# Okanagan TSA VRI Phase II
# Ground Sampling Pilot
## Project Implementation Plan

*Prepared for*

*Okanagan Innovative Forestry Society*

Project: OKI-002

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# 1. INTRODUCTION

## 1.1 BACKGROUND

This Vegetation Resource Inventory (VRI) Project Implementation Plan (VPIP) outlines the proposed Phase II timber emphasis ground sampling activities in the Okanagan Timber Supply Area (TSA).[1] The priority is to sample the Vegetated Treed portion of the operable land base within the Vegetated Treed (VT) land base. This VPIP was developed using the direction identified in the Okanagan TSA VRI Strategic Inventory Plan (2002 update) produced by the Okanagan Innovative Forestry Society (OIFS).[2]

The intent of this project is to provide the Kamloops Regional Manager with a reasonable level of confidence that the existing overall forest-cover inventory volume is appropriate for use in timber supply analysis. This analysis will be completed by September 2002 to support the application by the OIFS for an allowable annual cut (AAC) increase in the fall of 2002. This project is also designed so that ground sampling data can be used to statistically adjust a VRI Phase I (if it is completed in the near future).

This project is a pilot because there are planned modifications to the current VRI standards that will be tested in cooperation with the Ministry of Sustainable Resource Management (MSRM).[3] These modifications are designed to increase the efficiency of sampling by providing more information for the same cost as previous methods. These modifications are described in Appendix II and include:

- Selecting sample polygons using a minor adjustment to the PPSWR (probability proportional to size and with replacement) method.
- Adding four count plots to increase the cluster to nine sample points in the IDF.
- Measuring all auxiliary's on all plots.
- Tallying dead trees on all plots.
- Enhancing two auxiliaries in clusters identified for net volume adjustment factor (NVAF) sampling.
- Changing the compilation procedures to reflect the new plot methods.

## 1.2 REPORT OBJECTIVES

The objective of this report is to outline the process for implementing the timber emphasis VRI activities in the Okanagan TSA. This report is for use by the OIFS as a guide to completing the planned ground sampling in a timely and cost-effective manner.

## 1.3 TERMS OF REFERENCE

JST prepared this report under contract to the OIFS coordinated by Glen Dick, *RPF*. The team from J.S. Thrower and Assoc. Ltd. preparing this plan was A.Y. Omule, *PhD RPF,* Gord Lester, *RPF*, Karen Gelowitz, *BNRSc*, Hamish Robertson, *RPF,* Guilaume Therien, *PhD,* and Jim Thrower, *PhD, RPF.*

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[1] A glossary of terms is given in Appendix I.

[2] J.S. Thrower & Associates Ltd. 2002. Okanagan TSA Vegetation Resources Inventory Strategic Inventory Plan (2002 update). Contract report prepared for the Okanagan Innovative Forestry Society by J.S. Thrower & Associates Ltd. April 2002. 22 pp.

[3] Proposed amendments to VRI procedures were discussed with Lloyd Wilson, *RPF* (MSRM) and Hamish Robertson, *RPF* , Jim Thrower, *PhD RPF,* and Karen Gelowitz, *BNRSc* of J.S. Thrower & Associates Ltd (JST) on April 24, 2002. A conference call was held with Jon Vivian, *RPF,* Sam Otukol, *PhD RPF,* and Lloyd Wilson (all of MSRM) and Jim Thrower, Guillaume Thérien, *PhD* and Hamish Robertson of JST on April 26, 2002. The amendments were approved by the MSRM during these conference calls.

# 2. TIMBER EMPHASIS GROUND SAMPLING PLAN

## 2.1 OVERVIEW

This section summarizes the most important elements of the ground sampling plan, including objectives, sample size, and sampling approach. These elements were developed from the VSIP[2] and from recent developments in methods and discussions with MSRM staff.

## 2.2 OBJECTIVE

The objective of the Phase II sampling is to install an adequate number of timber emphasis plots (TEPs) to achieve a sampling error of ±15% (95% probability) for overall net timber volume[4] in the operable VT area of the TSA. This project is designed to achieve the target sampling error given reasonable estimates of stand variation and achieved sample plots; however, sampling error will depend on the variation in the sampled stands and the actual number of plots installed.

## 2.3 TARGET POPULATION

The target population is the Crown VT landbase (which approximates the productive forest landbase [PFLB] in the TSA). Sampling during the 2002 field season will focus on the operable VT landbase in polygons greater than 20 years of age.

## 2.4 NUMBER OF SAMPLE POINTS

The target is to install up to 140 TEPs. These plots will be randomly distributed over the TSA, thus all points will have same probability of selection and equal sampling weights. The plots will be installed in two batches. The first batch is 110 plots and is planned for completion by the end of the second shift. The size of the second batch will be determined by the number of plots that can be completed with the remaining budget.

## 2.5 MEASUREMENTS

The project priority is to measure the timber attributes at each plot. We will also include timber measurements over-and-above the VRI standard, and a modified version of the site series and succession interpretation. These measurements will be based on the current version of the *Vegetation Resources Inventory Ground Sampling Manual*.[5] Certified crews will gather the data using VRI Card Types 1, 2, 3, 8, 9, 10, 11, 12, and 16.[6]

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[4] The net volume is computed using a 12.5 cm diameter limit for pine and 17.5 cm+ for other species with less stumps, tops, decay, and waste.

[5] The VRI ground sampling procedures are available on the internet at: http://www.for.gov.bc.ca/RIC/Pubs/teVeg/gsp/index.htm

[6] Cards 12 and 16 provide ecology and succession data and will be collected once the timber emphasis data objectives have been completed. This information will be used for OIFS purposes only, and will not be part of the audit process. Biogeoclimatic (BGC) subzone and site series information will be collected on card 12.

### 2.6 SAMPLE SELECTION

A list of 550 potential sample points will be selected from the target landbase defined by the FIP files used in the recent Type II silviculture analysis for the TSA.[7] This will provide enough potential sample points for future flexibility should the OIFS or other agencies want to add to this Phase II sample. The samples for this project are then the first 140 in this list.

The current approach is to use the stratified PPSWR with proportional allocation, as mandated by the MSRM. We plan to modify this procedure slightly by stratifying by BGC zone and volume class rather than leading species and volume class. The selection proceeded is (Appendix II):

1. Stratify the VT target population into five strata by BGC zone (ESSF, ICH, IDF, MS, and Others [BG, PP, and AT]).
2. Create three sub-strata based on total polygon volume in each BGC zone stratum (low, medium, and high volume).
3. Allocate samples to BGC strata and substrata proportional to their area.
4. Apply PPSWR to each sub-stratum.[8]

Appendix III provides the list of sample polygons. BGC subzone and leading species comparisons for the sample plots and sample population are provided in Appendix IV.

### 2.7 BATCHES

The sample will be completed in two batches. The goal is to complete the first batch of 110 plots in the first two shifts. These plots will provide the sample frame for the NVAF program. The NVAF sampling will begin following completion of the TEP sampling from the first batch. The size of the second batch will depend on the available budget remaining. The goal is to install as many additional plots within the limit of the budget.

### 2.8 ENHANCEMENT FOR NVAF SAMPLING

Thirty (30) TEPs will be pre-selected from the first batch and enhanced for NVAF sampling during TEP installation.

### 2.9 FIELD ACTIVITIES

#### *2.9.1 Field Crews*

Two crews from each of Drake Forestry Services, Timberline Forest Inventory Consultants Ltd., and JST will install all TEPs. There will be at least one VRI-certified cruiser on each crew. Field operations will begin May 21 and scheduled completion is the second week of July. Delays in field operations caused by errors in the inventory data or poor access from high snow levels may compromise our ability to complete the project on time.

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[7] Timberline Forest Inventory Consultants Ltd. 2002. Okanagan Innovative Forestry Practices Agreement Type 2 incremental silviculture analysis. Information package. Contract report prepared for Tolko Industries Ltd. and the Okanagan Innovative Forestry Society. March 2002. 47 pp.

[8] Note that changes in polygon boundaries due to a new Phase I will not introduce bias to this sample selection process since every point in the target population has an equal chance of being selected.

### *2.9.2 Mentoring & Auditing*

Norm Shaw, *ACE* (Norm Shaw and Associates) will be the lead mentor assisted by Verne Sundstrom, *RPF ACE* of the MSRM. All crews will be in the field on May 21 for a field mentoring session. The mentors will work with the field crews in the days following the mentoring session and provide quality control on their initial plots.

Norm Shaw will audit approximately 10% of the plots following the *VRI Ground Sampling Quality Assurance Standards.*[9] Auditing will be done by batch, and failed plots may result in a failed batch. Crews may be required to revisit failed plots at their own expense.

### *2.9.3 Core Counting*

Tree age from sample cores will be counted by the consultant completing the fieldwork. Ages will be counted in the lab using a microscope and will be sent to the project manager (Hamish Robertson of JST) with the validated field data from each batch.

### *2.9.4 Data Entry*

Each consultant will enter their own plot data into VIDE (VRI data entry program) and provide validated data to the project manager. Data from the first and second shifts are due by June 21 and data from the second batch are due by July 5. Global Positioning System (GPS) data will be post-processed by the contractors, entered into VIDE, and delivered with the data to the project manager on these dates. Timely data transfer is critical to meet the OIFS timelines for this project.

[9] Minimum standards for VRI sampling are located on the internet at:
http://srmwww.gov.bc.ca/risc/PUBS/TEVEG/VRI QA/VRI_Ground_Sampling_2K2/QA Standards for VRI-02.pdf

# 3. NET VOLUME ADJUSTMENT FACTOR SAMPLING

## 3.1 OVERVIEW

This section summarizes the most important elements of the NVAF sampling plan, including objectives, sample size, and sampling steps. They are extracted from the Okanagan VSIP[2] and presented here for easy reference.

## 3.2 OBJECTIVE

The objective is to complete stem-analysis sampling to derive NVAFs to adjust the cruiser-called net volume to account for hidden decay, waste, and taper equation bias.

## 3.3 NUMBER OF SAMPLE TREES

A target of 95 trees (including five dead) will be selected from 30 sample points (seven immature stands [<100 years old] and 23 mature stands). These trees will be destructively sampled and measured for actual net merchantable volume (Table 1). The 30 sample points are a subset of the TEPs[10] and enhanced by the TEP crew to create a tree list from which to sample. The sample list will be provided by May 20, 2002, once final details can be confirmed with Will Smith, *RPF* (MSRM).

Table 1. Minimum number of NVAF sample locations and trees.

| Leading Species | Locations | Live Trees | Dead Trees | Total Trees |
|---|---|---|---|---|
| VT – Mature | | | | |
| Cedar-hemlock | 4 | 20 | 2 | 20 |
| Balsam | 6 | 20 | 2 | 20 |
| Fir/Pine/Spruce | 13 | 30 | 1 | 30 |
| VT – Immature (all species) | 7 | 20 | 0 | 10 |
| *Total* | *30* | *90* | *5* | *95* |

## 3.4 SAMPLING APPROACH

The NVAF sampling approach follows MSRM Terrestrial Information Branch standards. The NVAF sampling involves five steps:

1. Select and enhance the sample clusters by grading and net factoring two auxiliary plots in the selected TEPs.
2. Create a tree matrix using data from the enhanced auxiliary plots.
3. Select sample trees from the tree matrix
4. Complete stem analysis of the sample trees.
5. Analyze the data to develop volume adjustment factors.

## 3.5 PROJECT MANAGEMENT

Forsite Consultants Ltd. was selected by the OFIS to implement the destructive sampling phase of this project. Forsite is responsible for working with the MSRM to generate the tree list, contracting field crews, providing mentoring and auditing of the crews, entering field data, and providing clean data to JST.[11] JST is responsible for coordinating NVAF enhancement, compilation and analysis of the data, and producing the final report.

[10] Methods for sample location selection and stem analysis are described in the MSRM Terrestrial Information Branch manual *Net volume adjustment factor sampling standards and procedures, Version 2.0* (February 2001), available on the Internet at: www.for.gov.bc.ca/RIC/PUBS/OTHER/netvolume/index.htm

[11] A memo detailing implementation responsibilities of the NVAF program was sent to OIFS on May 16, 2002.

# 4. IMPLEMENTATION PLAN

## 4.1 SCHEDULE

The VRI Phase II and NVAF sampling will be implemented in 2002 as follows (Figure 1):

1. The OIFS will prepare and submit a VPIP (this Plan) for approval by the MSRM Southern Interior Region.
2. The MRSM will prepare a Standards Agreement and Schedule A (if required under FIA).
3. The OIFS will select 550 potential sample polygons from the operable Crown VT land base with 30 identified as NVAF samples (seven in immature and 23 in mature stands). The target of 140 TEPs will be installed in two batches. The first batch of 110 TEPs provides the sampling frame for the NVAF sampling. The remaining plots will be completed in the second batch (limited by remaining budget).
4. The OIFS will hire six VRI certified crews to install the TEPs.
5. The OIFS and MSRM will mentor all crews on the first day of field sampling.
6. The OIFS and MSRM will audit one plot from each of the first three plots completed by each crew.
7. The contractor crews will supply digital files of the TEP data to the OIFS for compilation and QA at the end of each shift.
8. The first NVAF sample crew will begin soon after the second 10-day TEP shift is complete.
9. The OIFS and MSRM will audit approximately 10% of the TEPs (if necessary).
10. The OIFS will complete the statistical analysis by July 20, 2002.

## 4.2 SAMPLE PACKAGES

Field sample packages will include:

1. The most recent and available photo stereo-pairs for access (pin-pricked).
2. A laser copy of the document photo.
3. Two ortho-photo maps (1:5,000 and 1:10,000) showing plot location.
4. Forest cover map (1:10,000) showing plot location.
5. Access maps (1:20,000) showing plot location
6. Overview map (1:250,000) for general polygon location.

## 4.3 FIELD SUPPLIES

Supplies such as aluminum stakes, field maps, photos, plot cards, handheld data recorders, GPS, and other required equipment are supplied by the contract crews.

## 4.4 FIELD SAMPLING

Fieldwork is scheduled to begin May 21. Mentoring of all six field crews will be done the first day and sampling will begin immediately thereafter. The VRI Card Types 1, 2, 3, 8,9, 10,11, 12, and 16 will be completed according to VRI Ground Sampling procedures.

The field sampling mentors will provide initial quality control over the first few days, and then will audit one plot from each crew from the first three plots installed by each crew. We plan to do QA inspections on approximately 10% of the samples. The field crews are responsible for the quality control of their own work.

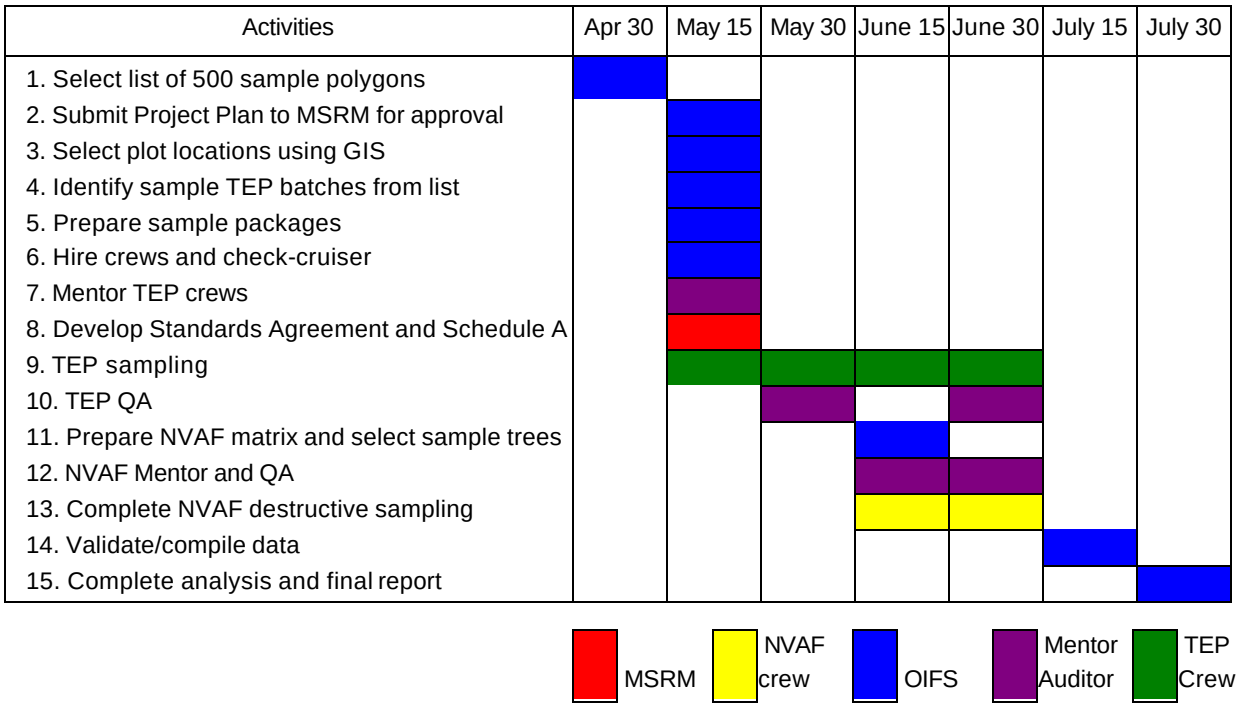


Figure 1. Proposed Okanagan VRI project schedule.

### 4.5 DATA COMPILATION, ANALYSIS, & ADJUSTMENT

The OIFS will:

1. Compile and validate the data.
2. Complete a statistical analysis following the MSRM Fraser Protocol method by the end of July 2002.
    - Calculate ground sample average volumes and inventory volumes for the total IFPA area and by BGC zone or group of BGC zones.
    - Adjust the inventory height and age.
    - Generate new VDYP volume using adjusted height and age.
    - Adjusted new volume using ratio of means method ratios.
    - Compute sampling errors for the TSA for the total IFPA area and by BGC zone or group of BGC zones.
    - Prepare a memo for the MSRM Kamloops Region describing the results and conclusions.

### 4.6 ROLES & RESPONSIBILITIES

***MSRM***

- Provide attribute files and minimum standards for statistical analysis.

- Prepare and sign-off Standards Agreement and Schedule A (if required under FIA).
- Help mentor TEP crews and NVAF samplers at the start of fieldwork.

***OIFS***

- Select sampling contractors.
- Coordinate project activities.
- Select sample polygons and locations within polygons.
- Prepare sample packages.
- Check data after initial compilation.
- Validate and compile data.

***TEP Field Contractors***

- Complete field sampling.
- Complete internal quality control and submit data to OIFS at conclusion of each batch.
- Enter the sample data.
- Complete call grading and net factoring for selected NVAF samples.

***Mentor/Check-cruiser*** (Independent Contractor)

- Mentor the crews at the beginning of the project.
- Complete QA work for 10% of the VRI samples.

***NVAF Field Contractor***

- Complete destructive sampling.
- Enter the sample data and provide to the OIFS
- Timelines are to be determined between Forsite and JST.

***NVAF Quality Assurance Mentor/Check-cruiser (Independent contractor)***

- Complete NVAF mentoring and QA.
- Submit QA results to OIFS at conclusion project.

### 4.7 APPROXIMATE COSTS

Estimated sample sizes and costs are provided in Table 2. The estimated total cost of installing the 140 TEPs and the NVAF destructive sampling, is $407,000. The destructive sampling costs are $55,000, the TEP sampling, NVAF support, project management, analysis and reporting costs are estimated at $352,000.

Table 2. Estimated costs for timber emphasis and NVAF sampling in the Okanagan TSA.

| VRI Activity | Sample Size | Unit Cost | Approx. Total Cost |
|---|---|---|---|
| TEP Samples | 140 | $1,250 | $174,000 |
| NVAF destructive sampling (Forsite) | 95 | $578 | $55,000 |
| *Sub-total* | | | *$229,000* |
| Project Management (TEP only) | | | $29,000 |
| Prepare sample packages (inc. photo purchase) | | | $22,000 |
| Mentoring/QA (TEP only) | | | $40,000 |
| Field Support (TEP data entry, core counting, and support) | | | $27,000 |
| Helicopter time (TEP only) | | | $30,000 |
| Data compilation, analysis, and reporting (inc. NVAF) | | | $30,000 |
| *Sub-total* | | | *$178,000* |
| *Total* | | | *$407,000* |

# APPENDIX I – GLOSSARY OF TERMS

***Ground Sampling***

VRI ground sampling (Phase I) is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. 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.

***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.

***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-Interpretation (Phase I)***

Photo-interpretion (Phase I) 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.

***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 Size***

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet specified target precision or cost.

***Statistical Adjustment***

Statistical adjustment (or 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 provincial 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 Population***

The target population is the unit from which the samples are chosen. For management inventories, the inventory unit is a TSA, TFL or other geographic area or specific attribute set, depending upon the sampling objectives.

***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:

- BC Landcover classification scheme (BCLCS).
- *Photo-interpreted estimates (Phase I)*: the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground sampling (Phase II)*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes. The data are used for the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit.
- *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.
- *Change Monitoring Inventory (CMI)*

The VRI can be deployed over the entire province (provincial VRI) measuring timber and non-timber resources, or over a large management unit (management VRI) 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.

# APPENDIX II – CHANGES TO CURRENT VRI METHODS

## Overview

The changes to current VRI methods include:

- For IDF plots, increase the plot cluster to nine sample points by adding four count plots.
- Tallying dead trees in all plots.
- Installing all auxiliary plots in all clusters (and count plots in the IDF).
- Selecting samples using an adjusted PPSWR method using BGC zone instead of volume.
- Change in compilation methods to reflect the new plots methods.

## Increasing Plot Cluster size

- To better capture volume variability in the IDF, we are piloting a 9-point cluster where species, DBH, live and dead standing will be measured on four additional count plots.
- Count plots will be located on a systematic grid; 50 m east of the north auxiliary, 50 m south of the east auxiliary, 50 m west of the south auxiliary, and 50 m north of the west auxiliary.

## Tallying Dead Trees in all Plots

- To record the incidence of Mountain Pine Beetle and other pests in the IFPA area, we propose tallying dead trees in all plots.

## Install all Auxiliary Plots in all Clusters

- All auxiliary plots must be installed regardless of whether the auxiliary is in the target polygon. This allows for the Phase II samples to be applied to the Phase I once it is completed.
- Data from auxiliary's located outside the identified Phase I polygon will be removed when the plots are transferred to the Phase I.

## Adjust the PPSWR Method to use BGC Zone Instead of Volume

- We propose adjusting the PPSWR method slightly by grouping by BGC zone instead of by volume. We are more likely to post-stratify the data by BGC zone than by leading species. The proposed modification to the PPSWR method will give optimal sample allocation by BGC zone.

## Change in the Compilation Methods

- Changes to the sampling methods require that the compiler be altered to accept the new data.
- Data will be submitted to the MSRM in standard VRI format. This will mean removing the additional information collected on this project.

## APPENDIX III – LIST OF POTENTIAL TEP SAMPLE POLYGONS

Table 3. Okanagan VRI sample list.

| Plot No | Volume Class | Mapstand | Ldg Spp | BGC Label | Age | Batch[a] |
|---|---|---|---|---|---|---|
| 1 | HIGH | M082L035 555 | B | ESSFdc 2 | 116 | 1 |
| 2 | HIGH | M082L087 82 | B | ESSFwc 2 | 228 | 1 |
| 3 | HIGH | M082L063 650 | S | ESSFdc 2 | 354 | 1 |
| 4 | HIGH | M082M014 417 | S | ESSFwc 2 | 216 | 1 |
| 5 | HIGH | M082L006 603 | S | ESSFdc 1 | 105 | 1 |
| 6 | HIGH | M082M025 164 | S | ESSFwc 2 | 236 | 1 |
| 7 | HIGH | M082E041 123 | PL | ESSFxc | 116 | 1 |
| 8 | HIGH | M082L008 304 | S | ESSFwc 4 | 232 | 1 |
| 9 | HIGH | M082L001 170 | S | ESSFxc | 189 | 1 |
| 10 | HIGH | M082M025 197 | B | ESSFwc 2 | 236 | 1 |
| 11 | LOW | M082M004 102 | BL | ESSFwc 2 | 32 | 1 |
| 12 | LOW | M082L066 387 | B | ESSFwc 2 | 35 | 1 |
| 13 | LOW | M092H009 270 | PL | ESSFxc | 80 | 1 |
| 14 | LOW | M082L032 257 | BL | ESSFdc 2 | 38 | 1 |
| 15 | LOW | M082E011 542 | S | ESSFxc | 210 | 1 |
| 16 | LOW | M082M015 369 | SE | ESSFwc 2 | 21 | 1 |
| 17 | LOW | M082E011 494 | S | ESSFxc | 290 | 1 |
| 18 | LOW | M082L063 505 | B | ESSFdc 2 | 214 | 1 |
| 19 | LOW | M082E074 206 | BL | ESSFdc 1 | 51 | 1 |
| 20 | MED | M082E021 56 | S | ESSFxc | 210 | 1 |
| 21 | MED | M082E054 727 | PL | ESSFdc 1 | 144 | 1 |
| 22 | MED | M082E096 250 | B | ESSFxc | 105 | 1 |
| 23 | MED | M082E001 72 | S | ESSFxcu | 290 | 1 |
| 24 | MED | M082M014 130 | S | ESSFwc 2 | 185 | 1 |
| 25 | MED | M082M014 342 | BL | ESSFwc 2 | 85 | 1 |
| 26 | MED | M082L068 181 | B | ESSFwc 2 | 177 | 1 |
| 27 | MED | M082E095 38 | PL | ESSFdc 1 | 99 | 1 |
| 28 | MED | M082E031 299 | FD | ESSFxc | 90 | 1 |
| 29 | MED | M082L063 252 | PL | ESSFdc 2 | 106 | 1 |
| 30 | MED | M082E096 296 | B | ESSFdc 1 | 216 | 1 |
| 31 | MED | M082E031 323 | PL | ESSFxc | 120 | 1 |
| 32 | HIGH | M082M036 14 | H | ICH wk 1 | 286 | 1 |
| 33 | HIGH | M082L067 275 | FD | ICH mk 1 | 127 | 1 |
| 34 | HIGH | M082M036 150 | H | ICH mw 3 | 296 | 1 |
| 35 | HIGH | M082M015 141 | S | ICH wk 1 | 236 | 1 |
| 36 | HIGH | M082L097 546 | H | ICH mw 3 | 328 | 1 |
| 37 | HIGH | M082M046 20 | CW | ICH vk 1 | 336 | 1 |
| 38 | HIGH | M082M006 1120 | CW | ICH wk 1 | 236 | 1 |
| 39 | HIGH | M082L078 398 | CW | ICH wk 1 | 327 | 1 |
| 40 | HIGH | M082L086 446 | FD | ICH mw 3 | 138 | 1 |
| 41 | HIGH | M082M037 172 | H | ICH vk 1 | 296 | 1 |
| 42 | HIGH | M082L096 76 | FD | ICH mw 3 | 128 | 1 |
| 43 | HIGH | M082L069 340 | CW | ICH mk 1 | 327 | 1 |
| 44 | LOW | M082E097 345 | PL | ICH mk 1 | 24 | 1 |
| 45 | LOW | M082L019 98 | H | ICH mw 2 | 227 | 1 |
| 46 | LOW | M082E095 224 | S | ICH mk 1 | 115 | 1 |
| 47 | LOW | M082L016 127 | PL | ICH mk 1 | 48 | 1 |
| 48 | LOW | M082L037 600 | PL | ICH mk 1 | 77 | 1 |
| 49 | LOW | M082L018 296 | FD | ICH mk 1 | 137 | 1 |
| 50 | LOW | M082L038 105 | FD | ICH mk 1 | 57 | 1 |
| 51 | LOW | M082L037 532 | BL | ICH mk 1 | 40 | 1 |
| 52 | LOW | M082L019 196 | H | ICH mw 2 | 227 | 1 |
| 53 | LOW | M082E097 686 | BL | ICH mk 1 | 27 | 1 |
| 54 | LOW | M082L097 671 | FD | ICH mw 3 | 25 | 1 |
| 55 | LOW | M082L038 473 | PL | ICH mk 1 | 57 | 1 |
| 56 | MED | M082E097 538 | PL | ICH mk 1 | 112 | 1 |

| Plot No | Volume Class | Mapstand | Ldg Spp | BGC Label | Age | Batch[a] |
|---|---|---|---|---|---|---|
| 57 | MED | M082L088 229 | FD | ICH wk 1 | 98 | 1 |
| 58 | MED | M082E085 840 | PL | ICH mk 1 | 124 | 1 |
| 59 | MED | M082L049 54 | CW | ICH wk 1 | 97 | 1 |
| 60 | MED | M082L046 48 | PL | ICH mk 1 | 107 | 1 |
| 61 | MED | M082L045 391 | FD | ICH mw 2 | 57 | 1 |
| 62 | MED | M082E097 325 | FD | ICH mk 1 | 92 | 1 |
| 63 | MED | M082L007 375 | PL | ICH mk 1 | 112 | 1 |
| 64 | MED | M082L097 286 | AT | ICH mw 3 | 88 | 1 |
| 65 | MED | M082L077 332 | FD | ICH mk 1 | 87 | 1 |
| 66 | MED | M082M003 152 | FD | ICH wk 1 | 116 | 1 |
| 67 | MED | M082L046 442 | L | ICH mk 1 | 107 | 1 |
| 68 | HIGH | M082E085 238 | PL | IDF mw 1 | 125 | 1 |
| 69 | HIGH | M082E041 333 | FD | IDF dk 1 | 230 | 1 |
| 70 | HIGH | M082E073 168 | FD | IDF xh 1 | 184 | 1 |
| 71 | HIGH | M082L042 322 | PL | IDF dk 1 | 163 | 1 |
| 72 | HIGH | M092H020 78 | PL | IDF dk 1 | 150 | 1 |
| 73 | HIGH | M082L016 32 | FD | IDF mw 1 | 117 | 1 |
| 74 | HIGH | M082E022 181 | FD | IDF dk 1 | 160 | 1 |
| 75 | LOW | M082E002 120 | FD | IDF xh 1 | 94 | 1 |
| 76 | LOW | M082E093 186 | PY | IDF xh 1 | 95 | 1 |
| 77 | LOW | M082E022 515 | FD | IDF xh 1 | 184 | 1 |
| 78 | LOW | M082E092 328 | PL | IDF dk 2 | 74 | 1 |
| 79 | LOW | M082E071 81 | FD | IDF dk 2 | 75 | 1 |
| 80 | LOW | M082L014 210 | PL | IDF xh 1 | 66 | 1 |
| 81 | LOW | M092H080 104 | PL | IDF dk 2 | 64 | 1 |
| 82 | MED | M082L043 210 | FD | IDF mw 1 | 114 | 1 |
| 83 | MED | M082L043 124 | FD | IDF mw 1 | 104 | 1 |
| 84 | MED | M082L074 89 | FD | IDF mw 2 | 114 | 1 |
| 85 | MED | M082L043 11 | FD | IDF xh 2 | 93 | 1 |
| 86 | MED | M082E082 240 | FD | IDF dk 2 | 134 | 1 |
| 87 | MED | M082E044 99 | PL | IDF dm 1 | 72 | 1 |
| 88 | MED | M082E022 452 | FD | IDF dk 1 | 210 | 1 |
| 89 | MED | M082L094 55 | E | IDF mw 2 | 74 | 1 |
| 90 | HIGH | M092H080 685 | PL | MS dm 2 | 114 | 1 |
| 91 | HIGH | M082E081 187 | PL | MS dm 2 | 184 | 1 |
| 92 | HIGH | M082L005 325 | S | MS dm 1 | 185 | 1 |
| 93 | HIGH | M082L001 4 | PL | MS xk | 129 | 1 |
| 94 | HIGH | M082E085 2 | PL | MS dm 1 | 114 | 1 |
| 95 | HIGH | M092I010 2002 | PL | MS xk | 118 | 1 |
| 96 | LOW | M082L004 296 | PL | MS dm 1 | 84 | 1 |
| 97 | LOW | M082E053 372 | PL | MS dm 1 | 22 | 1 |
| 98 | LOW | M082E011 622 | PL | MS xk | 60 | 1 |
| 99 | LOW | M082L004 117 | PL | MS dm 1 | 33 | 1 |
| 100 | LOW | M082L033 339 | PL | MS dm 2 | 64 | 1 |
| 101 | MED | M092H040 251 | FD | MS xk | 148 | 1 |
| 102 | MED | M082E095 195 | PL | MS dm 1 | 99 | 1 |
| 103 | MED | M082L004 156 | PL | MS dm 1 | 124 | 1 |
| 104 | MED | M082E051 79 | PL | MS xk | 124 | 1 |
| 105 | MED | M082L005 64 | PL | MS dm 1 | 107 | 1 |
| 106 | MED | M082E091 463 | PL | MS dm 2 | 129 | 1 |
| 107 | MED | M082E072 38 | PY | PP xh 1 | 196 | 1 |
| 108 | LOW | M082E064 699 | BL | MS dm 1 | 62 | 1 |
| 109 | LOW | M082E053 2622 | PL | MS dm 1 | 27 | 1 |
| 110 | LOW | M082E092 202 | PL | MS dm 2 | 84 | 1 |
| 111 | HIGH | M082E086 359 | PL | ESSFxc | 184 | 2 |
| 112 | MED | M082E064 33 | PL | ESSFdc 1 | 222 | 2 |
| 113 | HIGH | M082L075 230 | FD | ICH mk 1 | 154 | 2 |
| 114 | LOW | M082L059 644 | FD | ICH wk 1 | 57 | 2 |
| 115 | MED | M082L036 355 | H | ICH mk 1 | 118 | 2 |
| 116 | HIGH | M082L094 25 | FD | IDF mw 2 | 94 | 2 |

| Plot No | Volume Class | Mapstand | Ldg Spp | BGC Label | Age | Batch[a] |
|---|---|---|---|---|---|---|
| 117 | LOW | M082E081 385 | FD | IDF dk 2 | 65 | 2 |
| 118 | MED | M082E062 59 | FD | IDF xh 1 | 175 | 2 |
| 119 | HIGH | M092I010 195 | PL | MS xk | 138 | 2 |
| 120 | LOW | M082M014 280 | B | ESSFwc 2 | 50 | 2 |
| 121 | HIGH | M082M015 317 | S | ESSFwc 2 | 166 | 3 |
| 122 | MED | M082E086 80 | S | ESSFdc 1 | 222 | 3 |
| 123 | HIGH | M082M008 319 | H | ICH wk 1 | 108 | 3 |
| 124 | LOW | M082L038 337 | CW | ICH mk 1 | 167 | 3 |
| 125 | MED | M082E085 784 | PL | ICH mk 1 | 104 | 3 |
| 126 | MED | M082E071 601 | PL | MS dm 2 | 94 | 3 |
| 127 | HIGH | M082L076 64 | B | AT p | 258 | 3 |
| 128 | LOW | M082L007 95 | PL | ESSFdc 1 | 72 | 3 |
| 129 | LOW | M082L033 440 | AT | IDF dk 2 | 95 | 3 |
| 130 | LOW | M082E073 412 | PL | MS dm 1 | 85 | 3 |
| 131 | HIGH | M082M015 37 | S | ESSFwc 2 | 166 | 4 |
| 132 | MED | M082L068 229 | B | ESSFwc 2 | 227 | 4 |
| 133 | HIGH | M082L088 10 | FD | ICH wk 1 | 118 | 4 |
| 134 | LOW | M082L028 503 | CW | ICH mk 1 | 28 | 4 |
| 135 | LOW | M082L056 734 | HW | ICH mk 1 | 31 | 4 |
| 136 | MED | M082L025 60 | FD | ICH mk 1 | 125 | 4 |
| 137 | HIGH | M082L062 1500 | PL | IDF dk 2 | 115 | 4 |
| 138 | MED | M082L043 208 | LW | IDF mw 1 | 74 | 4 |
| 139 | HIGH | M092H080 2107 | PL | MS dm 2 | 124 | 4 |
| 140 | LOW | M082E054 377 | LW | IDF dm 1 | 72 | 4 |

[a] Batches 2-4 are stand-alone batches. Once the budget is determined for the third shift, we will group the maximum number of batches to form Batch 2 that will allow us to complete the project on budget.

# APPENDIX IV – TARGET AND SAMPLE POPULATION COMPARISONS

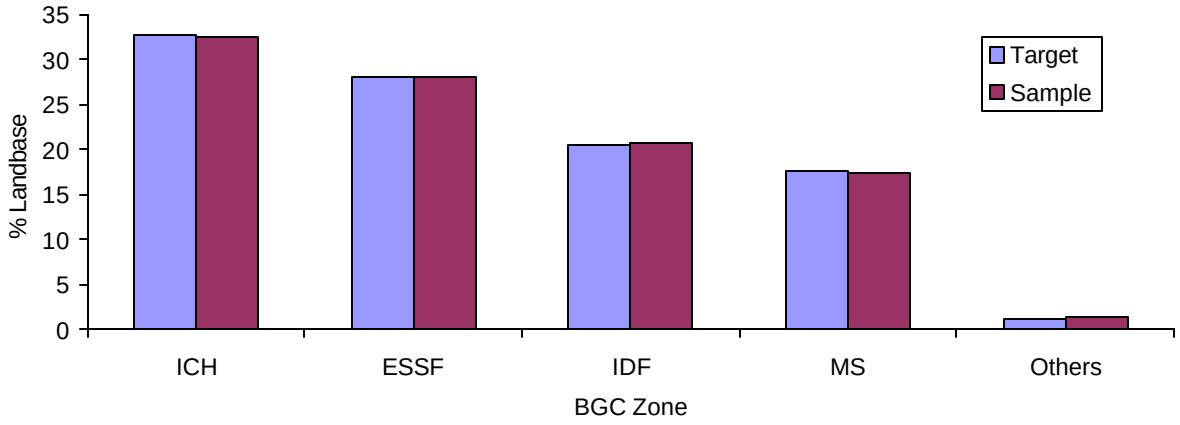


Figure 2. Target and sample population comparison by BGC zone.

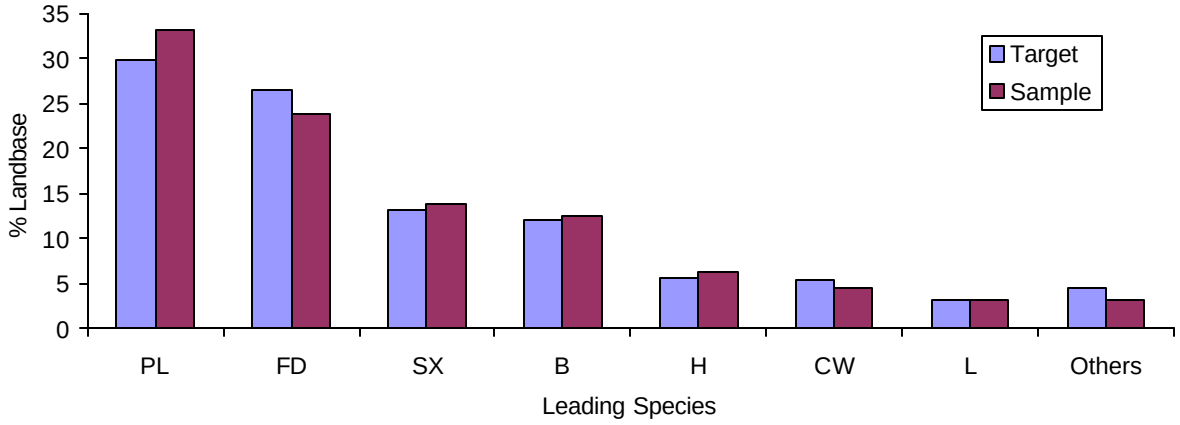


Figure 3. Target and sample population comparison by leading species.

# APPENDIX V – LIST OF NVAF SAMPLE LOCATIONS

[JST will complete sample selection once information is available.]