094	15,966	1.0	270	575	14

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G095	15,966	1.0	540	863	
082G096	15,966	1.0	654	707	175
082G097	9,808	0.61	607	499	12
082J005	15,933	1.0	235	589	
082J006	15,933	1.0	315	735	
082J007	9,842	0.61	308	1,617	
082J015	15,900	1.0	783	1,885	9
082J016	15,900	1.0	498	313	49
082J017	5,727	0.36	233	1,905	
082J025	15,867	1.0	823	1,747	34
082J026	15,867	1.0	798	139	19
082J027	3,493	0.22	142	18	
082J035	15,834	1.0	684	4,215	
082J036	15,115	0.94	2,137	1,882	44
082J037	848	0.05			
082J045	15,801	1.0	437	3,167	46
082J046	7,618	0.47	718	579	1
082J054	27	0.00			
082J055	11,353	0.71	398	739	
082J056	1,004	0.06	86	86	
082F020	72	0.00	5	1	1
082F030	3,472	0.22	128	386	
Totals:	***1,550,655***	***96.4***	***78,154***	***194,924***	***7,218***
% of Total Area:			***5.0%***	***12.6%***	***0.5%***

* FME calculation based on an average of 16,084 ha/mapsheet in the full Cranbrook inventory project area.
** Mapsheet is included in both the Phase 1 and LEFI projects.
*** Data is currently not included. Also not included is area in the Kootenay Lake TSA attributable to the "wiggle" boundary. Combined, this is ~ 26,871 ha, or 1.7 FMEs unaccounted for.

Table 12. Area and land cover summary for mapsheets included in the Cranbrook Phase 1 project area (excluding the LEFI-only area).

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082F020	72	0.00	5	1	1
082F030	3,472	0.22	128	386	
082F040	14,058	0.87	544	1,264	9
082F047	1,437	0.09	18	114	
082F048	2,858	0.18	84	175	
082F049	3,833	0.24	511	512	
082F050	16,118	1.0	398	1,079	11
082F057	3,874	0.24		95	25
082F058	14,706	0.91	668	584	6
082F059	14,196	0.88	696	1,211	8
082F060	16,096	1.0	266	2,425	
082F067	4,132	0.26	138	190	5
082F068	16,014	1.0	780	675	21
082F069	16,064	1.0	1,145	1,575	76
082F070	16,064	1.0	548	1,469	43
082F077	1,675	0.10	91	279	
082F078	15,867	1.0	812	632	
082F079	16,031	1.0	1,326	1,209	116
082F080	16,031	1.0	642	1,741	54
082F087	6,008	0.37	499	396	2
082F088	15,998	1.0	607	1,771	
082F089	15,998	1.0	742	569	
082F090	15,998	1.0	605	439	26
082F097***					
082F098***					
082F099***					
082G001	272	0.02			
082G002	13,230	0.82	169	34	13
082G003	16,182	1.0	476	1,581	15
082G004	16,255	1.0	196	2,031	18
082G005**	16,259	1.0	333	2,781	73
082G008	16,089	1.0	650	4,251	132
082G009	16,150	1.0	644	2,596	241
082G010	8,891	0.55	87	1,088	5

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G011	6,680	0.41	49	571	
082G012	16,226	1.0	199	678	4
082G013	16,226	1.0	377	1,298	27
082G014	16,226	1.0	342	2,830	7
082G015**	16,226	1.0	1,120	2,377	32
082G018	16,226	1.0	1,098	2,651	119
082G019	14,529	0.90	1,204	2,304	8
082G020	2,243	0.14	29	1,534	2
082G021	16,159	1.0	500	108	3
082G022	16,194	1.0	488	2,015	1
082G023	16,194	1.0	87	2,557	22
082G024	16,194	1.0	175	2,289	41
082G028	14,609	0.91	3,046	3,771	17
082G029	322	0.02	2	1,979	
082G031	16,161	1.0	206	1	41
082G032	16,161	1.0	251	4,281	11
082G033	16,161	1.0	233	1,585	62
082G034	16,161	1.0	115	1,446	628
082G038	6,914	0.43	1,459	1,956	41
082G041	16,129	1.0	345	1,160	131
082G042	16,129	1.0	225	2,822	381
082G043	16,129	1.0	496	2,134	226
082G044	16,129	1.0	1,377	4,976	365
082G048	220	0.01		2,302	
082G051	16,096	1.0	324	2,197	59
082G052	16,096	1.0	168	3,355	169
082G053	16,096	1.0	647	3,651	45
082G054	16,096	1.0	1,175	1,137	27
082G058	1,069	0.07		5,540	
082G061	16,064	1.0	101	4,494	245
082G062	16,064	1.0	338	1,449	309
082G063	16,064	1.0	707	2,086	29
082G064	16,064	1.0	1,062	762	541
082G071	16,031	1.0	357	3,946	71
082G072	16,031	1.0	650	1,329	26

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G073	16,031	1.0	906	2,823	9
082G074	16,031	1.0	1,246	745	34
082G081	15,998	1.0	804	5,195	44
082G082	15,998	1.0	743	702	8
082G083	15,998	1.0	180	1,045	9
082G084	15,998	1.0	772	588	6
082G091	114	0.01	32	2,098	
082G094	15,966	1.0	270	575	14
Totals:	***944,390***	***58.6***	***37,716***	***126,492***	***4,716***
% of Total Area:			***4.0%***	***13.4%***	***0.5%***

* FME calculation based on an average of 16,084 ha/mapsheet in the full Cranbrook inventory project area.

** Mapsheet is included in both the Phase 1 and LEFI projects.

*** Data is currently not included. Also not included is area in the Kootenay Lake TSA attributable to the "wiggle" boundary. Combined, this is ~ 26,871 ha, or 1.7 FMEs unaccounted for.

Table 13. Area and land cover summary for mapsheets included in the Cranbrook LEFI project area (excluding the Phase 1-only area).

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082G005**	16,259	1.0	333	2,781	73
082G006	16,235	1.0	2,262	4,245	9
082G007	16,160	1.0	3,749	1,140	112
082G015**	16,226	1.0	1,120	2,377	32
082G016	16,226	1.0	1,939	2,460	47
082G017	16,226	1.0	642	921	6
082G025	16,194	1.0	816	3,874	24
082G026	16,194	1.0	1,184	5,510	15
082G027	16,194	1.0	1,919	786	43
082G035	16,161	1.0	798	5,343	174
082G036	16,161	1.0	2,536	1,542	357
082G037	16,161	1.0	1,414	2,163	251
082G045	16,129	1.0	929	3,444	207
082G046	16,129	1.0	1,176	1,134	
082G047	16,091	1.0	2,413	1,115	85
082G055	16,096	1.0	536	959	136
082G056	16,096	1.0	296	669	14
082G057	11,140	0.69	1,472	1,059	51
082G065	16,064	1.0	1,182	941	33
082G066	16,064	1.0	651	357	
082G067	8,815	0.55	326	2,961	82
082G075	16,031	1.0	932	652	66
082G076	16,031	1.0	680	865	145
082G077	12,694	0.79	893	1,956	
082G085	15,998	1.0	483	2,233	
082G086	15,998	1.0	493	349	253
082G087	11,172	0.70	323	70	
082G095	15,966	1.0	540	863	
082G096	15,966	1.0	654	707	175
082G097	9,808	0.61	607	499	12
082J005	15,933	1.0	235	589	
082J006	15,933	1.0	315	735	
082J007	9,842	0.61	308	1,617	
082J015	15,900	1.0	783	1,885	9

Mapsheet	Total Area (ha)	Full Map Equivalent (FME)*	FIP NP Area (ha)	VRI Vegetated/ Non-Treed Area (ha)	VRI Non-Forest Descriptor Area (ha)
082J016	15,900	1.0	498	313	49
082J017	5,727	0.36	233	1,905	
082J025	15,867	1.0	823	1,747	34
082J026	15,867	1.0	798	139	19
082J027	3,493	0.22	142	18	
082J035	15,834	1.0	684	4,215	
082J036	15,115	0.94	2,137	1,882	44
082J037	848	0.05			
082J045	15,801	1.0	437	3,167	46
082J046	7,618	0.47	718	579	1
082J054	27	0.00			
082J055	11,353	0.71	398	739	
082J056	1,004	0.06	86	86	
Totals:	***638,750***	***39.8***	***41,892***	***73,590***	***2,607***
% of Total Area:			***6.6%***	***11.5%***	***0.4%***

* FME calculation based on an average of 16,084 ha/mapsheet in the full Cranbrook inventory project area.

** Mapsheet is included in both the Phase 1 and LEFI projects.