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**Fort St. John Forest District  
Vegetation Resources Inventory  
Strategic Implementation Plan**

Prepared for

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## Executive Summary

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the activities and products needed to address the forest management issues identified by stakeholders in the Fort St. John Forest District. The Ministry of Forests and Range (MoFR) Forest Analysis and Inventory Branch prepared the 1999 version of this VSIP following meetings with key forest inventory stakeholders. The updated 2006 version of the VSIP reflects the current views of stakeholders and the most up-to-date VRI standards.

The intent of the VSIP is to guide the coordinated VRI Project Implementation Plans (VPIP). The VPIP documents specific operational activities associated with implementing the photo-interpretation or ground sampling activities identified in the VSIP.

The stakeholders in the Fort St. John Forest District chose to pursue the following VRI activities and products:

1. Undertake a photo-interpreted estimates inventory to provide spatial data to support timber, ecosystem, habitat, riparian, and other mapping applications that provide information for land management.
2. Undertake timber emphasis ground sampling to provide statistically valid estimates of timber volumes and other tree attributes to support the next timber supply review of the Fort St. John Timber Supply Area (TSA).
3. Undertake photo interpretation/ground sampling in mixed-species stands with spruce understory, to provide data that will support identification of these stands for wildlife and timber management.
4. Develop more reliable factors to account for decay in coniferous, pure deciduous, and mixed-deciduous stands using the VRI net volume adjustment factor (NVAF) sampling methodology.

We propose installing approximately 170 VRI Phase II timber emphasis plots (TEPs) and destructively sampling 100 NVAF trees. The total cost for photo-interpretation, ground sampling, and NVAF programs is estimated at \$6,136,300.



## Table of Contents

<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1 BACKGROUND .....	1
1.2 THE VEGETATION RESOURCES INVENTORY .....	1
1.3 VRI OVERRIDING PRINCIPLES .....	1
1.4 INVENTORY PLANNING .....	2
1.5 DOCUMENT OBJECTIVES .....	2
1.6 VRI HISTORY ON THE FORT ST JOHN FOREST DISTRICT .....	2
<b>2. BUSINESS CONSIDERATIONS .....</b>	<b>4</b>
2.1 FOREST MANAGEMENT ISSUES .....	4
2.2 VRI ACTIVITIES AND PRODUCTS .....	6
<b>3. INVENTORY PLAN .....</b>	<b>8</b>
3.1 OVERVIEW .....	8
3.2 PHOTO-INTERPRETED ESTIMATES INVENTORY .....	8
3.3 VRI GROUND SAMPLING PROGRAM .....	9
3.4 VRI PHASE II IMPLEMENTATION .....	11
<b>4. IMPLEMENTATION STRATEGY .....</b>	<b>12</b>
4.1 PRIORITIES .....	12
4.2 PROJECT IMPLEMENTATION PLANS .....	12
4.3 SCHEDULING .....	12
4.4 COSTS .....	13
<b>5. APPROVAL/SIGNING .....</b>	<b>15</b>
<b>APPENDIX A – GLOSSARY OF TERMS .....</b>	<b>16</b>
<b>APPENDIX B – FORT ST. JOHN PHASE I WORK COMPLETED TO NOVEMBER 2005 .....</b>	<b>19</b>

### List of Tables

Table 1. Forest management issues and the use of the VRI to address issues in the Fort St. John Forest District. ....	4
Table 2. Status and description of areas to be completed for Phase I .....	8
Table 3. Estimated costs for the VRI Phase I program in Fort St. John Forest District. ....	13
Table 4. Estimated costs for the VRI Phase II program in Fort St. John Forest District. ....	14

### List of Figures

Figure 1. Map of Fort St. John TSA with Project Areas .....	19
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## 1. INTRODUCTION

### 1.1 BACKGROUND

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the activities and products needed to address the forest management issues identified by stakeholders in the Fort St. John Forest District. The VSIP provides general strategic direction for implementing the VRI program across the District.

The Ministry of Forests (MOF) Inventory Branch<sup>1</sup> prepared the initial VSIP in 1999.<sup>2</sup> The 2006 version of the VSIP (this document) reflects the current views of stakeholders, as discussed in a meeting on March 16, 2006, and incorporates the most recent VRI methods and implementation standards.

### 1.2 THE VEGETATION RESOURCES INVENTORY

The VRI is the Ministry of Forests and Range (MoFR) forest inventory standard on public lands in BC. Where possible, forest licencees must use the VRI standard in their data package when preparing the submission for Timber Supply Review (TSR).

The VRI process consists of procedures for:

#### 1. Phase I - Photo-Interpreted Estimates

- Delineating and classifying vegetated polygons using the BC Landcover Classification Scheme (BCLCS).<sup>3</sup>
- Making initial estimates of the vegetation attributes within polygons.

#### 2. Phase II - Ground Sampling

- Collecting data related to trees; site, soils, plants, and succession; coarse woody debris; and range resources.
- Collecting data related to taper and decay estimation.

The VRI procedures provide spatial and non-spatial products for timber, ecosystem, and habitat management, provincial inventory reporting, and vegetation inventory.

### 1.3 VRI OVERRIDING PRINCIPLES

Implementation of the VRI is based on the following guiding principles:

- Inventory projects are implemented to satisfy business needs as defined in the VSIP and the VRI Project Implementation Plan (VPIP) documents. The VSIP identifies the forest management issues in a District and the VRI activities and products required to address those issues; the VPIP identifies the implementation of VRI activities (Section 2).
- VRI is implemented following approved VRI implementation standards.<sup>4,5,6,7</sup>

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<sup>1</sup> The MOF Inventory Branch is now called the Ministry of Forests and Range Forest Analysis and Inventory Branch.

<sup>2</sup> [http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa\\_vsips/ftstjohnfd\\_vri\\_vsip.pdf](http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa_vsips/ftstjohnfd_vri_vsip.pdf)

<sup>3</sup> Technical VRI terms are defined in a glossary in Appendix A.

#### 1.4 INVENTORY PLANNING

The VRI planning process involves developing a VSIP and VPIP that identify resource-specific management issues, desired inventory products, and priorities. Both documents seek to ensure that VRI products address important issues in priority areas, and support resource-specific management interpretations that address forest management issues. This planning process defines the baseline inventory product needs, ensures that the right baseline products are selected to meet a range of applications, and achieves efficiencies in the delivery of the desired inventory products. Coordinated inventory planning also maximizes the value of the inventory data produced over issue areas by ensuring that the VRI products are useful for addressing more than one resource issue.

The District stakeholders can use this VSIP to prepare the ground sampling VPIP. The VPIP is a working document that details the specific operational activities associated with implementing and documenting the inventory activities identified in the VSIP. The VPIP identifies the project geographic areas, priorities, plot location coordination, inventory costs by year, and roles and responsibilities for implementation.

The stakeholders develop criteria for setting priorities among the VRI activities and products identified in the VSIP.

#### 1.5 DOCUMENT OBJECTIVES

This VSIP documents the strategic implementation of the VRI program in the Fort St. John Forest District in the Northern Interior Forest Region. It was developed in 1999 following consultation with District stakeholders who identified inventory needs and priorities. It was updated in 2006 and incorporated the input of stakeholders including the MoFR (Branch, Region, and District staff), BC Timber Sales, and the Timber Supply Area (TSA) licencees. This VSIP:

- Defines the strategy for the VRI program in the Fort St. John Forest District;
- Identifies the inventory activities required to produce the desired inventory products;
- Identifies approximate costs associated with each program phase; and
- Outlines a proposed implementation strategy.

The current document requires the approval of the Director of the Forest Analysis and Inventory Branch, and the Fort St. John stakeholders' representative.

#### 1.6 VRI HISTORY ON THE FORT ST JOHN FOREST DISTRICT

The 1999 version of the VSIP reflected the forest management priorities and VRI standards at the time. However, given the changing inventory methods and standards since that time, the stakeholders determined that it was necessary to update the VSIP to reflect current program activities.

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<sup>4</sup> [http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri-photointerp2k2/photo\\_interp2k2.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri-photointerp2k2/photo_interp2k2.pdf)

<sup>5</sup> <http://ilmbwww.gov.bc.ca/risc/pubs/teveg/photoestimation/assets/retrofit.pdf>

<sup>6</sup> [http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_gs\\_2k4/vri\\_gs\\_2k4.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_gs_2k4/vri_gs_2k4.pdf)

<sup>7</sup> [http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf2k4/nvaf\\_2k4.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf2k4/nvaf_2k4.pdf)



The Phase I VPIP was completed in November 2005 and documented the proposed Phase I activities for each of the six geographic units.<sup>8</sup> As of March 2006, the Phase I has been completed in three of these six units (the Halfway-Graham, Sikanni, and Blueberry units). Photo-interpretation used scanned 1:40,000 black & white Terrain Resource Information Management (TRIM) II aerial photography, while mapping was done in the Softcopy environment using TRIM II as a base.

The Phase I program for the three remaining units (the Milligan, Kahntah and MK-Sikanni units) should be completed by March 2008. The Phase I for the Milligan unit is already under contract and will be completed by March 2007. The Kahntah and MK-Sikanni have been awarded in 2007 and are anticipated to be completed by March 2008. Appendix B contains a map of the District showing the current status of the Phase I program.

Along with the Phase I inventory, bio-terrain mapping is being done to Terrestrial Ecosystem Mapping (TEM) standards. The bio-terrain delineation should be seamless with the VRI delineation in order to provide a foundation inventory to support future Predictive Ecosystem Mapping (PEM).

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<sup>8</sup> FDI Forest Dimensions Inc. and Canadian Forest Products Ltd. 2005. Fort St. John TSA Vegetation Resources Inventory Project Implementation Plan. November 28, 2005. 10pp.

## 2. BUSINESS CONSIDERATIONS

### 2.1 FOREST MANAGEMENT ISSUES

Priority forest management issues initially identified by stakeholders in the 1999 VSIP were reviewed and updated at the March 16, 2006 stakeholders meeting. The comments on the status of each issue are identified in the Remarks 2006 column in Table 1.

For each identified issue, the stakeholders identified whether the photo-interpreted or ground sampling programs could address the particular management issues. However, the table does not show the relative importance of these various issues. For example, a statistically accurate timber volume estimate may carry more weight than all other issues combined. In this case, the contribution of the VRI ground sampling will be quite significant.

Table 1. Forest management issues and the use of the VRI to address issues in the Fort St. John Forest District.

Issue <sup>9</sup>	VRI		Remarks 1999	Remarks 2006
	Photo-Interpreted Estimates	Ground Sampling		
1. Slope and terrain hazard mapping for ESAs: complete prior to next analysis.	Available	Available	Estimation phase data could be used by interpreters of terrain stability. Ground sampling will have a partial impact on slope stability as the ground sampling data will provide a check and act as an audit of the maps.	Not completed. Information is available and would need to be extracted. Would require a secondary project to get stability information.
2. Pre-inventory analysis, re-inventory: determine deficiencies in existing inventory.	Not Available	Not Available	A draft report has been completed (April 1997).	No change. No need to pursue further because VRI will replace former inventory.
3. Utilization standards for deciduous: re-examine prior to next analysis.	Not Available	Not Available		No change
4. Decay, waste, and breakage: develop better allowances, especially for deciduous stands.	Not Available	Available	Ground sampling (NVAF sampling) will provide information on decay. Estimates of breakage are not available.	No change
5. Unsalvaged losses: monitor salvaged and unsalvaged losses and develop estimates for deciduous stands.	Not Available	Not Available		No change
6. Unsalvaged losses from fire: examine prior to next analysis.	Not Available	Not Available		No change
7. Variability of inventory audit: determine sources of error.	Not Available	Available	Overall mature inventory was overstated by about 19%. Inventory audit results in the operable landbase need to be confirmed.	No need to pursue further because VRI will replace former inventory.
8. Roads, trails, and landings: monitor/reassess prior to next analysis.	Not Available	Available	Studies suggest that ground sample data may provide estimates for net downs for existing roads, trails and landings.	Can be measured from Phase I, but there are not enough samples to measure these attributes.

<sup>9</sup> BC Ministry of Forests, Timber Supply Branch. 1996. *Forest Management Issues Identified Through the AAC Determination Process, TSA/TFL Timber Supply Reviews: 1992-1996*. 31 December 1996. Victoria, BC. P.114. And BC Ministry of Forests, Fort St. John TSA Timber Supply Review Data Package. July 1997.

Issue <sup>9</sup>	VRI		Remarks 1999	Remarks 2006
	Photo-Interpreted Estimates	Ground Sampling		
9. LRMP: assess timber supply implications in next analysis.	Not Available	Not Available		No change
10. Regeneration delay and maintenance: solutions required.	Not Available	Not Available		No change
11. Recreation mapping and ESAs: complete new mapping and account for in future analyses.	Available	Available	The collection of ecological, soil, and slope stability data during ground sampling will assist in the confirmation of ESAs.	Ecology and soils information will not be collected in the Phase II program. This information will be collected as part of the bio-terrain project.
12. Alternative silviculture systems: incorporate into future analysis if systems become operational.	Available	Available	Improved inventory: estimation phase will provide layer information (vertical complexity) which can aid in assessing the impact of alternative silviculture systems on timber supply.	Spruce under aspen cannot be seen in Phase I but can be measured in Phase II.
13. Riparian, biodiversity, FENs, old growth, mature forest cover: clarify timber supply impacts and interactions.	Available	Available	<p>Photo-interpreted estimates should improve polygon delineation, provide better age class, stand structure, and vegetation attributes, and information on soil moisture and nutrient regimes to enhance the interpretation of FENs, riparian areas, seral stage and natural disturbance types interpretation.</p> <p>Ground sampling will provide overall district totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The reliability of the estimates obtained for these attributes will need to be evaluated based on natural disturbance types before comparisons to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data will be used to identify supplemental sampling needs.</p> <p>A new photo-interpreted estimates inventory is particularly important because of the age of the inventory in the District.</p>	No change. New inventory should identify these attributes.
14. Protect important ecosystems and habitats for red and blue listed species, key ungulates, and other regionally significant species.	Available	Available	<p>The VRI is needed to support mapping important ecosystems and habitats for red and blue listed species, key ungulate ranges, and other regionally significant species.</p> <p>The photo-interpreted estimates inventory provides a spatial inventory with attributes needed to support ecosystem and habitat mapping. Wildlife habitat mapping can not be accomplished without spatial data; these products are highly relevant to forestry planning. Ground sampling provides plant lists, forage production, and shrub transects, which can be used to support ecosystem and habitat mapping.</p>	PEM/TEM is the best tool for describing these attributes. PEM is being completed on the TSA.

Issue <sup>9</sup>	VRI		Remarks 1999	Remarks 2006
	Photo-Interpreted Estimates	Ground Sampling		
15. Landscape-level biodiversity: incorporate all guidelines, boundaries, objectives, and prescriptions, including designated landscape units and biodiversity emphases.	Available	Available	The VRI can provide supporting data, e.g., potential re-definition of "old growth" based on VRI stand structure and age attributes.	No change
16. Undertake ecosystem and habitat mapping and important areas analysis to assess and protect important ecosystems and habitats for red and blue listed species, key ungulates, and other regionally significant species.	Available	Available	VRI attributes are utilized in ecosystem and habitat mapping. This mapping needs to be supported after the VRI products are produced in order to address the identified forest management issues.	No change. VRI can be used along with TEM/PEM and/or projects specifically focused on habitat mapping.
17. Develop management practices to protect habitat. Work with Ministry of Environment to undertake appropriate forest management practices on important habitats and ecosystems.	Available	Available	Rationale for this statement is included in all of the above items. In particular, wildlife habitat spatial information provides a needed inventory-based approach for identifying critical areas and habitat features for wildlife and for use by forest managers to protect important ecosystems and habitats.	No change. The VRI and PEM can support development of management practices to protect habitat.
18. Forest Health, information might be needed in the future if the catastrophic health issues occur.	Available	Available		Mountain Pine Beetle is the only issue related to forest health. The current epidemic has only just started. The intended inventory will not address issues related to the current MPB infestation. However, some ground sampling methods could be implemented to assess the impact of change due to forest health if this becomes more of an issue in the future.
19. Oil and Gas exploration (i.e., Seismic lines and well sites)	Available	Available		Although this is an issue, seismic lines have been found to have little impact on timber supply as avoidance techniques have been used. Pipelines and well sites have been netted out of the inventory. If a Phase II plot lands on a seismic line, it will be sampled.

## 2.2 VRI ACTIVITIES AND PRODUCTS

The VRI activities and products that are needed to meet the forest management issues outlined in Table 1 are listed below:

1. Complete the photo-interpreted inventory for the District to provide spatial data to support the TSA timber inventory, habitat mapping, ecosystem mapping, riparian mapping, and other applications.
2. Undertake timber emphasis ground sampling in the TSA to provide spatial data, statistically valid timber volumes, and other tree attributes to support TSR.

3. Develop more reliable factors to account for decay and taper in coniferous, pure deciduous and deciduous mixed-woods stands using the NVAF sampling methodology.

Development of land management information from these VRI products includes (but is not limited to) the following post-inventory activities (not discussed in this VSIP):

- Timber supply analysis to support AAC determination.
- Ecosystem and habitat mapping to address ecosystem and habitat forest management issues.
- Seral stage mapping to provide estimates of coarse woody debris and other requirements described in the biodiversity guidelines.
- Standing inventory monitoring to provide a level of comfort to users that net merchantable volume remains accurate over time.

Note that the following information needs identified by the stakeholders are not addressed directly using the VRI procedures in this VSIP:

- Stagnation of pine stands is not accounted for in the growth models.
- Density (number of stems/ha) in openings may generally be over-stated.
- Area depletions due to seismic activity and well site activity.
- Base map information is inaccurate.
- OGSi - potential site index for spruce, pine, and aspen.
- Succession in mixed-species stands - growth and yield issue.

These needs could be addressed through other processes such as specialized inventory or research projects.

### 3. INVENTORY PLAN

#### 3.1 OVERVIEW

This section outlines plans for inventory activities needed to develop specific VRI products. It includes a description of the photo-interpretation program completed to 2005<sup>8</sup> as well as planned photo-interpretation activities to 2008. The inventory plan also includes a description of the ground sampling program, proposed for implementation following completion of the Phase I program. Table 2 describes the status of the Phase I program.

Table 2. Status and description of areas to be completed for Phase I

<b>Project Area</b>	<b>Area (ha)</b>	<b>Status</b>	<b>Approved</b>
Halfway-Graham	532,219	Completed March 2001	Yes
Sikanni-East	1,012,572	Completed March 2003	Yes
Blueberry	818,588	Completed March 2006	No
Milligan	1,164,817	Completed March 2007	No
Kahntah	848,853	Scheduled for Completion March 2008	N/A
MK-Sikanni	298,381	Scheduled for Completion March 2008	N/A

#### 3.2 PHOTO-INTERPRETED ESTIMATES INVENTORY

##### 3.2.1 Objective

The objective of this inventory is to improve the polygon delineation and estimation in the Fort St. John Forest District, especially in areas where specific management issues occur (e.g., deciduous stand types). Improvements are in terms of bringing the inventory up to date and to the current VRI standards and specifications. This process requires the collection of information on aspects of the land base that were not priorities in the past for timber and non-timber values. The VRI product is a spatial database consisting of unadjusted photo-interpreted estimates.

##### 3.2.2 Target Area

The target area for the photo-interpretation is the entire Fort St. John Forest District. To date, 100% of the TSA has been completed to VRI standards or is currently in progress (Appendix B).

Through the process of Phase I implementation, the stakeholders have identified priority strata (i.e., coniferous, deciduous, and deciduous mixed-wood)<sup>10</sup> and geographic areas, and developed a photo-interpretation schedule. In setting priorities, the stakeholders have considered operating areas, areas with aerial photo coverage, management issues, and important landscape units.

##### 3.2.3 Target Attributes

The target attributes for this inventory are all the attributes listed on the VRI photo-interpreted estimates attribute form. All attributes have and will be interpreted to VRI photo-interpreted standards. Bioterrain estimates will be made to TEM standards to facilitate future PEM mapping. Attributes could include surfacial material, terrain texture, landform, surface shape and expression, and soil drainage.

<sup>10</sup> Determination of appropriate strata for adjustment purposes will be further reviewed in the Phase II VPIP and may include more than those mentioned.

### 3.2.4 Options

Photo-estimation and VRI retrofit of the TSA were options considered by stakeholders during development of the 1999 VSIP. To date, FDI Forest Dimensions Inc. has successfully won all project areas. FDI has completed these areas using Softcopy technology (digital photogrammetry) for the photo-estimation phase.

### 3.2.5 Implementation

A VPIP for the photo-interpreted estimates inventory was developed and updated in November 2005.<sup>8</sup> The photo-interpretation VPIP followed guidelines outlined in the MoFR document *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation*.<sup>11</sup> The photo-interpretation VPIP identified the attributes and delineation that needed to be improved. This involved:

1. **Completing background review:** The photo-interpretation VPIP reviewed background documentation including the state of the current inventory and documenting VRI processes. The photo-interpretation VPIP included a discussion of the attributes, delineation, and line transfer, a review of calibration data sources, existing photos, maps, and technology.
2. **Identifying the needs.** The photo-interpretation VPIP was developed to address the forest management issues and business needs identified in the 1999 VSIP. The 2005 photo-interpretation VPIP reflects current VRI methods, tools, and objectives required to complete the Phase I program.
3. **Program implementation by priority area within the TSA.** The Phase I program has and will be implemented according to the priorities deemed by the District stakeholders. Implementation has been prioritized based on management needs and defined project implementation units (e.g., landscape units, mapsheets, and supply blocks).

## 3.3 VRI GROUND SAMPLING PROGRAM

### 3.3.1 Overview

The VRI provides baseline spatial and non-spatial databases for the entire Forest District. The VRI ground sampling activities include Phase II ground sampling and NVAF sampling and will provide:

1. A basis for calculating unbiased overall averages and totals for timber and non-timber vegetation resources for the entire landbase in the District.
2. The initial conditions and locations for measuring changes and trends in the indicators of sustainable forest management at the TSA level.<sup>12</sup>
3. Baseline VRI data to aid development of ecosystem and habitat mapping products to address ecosystem and habitat management issues in forest land management.
4. Baseline data to support initiatives such as District biodiversity objectives and site index-BEC correlations.
5. The VRI plot locations can be used to measure a variety of other resources (e.g., range) and special projects. The plot locations are established in an unbiased way and are re-locatable to allow re-visits.

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<sup>11</sup> [http://ilmbwww.gov.bc.ca/risc/pubs/teveg/photostandards/assets/vri\\_photo\\_interp\\_standards.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/photostandards/assets/vri_photo_interp_standards.pdf)

<sup>12</sup> Criteria and indicators of sustainable forest management were defined by the Canadian Council of Forest Ministers (CCFM) in their 1995 report *Defining Sustainable Forest Management. A Canadian Approach to Criteria and Indicators* (Natural Resources Canada, Canadian Forest Service, Ottawa, Ontario. 22 pages).

### **3.3.2 Landbase**

The Fort St. John Forest District is located in the northeastern interior of the province, and includes the Fort St. John TSA and private land. The TSA covers about 4.7 million ha of which 24%, or about 1.1 million hectares, comprise the long-term timber harvesting landbase.

### **3.3.3 Ground Sampling**

The Phase II ground sampling provides the statistical framework for obtaining unbiased estimates of the overall totals and averages for timber resources in the District. The total number of VRI sample clusters will aim to achieve a minimum sampling error of  $\pm 10\%$  (95% probability) for net merchantable timber volume in the vegetated treed portion of the District (30 years and older) and allow for calculation of sampling errors for other VRI attributes.<sup>13</sup> VRI ground data will be collected to support information needs identified by the stakeholders.

The number of samples required to achieve the target sampling error is a function of the variation of the ratio between Phase I and Phase II net merchantable volumes within the inventory unit. The coefficient of variation (CV) is a measure of this variation. Based on an estimated CV of 65%, a sample size of 170 Phase II plots will be required to achieve the target sampling error. To achieve the VRI standard at a reasonable cost, Timber Emphasis Plots (TEP) will be installed at each location and could include data collection on some or all of the following data collection attributes, including coarse woody debris, range, and ecology.

Additional samples will be considered during development of the Phase II VPIP and will be based on:

1. The business need to reduce the sample error;
2. The business need to collect more information in the Deciduous mixed-wood population; and
3. The funding available during Phase II implementation.

### **3.3.4 NVAF Sampling**

NVAF sampling is a component of the VRI program. NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. 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 estimate net volume is obtained from net factoring and taper equations).

### **3.3.5 Statistical Analysis**

Statistical analysis is the process of adjusting the photo-interpreted estimates using the ground sampling observations. The purpose of the analysis is to obtain overall averages and totals for the District that are statistically unbiased, and to adjust the photo-interpreted estimates to obtain individual polygon values. Statistical analysis includes two steps:

1. Statistical estimation of overall values. These values include totals and averages for continuous attributes for the District.
2. Statistical adjustment of polygon values. This is the process of assigning values to individual polygons such that their total for the District matches that obtained in Step 1.

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<sup>13</sup> Samples will likely be weighted 80:20 to the operable:inoperable landbase.



### 3.4 VRI PHASE II IMPLEMENTATION

#### 3.4.1 Overview

To achieve the VRI objectives, sampling should be implemented over the target population using a two-step process. This process can be done as follows:

- Step 1: install approximately 60 sample clusters over the target population and compile an interim analysis to calculate the remaining number of samples required to meet the precision target of  $\pm 10\%$  (95% probability) for net merchantable volume in the target population.
- Step 2: install the remaining sample clusters as needed

#### 3.4.2 Implementation Process

The implementation process could proceed as follows:

1. Prepare a Phase II VPIP, following the most recent Phase II VPIP standards.
2. Assemble all polygons within the District into one list; check to ensure no areas are missing or double counted.
3. Identify polygons that are in the target population (Vegetated Treed, 30 years and older). The list of polygons in the target population represents the sampling frame.
4. Stratify the population by criteria of interest. These criteria should most likely be operable/inoperable areas, age class, site productivity, and volume class.
5. Determine sample allocation within each stratum.
6. Select sample locations using a two-step process. First, select sample polygons within the sampling frame using probability proportional to size with replacement (PPSWR), using polygon area as the size measure. Second, select a random point within each sample polygon. This point is the sample location. Determine which samples will be NVAF-enhanced.
7. Prepare sample packages.
8. Locate and measure ground sample clusters.
9. Monitor quality assurance of field data and procedures during field sampling.
10. Submit Phase II plots to the MoFR VRI contact.
11. Compile the Phase II data
12. Complete the interim analysis to determine the remaining number of samples required to achieve the stated desired precision. Prepare NVAF tree sampling matrix.
13. Review the strata results and determine whether further sampling is required.
14. Begin NVAF stem analysis.
15. Monitor quality assurance of field data and procedures during NVAF sampling.
16. Compile all data.
17. Complete the statistical adjustment and report on the results
18. Submit results to the MoFR VRI contact.

## 4. IMPLEMENTATION STRATEGY

### 4.1 PRIORITIES

During the March 16, 2006 conference call, the stakeholders identified the following implementation priorities:

1. Continue with the program established in the November 2005 Phase I VPIP. This is expected to be completed in 2008.
2. Develop the Phase II VPIP to define Phase II sampling priorities.<sup>14</sup> This will occur during the 2007/2008 fiscal year.
3. Implement Phase II ground sampling program on the TSA upon completion of the Phase I. This will be completed in the 2008/2009 fiscal year.
4. Sample Deciduous mixed-wood stands with spruce understory. More information will be provided in the Phase II VPIP, including the number of plots required to support this information need.
5. Implement NVAF sampling to check decay estimates in coniferous and deciduous species, upon completion of the NVAF enhancement and tree selection.

### 4.2 PROJECT IMPLEMENTATION PLANS

The Phase II VPIP will be based on this VSIP. The Phase II VPIP will identify inventory activities, priority geographic areas, projected costs, and roles and responsibilities for implementation.

### 4.3 SCHEDULING

The VRI ground sampling in the District could be achieved as follows:

1. Review VSIP and build Phase II program to reflect the stated business needs.
2. Define the Phase II sample and target populations, strata, and sample size.
3. Select the Phase II polygons for the entire District. Identify Phase II plots that will be enhanced to populate the NVAF tree matrix.
4. Select plot locations within each polygon using a GIS.
5. Incorporate this information into the Phase II VPIP. Submit VPIP to MoFR contact for review and approval prior to commencing the field program.
6. Hire VRI-certified TEP ground samplers and qualified auditor to implement the field program.
7. Implement the Phase II field program, including data entry, core counting and GPS post-processing.
8. Audit approximately 10% of the TEPs.
9. Complete an interim analysis of the Phase II results. Determine the sample size, should more plots be required.
10. Install the remaining Phase II plots, including completing an audit on approximately 10% of the remaining plots.

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<sup>14</sup> Following the meeting, Canfor has decided to implement the Phase II program in the 2007-08 fiscal year assuming that the Phase I is complete. The first step in this process is to develop the Phase II VPIP.

11. Hire NVAF-certified ground samplers and qualified auditor for the NVAF program.
12. Implement the NVAF program.
13. Complete Phase II analysis and statistical adjustment of the Phase I estimates.
14. Complete NVAF analysis.
15. Report on the results of the statistical adjustment and the NVAF analysis.
16. Submit all plot data (Phase II and NVAF) to MoFR for data storage.

#### 4.4 COSTS

Estimated costs for the ground sampling inventory activities proposed in this VSIP are given in Table 2 (Phase I) and Table 4 (Phase II). The cost of the entire VRI program is projected to be approximately \$6,136,300. Of this, the total cost of obtaining photo-interpreted estimates for the District is approximately \$5,536,300.

Table 3. Estimated costs for the VRI Phase I program in Fort St. John Forest District.

VRI Phase I Program	New Photos	Photo- Interpretation	Total
<b>Completed to 2005</b>			
▪ VPIP (Phase I)		\$11,300	
▪ Halfway -Graham (2001)		\$685,000	
▪ Sikanni (2003)		\$1,120,000	
<i>Sub-total</i>			1,816,300
<b>2005/2006 Program</b>			
▪ Blueberry (March 2006)		\$672,000	
▪ Milligan	\$172,000	\$293,000	
<i>Sub-total</i>			\$1,137,000
<b>Projected Costs (2006/08)</b>			
▪ MK-Sikanni		\$470,000	
▪ Milligan		\$643,000	
▪ Kahntah	\$120,000	1,350,000	
<i>Sub-total</i>			\$2,583,000
<i>Program Total</i>	\$292,000	\$5,244,300	\$5,536,300

The proposed Phase II program cost is a function of the number of Phase II plots and NVAF trees required to meet the business needs of the stakeholders. The proposed costs identified in Table 4 are for program budgeting and will be updated in the VPIP to better reflect the proposed program and the associated costs. The proposed Phase II program cost (\$600,000) is approximately 37% of the program cost proposed in the 1999 VSIP (\$1,680,500).

Table 4. Estimated costs for the VRI Phase II program in Fort St. John Forest District.

VRI Tool	No. Samples	Est. Cost/Sample	Total
Develop VPIP			\$10,000
Develop Sample Packages			\$10,000
Timber Emphasis Plots	170	\$2,000	\$340,000
NVAF (trees)	100	\$600	\$60,000
Quality assurance (10% field costs)			\$40,000
Helicopter costs (25% field costs)			\$100,000
Interim analysis & statistical adjustment			\$20,000
NVAF analysis & program report			\$20,000
<i>Total</i>			<i>\$600,000</i>

### 5. APPROVAL/SIGNING

I have read and concur with the Fort St. John Forest District VRI Strategic Inventory Plan, dated March 31, 2007. 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 this plan or more detailed plans need to be reviewed and approved by the signatories.

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*Jon Vivian, R.P.F. Manager,*

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*Date*

*Vegetation Resources Inventory Section,  
Forest Analysis and Inventory Branch,  
Ministry of Forests and Range*

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*Fort St John TSA Representative*

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*Date*

## APPENDIX A – GLOSSARY OF TERMS

### 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. The inventory unit could be the Forest District, which includes the timber harvesting landbase, parks, recreational areas, private, and federal lands. The inventory unit could also be a subset of the Forest District that focuses on a geographic area or specific attribute set, depending upon the sampling objectives.

### Landcover Classification

The BC Landcover Classification Scheme (BCLCS) 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 BCLCS is hierarchical and reflects the current state of the landcover (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 VRI

Management VRI are specialized inventories that provide more detailed information required for specific resource management, i.e., day-to-day forest management. One or more VRI sampling procedures may be used for management inventories. Management inventories may focus on specific resource types (timber, range, ecology), geographic areas (e.g., landscape unit, TFL), attribute sets (e.g., Douglas-fir leading stands, age class 4+). They may use one or more of the following tools (e.g., photo-interpreted estimates, ground sampling, NVAF sampling).

### National Forest Inventory (NFI)

The NFI provides information on Canada’s resources across all provinces and allows the Federal Government a consistent framework for reporting on Canada's inventory. The inventory unit for the NFI is the entire country, although it is implemented province-by-province.

### Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. 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 estimate net volume is obtained from net factoring and taper equations).

## Photo-Interpreted Estimates

Photo-interpreted estimates inventory involves the subjective delineation of polygons and the photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs (1:15,000) are most often used in the photo-interpreted estimates inventory. However, if the existing photo-based inventory is acceptable, the database can be translated into VRI format and upgraded to include the additional VRI attributes.

## 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 are applied to the corresponding population post-strata to improve the precision of the inventory's overall averages and totals.

## 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.

## Retrofit

Retrofitting is the process of translating and upgrading an existing photo-based inventory to VRI standards. If the polygon linework and attributes are of acceptable quality, the existing FIP (Forest Inventory Planning) databases are translated to VIF (Vegetation Inventory Files) databases and the additional attributes required by the VRI are re-estimated from the aerial photographs.

## 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.

## Statistical Analysis

Statistical analysis is the process of adjusting the values of the photo-interpreted estimates variables using the ground sampling observations. For each sampled polygon, the ground observations are compared to the photo-estimated values to develop an adjustment factor. This factor is then applied to all polygons in the photo-interpreted estimates database to produce the final adjusted database.

## Sub-unit

The term sub-unit describes the inventory unit of a management inventory (i.e., the management inventory target population is a subset of the VRI inventory unit). A sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the Forest District.

## Target Precision

Target precision expresses the amount of variation in key attributes (e.g., timber volume) desired in the final results. The target precision, usually expressed as the coefficient of variation (CV), is used to calculate the minimum sample size for subsequent ground sampling.

## Vegetation Resources Inventory (VRI)

The VRI is an improved vegetation inventory process 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-interpreted estimates*: 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.
- *WPV Sampling*: Intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *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 the entire province measuring timber and non-timber resources, or over a large 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.

## Within Polygon Variation (WPV) Sampling

WPV sampling provides information for expressing the true individual polygon error, assessed as the difference between the adjusted polygon value and the "true" value for that polygon. The "true" value for the polygon is an estimate derived from a small sample of polygons that are intensively sampled on the ground.



### APPENDIX B – FORT ST. JOHN PHASE I WORK COMPLETED TO NOVEMBER 2005

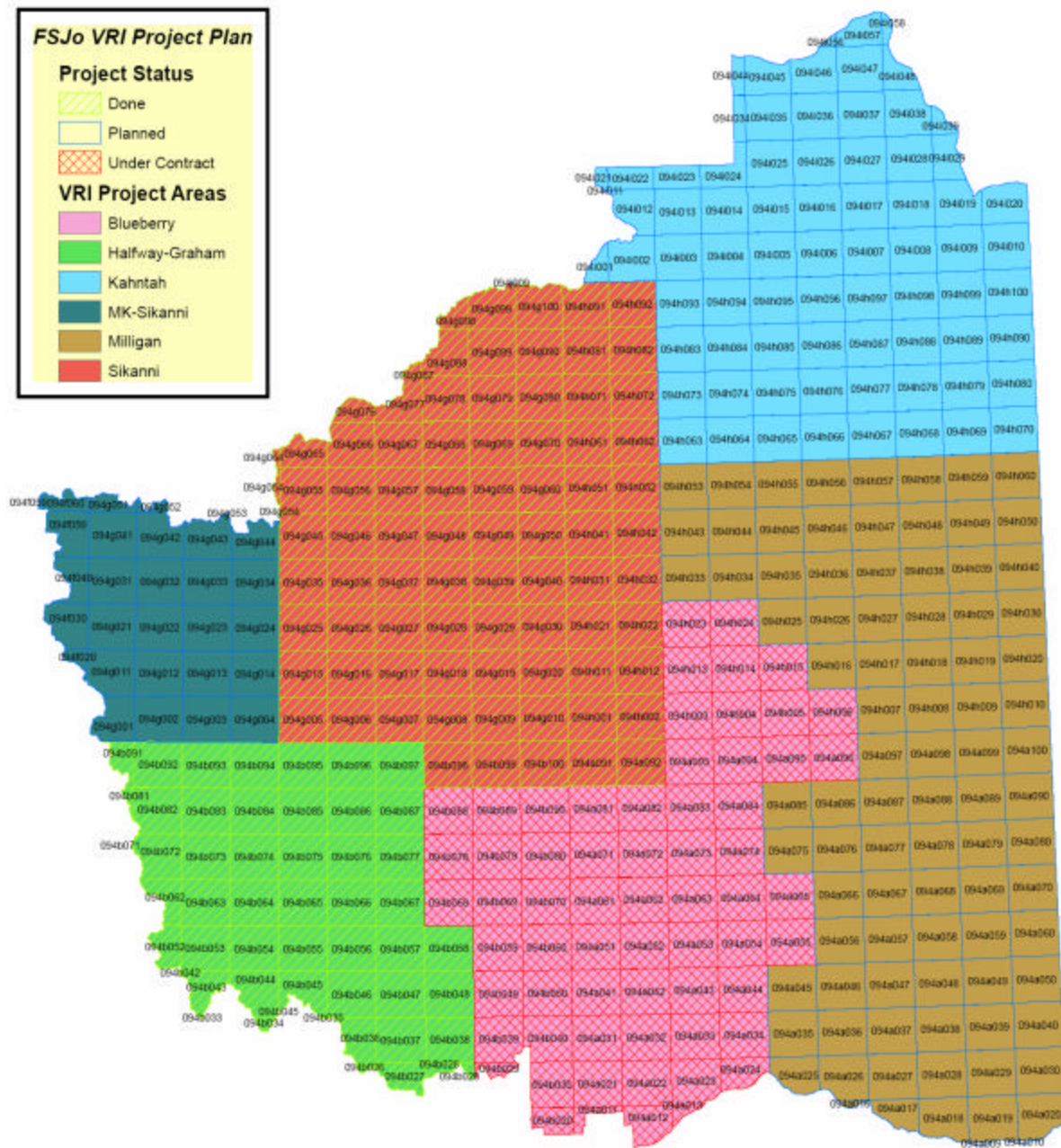


Figure 1. Map of Fort St. John TSA with Project Areas<sup>8</sup>