

Lakes Timber Supply Area

Vegetation Resources Inventory Strategic Inventory Plan

Nona Phillips Forestry Consulting

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Acknowledgements

The enthusiasm of the Stakeholders in this VRI planning process, including the Ministry of Forests & Range staff and the Licensees has provided momentum for this undertaking. Included in this group are those who contributed to making the Stakeholder meeting a success through their part in the presentations or the active discussion. Also acknowledged are those who have guided the preparation of the VRI Strategic and Project Ground Sampling and NVAF Plans, through their extensive experience:

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- Garth O'Meara, Barry Elliott and other District staff participants, MoFR Nadina District
- Dick Nakatsu, Northern Interior Forest Region
- Sam Otukol, Gary Johansen, Will Smith and Graham Hawkins, MoFR FAIB, VRI Section

Gitte Churlish provided expertise on evaluation of the population and ultimately the sample plan development for the VPIP, Chris Mulvihill shared his experience with recent sampling plan development projects, Dave Coates' research has caught the interest of the Stakeholder group and has provided another objective for the field work.

Thank you to the many others who contributed to the development of the planning documents for the Lakes TSA indirectly.

Finally – and perhaps the most critical recognition must be made to the MoFR-lead group who established priorities for the funding allocation from the Federal Government Mountain Pine Beetle funds and will be providing resources for the Lakes TSA VRI project.

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Executive Summary

The Ministry of Forests & Range, Forest Analysis & Inventory Branch is supportive of enhancing inventory knowledge in Mountain Pine Beetle infested TSAs across the province. This has allowed the Lakes TSA planning table to look for solutions to data questions through the ground sampling, NVAF and monitoring activities in Vegetation Resources Inventory.

The initial step was to draw together the identified Stakeholders in this unit to a meeting hosted by the Ministry of Forests & Range in Burns Lake. This was designed to provide an opportunity to:

1. provide a background on the Vegetation Resources Inventory process
2. assess client data needs in the TSA suggested by previous planning processes and generally identify support that can be provided through the Vegetation Resources Inventory
3. provide more TSA-specific recommendations for the undertaking of relevant phases of the VRI based on the forest management issues in the Lakes TSA

Some of the specific concerns that the Stakeholders are seeking information for include:

1. Better estimates of live and dead volume for all species.
2. Estimates of MPB killed pine 'shelf life'
3. Assessment of the accuracy of standing log grades, including the draft Interior log grades.
4. 'Mid-term timber supply' – amount, possible locations, additional data on these stands
5. Potential abundance of secondary structure¹, especially in Lodgepole Pine stands affected by Mountain Pine Beetle
6. Impact of mountain pine beetle on current wood supply.

The following details for the Lakes TSA project have evolved from the Stakeholder's meeting, a follow up Discussion Paper and additional discussions with specialists in the Ministry of Forests Forest Analysis and Inventory Branch, VRI section:

1. The recommended target population for sampling will be the Vegetated Treed component of the landbase, all ages, excluding private land, Indian reserve land, parks, and protected areas.
2. Phase 2 Ground Samples will be established randomly across the landbase, based on the strata determined in the VPIP. In addition to the regular Timber Emphasis data collection, supplementary data collected will include non-VRI ecology to a level that supports the shelf life study, shelf life attributes in pine leading stands, and additional 'small tree plot' data.

¹ Seedlings, saplings, sub-canopy and canopy trees that will likely survive a pine beetle attack (Coates 2006)

3. Net Volume Adjustment Factor destructive sampling will be completed as part of the Phase 2 work. The accuracy of the standing log grades, VRI and the draft Interior log grades, will be confirmed through a bush scale of each destructively sampled tree.
4. Analysis & Adjustment of the current Photo Interpreted Inventory will follow the Phase 2 field work, based on the ground sampling and NVAF data.
5. Supplementary data will be captured for analysis or incorporation in model development or research work.
6. Initiation of a Pine Monitoring project will occur concurrently.
7. A new Phase I or photo interpretation of the TSA will not be part of the project at this time.

The VRI Project Implementation Plan (VPIP) will be completed based on the decisions agreed to in the preparation of this VSIP. The VPIP will provide details for the implementation of VRI ground sampling including details on the sampling plan development – strata development decisions for the ground sampling ‘cluster’ samples and NVAF, sample lists, roles and responsibilities, implementation steps, and estimated costs.

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1. Introduction

1.1 Background

The Vegetation Resources Inventory (VRI) is one of a number of inventories that have been implemented since the 1990's in the province of British Columbia. The Forest Resources Commission (1991) recommended "that the Government of British Columbia undertake a commitment of complete inventories for all renewable forest resource values using standardized compatible systems". The Resources Information Standards Committee (RISC) has evolved as the group who continues to "support the effective, timely and integrated use of land and resource information from planning and decision making by developing and delivering focused, cost-effective, common, provincial standards and procedures for information collection, management and analysis."

The VRI has been the standard for forest cover inventory since 1996. As stated on the MoFR's website for the Vegetation Resources Inventory, the VRI was designed to answer two questions:

1. Where is the resource located?
2. How much of a given vegetation resource is within an inventory unit?

Among the strengths of the VRI are its statistically accurate procedures, its return to ground sampling and its multi-option approach to answering inventory related questions.

The VRI process starts with a formalized planning requirement, aimed at involving local Stakeholders in the decisions on the direction for the process. This includes preparing a VRI Strategic Inventory Plan (VSIP) followed by one or more VRI Project Implementation Plans (VPIP). This documentation should be thorough enough that those following up on the project in the future can use these documents to build upon.

The current beetle epidemic in the pine forests of British Columbia and the changing information needs related to this epidemic are behind the Lakes TSA initiative. While many similar inventory projects are funded by the Licensees, this TSA was identified by the Forest Analysis and Inventory Branch of the Ministry of Forests & Range as a high priority for developing a plan to supplement currently available data.

1.2 Scope and Objectives

The VSIP attempts to identify issues in the TSA that can be addressed by the Vegetation Resources Inventory. Various components of the inventory can be selected to address specific inventory needs. This document provides direction for the development of the more detail-oriented VPIP.

Nona Phillips Forestry Consulting is preparing this report in consultation with the Lakes TSA Stakeholders. Included in their number are the following:

- MoFR – Forest Analysis and Inventory Branch
 - – Northern Interior Forest Region
 - – Nadina Forest District
- Babine Forest Products, Burns Lake
- Fraser lake Sawmills, Fraser Lake
- Babine Timber Ltd., Burns Lake
- CANFOR, Houston Division
- L & M Lumber, Vanderhoof
- Cheslatta Forest Products, Burns Lake
- Pacific Inland Resources, Smithers
- Tahtsa Timber, Burns Lake
- Houston Forest Products, Houston
- Burns Lake Community Forest

This VSIP has been written following the Stakeholders meeting in Burns Lake held on Friday, July 7, 2006. A list of the stakeholders attending this meeting is in Appendix A.

1.3 Vegetation Resources Inventory Overview

Before deciding the direction for a VRI project, it is important to have familiarity and some understanding of this inventory. There are numerous activities that may be undertaken in combination or in some cases, individually.

The Vegetation Resources Inventory has several components.

1. Phase 1 or Photo Interpretation

The Photo Interpretation phase involves estimating vegetation polygon characteristics from aerial photographs.

The key steps involve:

- Delineating the vegetated and non-vegetated land base into polygons based on similar vegetation characteristics
- Field calibration for the photo interpreters
- Attribute estimation, incorporating historical data, field calibration data and the skills of the photo interpreters
- Digital capture of attribute and graphic information to produce forest cover maps

2. Phase 2 or Ground Sampling activities

The ground sampling phase provides the information necessary to determine how much of a given attribute is within the inventory area.

There are two parts to this phase.

- i) Establishment of 'cluster' samples randomly across the project area. The data collected at the cluster samples may include the measurement of timber and/or ecology attributes. Net close utilization volume is obtained by call grading and net factoring trees, and breakage loss factors.
- ii) Destructive sampling following the protocols established in the Net Volume Adjustment Factor process is used to correct for errors in the estimation of net tree volume. The NVAF work provides an adjustment factor that is used during sample compilation to produce unbiased estimates of net close utilization tree volume and adjust the net factor volumes from the plot establishment activity.

3. Analysis and Adjustment

- Data analysis is the process of screening, preparing, and comparing compiled ground sample data to the phase 1 inventory data, to determine the relationships between these data.
- Attribute adjustment is the process of applying the relationship between photo estimation data and ground sampling data to the initial estimates in the photo interpreted database.

4. Monitoring plots

Monitoring is not considered part of the Vegetation Resources Inventory "toolkit" but is being included in this project to track changes associated with the pine beetle infestation. The permanent plot design of the National Forest Inventory – British Columbia standard allows for repeated measurement of forest attributes over time, at defined locations. The following are features of this work:

- cross between a VRI and a Growth & Yield Permanent Sample Plot creates a permanent, remeasurable design that is a statistically based system of monitoring and reporting
- most often includes collecting full VRI ground sampling data, including timber and ecology
- intention is to monitor change over a long term at intervals of 5 to 10 years

1.4 Vegetation Resources Inventory Overriding Principles

To ensure consistent and effective implementation of the inventory the following principles guide projects across the province:

- Strategic and Project Implementation Plans are produced to provide background on the VRI process, identify the project area and tailor the inventory to the specific needs of the inventory unit as identified by the Stakeholders. Project Implementation plans identify specific timelines, roles and responsibilities, and deliverables. These plans form a critical part of the

record for Vegetation Resources Inventory projects and they have high value in both the short and long term.

- Implementation will follow standards and procedures established by the Resources Information Standards Committee (RISC) that are available at the website:
<http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm>

1.5 Vegetation Resource Inventory Planning

The MOFR requires that a VSIP be prepared before starting a VRI. This is to ensure that the inventory is tailored to address issues identified in the TSA.

The overall planning process is as follows:

- Identify stakeholders and consult with them throughout the project. Initially, there is a meeting with the stakeholders to describe the process and identify issues specific to their planning area. Throughout the planning process, this client group should be kept informed and at some junctures, involved in the process.
- Develop a VRI Strategic Inventory Plan (VSIP) that creates a project addressing stakeholder needs. Specific VRI tools are identified to support the collection of data or products to resolve issues
- As directed through the VSIP, the VRI Project Implementation Plan (VPIP) will be the more detailed plan, outlining specifics for each prescribed activity.

1.6 Funding

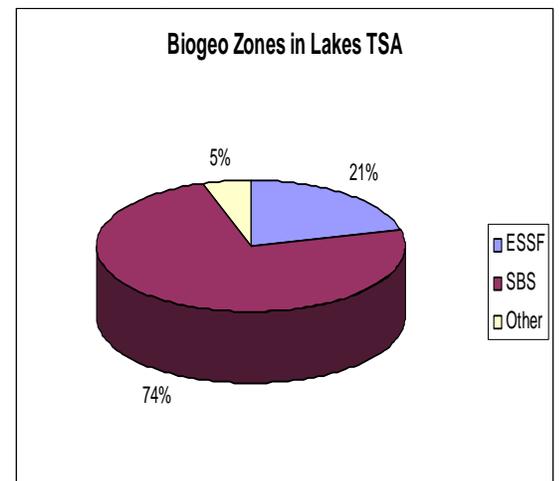
As previously stated, this project is being undertaken through Federal Mountain Pine Beetle funding. At this time funding is available to cover the field work and analysis components of this project. If it is possible, every effort will be made to accelerate all field work for this project to be completed by the end of the 2007 field season, and all analysis by the end of the fiscal year 2007/08. This will help to secure funding and make the data available in the requisite timeframe for the timber supply review (TSR).

2. Business Considerations

2.1 Landbase (adapted from the Lakes TSA AAC Rationale –October, 2004)

The Lakes TSA is located in north central BC between Babine Lake in the north and the Entiako River in the South. It comprises approximately 1.12 million hectares of the Nadina Forest District and includes the community of Burns Lake and several smaller communities. Lakes comprise almost 10% of the TSA area, the three largest being Babine, Francois, and Ootsa. Part of Tweedsmuir Park is in the southern end of the TSA. Figure 1 is an overview map of the area.

The TSA is on the western edge of BC's interior plateau with terrain that is characterized by gently rolling uplands. The predominant biogeoclimatic zone is Sub-Boreal Spruce (SBS) found in the valley bottoms dominated by lodgepole pine, hybrid white spruce, and subalpine fir. The climate here includes severe, snowy winters, and relatively short warm, moist summers. Above this, in steeper terrain, is the Engleman Spruce-Subalpine Fir (ESSF) zone with Engleman spruce and subalpine fir predominating climax forests. Pine is common in pioneer stands establishing following fire. The weather here is cooler and wetter/snowier than SBS. At the highest elevations is the largely treeless, rugged, Alpine Tundra (AT).



About 75% of the TSA is in the "vegetated treed" (VT) category of the BC Land Cover Classification Scheme. Table 1 shows the VT area by mature and immature age classed and by leading species. Pine is by far the largest component of the VT area.

There are several First Nations within the TSA. They are as follows:

- Cheslatta Carrier Nation
- Burns Lake Band
- Nee Tahi Buhn Band
- Skin Tyee Band
- Wet'suwet'en First Nation
- Babine Nation.

In addition, there are seven other First Nations, that don't have reserve land or communities within the TSA, but claim traditional territories that overlap the area. They are:

- Nadleh Whut'en Band
- Office of the Wet'suwet'en

- Stelat'en First Nation
- Tl'azt'en Nation
- Ulkatcho Band
- Yekooche First Nation
- Carrier-Sekani First Nation.

Figure 1. Lakes TSA

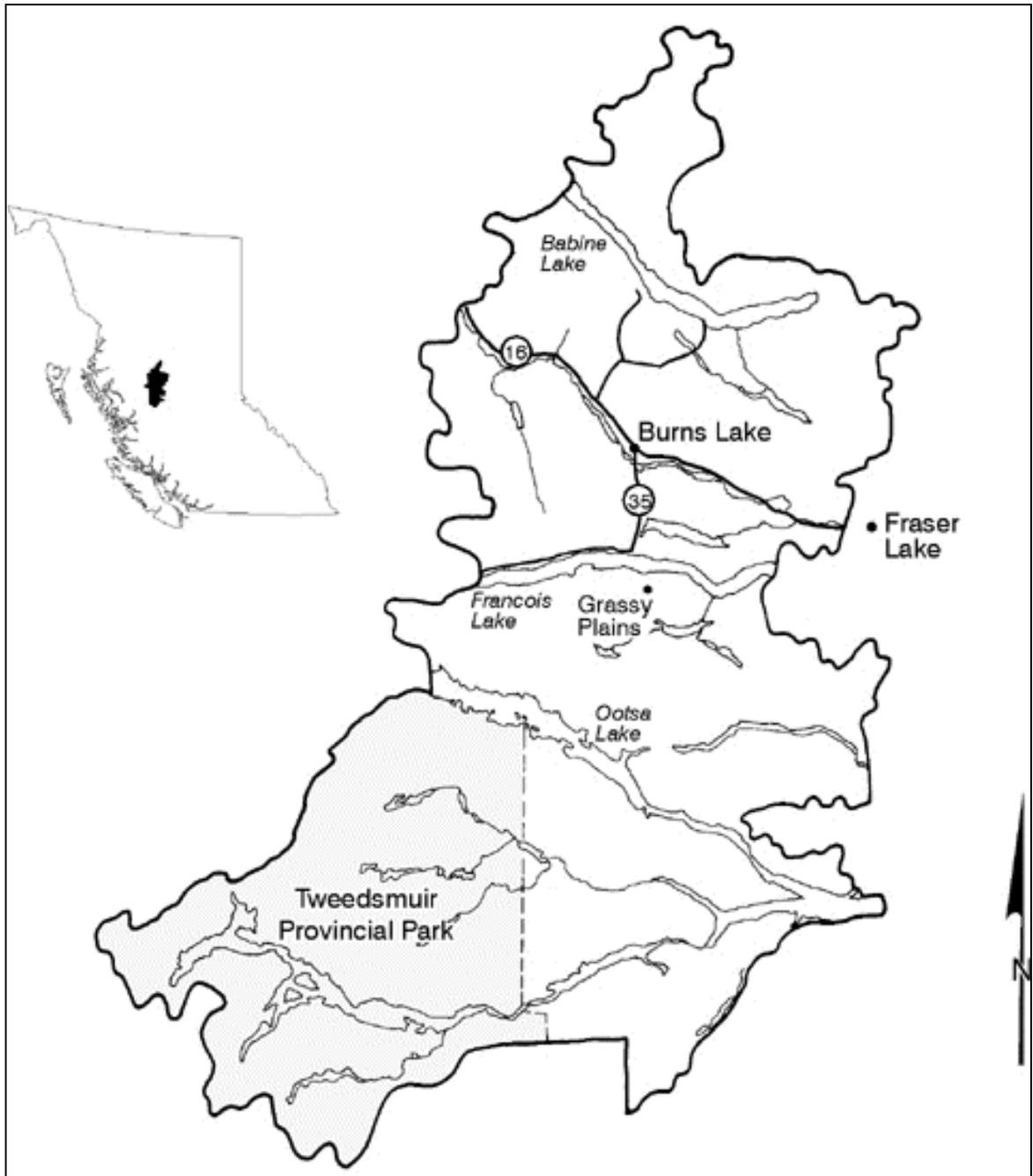


Table 1. Land Base of the Lakes TSA

Total TSA Area (ha)	1,121,723	
Classification of Vegetated Treed (VT)	Area (ha)	% of VT
Total VT	844,457	100
Immature	72,797	9
Mature	771,660	91
Leading Species		
PL	553814	65.6
SW	80755	9.5
SX	75657	9.0
AT	69000	8.2
BL	45551	5.4
S	8366	1.0
SB	6929	0.8
AC	1413	0.2
B	1449	0.2
FD	1238	0.1
EP	286	<1%

2.2 Forest Cover Inventory History

The Lakes TSA completed a reinventory process of their forest cover in 1989-90.

Another significant inventory initiative for the 2001 Timber Supply Review was the Old Growth Site Index (OGSI) work in the TSA. This was part of a Ministry of Forests-lead project in the province by the Growth & Yield section of the provincial inventory group. The work resulted in increased site index values which was incorporated into the TSR process.

The most current update year for the Veg files for the Lakes TSA in the LRDW is 2000.

2.3 Inventory Audit

In response to questions surrounding the accuracy of the forest cover inventory, the Ministry of Forests developed an inventory audit methodology in the 1990s. The procedure was designed to test the overall accuracy of estimates of the total standing volume in a timber supply area.

The sampling entailed assessing three primary components of the inventory: the mature forests, immature forests and non-forest areas. The audit provides information to the Chief Forester about the inventory's statistical reliability when determining annual cut. It provides a general assessment of the uncertainty associated with mature timber volumes, immature site index and non-forest classification.

The results of the audit for the Lakes TSA were released in 1997 and the findings were as follows:

1. Analysis of mature volumes: There was a 3 cubic m/hectare difference between the mean inventory estimate for mature volume and the audit estimate. A paired sample t-test determined that this difference was not statistically significant 19 times out of 20.
2. Analysis of the operable and inoperable volumes: The difference between the mean volume estimates located within the operable forested area in the audit and the inventory was 2 cubic metres. It was not statistically significant, 19 times out of 20. There were inadequate samples in the inoperable forested areas to make any meaningful comparisons.

In conclusion, the audit results for this inventory showed:

1. For the mature component, the inventory is statistically acceptable.
2. There is a similar level of acceptability in the operable forested area.
3. For the immature component, the immature site index assignment may not be accurate. The audit report recommended further review of this component.
4. Growth type groups (GTG) from the inventory (i.e. map labels) matched the audit GTG 52% for 60 year + and 60% for <60 years.

2.4 Forest Management and Inventory Issues

At the Stakeholders' meeting on July 7, 2006 there was a discussion about the TSA issues and how the VRI might help to address them. The mountain pine beetle devastation is currently a chief concern of forest managers so it is not surprising that stakeholders identified the pine beetle as a key focus for the inventory. There are, however, other inventory related concerns.

This section outlines the list of management issues that were discussed at the meeting. Issues #1 to #7 are taken from previous planning processes including Land Use planning and Timber Supply Analysis for the Lakes TSA. Items #8 to 10 were added based on suggestions from participants at the Stakeholders'

meeting. The remaining issues are common ones identified at previous Vegetation Resources Inventory planning tables throughout the province. In some cases, they were felt to be relevant.

A rating of high, moderate, low or not applicable (N/A) has been applied to the effectiveness of Phase I or VRI Photo Interpretation, Phase 2 - Ground Sampling or NVAF and Monitoring activities to providing relevant data for each issue.

	Issue	VRI Effectiveness		Remarks
		Photo-Interpreted Estimates	Ground Sampling	
1.	Mountain Pine Beetle Currently lodgepole pine leading stands, both pure and mixed with other species, represent approximately 55 percent of the TSA's timber harvesting land base. There needs to be more information about existing structure.	Low	Moderate - High	New photo interpreted Estimates (Phase I) are not useful in management of MPB issues. New Phase I will be useful after the infestation is finished. Ground Sampling (Phase 2) can give good information about current attributes and volumes of MPB stands across the TSA.
2.	Mountain Pine Beetle Shelf Life: Monitor the duration of merchantability of dead timber in beetle attacked areas.	NA	Moderate-High	MOFR is piloting the collection of shelf life attributes in other VRI and Monitoring projects in 2006/07. Data is to be used for building a shelf life model. Shelf life data collection could be incorporated into the ground sampling, NVAF and monitoring projects in the Lakes TSA.
3.	Volume of dead wood. Changes in Interior log grades requires that the Chief Forester consider dead wood volumes in TSR determinations.	Low	High	Ground Sampling would provide good information on dead potential volumes. The NVAF could incorporate a scaling component.
4.	Mortality in immature stands. Timber Supply group is interested in the amount of MPB activity in stands less than 60 years old.	Low	Moderate	Ground Sampling can target a strata with age classes 31 to 60 years to collect data. The Monitoring plot sample selection could also target this population to provide data at establishment and at intervals.
5.	Mid-term source of wood supply	Low	High	Identify strata that define this part of the population. Make this a priority in the ground sampling.
6.	'growth rates' Site index in both managed and unmanaged stands: <ul style="list-style-type: none"> - Better estimates in immature stands. - Concern that current SI may underestimate growth rates - SI adjustments for species other than PI 	Moderate	High	Phase I can provide better estimates of height for use in determining Site index. Ground Sampling can provide good data for Site Index based on current stands. Monitoring can provide data, over time. Target populations i.e. managed stands can become strata in either sampling process.
7.	Problem Forest Types <ul style="list-style-type: none"> - Identification - Improve site productivity estimates 	Moderate	High	New PI can verify/improve the estimates in these stands. Targeted Ground Sampling in these types will provide good data. Area in Lakes TSA is small and will have to consider whether creating separate stratum is worthwhile. Alternately, analysis can target this stratum. Reference "site index" issue.
8.	Landscape-level biodiversity	Moderate	Moderate	Photo interpretation can provide more detailed information on non-forest attributes.

	Issue	VRI Effectiveness		Remarks
		Photo-Interpreted Estimates	Ground Sampling	
				Ground Sampling can provide data on Coarse Woody Debris, Forest Succession and ecology.
9.	Polygon delineation and species composition in younger age classes.	High	Moderate	New Photo Interpretation can improve delineation and species composition estimates on openings older than those populated by RESULTS. Ground Sampling will provide attribute information for openings age 31+.
10.	Additional data on understory is desirable (i.e. poles, saplings) to identify potential for mid term wood supply.	Low	High	Ground sampling can provide data on the understory. An investigation of Dave Coates' paper may result in several additional classes in the 'small tree plot'.
11.	Coordination with PEM process.	Low	Low	In an attempt to increase accuracy in PEM inventories, methodology is being developed that does not incorporate forest cover data as a layer.
12.	'snapshot' estimates of current volumes for managed stands. Concern that the current inventory does not present the existing volume accurately.	Moderate	High	New Phase I can provide more accurate attributes for VDYP to use in deriving volumes. Ground Sampling will provide very good data on actual volumes. The data can then be used to adjust the database.
13.	Errors in inventory attributes: species composition, age, height.	Moderate	Moderate	Both Phase 1 and 2 may improve individual polygon values and reduce errors in attributes. Further analysis by age and species could also identify trends within the inventory. Photo Interpreted database can be adjusted for some attributes using Ground Sampling.
14.	Environmentally Sensitive Areas	Low	Low	ESAs are not part of current Photo Interpretation procedures. The District agrees that there are much better methods to do this work.
15.	Decay, waste, and breakage	Low	High	NVAF data will provide information on decay and waste. This data could be used to provide information to verify the current loss factors and VRI net factors. Breakage is not part of the VRI system.
16.	Implications of managing for species at risk	Moderate	Low	New Phase I can provide finer delineation and specific attributes for non-forest areas.

In summary, the following information of particular interest to the Stakeholder group could be derived from the completion of VRI activities:

- Provide additional information about current attributes and volumes of mature and immature stands in the TSA. This includes the desire for increased data on Mountain Pine Beetle stands.
- Collected Shelf life data could be analysed to provide local knowledge and could contribute to data collected provincially by other MoFR projects to provide a larger data base for analysis and possibly model development.

- Ground sampling and NVAF sampling would provide good information on volume for 'dead potential' trees.
- By targeting a stratum in immature coniferous polygons (stands up to 60 years of age), data collection in this strata will provide Timber Supply staff with some information on mid-term wood supply.
- Improved site index information can be gained from the collection of age and height data.
- By identifying a stratum based on attributes for "Problem Forest Types", this population can be better identified and analysed in the inventory.
- Collecting non-tree information on the land base, including coarse woody debris, forest succession and ecological attributes can help to make decisions on landscape-level biodiversity.
- Additional data collected in the small tree plot regarding the secondary canopy could support the Research project and work of David Coates, a MoFR Research Silviculturist at the Bulkley Valley Centre for Natural Resources Research & Management.
- Obtain accurate information on non-pine species which will form the mid-term timber supply.

2.5 VRI Activities and Products

2.5.1 VRI Photo Interpretation

New photo interpretation would require the acquisition of new air photos to an acceptable scale. With the acquisition of these photos complete, the process to complete a new Phase I would likely take 2 to 3 years.

As part of the ongoing operational program, part of the TSA was flown and photographed at 1:20,000 scale, colour in 2005. The intention is to complete the photography on the TSA through a MoFR contract in 2006. At this time there is no defined funding to create orthophotos.

The Lakes TSA has a forest cover reinventory dated 1989-1990 that has been updated to 2000. The inventory audit did not indicate that this inventory had any issues regarding the comparison of the actual versus inventory volume. The Chief Forester in his Timber Supply Review documents has not identified any issues with the inventory that would suggest undergoing the expense of a new photo interpretation of the land base.

The most important consideration is whether there is a business need for a new inventory. This new inventory will give an up-to-date snapshot of the forest. There is an assumption that "new is better" but as stated above, no issues have been identified with the overall inventory volume or polygon attributes in the Lakes TSA. There is some frustration over the delay in

update and the change occurring in the forest. New orthophotos could be helpful operationally but a new photo interpretation inventory will not necessarily be better at filling in the information gaps that the Stakeholders have identified. In the case of the Lakes TSA, dramatic changes are occurring on the landscape with the Mountain Pine Beetle infestation. The work that has been lead by the MoFR's Forest Analysis and Inventory Branch suggests that in beetle affected TSAs, the focus should be on ground sampling. In conclusion, a new Phase I should be deferred until the pine beetle attack is over in the TSA.

2.5.2 VRI Ground Sampling

The VRI Ground Sampling phase requires a completed photo interpreted inventory – either new or existing. It involves establishment of 'cluster' ground samples and the NVAF. It should be followed up by the statistical analysis and adjustment of the photo interpreted database.

When undertaking a Phase 2 Ground Sampling program, there are three essential components that must be completed.

1. Decisions on the overall project design, with Stakeholder input: This includes deciding the sampling population, the sample strata and working out the number of samples that will be completed in the project.
2. Selecting activities to be completed in the project from the "ground sampling toolkit": The main modules in Phase 2 VRI include:
 - Full VRI – includes ecological, timber and Coarse Woody Debris (CWD) information to VRI certification standards
 - Timber Emphasis – tree information only is collected
 - CWD – Coarse Woody debris data is collected as an additional option on Timber Emphasis plots
 - Succession information – The Succession card's completion is an option on Timber Emphasis plots
3. Net Volume Adjustment Factor Sampling

NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations). Net Volume Adjustment Factor destructive sampling has been recognized as a mandatory component of the Phase 2. The NVAF data provides an adjustment factor that is used during sample compilation to produce unbiased estimates of net merchantable tree volume. Its completion involves the following:

- Step 1 - Random selection of sample trees from a sub-set of the ground samples, following the initial data collection.
- Step 2 – The sample trees selected in Step 1 are felled and sectioned to measure actual net volume.

Each of the Phase 2 activities was presented at the Stakeholders meeting, with some discussion focused on how different options could help to provide answers to ‘traditional’ questions asked of the VRI inventory. Some additions or variations were proposed to support the Stakeholder’s information needs. Section 3 of this document, “Inventory Plan”, will outline decisions on the options.

There was also some discussion at the meeting about a plan formulated in the Bulkley TSA planning process to collect interior log grades using a scaler on the NVAF sampling crew. The interest expressed by the group has resulted in government support to pilot this approach on the Lakes TSA project.

2.6 Follow up Activities

2.6.1 Ground Sampling Analysis and Inventory Attribute Adjustment

An initial step in this process will be the decision of the Forest Analysis and Inventory Branch staff regarding utility of ground sampling work completed during previous VRI projects⁴. Branch has indicated that they will review existing VRI sampling projects’ data that exists in a portion of the Lakes TSA (including ground samples and NVAF trees) and possibly integrate it at a later date.

For the NVAF work, in addition to the standard procedure’s analysis, there will be the analysis related to the scaling procedure added to the Lakes TSA project.

2.6.2 Shelf Life and Secondary Structure Attributes – Analysis

Shelf Life and Secondary Structure Attributes includes data not normally collected during VRI sampling. It will provide valuable baseline data for Shelf life and “Mid-term timber”. The additional work being completed includes:

1. Increased diameter classes in the ‘Small tree’ plot
2. Detailed check and spiral grain measurements of MPB killed pine trees at the Integrated Plot Centre

⁴ Babine Enhanced Forest Management Pilot Project

3. Detailed check measurements, log merchantability and grades of felled NVAF sample trees.
4. Dead trees tallied in the auxiliary plots
5. Ecological data to support shelf life work

Since much of this data will be outside of the regular compilation for VRI, it will need to be collected on supplementary data sheets. Compilation will have to be conducted as directed by Branch staff.

2.6.3 Monitoring

The Ministry of Forests & Range has recently undertaken a series of monitoring projects throughout the province, related to studying the effects of the Mountain Pine Beetle infestation. The goal is to monitor the changes and trends of the timber and non-timber resources of MPB affected stands, over time.

The monitoring protocols currently in use were developed for the National Forest Inventory and they are being used for management unit monitoring. The Monitoring project in the Lakes TSA will be undertaken with a similar objective and protocols to the other projects in the province. If new protocols are developed for management units prior to the 2007 field season they will be incorporated into the Lakes TSA work through an amendment to the VPIP.

3 Inventory Plan

3.1 Overview

This section takes the theoretical discussions on the Vegetation Resources Inventory in Sections 1.3, 2.5 and 2.6 and describes how it will be applied in the Lakes TSA project.

3.2 Phase I –Photo Interpretation

Based on the suggestions by the MoFR Forest Inventory and Analysis Branch and the Mountain Pine Beetle study group, there will be no plan prepared to undertake a new photo interpretation inventory in the Lakes TSA at this time.

3.3 Phase II Ground Sampling

3.3.1 Inventory Objectives

The objective of VRI ground sampling is to attain statistically valid timber volumes in the live and dead timber. A sample error objective of +/- 10% for overall inventory volumes, 95% probability will be targeted. In addition, there is other information that will be gained including more accurate polygon-specific attributes and shelf-life data.

3.3.2 Target Population

The target population will be derived from the Vegetated Treed⁵ landbase with no lower age limit but excluding private land, Indian reserve, parks, and protected areas.

3.3.3 Sample Size

Based on a sampling objective of +/- 10% for overall inventory volumes, 95% probability, and an estimated CV of 50% (taken from the Lakes TSA Inventory Audit report - <http://www.for.gov.bc.ca/hts/vri/audits/reports&pub/reports/lakes-auditreport.pdf>), approximately 100 samples will be required. Additional samples will also be collected in immature stands to investigate the impact of MPB on young pine.

The population will be divided into 4 strata. Table 2 shows the planned distribution of samples across the stratum.

⁵ B.C. Land Cover Classification Scheme

Table 2⁶: Planned Distribution of Samples

Stratum	Population Area (ha)	Planned number of samples	Number of hectares represented by each sample
Mature – Pure PI (>80%)	274742.5	35	7849.78
Mature – PI (50-80%)	190523.6	25	7620.94
Mature – Other coniferous leading, PI<50%, Deciduous	306393.5	40	7659.84
Immature	72797.2	15	4853.15

3.3.4 Sample Selection

The sample selection will follow the Provincial standard. The selection of sample polygons is based on stratified sampling using the Probability Proportional to Size with Replacement (PPSWR) sampling method.

Samples will be selected from 4 strata. At previous planning tables these strata were typically based on species groupings. For this TSA the strata may have a link to other interests such as ‘mid-term timber’. At the Stakeholders’ meeting information on “species groups relative to minimum harvestable age” from the 2001 AAC Rationale was used to roughly identify the population breakdown. Based on this, tentative strata were identified. It was decided that samples will be located in each stratum based on their proportion in the TSA.

Following this meeting, a ‘Discussion Paper’ was produced to allow the Stakeholders to comment on the strata that will be the basis for the sample selection. The results of the ‘Discussion Paper’ review, including decisions on strata and distribution of samples will be reflected in the Project Implementation Plan.

3.3.5 Sampling Approach

VRI Timber Emphasis Plots (TEP) plus Succession will be used to gather data as per the Ground Sampling Procedures manual. According to the Procedures, only auxiliary plots that fall within the sample polygon will be included. The following additional data will be collected:

⁶ The actual number of samples and the number of hectares represented by each sample will not be known until after the ground sampling has been completed. A revised Table 1 will be provided in the final analysis documentation.

- Dead trees in the auxiliary plots
- The 'small tree plot' at the IPC will be increased in size to 3.99 m in diameter and two additional size classes will be added
- Shelf life attributes' procedure on all dead PI within the IPC
- Ecological data – A 'Ground Inspection Form' or GIF will be used to identify site series. Its completion should satisfy attributes of interest for MPB - slope, slope position, aspect, soil nutrient, moisture grid position and site series. This work can be collected by a non-certified VRI ecologist who is experienced in the area. This ecology data is deemed to be valuable for both the shelf life attributes study and the mid-term wood supply. The latter relates to results of the study 'Abundance of Secondary Structure in Lodgepole Pine Stands Affected by the Mountain Pine Beetle by K. David Coates et al. where a relationship between secondary structure and biogeoclimatic subzone is identified.

3.3.6 Net Volume Adjustment Factor Sampling

The MoFR Forest Analysis & Inventory Branch will provide a sampling plan that identifies the number of ground samples that may potentially contain trees to be destructively sampled. The actual samples where additional NVAF data is to be collected will be identified during the overall sample selection process (see Section 3.3.4)

Depending on the schedule for work, there are two options for the NVAF tree selection data collection:

1. The samples selected for potential NVAF trees are sampled early in the project, and additional work as required by the NVAF process is completed at all auxiliary plots. When the destructive sampling occurs, there is no requirement to have a Timber certified contractor present since all work is done. This is the preferred option as is most efficient.
2. The samples selected for potential NVAF trees are sampled early in the project, but there is no NVAF 'enhancement' at the auxiliary plots. There will then be a requirement to have a Timber certified contractor present to do the additional data collection on the trees selected for destructive sampling only, at the time of destructive sampling.

As discussed in Section 2.5.2, there will be a scaler present for the NVAF destructive sampling work to provide estimates of log merchantability and log grades based on both the VRI and draft Interior log grades. This additional data collection is a pilot project.

An update in the NVAF sampling standard in 2006 has increased the sample size to 100 trees, 75 live and 25 dead. Forest Analysis & Inventory Branch

staff will provide guidance and assistance to the group to ensure appropriate decisions are made regarding sampling strata, sample size and the live/dead ratio in this TSA.

3.3.7 Monitoring Plots

At the time of the writing of the VSIP, this part of the overall project has only been generally discussed. The intent is to establish 25 monitoring plots on the TSA. This will be completed during the 2007/08 fiscal year. The sampling will follow the Change Monitoring Procedure, and its modifications may include:

- Complete shelf life study work at the plot centre
- Increase the size and classes in the 'small tree plot'
- Modify the Coarse Woody Debris (CWD) as per the pine study monitoring plot procedures
- Modify VRI certified ecology data collection according to the pine study monitoring plot procedures

Options for the location of the monitoring plots are still open at this time, and include:

1. Using a grid to randomly locate the monitoring plots across the TSA landscape.
2. Using a sub-sample of the VRI plots, without focus on the strata.
3. Using a sub-sample of the VRI plots, focusing on specific strata i.e. pine leading.

3.3.8 Implementation

All phases of a ground sampling program could be completed by the end of the 2007/08 fiscal year pending sufficient funding and availability of certified crews.

3.4 VPIP Project Implementation Plan

The next step in the planning process is to develop the VPIP. Using the direction of the VSIP, with input from the Stakeholders, the VPIP will specify the operational details for the inventory.

3.5 Roles and Responsibilities

A VSIP usually outlines organizational roles and responsibilities in the development of a VRI project. Since funding was initiated through the Federal

MPB initiative, VRI section has the majority of these, from the setting of standards to the insuring that these are followed.

The other Stakeholders, including local levels of government and Licensees will be important in their provision of input and possibly some operational support such as GIS and local knowledge for crew work. It is anticipated that they will be included in a final information session when the work is complete.

3.6 Costs

The following Tables, 3, 4, and 5 outline estimated costs for the project.

Table 3. Estimated sample sizes and costs for VRI Phase II activities in the Lakes TSA

VRI Activity	Sample Size	Unit Cost	Total Cost
<i><u>GROUND SAMPLING</u></i>			
Contract administration & materials-Year 2 1 and 2?			\$11,000
Year 1 - VSIP and VPIP preparation -includes Sampling plan development and package preparation			\$30,000
Timber Emphasis Plot – timber and ecology data collection	85	\$1,500/sample	\$127,500
Year 1 - Timber Emphasis Plots – timber data collection	30	\$1,300/sample	\$39,000
Year 2 - Timber Emphasis Plots – ecology data collection	30	\$600/sample	\$18,000
NVAF destructive sampling - includes scaler	120	\$750/tree	\$90,000
Helicopter access-VRI Est. Year 1-\$6,000 and Year 2-\$24,000			\$30,000
Helicopter access-NVAF			\$10,000
Mentoring (crew training) Year 1-\$1,000 Year 2-\$4,000			\$5,000
Quality Assurance-Timber Year 1-\$3,000 Year 2-\$9,000			\$12,000
Quality Assurance-NVAF			\$7,000
Final Compilation/analysis and inventory file adjustment			\$15,000
Total Phase II			\$394,500

Costs will be incurred in Year 2 unless otherwise indicated.

NOTE: Non-standard ecology data collection will be reduced by 25 plots if the Monitoring plots are located on a sub-set of the VRI Timber Emphasis samples.

Table 4. Sample size and estimated funding breakdown for VRI Monitoring project

<i>MONITORING</i>			
Contract Administration – includes GIS work			\$6,000
Sample Establishment	25	\$2,500/sample	\$62,500
Helicopter Access			\$5,000
Mentoring	1 crew	\$1,000	\$1,000
Quality Assurance		\$3000	\$3,000
Total Monitoring			\$77,500

Table 5. Estimated funding breakdown by year, based on timing of VRI activities

Year	Activity	Costs
1-2006/07	All costs for plan preparation and establishment of 30 Ground sampling – timber	\$79,000
Year 1 total		\$79,000
2-2007/08	Contract Administration	\$11,000
	Ground sampling – timber & ecology	\$151,500
	Timber mentoring & QA	\$13,000
	Ground sampling – ecology	\$18,000
	NVAF	\$100,000
	NVAF QA	\$7,000
	Analysis & Adjustment	\$15,000
	Monitoring	\$77,500
Year 2 total		393,000
Grand Total		\$472,000

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12. Osborn, Steve. June 23, 2006. Nadina Forest District Timber Information Needs Analysis –District Meeting. Nexus Forest Solutions.

13. Timberline Forest Inventory Consultants. September 1, 2000. Babine Forest Products Co. Enhanced Forest Management Pilot Project Vegetation Resources Inventory Sampling Plan.
14. Timberline Forest Inventory Consultants. March 31, 2005. A User's Guide to the Vegetation Resources Inventory. FIA/ Tolko Industries Limited.

The most recent edition of the **Vegetation Resources Inventory Standards and Procedures** will be followed for the completing this project. These are located at the website:

<http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm>

The following is a list for the critical Standards and Procedures for the Burns Lake TSA VRI project:

Ground Sampling:

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 2.0, March 2006

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling Version 3.3, December 2002

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling Version 3.3 Errata No. 1, April 2005

Vegetation Resources Inventory Ground Sampling Procedures Version 4.5, March 2004

Vegetation Resources Inventory Ground Sampling Procedures Version 4.5 Errata No. 1, February 2005

Vegetation Resources Inventory Quality Assurance Procedures for VRI Ground Sampling Version 3.0, March 2004

Vegetation Resources Inventory Data Collection Standards for VRI Ground Sampling Version 2.1, March 2006
Vegetation Resources Inventory Ground Sampling Data Collection Procedures for Inaccessible Samples Version 1.0, March 2003

Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.1, March 2006

VRI – Analysis and Adjustment

Vegetation Resources Inventory Procedures and Standards for Data Analysis
Attribute Adjustment and Implementation of Adjustment in a Corporate Database
Version 2.0, March 2004

Monitoring

National Forest Inventory BC Change Monitoring Procedures for Provincial and
National Reporting Version 1.4, March 2005

Change Monitoring Inventory Ground Sampling Quality Assurance Procedures
Version 1.1, March 2002

Change Monitoring Inventory Ground Sampling Quality Assurance Standards
Version 1.1, March 2002

Photo Interpretation

Vegetation Resources Inventory Photo Interpretation Procedures Version 2.4,
March 2002

Appendix A

Attendance at Stakeholder Meeting

List of People Contacted

Jason Platzer –Babine Forest Products & Babine Timber Ltd.

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Based on list provided by the District identifying major licensees in the TSA.

Attendance at Stakeholders' Meeting

Participant	Affiliation
Jason Platzer	Babine Forest Products & Babine Timber Ltd
Ross Hyam (for Alistair Schroff)	Burns Lake Community Forest
Bryan Jakebec	Canfor
Chris Hunter	BC Timber Sales
Jim McCormack	Canfor
Dick Nakatsu	MOFR
Brian Westgate	MOFR
Gary Johansen	MOFR (Forest Analysis Inventory Branch)
Will Smith	MOFR (Forest Analysis Inventory Branch)
Barry Elliott	MOFR
Sue McDirmid	MOFR
John Illes	MOFR
Garth O'Meara	MOFR
Alison Patch	MOFR

Appendix B

Glossary of Terms

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Glossary of Terms (From 14 March 2006 RISC Standard, VRI Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling)

Ground Sampling

Ground sampling is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. The sample polygons are selected proportional to their area from a sorted list. To accommodate the wide variety of resources, various types and sizes of sampling units (e.g., fixed and variable plots, transects) are used to make the measurements.

Inventory Unit

An inventory unit is the target population from which the samples are chosen. For management unit inventories, the unit is usually a TSA or TFL.

Land Cover Classification

The BC Land Cover Classification Scheme (BCLCCS) was designed specifically to meet the requirements of the VRI, in addition to providing general information useful for “global vegetation accounting” and “integrated resource management.” The BCLCCS is hierarchical and reflects the current state of the land cover (e.g., presence or absence of vegetation, type and density of vegetation) and such fixed characteristics as landscape position (i.e., wetland, upland, alpine). There are two main classes of polygons: Vegetated and Non-Vegetated.

Management Unit.

A management unit is an administrative area used for inventory reporting purposes. The most common inventory units are TFLs and TSAs. However, forest districts or provincial parks could also be considered as inventory units if they were identified as areas of interest for reporting purposes.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume from the ground sampling, where net tree volume is estimated from the VRI net factoring process and taper equations. The factors account for hidden decay and possible taper equation bias. Sampling involves detailed stem analysis of sample trees to calculate actual net volume. The actual net volume is compared to the estimated net volume.

Photo Interpretation

Photo-interpretation involves the subjective delineation of polygons and the photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs are most often used in the photo-interpretation process.

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Post-Stratification

Post-stratification involves the division of an inventory unit into mutually exclusive sub-populations (strata) after ground sampling has been completed. Samples that fall in each post-stratum are analyzed separately, and the results may be applied to the corresponding population post-strata to improve the precision of the inventory's overall averages and totals. In the VRI, these strata (leading species) are usually pre-defined in the sample selection phase.

Pre-Stratification

Pre-stratification involves the division of an inventory unit into mutually exclusive sub-populations (strata) before ground sampling to provide estimates for specific areas, or to increase the confidence in the overall estimates by considering the special characteristics of each stratum.

Sample

A set of sampling units selected randomly to represent a population.

Sample Size

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet the target precision. The current sampling error requirements for a management unit is +/- 10% at the 95% level of probability.

Sampling Unit

The smallest indivisible unit in the population that is eligible for sample selection.

Statistical Adjustment

Statistical adjustment is the application of adjustment factors, computed from a random sample, to adjust timber attributes.

Sub-unit

A sub-unit is a small area or stratum of interest within an inventory unit such as a TSA or a TFL

Target Population

The population is the portion of a forest district, TFL, or TSA, for which statistical estimates are required. For instance, in a TSA where vegetated treed, vegetated non-treed, and non vegetated polygons are delineated, the target population may be only the vegetated treed (VT) polygons.

Target Sampling Error

Is the precision we expect a sample of a given sample size to produce. This precision depends on confidence we wish to place on a sample and the variability (CV) within the population.

Vegetation Resources Inventory (VRI)

The VRI is the MOFR standard for assessing the quantity and quality of BC's vegetation resources. The VRI process is designed to include a flexible set of sampling procedures for collecting vegetation resource information. The VRI is essentially a toolbox of procedures, which include:

- *Photo Interpretation*: the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground Sampling*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes.
- *NVAF Sampling*: Stem analysis sampling of individual trees for net volume adjustment.
- *Statistical Adjustment*: the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

The VRI can be deployed over a management unit measuring selected resources in specific portions of the landbase. The VRI sampling process produces spatial and non-spatial databases that can be used in multiple resource management applications including timber, ecosystem, and wildlife habitat management.

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Appendix C

VSIP Approval Signature Page

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Lakes Timber Supply Area Vegetation Resources Inventory Strategic Inventory Plan Approval

It is the intention of The Ministry of Forests and Range (MOFR), Forest Analysis and Inventory Branch to implement the Lakes TSA Vegetation Resources Inventory Strategic Inventory Plan (VSIP), prepared by Nona Phillips Forestry Consulting and dated September 1, 2006, as described.

I have reviewed the Lakes TSA Vegetation Resources Inventory Strategic Inventory Plan in consultation with MOFR staff, and have concluded that it meets current Vegetation Resources Inventory Standards and MOFR business needs.

Jon Vivian, R.P.F.
Manager
Vegetation Resource Inventory
Forest Analysis and Inventory Branch
Ministry of Forests and Range

Date