Tree Farm License 18

Vegetation Resources Inventory

Photo Interpretation
Project Implementation Plan

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CANADIAN FOREST PRODUCTS, VAVENBY DIVISION

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1. INTRODUCTION

1.1 Background Information

Tree Farm License (TFL) 18 is held by Canadian Forest Products Limited (Canfor). In 2004, Canfor acquired Slocan Forest Products Ltd who previously held the Licence. TFL 18 is located immediately west of Clearwater in the Headwaters Forest District of the Southern Interior Forest Region.

The Ministry of Forests and Range (MoFR) has developed a business plan to ensure the successful implementation of the Vegetation Resources Inventory (VRI) ground sampling and photo interpretation projects. The process includes the preparation of VRI Strategic Inventory plans (VSIPs) and Project Implementation Plans (VPIPs).

A VSIP provides a general strategic direction for implementing the provincial VRI. The VSIP for TFL 18 was prepared in March 2005 and should be referred to for details on background information to Vegetation Resources Inventory VRI activities and also for products needed to address the forest management and inventory issues identified by the licensee.

This VPIP for TFL 18 outlines the VRI activities and products needed to address the forest management and inventory issues identified in the TFL 18 VSIP.

A VPIP is a working document that details the specific operational activities associated with the implementation and documentation of a VRI project. It identifies the target areas for new photo interpretation, availability of existing aerial photographs or acquisition plan for new aerial photographs, data collection requirements, format of base files, project scheduling and deliverables.[1]

This document has been drafted because the licensee wishes to conduct a new inventory utilizing softcopy technology on the TFL 18 land base.

The new inventory will be of assistance in operational planning, provide better estimates of the current and future timber supply, and assist in addressing numerous forest management issues on TFL 18 VRI as well as providing support to the current FSP LiDAR Research work being conducted on the TFL.

[1] Preparing a VRI Project Implementation Plan for Photo Interpretation, MoFR (Ver. 2.0, April 2006)

Of the management issues that exist for TFL 18, the productivity and volumes of Balsam residual stands, classification of non forested polygons, and volume and productivity estimates of deciduous leading stands will be significantly clearer after the completion of an inventory.[2] The following table is a summary of management issues and associated benefits with a new VRI

Table 1: Management Issues and associated benefits of a new VRI.

Management Issue	Remarks
Mountain Pine Beetle	Photo interpretation and ground sampling may assist in estimation of OAF's for beetle damage. This will be achieved by application of the new inventory estimates for volume, species composition, and age. The inventory will also help to identify changes to landscape and volume from beetle caused tree mortality by identifying new openings, adjustment of volumes, and species compositions.
Spruce Beetle	There has been an active infestation in the northern portions of the TFL for many years with scattered mortality. Photo interpretation and ground sampling may assist in estimation of OAF's for beetle damage. This will be achieved by application of the new inventory estimates for volume, species composition, and age. The inventory will also help to identify changes to landscape and volume from beetle caused tree mortality by identifying new openings, adjustment of volumes, and species compositions.
Balsam Bark Beetle	The balsam bark beetle has and is killing off the mid term timber supply. Photo interpretation and ground sampling may assist in estimation of OAF's for beetle damage. This will be achieved by application of the new inventory estimates for volume, species composition, and age. The inventory will also help to identify changes to landscape and volume from beetle caused tree mortality by identifying new openings,

[2] Canadian Forest Products Ltd. TFL 18 VSIP (March 2005)

	adjustment of volumes, and species compositions.
Budworm	The 2 year cycle budworm has killed the understory in higher elevation spruce/balsam stands and resulted in stands in poor and decaying condition. The inventory will help to identify changes to landscape and volume from budworm caused mortality by adjustment of volumes, and species compositions.
White Pine Weevil	The Phase I of the inventory will help to identify the spruce regenerated stands. By combining the contours a GIS query can be completed to identify the spruce regenerated stands below 1400 m that are at a higher risk to this forest insect.
Root Rot	Photo interpretation and ground sampling may assist in evaluating changes to landscape and volume from root rot. This information may then be compared to older inventories to compare stand structure, volumes, and species composition for possible identification of root rot infestations.
Wind Throw	Photo interpretation and ground sampling may assist in evaluating changes to landscape and volume from wind throw. This will be achieved through volume estimation of stands, data collected during the Phase I Ground Calls and the Phase II Plots. Although the standards for VRI do not specifically assign a windthrow category, this information may be available from the resulting inventory and subsequent GIS queries.
Unsalvaged Losses	Photo interpretation can identify the areas of unsalvaged losses.
Residual Balsam Stands	There is a heavy reliance on Balsam IU stands and their information is required to bring them into the inventory correctly in the next analysis. The VRI will help to verify the findings of the JS Thrower report in such a way as to be statistically acceptable within timber supply calculations. The data collected from the JS Thrower study is not considered statistically acceptable for timber supply calculations but may be used as a consideration for the base case of timber supply analyses. The information from this report should be considered during the Phase I attribute estimation. It is anticipated that the site index and volumes of Balsam residual stands will

	increase due to the fact that the photo interpreter(s) will estimate the stand age/height based on this data. Furthermore, the layer information will be verified during the inventory to ensure that regeneration is properly identified within the Net Productive Forested Area.
Non forested polygons	Application of the inventory will assist in re-classifying these areas and their productive capacity for contributing to the land base. Photo interpretation will likely improve the classification of these non-forested types which may be important for biodiversity or assessment of wetlands and other non-forested types.
Growth and Yield	At this time the data collected from the Permanent Sample Plots is not considered statistically acceptable for timber supply calculations but may be used as a consideration for the timber supply levels. This information should be considered during the Phase I attribute estimation for attribute estimation.
Improved volume prediction	Application of the inventory will help to improve volume predictions and offset volume shortfalls as the Phase 2 Ground sampling phase will verify the volumes, ages, and amount of decay for various sample strata. This information is applied to the Phase I portion of the VRI and the attributes are adjusted accordingly during the final compilation phase.
OAF refinement and adjustment	VRI may not be of assistance to address this forest management consideration. It will depend on the existing OAF's and any associated issues with these values.
Environmentally Sensitive Areas (ESA's)	Ground sampling with ecological attribute collection may help to further define ESA classifications for "problem" regeneration types.
Visual Quality Objectives (VQO)	The VRI will allow one to identify the stand height, site index, and openings so that when one prepares the perspective views for VQO purposes, tree heights can be factored in. Furthermore, over time site index will assist in modeling the growth rate of the trees for VQO temporal modeling
Old Growth Management Areas (OGMA's)	Application of the inventory will help to verify age class and stand structure of OGMA's as the re delineated polygons will have up dated information on age, stand structure, species composition, volumes, and such.

WTP Retention Budget	Application of the inventory will assist in determining retention budget numbers as the new inventory will provide updated information for the TFL regarding species composition, volume, stand structure, site index, age, and etcetera.
Deciduous leading stands	Application of the inventory will help to determine the contributing amount of these stands to the productive forested land base and where these stands are located. The Phase II and NVAF portions of the VRI will help in volume estimates for deciduous leading stands.
Site Productivity Estimates	Assigning site index based upon ecological units has a tendency to increase site productivity of the forested polygons in the area and therefore may have an upward influence on harvest levels

For additional background information, please refer to **VRI Strategic Inventory Plan Canadian Forest Products Ltd., Vavenby Division, Tree Farm License 18 (March 7, 2005)**

1.2 The VRI Process

The VRI is a vegetation (forest) inventory process that has been approved by the Resources Inventory Committee (RIC) to assess the quantity and quality of BC's timber and vegetation resources. The VRI estimates overall population totals and averages, as well as individual polygon attributes, for timber and non-timber resources. Its design is simple, reasonably efficient, statistically defensible, and addresses issues raised by the Forest Resources Commission in its 1991 report, The Future of Our Forests.

The VRI consists of several components:

1. BC Land Cover Classification Scheme (BCLCS)
2. Photo Interpreted Estimates (Phase I)
3. Ground Sampling (Phase II) – timber emphasis, ecology, coarse woody debris
4. Net Volume Adjustment Factor (NVAF) sampling
5. Within Polygon Variation (WPV) sampling
6. Statistical Adjustment.

One or more of these components can address specific forest management or inventory issues. For more information, VRI manuals are available at http://www.for.gov.bc.ca/hts/vri/standards/index.html

1.3 VRI Planning

The VRI planning process is an important component of the overall VRI process and related activities (Figure 1). The intent of the VRI planning process is to ensure that baseline products meet a range of applications and they are efficiently implemented.

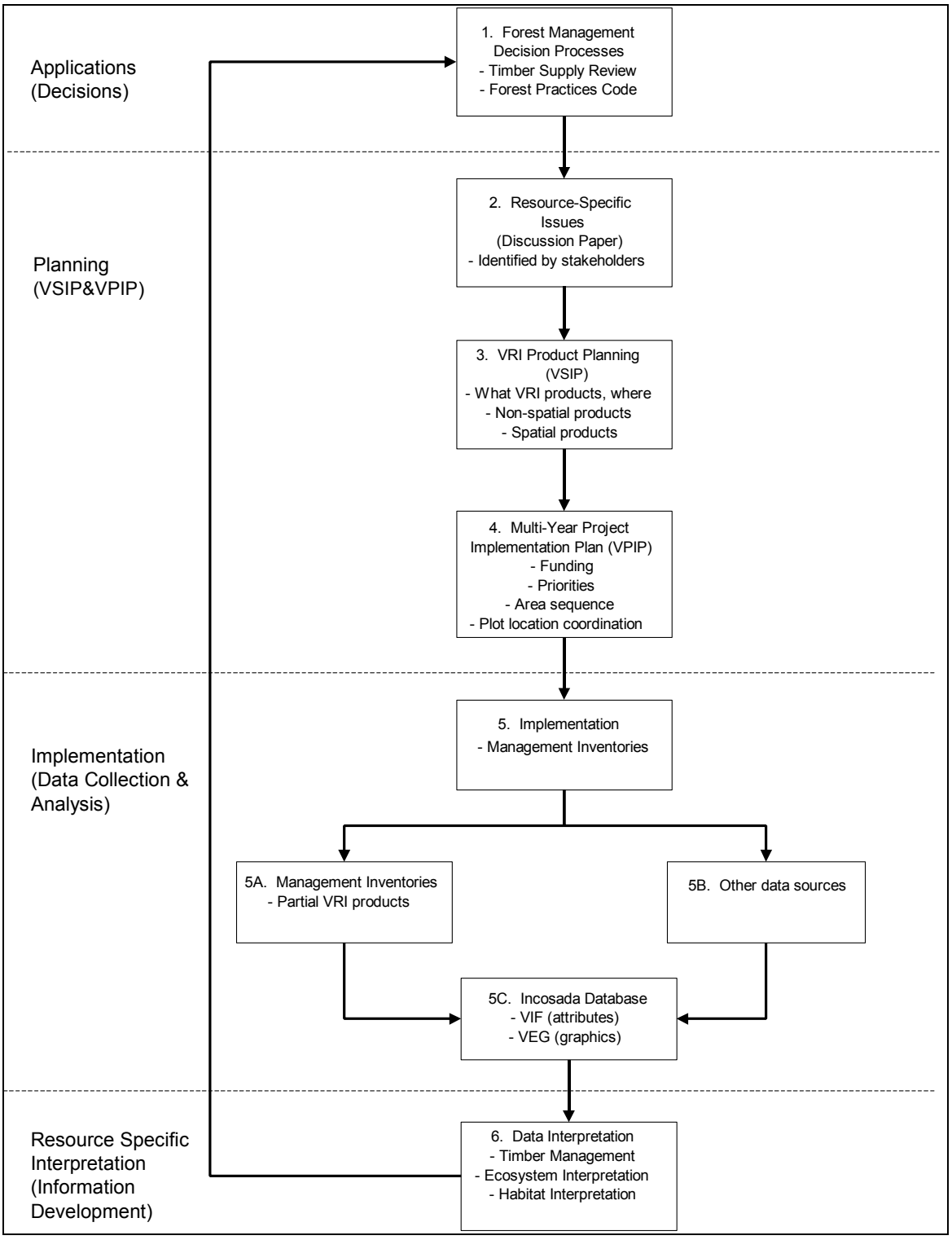

Figure 1. The VRI management inventory process.[3]

[3] Preparing a VRI Project Implementation Plan for Photo Interpretation, MoFR (Ver. 2.0, April 2006)

1.4 State of the Current Inventory

In 1980, an inventory update on the **1974 inventory information** was completed on TFL 18 through the use of 1:80 000 scale black and white photography.

In 1991, Reid Collins Forest Resource Consultants began a retro-fit of the existing 1974 inventory. This project added some additional polygons to the existing inventory and ran some transect lines of observation points with measurements as ground calls.[4] This retro-fit was completed and accepted by the Kamloops Forest Region in 1994.

In 1997, satellite imagery was used to update the forest cover database depletions to account for stand growth and natural and man-made disturbances such as wildfire, harvesting, and silviculture treatments.[5]

In June 1997 the Ministry of Forests conducted an audit of the Inventory on TFL 18. The mature, immature, and non-forested components of the land base were audited. For the mature forested component of the TFL, a total of 50 polygons from the land base were selected for sampling and 49 of these were utilized for the audit calculations. Within these polygons, up to 4 full measure prism plots and 5 count plots were established. Data from these plots was collected following the Ministry of Forests cruising and cruise compilation procedures.[6]

The mature and immature components of the current inventory were found to be statistically acceptable for accuracy. The immature component of the audit showed that the site indices have been accurately assigned in immature stands.

Thirty stands classified as non-forest were also assessed for accuracy. The inventory audit found that these non-forested stands did not meet the provincial inventory standard for classification. The majority of the inventory issues with these non-forested polygons were associated with incorrect classification of swamp and other non-productive types that contain some merchantable tree species. However, this has been

[4] Jim Grace - MoFR comment during Draft Review of TFL 18 VSIP-January, 2005

[5] Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

[6] TFL 18 Inventory Audit – Ministry of Forests Resource Inventory Branch – June, 1997

determined by the Ministry of Forests to have no effect on the forested area available for harvesting. [7]

For additional background information, please refer to **VRI Strategic Inventory Plan Canadian Forest Products Ltd., Vavenby Division, Tree Farm License 18 (March 7, 2005)**

1.5 Document Objectives

The objectives of the VRI for TFL 18 are to improve on the existing inventory, provide more detailed information on the noted inventory issues in section 1.1, and overall improvement of forest management and strategic planning.

The objective of this report is to outline and describe the VRI Phase 1 activities to be completed within TFL 18. This VPIP is a working document that details the specific operational activities associated with the implementation and documentation of a VRI project. It identifies the target areas for new photo interpretation, availability of existing aerial photographs or acquisition plan for new aerial photographs, data sources, fieldwork, format of base files, project scheduling and deliverables.[8]

It provides some basic landbase information, some background information from the previous Annual Allowable Cut Rationale document (March 2006), and it outlines the implementation plan for the field sampling.

Much of the information requested in this VPIP has been addressed in other related planning documents (i.e. *Canadian Forest Products Ltd. TFL 18 VSIP, March 2005*) and they are indicated under the appropriate headings. Please refer to the documents for the necessary information.

1.6 Landbase[9]

TFL 18 is located west of the Thompson River near Clearwater, and is administered by Canadian Forest Products (Vavenby Division) and the Clearwater Forest District. The TFL is a contiguous unit covering an area of 74,542 ha, of which 63,812 ha is currently available for harvesting. The current standing volume for TFL 18, based on the projected inventory to December 31, 2003, is 12,553,000 m^3.

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[7] Canadian Forest Products Ltd. TFL 18 VSIP (March 2005)

[8] Preparing a VRI Project Implementation Plan for Photo Interpretation, MoFR (Version 2.0, April 2006)

[9] TFL 18 MP#10 Timber Supply Analysis. Forest Ecosystem Solutions Ltd. (May 27, 2005)

TFL 18 is located entirely within the Clearwater Landscape Unit, which has a low biodiversity emphasis. All areas of the TFL are classified as Schedule "B" lands. The Clearwater Landscape Unit includes other forest licenses including BC Timber Sales, Woodlots, and Weyerhaeuser Canada.

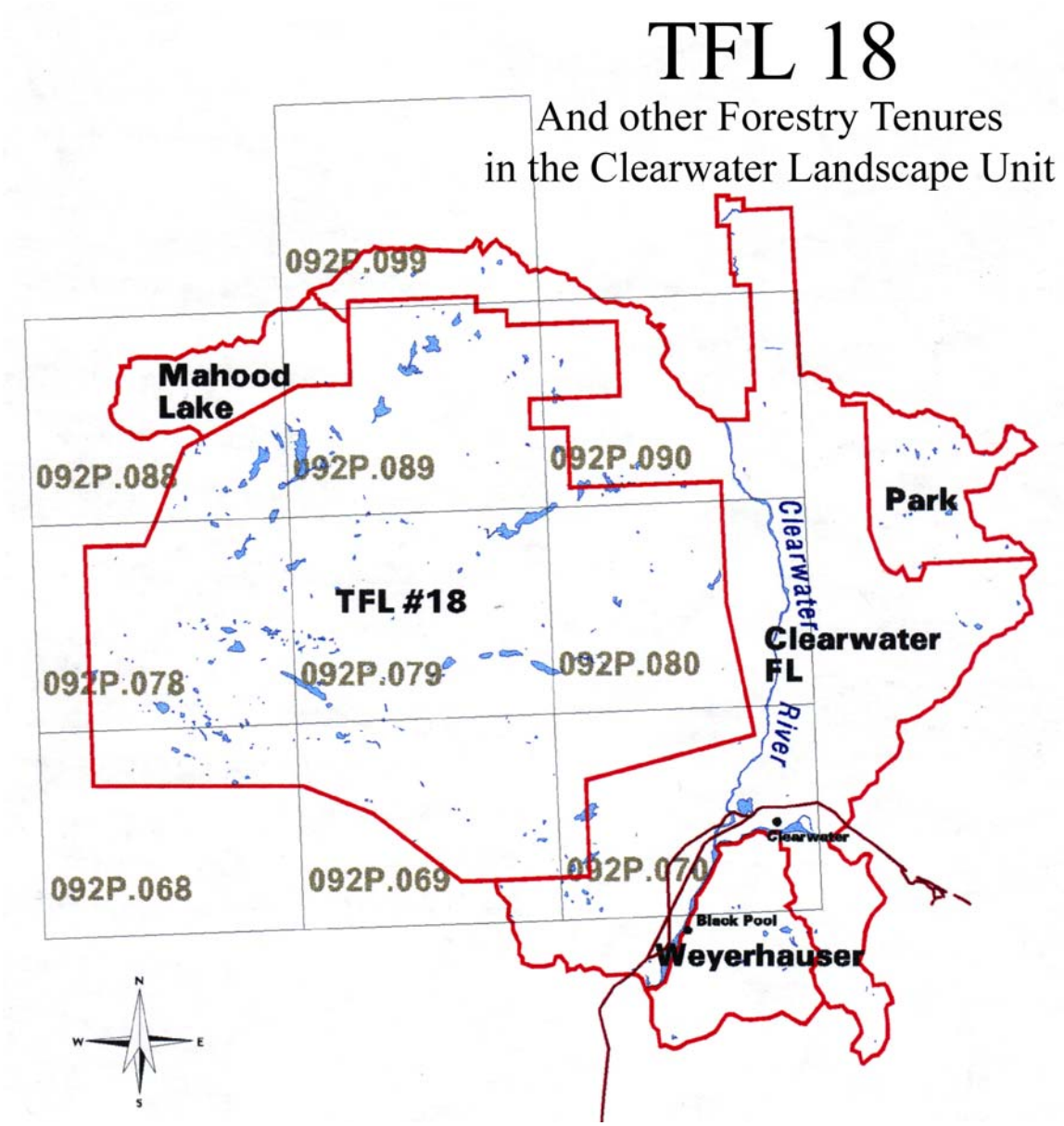


Figure 2: Location of TFL18 within the Clearwater Landscape Unit

TFL 18 covers portions of 10 BCGS mapsheets including: 082P068, 082P069, 082P070, 082P078, 082P079, 082P080, 082P088, 082P089, 082P090, and 082P099.

Climates of TFL18 are variants of the ESSF and SBS biogeoclimatic zones, with a minor proportion of ICH in the southwest area of the TFL. The dominant climatic variants are ESSFwc2 and SBSmm. Consistent with this climatic range, the leading species are primarily spruce (*Picea engelmanii, P. glauca*, and hybrids), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*). Interior Douglas-fir (*Pseudotsuga menziesii v. glauca*) is the leading species in about 4% of the stands in TFL18.

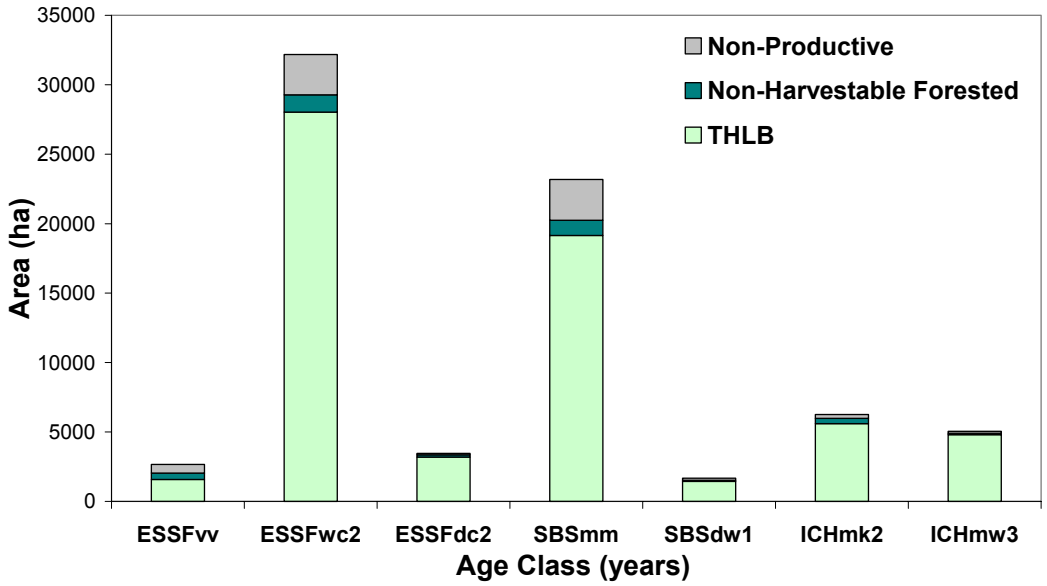


Figure 3: Biogeoclimatic variants of TFL 18

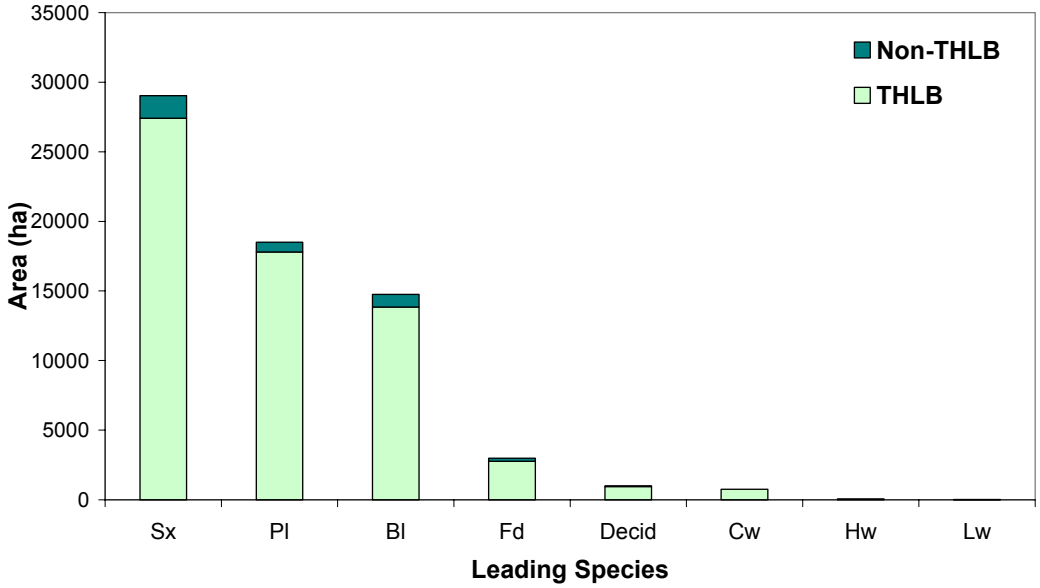


Figure 4: PFLB area by leading species

The age structure of the landscape is bimodal, with more than half of the productive area in either very young (<40 years old) or very old (>140) ages (Figure 5). The non-harvestable (non-THLB) land base is not significantly biased towards any region of the age structure.

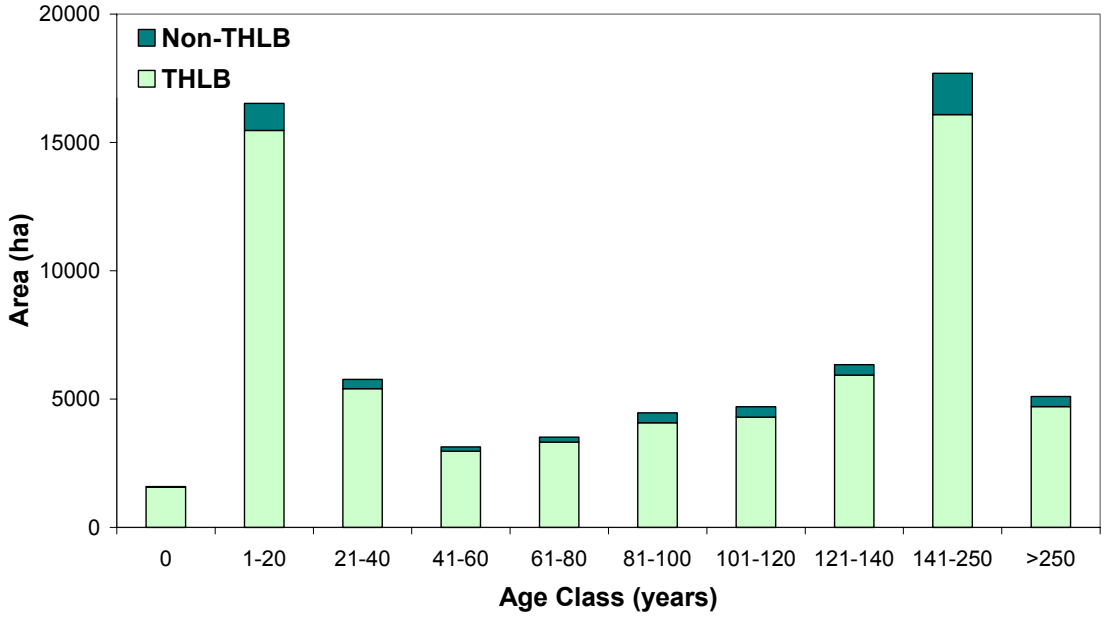


Figure 5: Age Structure of the Productive Forest Land Base

Mean annual increment (MAI) is the average volume growth rate of a stand measured since the stand started growing. Culmination MAI is the maximum rate of growth for a stand, and is a good way of comparing the productivity of a stand in terms of timber volume. Site index is another such measure, but it is not used here because it is a species-specific index. The diversity of leading species in TFL18 limits the utility of site index as a comparative measure of site productivity. Figure 6 shows that natural stands and future managed stands occupy a similar range of stand productivity, but that natural stands are biased towards lower stand productivity. This is primarily due to the use of potential site index for existing and future managed stands. The range of productivity of future managed stands is narrow, and is generally confined to the range from 2.5 m^3/ha/yr to 4.5 m^3/ha/yr.

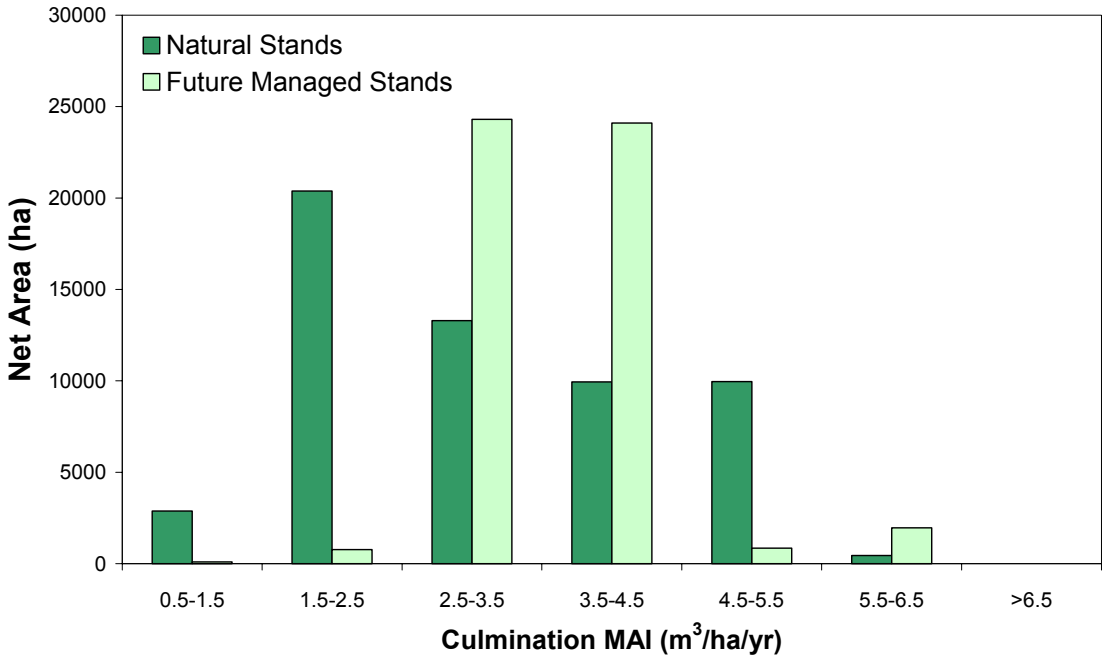


Figure 6: Stand productivity of the Timber Harvesting Land Base (excluding OGMAs).

A major forest management consideration for TFL 18 is the severity of the mountain pine beetle infestation. In January 2004, it was estimated that 3,460,640 cubic meters of mature pine volume in TFL 18 were considered susceptible to attack by the mountain pine beetle. A significant portion of the current AAC is dedicated to harvesting infested or susceptible lodgepole pine stands.[10]

There is no private land within TFL 18.[11]

The new AAC for TFL 18 was set at 290,000 cubic meters on March 9, 2006. This AAC was intended to address salvage harvesting of lodgepole pine-leading stands that are highly susceptible to being attacked by the mountain pine beetle, and other stands affected by forest health agents such as the spruce bark beetle. This AAC will remain in effect until a new AAC is determined, which must take place within five years of the present determination.[12] This may be reviewed sooner depending on the rate of spread of beetle.[13] Currently the primary wave of the MPB is complete with the expectation

[10] TFL 18 Rationale for Allowable Annual Cut (AAC) Determination, BC Ministry of Forests, March 9 2006

[11] Canadian Forest Products Ltd., Vavenby Division TFL #18 Draft Management Plan #10

[12] TFL 18 Rationale for Allowable Annual Cut (AAC) Determination, BC Ministry of Forests, March 9 2006

[13] Comment from Dave Dobi, TFL 18 Forestry and Planning Superintendent (October 6, 2006)

that prior to any calibration work the beetle will have gone through the tree farm. The map below indicates the 2005 levels of MPB infestation in the Kamloops TSA.

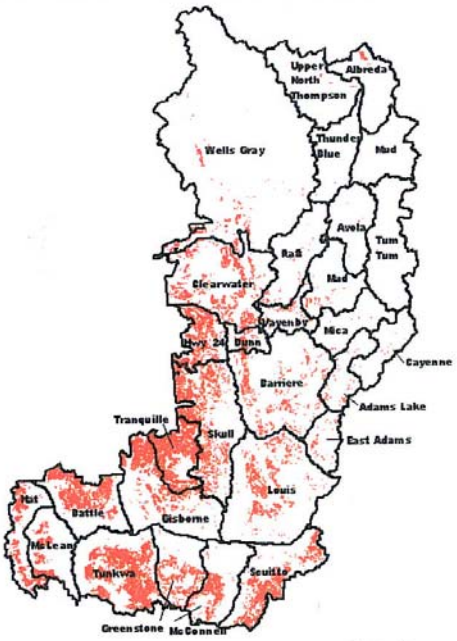


Figure 2 2005 detected mountain pine beetle infestations in the Kamloops TSA. (Source: 2005 Southern Interior Forest Region Aerial Overview Survey).

2. PHOTO INTEPRETATION PLAN

2.1 Project Objectives

The objectives of the VRI for TFL 18 are to improve on the existing inventory, provide more detailed information on the above noted inventory issues, and overall improvement of forest management and strategic planning.[14] As mentioned in section 1.6, Canfor's next AAC determination is in 5 years, meaning the data package is due in approximately 3.5 years, and since there will most likely be limited funding available work will be completed by mapsheet or combinations thereof starting with areas where the primary wave of attack has progressed through.

The Inventory for TFL 18 is primarily a 1974 inventory that has been updated to varying degrees using minor update processes (Section 1.4) over the last 30 years and is not to

[14] Canadian Forest Products Ltd. TFL 18 VSIP (March 2005)

VRI Standards. While the 1997 inventory audit indicated that the inventory is good from a volume perspective, Canfor believes that the inventory is dated and in need of a replacement because of the issues addressed under Section 1.1 Table 1.

2006 digital colour, (23 cm Ground Sampling Distance (GSD)) photography has been acquired for this VRI. Detail on this imagery and its utility can be found in Section 3.2

The VRI Phase I program proposes to use this large scale digital (23 cm ground sampling distance (GSD)) photography to fulfill the following objectives:

- Improve species composition;
- Improve stand heights;
- Improve stand structure identification, especially in residual balsam and conifer understory in MPB effected stands;
- Improve harvest scheduling through information provided by the VRI (i.e. better estimates of current and future timber supply);
- Determine and capture change occurring because of the effect of MPB and other insect and disease factors; and
- Ongoing operational planning.

2.2 Target Area

Please refer to *Section 1.6 – Landbase*.

TFL 18 covers portions of following BCGS mapsheets: 082P068, 082P069, 082P070, 082P078, 082P079, 082P080, 082P088, 082P089, 082P090, and 082P099. In the southwest corner of the TFL, the Taweel Protected Area overlaps approximately 275 hectares of the TFL.

All TFL lands will be updated to current VRI standards through new photo interpretation.

2.3 Inventory Documentation and Archive

Please refer to *Section 1.4 – Inventory History.*

In 1998, the TFL 18 licensee participated in the development of the *Kamloops Clearwater Inventory Plan.* The scope of the plan included the Kamloops TSA, TFL 18, TFL 35, and Wells Gray Provincial Park. The plan outlined a process for a Phase 1 VRI

retro-fit and Phase 2 VRI ground sampling. This plan has not been implemented in TFL 18.[15] As of today, the above plan is considered out of date as is the inventory.

Of note are the following;

- Original document photos are not available for this project (since the existing 1974 inventory was completed on 1:80 000 scale black and white photography);
- Standard TRIM base maps will be used for this VRI as noted in Figure 2;
- There is a lack of calibration data from the 1974 inventory (see the following section)

The current Phase 1 VRI project will be completed using softcopy technology. Refer to Section 3.2 (Photo Scale) and Figure 7 for additional information on the extent of photo acquisition and specifications.

2.4 Calibration Data Sources

'The number of calibration points, both ground calls and air calls, required to support VRI Photo Interpretation depends in part on the management issues and inventory needs identified by the TFL stakeholders. Current VRI Standards do not attempt to give precise estimates and neither did the earlier forest cover inventory manual, because any estimate comes from a proper analysis of existing calibration points and the forest management issues and inventory needs as identified by the TFL Stakeholders.

There is a lack of calibration data from the 1974 Inventory. In 1991, a retro-fit of the existing 1974 inventory was completed on 1:80 000 scale black and white photography. This project ran some transect lines of observation points with measurements as ground calls. Notwithstanding the observation points with measurements completed in 1991, and aside from inventory information extrapolated from current cruise and balsam IU plots, **there are very few 'standard' forest cover or VRI calibration points available in the TFL meaning there will be a need for some calibration intensity.**

Because this initial review of existing calibration data sources indicates that there are very few historic points available; as a general guideline, Canfor should consider establishing a minimum of 10 ground calls, 10 air calls and 10 observations per full BCGS mapsheet equivalent, however the intensity and type of field data collection

[15] MSRM Kamloops Inventory Staff Conference Call- December 9, 2004.

required for this project will be determined following an analysis of existing field data sources.

The objective of this analysis will be to provide a sample design that will ensure the cost effectiveness of the project's field data collection program and as such any recommended sampling intensity has to take into consideration budget levels. It will also ensure that adequate establishment of calibration data sources will occur to meet the needs of this VRI as summarized in Table 1. The analysis will focus on the type, frequency, distribution and availability of existing data sources. `

All existing data sources will be retained on or transferred to the new graphics file except when justifiable changes, such as major disturbance (logging, fire) or large stand structure changes occur.

For more information on this topic please refer to the following:

- VRI Air Calibration Data Collection Procedures and Standards (Current Version);
- VRI Ground Calibration Data Collection Procedures and Standards (Current Version);

2.5 Polygon Delineation

Provincially Certified Photo Interpreters will complete VRI Phase I polygon delineation (based on the BC Land Cover Classification Scheme) according to current MoFR VRI standards.

A specific issue to Canfor is the status of backlog blocks and as such the most current list of backlog blocks within TFL 18 will be provided. Regardless of their free-to-grow status in RESULTS, all backlog blocks will be re-delineated and photo-interpreted as opposed to populating the database with existing information from RESULTS.

Special consideration will be given to polygons that exist within silviculture openings
The MoFR Update Section based in Kamloops will be contacted to ensure compliance with existing protocols related to silviculture openings. As a general guideline:

- Retain existing opening numbers and provide VRI attributes for the largest polygon of the silviculture opening (based on VRI source files). If opening numbers are not in the VRI source files, obtain the opening numbers from the RESULTS spatial file. MoFR VRI Update section will provide access to the RESULTS data as required. *

- Add new openings that are not in the VRI source files. Obtain the opening number from RESULTS and provide full VRI attributes. Additional internal polygon delineation and attribute estimation is not required.
- Internal stratification of openings is required where an opening has been declared Free Growing in RESULTS. Each polygon requires full attribution plus the designation "FTG" in the VegCap polygon record project field.
- Any polygon from the VRI source files that have "FTG" (or a unique Canfor identifier) in the project field must be re-interpreted to VRI standards and the "FTG" (or unique identifier) designation retained.[16]

Specific silviculture issues to TFL 18 will be discussed in the RFP.

All delineation will be quality control checked and audited to ensure adherence to project objectives and MoFR Standards.

*At the time of this report the MoFR Update Section has indicated that they will not provide access to RESULTS and the contractor must obtain (as per protocol) a BCeID to access the data. http://www.for.gov.bc.ca/his/results/

2.6 New Field Calibration

Upon completion of an analysis as outlined in *Section 2.4 – Calibration Sources*, and "prior to the initiation of a field calibration program, a Field Calibration Sampling Plan must be submitted to the MoFR"[17].

Initial review of available calibration data points (section 2.4) indicates that there are very few calibration data points available from previous inventory activities.

Because this initial review of existing calibration data sources indicates that there are very few historic points available; as a general guideline, Canfor should consider establishing a minimum of 10 ground calls, 10 air calls and 10 observations per full BCGS mapsheet equivalent.

Fieldwork will be completed in the priority areas such as:

- a cross-section of stand stages of development;
- second growth types;
- deciduous-coniferous mixes;
- deciduous stands with possible coniferous in-growth; and
- multi-layered or uneven aged stands.

[16] MoFR Preparing a VRI Project Implementation Plan for Photo Interpretation, Version 2.0 (April 2006)

[17] MoFR Preparing a VRI Project Implementation Plan for Photo Interpretation, Version 2.0 (April 2006)

All new calibration data sources established within the TFL will be delivered to the MoFR in a suitable digital format.

2.7 Polygon Descriptions (Attribute Estimation)

All polygon descriptions will be conducted to MoFR VRI standards using softcopy technology. It is expected by MoFR and the Licensee that the same photo interpreters who complete the field calibration phase will complete the same maps for the polygon description phases. Initial polygon delineation will be re-assessed during the final polygon description phase to ensure consistency and to ensure that VRI standards are met.

It is anticipated that using 23 cm. GSD, digital colour photography will further assist in the identification of mortality from forest insects, identification of deciduous stands, and improve the description of Non Forested Polygons. Improved information will come from the ability of the interpreter to view attributes not recognized from the previous inventories that used smaller scale photography. In addition the opportunity to make accurate measurements off stereo models using softcopy technology should be expected. Measurements such as tree heights, potential understory vegetation and what might be left of a mature stand components in MPB affected stands would be beneficial to provide a more accurate inventory to the licensee. MoFR will be tracking this project and any potential benefit it might provide to the VRI program.

There are five general categories of data that are estimated during the attribute estimation of polygons:

1. Ecology - Data to be collected is to include surface expression, modifying process, site situation and slope position, alpine designations, and soil nutrient regime.

2. Land Classification – Land cover component: Data to be collected is to include treed (broadleaf, coniferous, mixed) terrain identification if trees are absent including snow, water, rock, and soil moisture regime.

3. Site Index – Data to be collected is to include species, source, and site index.

4. Tree Attributes – Data to be collected is to include crown closure, tree layer, vertical complexity, species and age of leading and second species, basal area, density, and snag frequency

5. Non-treed attributes- Data to be collected is to include: Shrub height and crown closure, herb type and percent cover, and Bryoid percent cover.

Since softcopy is the recommended choice to complete the VRI Phase 1, the ability of the interpreter to measure heights is available. The additional heights will be quantified by proponents during the RFP process. All VRI attribute files will be validated through VEGCAPS and delivered in .mdb format consistent with Ministry standards.

2.8 Mapping

This project will be completed to the current MoFR mapping standards and specifications. Attribute graphic data specifications and deliverables are in the process of changing and will be available from the Ministry of Forests and Range in the near future.[18]

For more detailed information, please refer to

- http://www.for.gov.bc.ca/hts/vri/standards/spatial/spatial_vri_digital_mapping_specification.pdf

3. PROJECT IMPLEMENTATION

3.1 Scheduling

Canfor would prefer to complete the entire project in one fiscal year, however due to funding levels the project may be completed over several years. Activities will include:

- Polygon Delineation (using softcopy);
- Analysis of existing data sources;
- Sample Plan design;
- Field Data Collection;
- Polygon Descriptions (using softcopy);
- Final Digital Mapping; and,
- Final Deliverables

[18] Email from MoFR, October. 25, 2006

Table 2: TFL 18 Summary of Estimated Delivery Schedule by Phase

Fiscal Year	100% Digital Photos flown	Viewer Set Preps. (for use in softcopy)	Polygon Delineation	Sample Design	Field Data Collection	Polygon Descriptions	Final Digital Mapping and Deliverables	Quality Control
06/07	Summer 2007	Fall 2006 and Summer 2007	Winter 2006/2007 And Summer 2007	Spring 2007	Summer 2007	Fall 2007	Fall 2007	Ongoing

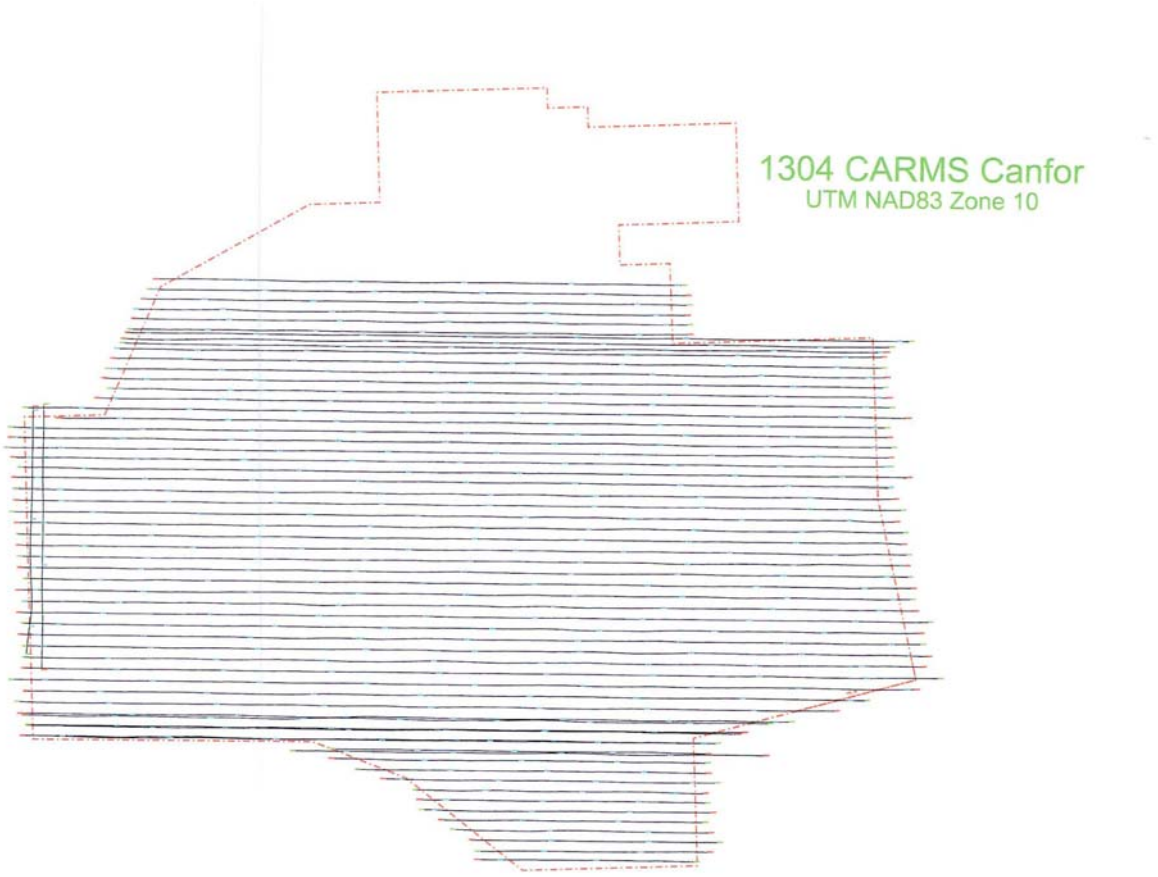
3.2 Photo Scale

The Imagery Acquisition for this VRI is not standard format. Photography for TFL 18 is currently being flown using digital cameras (90% completed in 2006). Digital Cameras are becoming a commonly used tool for the purposes of capturing imagery to be used in mapping and photo interpretation applications.[19] The use of certain digital cameras for mapping applications (specifically for approved calibration and stability of cameras tested) has been endorsed by the Base Mapping and Geomatic Services of the Integrated Land Management Bureau (ILMB). A draft copy of the specifications can be obtained by contacting the appropriate branch of the ILMB. This document outlines the technical specifications of the imagery as well as camera calibration protocol. The Camera Specifications document doesn't indicate that any specific small or medium format digital camera is suitable for VRI purposes.

Refer to the following map which shows the completion level of the imagery to October 2, 2006;

[19] Specifications for Small and Medium Scale Format Digital Cameras Specifications. ILMB (Version 0.09, July 17 1006)

Figure 7 - Digital Imagery Coverage current to October 2, 2006



The camera's acquiring the digital color photos for this project has been endorsed by BMGS to acquire digital imagery and have the following specifications;

- 14N Kodak
- CCD Array: 4500 x 3000 pixels 13.5 Mega pixel.
- Lens: 50 mm Nikkor.

The digital photos are approximately 23 cm GSD or an approximate scale of 1:3000 - 1:5,000 with nearly 400 stereo models for 1 full mapsheet equivalent.

Several technical questions are yet to be resolved on the use of this specific digital imagery in the softcopy environment and its use for VRI. Questions such as;

1: Are the images suitable for VRI procedures such as delineation etc.?

2: Are the images compatible with the current version of softcopy and if not, what are the alternatives?

3: Will the cost associated with producing viewer sets for softcopy be exponentially

higher since the amount of images on a full mapsheet equivalent is approximately 8 times that of conventional 1:15,000 scale photography and almost 30 times more than 1:30,000 scale photography?

The licensee may undertake a pilot project on a portion of the TFL to address some of the compatibility issues with digital imagery before completing the entire landbase.

As an alternative, if it is determined that the digital imagery is not suitable on its own for VRI, the use of 1:30,000 colour photo acquired in 2004, could be adequate for at least the initial delineation for this VRI project. Following the delineation, the possibility exists that the 23 cm GSD digital imagery could then be used. Viewer sets for softcopy using the scanned 1:30,000 imagery are the only outstanding support items needed.

3.3 Project Coordinator

Dave Dobi, RPF, Forestry and Planning Superintendent.
The project coordinator will at a minimum;

1. Coordinate the project;
2. Monitor and communicate project progress;
3. Liaise with the project manager to ensure all expectations are met;
4. Oversee the Photo Interpretation Activities;
5. Ensure all contractors are qualified and certified; and
6. Ensure all deliverables are provided to the MoFR.

3.4 Personnel

All VRI photo interpretation work will be completed by VRI Certified Photo Interpreters.

3.5 Quality Assurance and Quality Control

The VRI contractor will use a certified photo interpreter to conduct proper quality control on 2-5% of each phase of the project. Documentation of all quality control checks will be maintained and made available to the Project Coordinator.
As part of the quality control program, the VRI contractor will hold a field data collection workshop in the project area at the commencement of the fieldwork program. The purpose of the workshop is to make sure that all individuals involved in the field data collection, monitoring and/or evaluation have a common understanding of the standards, specifications, and procedures that will be employed in the TFL. It will also ensure that all vegetation attributes are collected in a consistent and accurate manner.

Attending will be:

- Project Manager
- VRI interpreters
- Project Coordinator

Invited to attend will include:

- Quality Assurance Contractor
- Ministry VRI 'specialist'

At the beginning of the fieldwork, the Project Manager will accompany each interpreter in the field for a day and check their work as the plots are being established. Any errors or discrepancies will be corrected on site until the work meets the required standards of the supervisor.

The Project Manager will accompany the interpreters on their first flight plan to ensure that air call estimates are complete and correct. All subsequent air calls will be flown with two certified photo interpreters, in the helicopter, so that the second interpreter can check all estimates.

A Quality Assurance contractor will conduct an independent and comprehensive quality assurance program on all phases and throughout all phases of the VRI Project. The work of all personnel involved through each phase of the project is expected to be reviewed. This contractor will ensure the VRI contractor produces a consistent and reliable product. The third party Quality Assurance Contractor will have a minimum of 5 years' VRI delineation, fieldwork and final attributing experience and will check all phases of the VRI as follows:

- Delineation – approximately 2% check of polygons for 80% of mapsheets
- Fieldwork – approximately 7.5% check of ground calls and air calls representative of the project area
- Final Attributing – approximately 2% check of polygons for 80% of mapsheets

The Project Manager will ensure the inventory provides adequate and ongoing internal quality assurance (QA) for all personel involved and on all deliverables. The results of all quality control and quality assurance will be recorded on approved QA/QC forms.

Internal quality control of delineation, field work, attribute estimation, and digital map production will be undertaken by the contractor in accordance with the appropriate standards. Copies of all internal quality control documentation and QA reports will be made available to the MoFR Regional VRI representative.

The standards and procedures for Quality Assurance will adhere to the VRI Photo Interpretation Standards and Quality Assurance Procedures Version 3.0 (April 2006) which is available at:

- http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_qa_photointerp_2k6/qa_photointerp_2k6.pdf

3.6 Deliverables

Upon completion of the Phase I VRI Project the following will be delivered to Canfor and the Ministry of Forests and Range:

- Project Completion Form;
- Digital map and attribute data;
- Any data and photos provided by the Ministry of Forests and Range;
- Attribute and graphic data in the revised format as indicated in section 2.8;
- Hardcopy and digital copies of all field calibration data; and
- Submission of Quality Assurance reports.

3.7 Reference Materials

The following material is readily available for the project:

Summary of the project specifications;

- VRI BC Land Cover Classification Scheme (2002);
- VRI Photo Interpretation Procedures (2002);
- VRI Quality Assurance Procedures for Photo Interpretation (2006);
- VRI Photo Interpretation Standards (2006);
- VRI Air Calibration Data Collection Procedures and Standards (2003);
- VRI Ground Calibration Data Collection Procedures and Standards (2004);
- MOF Vector Cleaning Specifications (1997);
- BC Ministry of Forests' Inventory Manual;
- BC Ministry of Forests' Biodiversity Guidebook;
- BC Ministry of Forests' Color Stereogram Handbook;
- BC Ministry of Forests' Black and White Stereogram Handbook;
- Several tree and plant identification field guides;
- Canfor Silviculture Opening History records.

3.8 Costs

VRI Task	Estimated Cost
Digital Photo acquisition	**$80,000.00**
Viewer sets for Softcopy	**$3000.00**
Phase I VRI and Digital Map Production (inclusive of QA costs) **1.** Data Acquisition/Sample Design/Delineation **2.** Field Calibration **3.** Attribute Estimation/Digital Mapping **4.** Final Reporting/Management **Total Estimated Cost**	 **$0.32 – $0.42/ha** **$0.45 - $0.50/ha** **$0..50 - $0.70/ha** **$0.04 - $0.05/ha** **$99,000 - $126,000**
Phase I – Air and Ground Calibration (inclusive of all helicopter costs)	$100 - $150/air call $250 - $300/ground call
Phase I – Air and Ground Calibration Helicopter Cost*	Dependent upon the sample plan air calls and ground call access*

*Neither VRI nor the previous reinventory standards (manuals) specify how many calibration points are required in a mgt unit to support photo interpretation. Each case is unique and depends on:

- the amount and composition of productive forest
- amount of existing, usable calibration data
- distribution of existing calibration data
- knowledge and skill of the interpreter(s) and their familiarity with the area
- lots of other considerations, including available budget.

MOF set "benchmarks" for the number of air calls and ground observations with measurements (these replaced the earlier ground calls) that would be established. These were not a Standard, but more a "Best Practise" to ensure that the interpreters had adequate data to be confident in their attribute estimates. Note, also, that this "benchmark" specified that the air and ground calls were done by the individual interpreters in the areas they were assigned, to calibrate themselves for later work with the photos. [20]

[20] Email document from MoFR, June 23, 2005

3.9 Approval/Sign-off of VPIP

I have read and agree that the procedures and process outlined in this plan meet current Ministry of Forests and Range standards and business needs and considerations.

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Manager, Vegetation Resources inventory
Forest Analysis and Inventory branch
Ministry of Forests and Range

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Licensee Representative