



**CANADIAN FOREST PRODUCTS LTD.
VAVENBY DIVISION
TREE FARM LICENSE #18**

**Vegetation Resource Inventory Strategic Inventory Plan
(VSIP)**

March 7, 2005

EXECUTIVE SUMMARY

Highwood Forest Management and Atticus Spatial Information Management Ltd. consulted with MSRM Inventory Branch Staff and Canadian Forest Products Ltd. staff during the development of this plan for implementing a Vegetation Resource Inventory project on TFL 18.

This document has been compiled to explain the process for implementing a Vegetation Resource Inventory on TFL 18, identify forest management issues that may benefit from a Vegetation Resource Inventory, and the associated costs for implementing a new inventory on the TFL 18 land base.

This document has been drafted in the event that the licensee wishes to conduct a new inventory on the TFL 18 land base. However, submission of, and subsequent approval of this plan does not constitute a commitment on behalf of the licensee to conduct a Vegetation Resource Inventory project. It is also recognized that any time delay between completion of this VSIP and start of any VRI, may result in the need to revise this plan to meet new VRI Standards.

A 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. 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.

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1.0 INTRODUCTION

Background

The purpose of this Vegetation Resources Inventory (VRI) Strategic Plan (VSIP) is to outline the VRI activities and products required to create a new inventory for Tree Farm License 18 that addresses forest management and inventory issues as identified in the TFL 18 Management Plan, the *2000 Rationale For Allowable Annual Cut Determination*, and other documents relating to forest inventory issues on TFL 18.

The Ministry of Sustainable Resource Management's objectives for Vegetation Resource Inventories are to determine the locations of the forest resources, and the amount of the forest resource within an inventory unit. The inventory unit being utilized for this VSIP is that of TFL 18's land base.

TFL 18 is managed by Canadian Forest Products Ltd. (Canfor) and is located immediately west of Clearwater in the Headwaters Forest District of the Southern Interior Forest Region. (See Diagram 2.1)

Highwood Forest Management and Atticus Spatial Information Systems have worked with Ministry of Sustainable Resource Management (MSRM) and Canfor staff in the development of this strategic document. The VSIP provides broad details for the implementation of the various VRI phases. The VSIP will be reviewed by Canfor and MSRM - Kamloops Service Center Inventory staff prior to its approval as a VSIP for TFL 18, and signed off by the District Manager and MSRM Kamloops Service Center Regional Manager and the Licensee.

1.1 Vegetation Resource Inventory (VRI)

Vegetation Resource Inventories are commonly conducted by Tree Farm Licensees every 10 to 30 years and completed following provincial standards and procedures approved by the Ministry of Sustainable Resource Management's Vegetation Resources Inventory Section – Resources Information Branch ¹

1.11 Overview of the VRI Process:

VRI is a MSRM approved process consisting of the following 4 components.

Phase I-Photo Interpretation:

Prior to commencing the Phase I of a VRI project, a *Vegetation Resource Inventory Project Implementation Plan (VPIP) for Photo Interpretation*- must be completed and subsequently approved by MSRM. This plan will detail photo acquisition requirements,

¹ TFL 18 Inventory Audit – Ministry of Forests Resource Inventory Branch – June, 1997

the VRI Phase 1 process, standards for adherence, and a photo interpretation plan to carry out the Phase 1 of the VRI.

Phase I is the photo interpretation phase of a VRI and entails polygon delineation and attribute estimation by certified photo interpreters through the use of aerial photographs or softcopy images. The delineation identifies the location of the forest resources and the attribute estimation component provides estimates of numerous attributes including land cover type, crown closure, tree species, height, age, stand structure, volume, basal area, density, slope position, moisture and nutrient regime, snags, shrubs, herbs, and bryoids.

Estimation of attributes from field reference points is based upon field procedures using a combination of air and ground calibration points.

Phase II- Ground Sampling

Prior to commencing Phase II, a *Vegetation Resource Inventory Project Implementation Plan (VPIP) for Ground Sampling* must be completed and subsequently approved by MSRM. This plan details the Phase II sample selection process and standards for adherence.

The samples selected for the Phase II ground sampling are based on the delineated polygons and attributes estimated during Phase I. Samples are selected randomly and are based on achieving a resultant sampling error of less than 15 percent for forest stand volume that are proportionally distributed across the different target populations.

Samples are “plot clusters” and consist of a main plot and up to 4 associated auxiliaries.

Net Volume Adjustment Factor (NVAF) Sampling

As per the MSRM Vegetation Resource Inventory standards, all new Ground Sampling Vegetation Resource Inventories must complete Net Volume Adjustment Factor Sampling.

This sampling involves detailed stem analysis of sample trees that have been randomly selected from the Phase II plots. The data obtained from the NVAF sampling is used to determine net tree volumes that are used to adjust ground sample estimates of age, height, and gross and net volume.

Final Compilation, Analysis and Statistical Adjustment

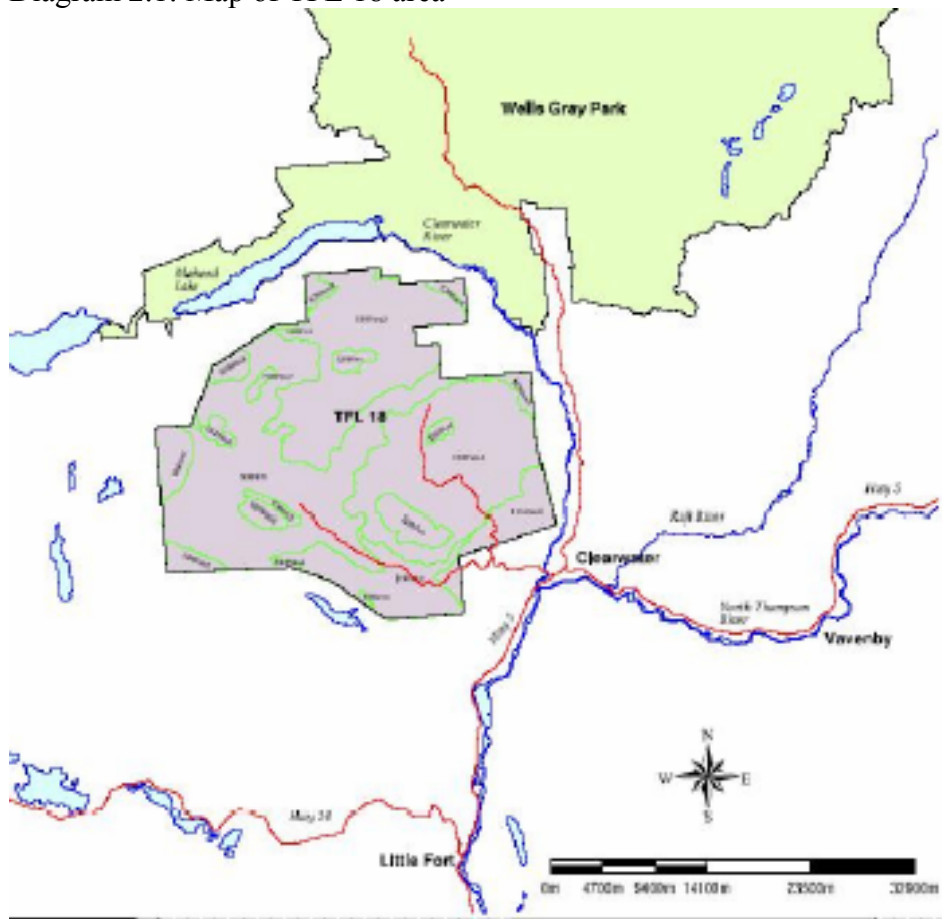
Adjustment to the Phase I using the results of Phase 2 sampling data for the entire VRI project area is the final VRI phase. The NVAF information is utilized to adjust the Phase

II sample estimates for hidden decay and taper equation bias and the Phase II plot estimates are used to adjust the Phase I photo interpretation attribute estimates. The final product is a statistically valid new inventory supported by re-adjustment of photo-estimated attributes based on ground samples.

2.0 BUSINESS CONSIDERATION

Tree Farm License 18 is located in the central interior of British Columbia immediately west of the community of Clearwater and south of Wells Grey Provincial Park. The total area of TFL 18 is 74 545 ha. In the southwest corner of the TFL, the Taweel Protected Area overlaps approximately 275 hectares of the TFL.

Diagram 2.1: Map of TFL 18 area²



TFL 18 covers a total of 10 IGDS Mapsheets including: 082P068, 082P069, 082P070, 082P078, 082P079, 082P080, 082P088, 082P089, 082P090, and 082P099.

² Map from J.S. Thrower report. Growth & Yield of Residual Balsam Stands on TFL 18, October 2003.

TFL 18 is characterized by rolling terrain and is situated on a high elevation plateau ranging from 516 meters to 1 989 meters elevation. There are three biogeoclimatic zones within the TFL including the Interior Cedar Hemlock (ICH) Zone, the Sub-Boreal Spruce (SBS) Zone, and the Engelmann Spruce Subalpine-Fir (ESSF) Zone.³ A summary of the area each sub-zone occupies on the TFL is found in Table 2.1.

Table 2.1: Biogeoclimatic Sub-Zones for TFL 18⁴

Biogeoclimatic Sub-zone	Area (Hectares)
ESSFdc2	3 465 ha
ESSFvv	2 667 ha
ESSFwc2	32 183 ha
ICHmk2	6 262 ha
ICHmw3	5 100 ha
SBSdw1	1 674 ha
SBSmm	23 194 ha

TFL 18 covers 74 545 hectares, of which 92 percent is considered to be productive forest. There is no private land component within TFL 18.⁵ A summary of the TFL land base is provided in Table 2.2.

Table 2.2: Summary of TFL 18 Area.⁶

Area description	Hectares*	Percentage
Total TFL 18 Area	74 545 ha	100.00 %
Deductions:		
Areas of low growth potential	969 ha	1.30 %
Areas of low productivity / deciduous stands	2 779 ha	3.73 %
Environmentally Sensitive Areas	1 715 ha	2.30 %
Roads and trails	162 ha	0.22 %
Landings	81 ha	0.11 %
Non Commercial Cover (Brush)	13 ha	0.02
Inoperable Area	0 ha	0.00 %
Total deductions from the Timber Harvesting Land Base	5 719 ha	7.68%
Timber Harvesting Land Base (Total TFL 18 area – Total Deductions)	68 901 ha	92.32 %

*Note; the total TFL 18 area is based on the final draft of Management Plan #10. The deductions have been based on the Rational for Annual Allowable Cut Determination-October 25, 2000.

³ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25,

⁴ Canadian Forest Products Ltd., Vavenby Division TFL 18 Draft Management Plan #10

⁵ Canadian Forest Products Ltd., Vavenby Division TFL 18 Draft Management Plan #10

⁶ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

The current AAC for TFL 18 has been set at 177 650 cubic meters. Of this, 10 500 cubic meters of the AAC has been apportioned to the British Columbia Timber Sales Branch of the Ministry of Forests.⁷ The species profile and age distribution for TFL 18 is provided in Table 2.3 and 2.4, respectively.

Table 2.3: Species profile for TFL 18⁸

Species Profile	Percentage
Spruce leading stands	48 %
Pine leading stands	26 %
Balsam leading stands	20 %

Table 2.4: Age class distribution for TFL 18⁹

Age Class	Percentage
Greater than 260 years	6 %
140 to 260 years	27 %
80 to 139 years	24 %
40 to 79 years	12 %
Less than 40 years	31 %

Inventory History

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 commenced 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.¹⁰ 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.¹¹

⁷ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

⁸ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

⁹ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

¹⁰ Jim Grace-MSRM Comment during Draft Review of TFL 18 VSIP-January, 2005

¹¹ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

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.¹²

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.

30 stands classified as non-forest were assessed for accuracy of the inventory. 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 determined by the Ministry of Forests to have no effect on the forested area available for harvesting.

Table 2.5 Ministry of Forests Inventory Audit Results for TFL 18¹³

	Audit Volume Estimate	Inventory Volume Estimate
Number of samples	49	49
Mean (m ³ /ha)	283	311
Coefficient of variation (%)	38	46
Standard error	15.4	20.3
Sampling error (%)	10.9	13.1
95% confidence interval (m ³ /ha)	252-314	270-352

In 1998 TFL 18 participated in 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. To date, there has been no progress on the TFL 18 portion of the project.¹⁴

¹² TFL 18 Inventory Audit – Ministry of Forests Resource Inventory Branch – June, 1997

¹³ TFL 18 Inventory Audit – Ministry of Forests Resource Inventory Branch – June, 1997

¹⁴ MSRM Kamloops Inventory Staff Conference Call- December 9, 2004.

Forest Management Considerations on TFL 18¹⁵

The following issues are forest management considerations on TFL 18 that should be considered during the VRI planning and implementation processes.

Mountain Pine Beetle *Dendroctonus ponderosae*:

Mountain Pine Beetle populations were at epidemic levels to the south and to the west of TFL 18 during the term of Management Plan 9. Current populations of Mountain Pine beetle have expanded significantly and are now at epidemic levels throughout TFL 18. In the past, Canfor has aggressively pursued harvesting of beetle-infested stands.

Spruce Beetle *Dendroctonus rufipennis*:

Spruce Beetle continues to be a forest health agent within TFL 18. Epidemic levels of this forest insect were detected in the southwest portion of TFL 18 in 1997. Canfor continues to implement control measures to address this forest pest, and although progress has been made towards controlling Spruce Beetle, an increase in spruce beetle populations was detected in 2003.

Canfor is managing mature Spruce and Balsam stands in the western and northern areas of the TFL that they consider to have a high risk of infestation over the next few years.

Balsam Bark Beetle (*Dryocetes Confusus*)

Balsam Bark Beetle populations have been noted to be increasing in the north and central areas of TFL 18 and appear to be contributing to balsam mortality.

Spruce Budworm (*Choristoneura biennis*)

Spruce budworm is active throughout much of TFL 18. Mortality of timber has been identified in stands subject to repeated attack, particularly in the under story regeneration and pole layers.

¹⁵ Canadian Forest Products Ltd., Vavenby Division TFL 18 Draft Management Plan #10

White Pine Weevil (*Pissodes strobi*)

The White Pine Weevil targets spruce regenerated stands on TFL 18, particularly on regenerated stands below 1400 meters elevation.

Root Rot

Root rot is present in TFL 18 in moderate to low severity within the Interior Cedar Hemlock sub-zones.

Wind Throw

Due to the fact that TFL 18 exists on a large plateau, variable prevailing wind speeds are a constant concern, and the effects of wind throw are a present and historical management issue. Wind throw management is an ongoing management consideration for TFL 18.

Unsalvaged Losses

Unsalvaged losses are losses in timber volume due to natural or unnatural disturbances. Endemic losses are accounted for in yield calculations for timber supply. These disturbances are usually due to fire, epidemic insect or disease incidence, or wind throw. This type of loss is kept to a minimum on the TFL due to excellent access on the extensive road network.

Canfor will continue to take an aggressive approach to facilitate the timely harvest of damaged timber.

Residual Balsam Stands

Residual Balsam stands are considered to be Balsam stands that were created through partial cutting of spruce leading stands from 1945 to 1979 as identified in the Forest Inventory Production (FIP) Files.¹⁶

A total of 8 818 hectares of residual Balsam stands are present on TFL 18, with 1 830 hectares considered to be low productivity. Residual Balsam stands comprise approximately 11 percent of the timber harvesting land base for TFL 18.

The Chief Forester stated in his September, 28, 2000 AAC Determination letter that continued data collection and associated analysis of balsam intermediate utilization

¹⁶ J.S. Thrower report. Growth & Yield of Residual Balsam Stands on TFL 18, October 2003.

stands for site index, yield productivity, and forest management strategies is to occur. This data collection has been incorporated into the formulation of Management Plan #10.

JS Thrower and Associates has completed a study of the residual Balsam stands due to the uncertainty around stocking, site productivity, volume projections, and merchantability / wood quality of these stands. The study was a combination of field work and data analysis and has determined the following:

- The Site Index is approximately 26 percent higher than current inventory calculations estimate;
- The species composition of the Balsam residual stands is comparable to the current inventory;
- The net merchantable volume of the Balsam residual stands is 35% higher than that of the current inventory data;
- The net merchantable volume may be underestimated by as much as 35 percent from the current forest inventory. Most residual balsam stands evaluated in the study had at least 125 cubic meters per hectare net merchantable volume.

Non Forested Polygons

The 1998 audit of the inventory for TFL 18 has shown that the non-forested polygon classifications did not meet Provincial Standards. The majority of the inventory issues with these non-forested polygons were associated with incorrect classification of swamp and other non-productive types that did contain merchantable tree species. *See Section on Inventory History.*

Growth and Yield

Sixty-four permanent growth and yield plots were established on the TFL with Forest Renewal B.C. Funding in 1996. There are also numerous permanent sample plots that were established during the 1950's to 1970's.¹⁷

Improved volume prediction

See sections on *Residual Balsam Stands* and *Deciduous Leading Stands*.

Improvement of ecological base information

The ecological base information can be continually improved upon to refine non-forested areas.

¹⁷ Slocan Forest Products TFL 18 Management Plan #9.

Environmentally Sensitive Areas (ESA's)

ESA's are defined as areas identified during a forest inventory that are sensitive to disturbance and / or is significantly valuable for resources other than timber. ESA's on TFL 18 have been derived from the 1992 re-inventory. A new inventory will assist in identification of Regeneration ESA's through the evaluation of site index, species composition, and crown closure. Although not a part of the current VRI standard, the inventory information will be of benefit to the licensee for identifying these Regeneration ESA's.

Visual Quality Objectives

Visual Quality is an ongoing management practice on TFL 18 due to the close proximity to the community of Clearwater and Highways 5 and 24. Canfor currently manages for visual quality during their operational planning processes.

Old Growth Management Areas (OGMA's)

TFL 18's Management Plan 10 states a continued commitment to review and revise OGMA locations to meet biodiversity objectives while minimizing impacts on timber supply.

Operational Adjustment Factors (OAF's)

OAF's are important to timber supply analyses as they determine losses to the timber resource that can be attributed to unproductive areas, pests, disease, decay, waste and breakage.

Canfor's Draft Management Plan #10 has expressed a commitment to improved volume predictions. The Chief Forester also determined that Canfor should continue to review and refine OAF's for TFL 18.¹⁸

Wildlife Tree Patch (WTP) Retention

Wildlife Tree Patch retention is an ongoing management practice on TFL 18.

Deciduous Leading Stands:

The Chief Forester has requested that Canfor consider inclusion of deciduous leading stands in the productive forested land base for the next timber supply determination.¹⁹

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

Site Productivity Estimates

Based on provincial Old Growth Site Index (OGSI) studies, there is a possibility that the future yields of regenerating stands may be underestimated by up to 11 percent. This estimation was based on evaluation of the base case that was utilized for the 2000 Timber Supply Analysis.

Table 2.6: Summary of Management Issues and associated benefits of a new VRI.

Management Issue	Remarks
Mountain Pine Beetle	<p>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.</p> <p>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.</p>
Spruce Beetle	<p>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.</p> <p>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.</p>
Balsam Bark Beetle	<p>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.</p> <p>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.</p>
White Pine Weevil	<p>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.</p>
Root Rot	<p>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</p>

¹⁹ Tree Farm License 18 Rational for Allowable Annual Cut (AAC) Determination Effective October 25, 2000 – Larry Pedersen, Chief Forester

	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	New Inventory 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, 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

VRI Activities and Products

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.

3.0 INVENTORY PLAN

Overview

From discussions with MSRM and Canfor and review of current management issues on TFL 18, it is recommended that an entire new inventory be undertaken on TFL 18 due to the fact that there has not been an entire new Inventory since 1974. The inventory should encompass the entire land base of TFL 18.

Phase I-Photo Interpretation

The following plan has been based on implementation of this plan for the 2005-2006 Fiscal year. The licensee reserves the right to make changes to the technology and digital data to be obtained in the scope of this plan if new technology, or more recent digital data

becomes available that is accepted by the Vegetation Resources Inventory – Resources Information Branch, for inventory purposes. MSRM also reserves the right that, as Standards evolve over time, approval may have to be re-obtained from MSRM.

Aerial Photograph Acquisition:

It is recommended that the 2004 Color 1:30,000 scale photography in softcopy (DiAP) format be obtained for the Phase I. Base Mapping and Geomatic Services is currently having digital orthophotography products produced, which will cover TFL 18. Delays in years to start this project may require new approval of photo products by MSRM for VRI purposes.

Polygon Delineation and Attribute Estimation:

Provincially Certified Photo Interpreters will be hired to complete the Phase I polygon delineation and attribute estimation using Softcopy methodology according to the most current MSRM VRI standards. It is anticipated that the color orthophotographic product will further assist in the identification of mortality from forest insects, identification of deciduous stands, and improve classification of Non Forested Polygons.

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.

Phase I-Air and Ground Calibration

Following quality assurance by a qualified third party contractor of the polygon delineation, air and ground calibration is to occur on the land base according to the latest MSRM approved standards. This calibration consists of air and ground calls, and air and ground observations.

Phase II- Ground Sampling

Upon successful completion of the Phase I and approval of the Phase I deliverables to MSRM Standards, random sampling of polygons and location of sample plots for the ground sampling will occur.

Sample selection must follow MSRM standards and the listing of the samples selected, methodology of the selection process, and details of implementing the Phase II is to be included within the MSRM approved *VPIP for Ground Sampling* document.

Discussions have occurred with MSRM regarding the strata to be selected and utilized and the recommended sample sizes for phase II plots on TFL 18. Table 3.1 is a summary of these recommendations. Depending on the standard error after sampling, the actual sample size may increase.²⁰

Table 3.1: Stratum and Phase II Sample Summary²¹

Stratum Description (by leading species)	Number of Phase II Samples
Spruce – Balsam / Balsam – Spruce	40
Pine	25
Douglas-fir and other	10
TOTAL	75

The total number of plots will consist of the plot center and up to four auxiliaries where data will be collected during the Phase II process.

Net Volume Adjustment Factor (NVAF) Sampling:

²⁰ Email correspondence between Carole Dascher, RPF and Lloyd Wilson, RPF of MSRM- November 29, 2004

²¹ Email correspondence between Carole Dascher, RPF and Lloyd Wilson, RPF of MSRM- November 29, 2004

It is recommended that the samples to be enhanced for the Net Volume Adjustment Factor Sampling be done at the same time as the Phase II plots. The slight increase in per plot cost is of benefit as it decreases the variability in costing for the bids for the NVAF portion of the inventory.

Final Compilation:

Adjustment to the Phase I data for the entire VRI project area is the final VRI phase and is to be completed after the Phase II plots and NVAF sampling has had quality assurance completed. This final adjustment creates a statistically valid inventory that combines all phases of the VRI.

Table 3.2: Summary of VRI Costs

Note: Quality Assurance of the VRI phases are to be contracted out to a qualified third party if possible. Otherwise, MSRM staff may complete quality assurance.

VRI Task	Anticipated Cost	Comments
Phase I – VPIP For Photo Interpretation	\$4 240.00	Tendered cost.
Phase I – Photo acquisition for Softcopy for a total of 10 mapsheets ²²	\$17 000.00	Cost per map sheet for orthophoto product \$1700.00 acquisition and preset viewer models Based on 1:30,000 colour photo costs.
Phase I – Polygon Delineation and Attribute Estimation ²³	0.85 to \$1.25 per hectare = \$63 363.25 to \$93 181.25	
Phase I Quality Assurance of Polygon Delineation and Estimation ²⁴	Contractor QA \$3 000.00	Latest Quality Assurance Procedures for Photo Interpretation to be used
Phase I – Air and Ground Calibration ²⁵	\$19 500.00	Based on \$1 950.00 per map sheet from past VRI projects in the Southern Interior.
Phase I – Air and Ground Calibration Helicopter Cost	\$7 000.00	Based on 7 hours' helicopter time.
Phase I – Quality Assurance of Air and Ground Calibration	Contractor QA \$2 300.00	Latest Quality Assurance Procedures for Air and Ground Calls to be used.
TOTAL PHASE I COSTS	\$114 103.30 to \$146 221.30	
Phase II - VPIP for Ground Sampling	\$7 901.26	Tendered cost.
Phase II – Sample Selection and Sample Package Preparation	\$15 000.00	Costing has been based on 75 samples at \$200.00 per package.
Phase II - Sampling	\$90 000.00	Based on MSRM recommended

²² Correspondence with Paul Quackenbush of Base Mapping and Geomatic Services, MSRM –December 2004.

²³ Email correspondence with Chris Mulvihill, RPF regarding average VRI costs in the Southern Interior Forest Region.

²⁴ Costing based on TSA 41 polygon delineation QA costing for third party QA.

²⁵ Costing based on TSA 41 air and ground calibration average costs.

			75 sample size. Additional samples may be required up to a total of 100 samples. Estimated cost per plot is \$1200.00
Phase II – Sampling Helicopter Cost	\$20 000.00		General approximation only. Actual cost will depend on access issues.
Phase II – Quality Assurance of Phase II Samples ²⁶		Contractor QA \$9 900.00	Latest VRI Phase 2 Q&A Procedures and 10% check of samples is to be implemented
NVAF Sample Selection and Sampling Plan	\$4 400.00		
NVAF Sample Package Preparation	\$5 625.00		Costing has been based on 75 samples at \$75.00 per package.
NVAF Sampling	\$45000.00		General approximation only based on 60 trees at \$750.00 each. Actual cost will depend on access issues, size and species of tree, and bid prices received.
NVAF Sampling Helicopter Costs	\$15 000.00		General approximation only. Actual cost will depend on access issues, and location of plots.
NVAF Sampling Quality Assurance		Contractor QA \$5 500.00	Latest NVAF Q&A procedures are to be utilized..
Total Phase II and NVAF Costs	\$208 176.30 – \$218 326.30		
Phase III - Final Compilation – Data Analysis	\$5 000.00 to \$15 000.00		
Phase III - Final Compilation – Adjustment of Phase I and II Data	\$5 000.00 to \$10 000.00		
Total Phase III Costs:	\$10 000.00 - \$25 000.00		
Total Cost for New Inventory	\$332 279.60 to \$389 547.60		

²⁶ Costing has been based on actual costs incurred for third party QA on TSA 07 Phase II VRI project.

4.0 PLAN SIGN OFF

I have read and concur with the TFL 18 VRI Strategic Inventory Plan, dated March 7, 2005. It is understood that this is an agreement in principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to the plan and / or more detailed plans are required to be reviewed and approved by all signatories.

All signatories acknowledge that the licensee reserves the right to obtain newer imagery and technology for any inventory work undertaken and that this imagery and technology and actual works undertaken will be to MSRM approved standards and/or procedures in place at the time of project commencement.

District Manager
Headwaters Forest District

Business Ops. Manager – MSRM
Kamloops Service Center.

Canadian Forest Products Ltd. – Vavenby Division