VEGETATION RESOURCES INVENTORY PHASE II PROJECT IMPLEMENTATION PLAN

TIMBERWEST FOREST LTD. TREE FARM LICENSE 47

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1.0 INTRODUCTION

1.1 Terms of Reference

TimberWest Forest Corp. (TimberWest) contracted Timberline Natural Resource Group (TNRG) to prepare the Vegetation Resources Inventory (VRI) Phase II Project Implementation Plan (VPIP) for Tree Farm Licence (TFL) 47. The TNRG team who prepared the VPIP included René de Jong, *RPF* (project manager), Guillaume Thérien, *PhD* (technical advisor), Hamish Robertson, *RPF* (technical advisor), and Darryl Klassen, *BNRSc* (Geographic Information System analyst). Scott Weston, *RPF* of Madrone Environmental Services Ltd. is TimberWest's Forest Investment Account (FIA) coordinator and is the client contact for this initiative.

1.2 Background

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

The VRI is a four-step process (Figure 1):

- 1. Phase I (unadjusted inventory data¹) Estimates of polygon attributes are derived for the target population from photo-interpretation.
- 2. Phase II (ground sample data) Measurements are taken from randomly located ground samples in the target population.
- 3. Net Volume Adjustment Factor (NVAF) sampling Random trees are selected for stem-analysis, from the Phase II samples, to develop adjustment ratios that correct taper and decay estimation bias.
- 4. Adjustment Phase The Phase I estimates are adjusted using the NVAF-corrected Phase II ground samples to provide an adjusted unbiased estimate of forest inventory attributes. The final product is an adjusted VRI database.



Figure 1. VRI flow-chart.

¹ A glossary of terms is provided in Appendix I.





1.3 Project Objective

The project objective is to:

Upgrade and adjust the TFL 47 VRI Phase I forest inventory to MoFR standards in preparation for the next Timber Supply Review.

Forest management issues on TFL 47 that will benefit from an adjusted VRI inventory include:

- 1. Timber supply analysis will help to remove uncertainty in timber supply analysis projections.
- 2. Operability mapping will provide additional information to confirm distribution of merchantable timber. Better age and height data may also improve the identification and classification of problem forest types, sites with low growing potential, and deciduous stands.
- *3. Biodiversity may aid in delineating wildlife tree patches, deer winter range, and seral stages.*
- 4. Land use planning will help identify areas of specific interest for the 'Central Coast Land Resource Management Plan', and 'Vancouver Island Land Use Plan'.

1.4 Document Objective

The VRI Phase II VPIP objective is to:

- 1. Develop the Phase II sampling program to address TimberWest's inventory issues.
- 2. Present the proposed NVAF program.
- 3. Outline the strategy for Phase II implementation including definition of the target population, sampling objectives, statistical adjustment approaches, roles and responsibilities and the proposed budget and program scheduling.

The intent is that MoFR will review and approve the proposed Phase II sampling program. TimberWest will update this VPIP with the proposed NVAF methods prior to the NVAF program commencing.

1.5 TFL 47 Landbase

TFL 47 comprises two² management units (MU) located on northern Vancouver Island near Port McNeill (Bonanza Lake MU) and parts of the coastal mainland and islands in the Johnstone Strait (Johnstone Strait MU) (Figure 2). The total TFL area is 123,034 ha.³

TFL 47 is located in the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic zones (Figure 3). The dominant species in both management units is western hemlock (Hw) comprising on average 58% of the area, followed (in decreasing area proportion) by Douglas-fir (Fdc), western redcedar (Cw), yellow cedar (Yc) mountain hemlock (Hm), and other species (Table 1 and Table 2). Yc occurs only in the Bonanza MU, while the majority of Fdc is in the Johnstone Strait MU.

The majority (70%) of the area is in younger stands (< 80 years old) with 25% occurring in mature stands (>120 years old). The Bonanza MU comprises the bulk of mature stands, while the Johnstone Strait MU dominates the proportion of younger stands.

³ Based on the TFL boundaries provided by TimberWest (K.Price, GIS analyst, TimberWest on June 15, 2007), portions of the 2006 inventoried area were removed from the TFL, and include areas on Hanson Island, Forward Harbor and Thurston Bay. This accounts for 3,111 ha of inventoried area falling outside the current TFL boundary. However, there remains an additional 580 ha inside the TFL boundary where there was no Phase I inventory mapping completed. For this VPIP, we excluded the 'non-inventoried' areas from the total TFL area. See Table 4.





² A third unit (Moresby Island MU) is no longer part of TFL 47.

| Leading | MoFR Age Class | | | | | | | | | Tota | Total | |
|---------|----------------|-------|-------|-------|-----|-----|----|-----|-------|--------|--------|------|
| Species | Blank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Ha | % |
| Blank | 1,930 | | | | | | | | | | 1,930 | 5% |
| BA | | 713 | 48 | 32 | 50 | 21 | | 24 | 837 | 1,555 | 3,279 | 9% |
| CW | | 205 | 108 | 59 | | | | 18 | 39 | 139 | 568 | 2% |
| DR | | 8 | 141 | 83 | | | | | | 12 | 245 | 1% |
| FDC | | 723 | 1,339 | 14 | | | 4 | | | | 2,079 | 6% |
| HM | | 93 | | 14 | | 21 | | | 1,098 | 2,762 | 3,988 | 11% |
| HW | | 5,681 | 5,714 | 2,270 | 749 | 95 | 47 | 25 | 959 | 3,519 | 19,058 | 51% |
| SS | | 24 | 127 | 64 | 6 | | 5 | | | 13 | 240 | 1% |
| YC | | 404 | 24 | | | | 5 | 530 | 2,697 | 2,592 | 6,252 | 17% |
| Total | 1,930 | 7,850 | 7,502 | 2,534 | 805 | 137 | 61 | 598 | 5,629 | 10,592 | 37,638 | 100% |
| | 5% | 21% | 20% | 7% | 2% | 0% | 0% | 2% | 15% | 28% | 100% | |

 Table 1. TFL 47 species and age class distribution – Bonanza Management Unit.

 Table 2. TFL 47 species and age class distribution – Johnstone Strait Management Unit.

| Leading | | MoFR Age Class | | | | | | | | Tota | ıl | |
|-----------|-------|----------------|--------|-------|--------|-------|-------|-----|-------|-------|--------|------|
| Species _ | Blank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Ha | % |
| Blank | 3,642 | | | | | | | | | | 3,642 | 4% |
| BA | | 96 | 42 | | | | | | 7 | 47 | 192 | 0% |
| BG | | 27 | | 4 | | | | | | | 31 | 0% |
| CW | 17 | 1,133 | 705 | 304 | 760 | 381 | 204 | 34 | 1,902 | 854 | 6,294 | 7% |
| DR | 33 | 156 | 909 | 1,430 | 931 | 12 | | | | | 3,471 | 4% |
| FDC | 116 | 4,031 | 2,665 | 780 | 5,670 | 2,315 | 759 | 39 | 994 | 176 | 17,545 | 21% |
| HM | | | | | | | | | 172 | 119 | 291 | 0% |
| HW | 240 | 8,456 | 9,789 | 7,183 | 14,964 | 3,545 | 900 | 316 | 4,634 | 2,002 | 52,030 | 61% |
| PL | 0 | | 128 | 129 | 774 | 306 | 11 | | 9 | | 1,356 | 2% |
| SS | | | | | | | 16 | 4 | | | 20 | 0% |
| VB | | 213 | | | | | | | | | 213 | 0% |
| YC | | | | | | | | | 296 | 16 | 312 | 0% |
| Total | 4,049 | 14,111 | 14,238 | 9,830 | 23,099 | 6,560 | 1,891 | 392 | 8,015 | 3,213 | 85,396 | 100% |
| | 5% | 17% | 17% | 12% | 27% | 8% | 2% | 0% | 9% | 4% | 100% | |







Figure 2. Geographic location of TFL 47, including sample locations (batch 1 and batch 2).



Figure 3. TFL 47 BGC subzone area distribution.





In 2006 TimberWest completed a VRI Phase I Strategic Inventory Plan⁴ covering the Bonanza and Johnstone Strait MU's. Subsequently, Inventory Resources Co-operative (IRC) completed the TFL 47 Phase I inventory on March 31, 2007 using 2006 1:15,000 aerial photos.

All spatial GIS coverages used to define the TFL 47 landbase were obtained from TimberWest and Madrone staff (Table 3).

| Table 3. | TFL 47 | Source | coverages | used | in this | project. |
|----------|--------|--------|-----------|------|---------|----------|
|----------|--------|--------|-----------|------|---------|----------|

| Coverage Name | Description | Date Received |
|------------------------|--|---------------|
| TFL47.SHP | TFL 47 boundary coverage of Bonanza and Johnstone Strait MU's. Received as shape file from Ken Price, TimberWest. | 2007-June-15 |
| TFL47_DEPLETIONS06.SHP | Harvest depletions coverage occurring in 2006. Received from Ken Price, TimberWest. | 2007-June-15 |
| TEM_SUBZ.SHP | BGC subzone/variant linework, originating from the TFL 47 TEM coverage. Created by Ken Price, TimberWest. | 2007-June-15 |
| VRI.E00 | VRI Phase I inventory of Bonanza and Johnstone Strait MU's. Originally created by IRC, March 31, 2007, and forwarded by Debora Soutar, Madrone. Note, this coverage has not yet gone through any data translation / conversion routines by the MoFR. | 2007-June-05 |
| | TFL 47 2006 1:15,000 air photo flight lines. | 2007-June-05 |

⁴ TimberWest Forest Corp. 2006. TFL 47 Bonanza Lake and Johnstone Straits Management Units VRI Strategic Inventory Plan. Prepared by Warren Nimchuk, RPF and Doug Reeve, RFT, on behalf of TimberWest Forest Corp.





2.0 GROUND SAMPLING PLAN

2.1 Standards and Guidelines

The standards and guidelines used in preparation of this VPIP were obtained from the MoFR publication *Vegetation Resources Inventory – Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Factor Sampling, May 2007 ver. 3.0.*⁵

2.2 Sampling Objectives

The objective of the VRI Phase II ground sampling program is to:

Estimate the average net merchantable volume in the target population with a sampling error of $\pm 10\%$ *at a 95% confidence level.*

The objective of the NVAF component is to:

Estimate the ratio true net merchantable volume / net factored ground sample volume in the target population with a sampling error of $\pm 7.5\%$ *at a* 95% *confidence level.*⁶

2.3 Target Population

The target population for the VRI Phase II was defined as all TFL 47 vegetated treed⁷ (VT) polygons where the main layer is treed and greater than 30 years of age.⁸ The main layer was defined as the layer with the largest crown closure, and a layer was considered treed if the leading species was present with a minimum crown closure of 10%. The total area of the target population was 89,736 ha (Table 4; 76% of the total landbase or 81% of the VT landbase). All harvest depletions since the 2006 Phase I inventory mapping were also updated into the inventory.

| | Area removed (ha) | Area remaining (ha) | % of total | % of VT |
|--|-------------------------|---------------------------|---------------|------------|
| Total Inventoried Area in 2006 | | 126,654 | | |
| Area inside TFL in 2007 | 3,111 | 123,543 | | |
| Inventoried Area inside TFL in 2007 3 | 508 | 123,034 | 100% | |
| Vegetated Treed | 12,847 | 110,188 | 90% | 100% |
| Stands >30 years old | 20,451 | 89,736 | 73% | 81% |
| Bonanza MU | 0 | 25,475 | 21% | 23% |
| Johnstone Strait MU | 0 | 64,261 | 52% | 58% |

| Table 4. | TFL 47 | Phase II | [target | population | net d | own. |
|----------|---------------|----------|----------|------------|-------|------|
|----------|---------------|----------|----------|------------|-------|------|

⁵ <u>http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_gs_2k7/guidelines_for_gs_net_factoring.pdf</u>

⁶ The required sampling error was reduced from 10% down to 7.5% in the 2007 Phase II VPIP guidelines.

⁷ Discussions with B.Storry, TimberWest that the majority of the forested landbase was operable, helped to confirm that the entire VT portion should be included in the target population (email corresp 21 June, 2007).

⁸ Stand age definition criteria were based on the 2007 projected year.





2.4 Stratification

2.4.1 Ground Sampling

We expect the adjustment ratios and variability will be different between second-growth and mature stands. Therefore, the target population was stratified by age and species using two age groups (30-100 years vs. 101+ years) and two species groups (Hw+Hm, vs. all others). This stratification will also reflect the two different MUs since Johnstone Strait is mainly composed of second-growth stands while Bonanza includes a larger component of mature stands.

While the leading species is dominated by Hw, we combined both Hw and Hm into one species group for consistency, separated from all other species. Each stratum was further sub-stratified into volume⁹ classes (<=400m3/ha, and >400m3/ha) to ensure appropriate distribution of the ground samples across the range of possible values (Table 5).¹⁰

| Sub-stratum Area | | Stratum | Area (ha) | | |
|--|-------------------|--------------------|------------------|-------------------|---------------|
| (ha) | Hw/Hm <=100yrs | Others <=100yrs | Hw/Hm >100yrs | Others >100yrs | Total (ha) |
| Low volume ($\leq 400 \text{m}^3/\text{ha}$) | 21,135 | 11,291 | 5,064 | 6,684 | 44,174 |
| High volume (> 400m ³ /ha) | 20,069 | 6,179 | 12,391 | 6,923 | 45,562 |
| Total | 41,204 | 17,470 | 17,455 | 13,607 | 89,736 |

Table 5. Stratum and sub-stratum area distribution within the target population.

2.4.2 NVAF

The stratification for NVAF purposes was based on MoFR maturity classes: immature (30-120 years representing 65% of the target population total inventory volume) and mature (121+ years representing 35% of the target population total inventory volume). This maturity-based stratification was selected because it has been used in most previous NVAF projects and corresponds to variability observed among maturity classes.

2.5 Sample Size

2.5.1 Ground Sampling

The sample size is set at 100 plots. Assuming a coefficient of variation of 50% ¹¹ a sample size of 100 plots is expected to meet the target sampling error. The sample was split into two batches of 60 and 40 plots, respectively. The sample size (60 plots) for batch 1 was distributed proportionally to area within

¹¹ The CV originates from the MoFR inventory audit on TFL 47 which showed an audit volume CV of 41% and 38% for the Johnstone and Bonanza management units, respectively. The Phase II VPIP guidelines recommend adding an additional 10% CV to account for different sampling methodologies.





⁹ Polygon specific net merchantable volume estimates were generated with Batch VDYP ver. 6, at 17.5cm DBH utilization limit. Note, stocking class codes were not provided in the VRI Phase I inventory. Therefore, stocking class codes were estimated at 0 for VT stands 0-120 years old, and 1 for VT stands >120 years old. Age, height and volume were projected to 2007.

¹⁰ While the Bonanza and Johnstone Strait MU's have somewhat different stand characteristics, we chose not to separate the two as part of the stratification. The main reason is that the Johnstone Strait MU is much larger than the Bonanza, plus the MU differences are already largely addressed in the proposed stratification criteria.

each sub-stratum, so each plot represented approximately the same area (Table 6).¹² The batch 1 samples (Appendix III - Table 11) will provide a good estimate of the coefficient of variation (CV) within each stratum for an interim analysis. Upon completion of the interim analysis the second batch of plots will be used to distribute plots proportional to area and CV to maximize sampling efficiency and provide the MoFR timber supply analyst an adequate level of comfort across all strata. Therefore, the list of batch 2 samples (Appendix III - Table 12) may be subject to change. The VPIP will be updated when the allocation of the second batch is decided.

| Stratum | Sub- Stratum | Area (ha) | (%) | Sample Size | (%) | Ha/ Plot |
|--------------|---------------------|------------------|------------|----------------|------------|----------------|
| <=120_H | High_vol Low_vol | 20,069 21,135 | 49% 51% | 14 14 | 50% 50% | 1,434 1,510 |
| | Total | 41,204 | 46% | 28 | 47% | 1,472 |
| <=120_Others | High_vol Low_vol | 6,179 11,291 | 35% 65% | 4 8 | 33% 56% | 1,545 1,411 |
| | Total | 17,470 | 19% | 12 | 20% | 1,456 |
| >120_H | High_vol Low_vol | 12,391 5,064 | 71% 29% | 8 3 | 73% 27% | 1,549 1,688 |
| | Total | 17,455 | 19% | 11 | 18% | 1,587 |
| >120_Others | High_vol Low_vol | 6,913 6,695 | 51% 49% | 5 4 | 56% 44% | 1,383 1,674 |
| | Total | 13,607 | 15% | 9 | 15% | 1,512 |
| Total | | 89,736 | 100% | 60 | | 1,496 |

Table 6. Sample size distribution by stratum and sub-stratum.

2.5.2 NVAF

Thirty plots were selected for NVAF enhancement from the first batch of samples (15 immature and 15 mature).¹³ While the total volume¹⁴ distribution in the target population was about 65% immature and 35% mature, we expect greater variability with mature samples. Therefore, we recommend distribution of NVAF samples to be equally distributed between immature and mature classes. These NVAF-enhanced ground samples will provide the tree matrix from which NVAF trees will be selected for destructive sampling.

The sample size (ie., the total number of trees to be destructively sampled) will conform to the minimum required by the MoFR (Table 7). The allocation by species within the selection strata will be based on the species proportions calculated from the Phase II ground samples once ground sampling is completed. The exact sample size by species will be updated in the VPIP prior to implementation of the NVAF destructive sampling program.

Table 7. NVAF sampledistribution.

| Live / Dead | NVAF Strata | Sample Size |
|----------------|----------------|----------------|
| Dead | All | 10 |
| Live | Immature | 45 |
| Live | Mature | 45 |
| Total | | 100 |

¹² The area represented by each plot will likely change prior to the inventory statistical adjustment due to upcoming depletion updates, and the final sample list used.

¹⁴ The total volume in the target population (m^3) was calculated by summing the product of net merchantable volume (m^3/ha) and area (ha) for each resultant polygon.





¹³ NVAF ground sample size is based on one plot for every three trees being sampled.

2.6 Sample Selection

2.6.1 Ground Sampling

Ground sampling plot locations were selected using the probability proportional to size with replacement (PPSWR) method as defined in the MoFR standards. The selected sample was considered representative of the target population when compare across leading species, net merchantable volume, age, height, and inventory site index classes (Appendix II).

2.6.2 NVAF

The ground sampling clusters selected for NVAF enhancement were systematically selected with a random start from a list sorted by leading species. Different random starts were used for each maturity class.

2.7 Sampling Approach

TimberWest's proposed approach is to complete as much of the Phase II program as possible within this fiscal year. TimberWest believes that the first batch (60 plots) of the Phase II program can be installed this year within its current FIA allocation, but the goal is to try to complete the entire Phase II program this year.

The NVAF program will be implemented once the NVAF tree matrix has been built, the sample trees have been selected from the tree matrix, and the NVAF sample plan approved by the MoFR. The NVAF program should be completed before the end of the 2008-09 fiscal year.

An independent third party will be hired to complete the audit on a minimum of 10% of the Phase II samples and 10% of the trees undergoing NVAF destructive sampling.

2.8 Sample Type

The sample type for this project will be timber emphasis plots (type Q). Thus, data on VRI plot cards 1, 2, 3, 8, 9, 10, and 11 will be collected, unless handheld data loggers and TIMVEG software is used.

2.9 Analysis and Statistical Adjustment

Two analyses will be completed through this project. An interim analysis will be completed after the first batch of 60 plots is installed. If the preliminary analysis demonstrates that more plots are needed, the second batch of plots will be established after an assessment of their distribution amongst strata. A complete analysis and statistical adjustment will be completed once all plots for the project are installed. In all analyses, summary statistics by MU will be presented.





3.0 PROJECT IMPLEMENTATION

3.1 Schedule

The tendering process to select the Phase II ground sampling crews will start as soon as the MoFR approves the VPIP. At the end of the Phase II program, the NVAF sample list will be selected, the NVAF crew selected, and this version of the VPIP updated to reflect the final methods for the NVAF program.

It is possible that both the Phase II ground sampling and NVAF sampling components of the VRI program could be completed in the 2007/08 fiscal year. However, the most likely scenario is that NVAF sampling will be completed in the next fiscal.

All deliverables will be sent to the MoFR at the end of each fiscal year. Table 8 and Table 9 list the proposed implementation schedule for 2007/08 and 2008/09, respectively.

| Activities | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
|--|-----|-----|--------|-----|-----|-----|-----|-----|-----|-----|
| 1. Generate sample list | | | | | | | | | | |
| 2. Prepare sample packages | | | | | | | | | | |
| 3. Submit plan for to MoFR for approval | | | | | | | | | | |
| 4. Tender & select Phase II crews | | | | | | | | | | |
| 5. Mentor crews | | | | | | | | | | |
| 6. Implement Phase II plot establishment | | | | | | | | | | |
| 7. Complete quality assurance (QA) | | | | | | | | | | |
| 8. Complete interim analysis | | | | | | | | | | |
| TimberWest Mentor/ Auditor | | Fi | eld Cr | ew | | | | | | |

Table 8. Proposed VRI Phase II implementation schedule for the 2007/08 fiscal year.

Table 9. Proposed VRI Phase II implementation schedule for the 2008/2009 fiscal year.

| Activities | Apr | May | June | July | Aug | Sept | Oct | Nov- Mar |
|---|-----|--------|------|------|-----|------|-----|-------------|
| 9. Complete Phase II plot establishment (if necessary) | | | | | | | | |
| 10. Complete quality assurance (QA) | | | | | | | | |
| 10. Determine NVAF sample size and allocation | | | | | | | | |
| 11. Select NVAF sample trees | | | | | | | | |
| 12. Update Phase II VPIP with NVAF plan & submit to MoFR | | | | | | | | |
| 13. Submit NVAF plan to MoFR for approval | | | | | | | | |
| 14. Tender & select NVAF crew | | | | | | | | |
| 15. Complete NVAF sampling | | | | | | | | |
| 16. Complete Statistical Adjustment, NVAF analysis & Report | | | | | | | | |
| 17. Submit all deliverables to MoFR | | | | | | | | |
| Timber West Mentor/ Auditor Field Crew | NVA | F Crew | 7 | | | | | |





3.2 Sample Packages

The TNRG GIS department will prepare the sample packages for the TFL 47 VRI Phase II. The sample package for each plot will include:

- 1. Overview maps showing target polygon location (approximately 1:100,000).
- 2. 1:20,000 forest cover maps with all features and sample locations identified.
- 3. 8" X 11" 1:5,000 and 1:10,000 forest cover maps with label.
- 4. 1:15,000 aerial photo stereo pair (which may also include a laser copy of the document photos).

3.3 Standards

The following standards and procedures will be used for this VRI Phase II project:

- Ministry of Forests Forest Analysis and Inventory Branch. 2002. Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling. Version 3.3. Victoria BC. 26 pp. http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri sample selection 2k2/sample selection vri dec final.pdf
- Ministry of Forests Forest Analysis and Inventory Branch. 2004. Vegetation Resources Inventory Ground Sampling Procedures. Version 4.5. Victoria BC. 213 pp.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_gs_2k4/vri_gs_2k4.pdf

 Ministry of Forests – 2007 Addendum to VRI Ground Sampling Procedures. Version 4.7. Victoria BC. 213 pp.

http://www.for.gov.bc.ca/hts/vri/standards/grnd_sample/addendum_gs_procedures_v47_risc2007.pdf

 Ministry of Forests – Forest Analysis and Inventory Branch. 2003. Vegetation Resources Inventory Ground Sampling Data Collection Procedures for Inaccessible Plots. Version 1.0. Victoria BC. 24 pp.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_data_collection_procedures2k3/vri_data_collection_procedures_2k3.pdf

 Ministry of Forests – Forest Analysis and Inventory Branch. 2006. Vegetation Resources Inventory Data Collection Standards for VRI Ground Sampling. Version 2.1. Victoria BC. 11 pp.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri data_collect_stand_2k6/vri data_collect_stand_2k6.pdf

 Ministry of Forests – Forest Analysis and Inventory Branch. 2004. Vegetation Resources Inventory Quality Assurance Procedures for VRI Ground Sampling. Version 3.0. Victoria BC. 11 pp.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri qa gs 2k4/vri qa gs 2k4.pdf

 Ministry of Forests – Forest Analysis and Inventory Branch. 2006. Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.1. Victoria BC. 83 pp.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf_2k6/nvaf_2k6.pdf

 Ministry of Forests – 2007 Addendum to Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.2. Victoria BC. 83 pp. http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf_2k7/addendum_nvaf_sampling_procedures_v42_risc2007.pdf





3.4 Roles and Responsibilities

The MoFR VRI Section Manager will:

- Sign-off the approval of the VPIP.
- Review and approval of the analyses and statistical adjustment.
- Perform a final audit of the process and results of the ground sampling program.

TimberWest's Project Coordinator will:

- Sign-off the approval of the VPIP.
- Coordinate the project.
- Select the field contractors and auditor/mentor.
- Liaise with MoFR.
- Ensure selected samples are valid.
- Monitor and communicate project progress.
- Ensure all contractors are qualified and certified, and manage fieldwork contracts.
- Monitor the budget.
- Ensure the sample packages are assembled and complete.
- Oversee ground-sampling activities.
- Ensure QA is complete.
- Assist in coordinating technical expertise where required.
- Complete interim and final analyses and statistical adjustment.
- Provide MoFR with all project deliverables, according to standards and timelines agreed with the MoFR.

The Fieldwork Contractors will:

- Complete field sampling.
- Conduct internal quality control.
- Electronically enter and validate the sampled data.

The Mentor/Auditor will:

- Complete QA work for approximately 10% of the VRI samples.
- Enter and validate the sample data.
- Prepare the QA report.

3.5 Sample List

The sample list is presented in Appendix III. If a plot cannot be established because the location has been logged or for safety reasons, an alternate plot location will be discussed with Regional Resource Inventory Forester and selected according to MoFR standards.





3.6 Deliverables

The deliverables for the project include:

- 1. The VPIP
- 2. A digital copy of the map of the target population
- 3. A digital copy of the target population database
- 4. Sample list modifications (if any),
- 5. The sample packages,
- 6. The plot cards,
- 7. The ground sampling field data in a digital format accepted by the MoFR,¹⁵
- 8. The NVAF destructive sampling data in a digital format accepted by the MoFR,
- 9. A copy of the quality assurance report for each of the Phase II and NVAF programs,
- 10. Statistical adjustment and final report including any interim analyses.

3.7 Costs

The estimated cost to implement the Phase II ground sampling and NVAF field programs will be approximately \$403,000 including field sampling, helicopter, data entry, audit, analysis and reporting costs (Table 10). This estimate should be refined once the ground sampling bids become known and the access costs for each plot location are clarified following the sample package development stage.

| VRI Phase II and NVAF | Cost | % |
|---|-----------|------|
| Project management | \$15,000 | 4% |
| Field sampling (100 plots with 70% helicopter access) 16 | \$258,000 | 64% |
| NVAF sampling | \$80,000 | 20% |
| Mentoring & QA | \$25,000 | 6% |
| Analyses, Statistical Adjustment, Report | \$25,000 | 6% |
| Total | \$403,000 | 100% |

Table 10.Expected budget for the TFL 47 VRI Phase II and NVAFprogram.

¹⁶ Phase II field sampling costs are estimated at \$1,600 / plot. Considering limited access to the TFL, we included an estimate that 70% of the plots (Johnstone Strait MU) will require helicopter access @ \$1,400 / plot. For 100 plots, this results in a field sampling cost of \$258,000. Costs are roughly based on a comparison of a similar program recently completed in an adjacent landbase, where combined field sampling and helicopter costs averaged about \$3,500 / plot.





¹⁵ Phase II and NVAF field sampling data will be submitted to the licensee and MoFR at the conclusion of each fiscal year.

4.0 SIGN-OFF SHEET

It is the intention of the proponent to implement the TFL 47 Vegetation Resources Inventory Phase II Ground Sampling Plan (VPIP) as described. As a key stakeholder in the inventory, Ministry of Forest and Range (MoFR) VRI staff has been consulted throughout the development of this plan.

Proponent Name: Bruce Storry, RPFDate:Title: Planning ForesterCompany: TimberWest Forest Corp. (TimberWest)Location: Johnstone Straits Operations

I have reviewed the TFL 47 Vegetation Resources Inventory Phase II Ground Sampling Plan. I will be advising Price Waterhouse Coopers that the work proposed in this plan meets Vegetation Resources Inventory standards and MoFR business needs.

Date:

Manager Name: Jon Vivian Manager Vegetation Resources Inventory Section Forest Analysis and Inventory Branch

Ministry of Forests and Range





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-interpretation (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. Calculation of a theoretical target sample size requires an estimate of the CV of the key attributes of interest under the proposed sampling procedures and a statement of the precision desired in these attributes.





The formal process for determining sample size for an inventory unit is to anticipate the results (e.g., target sampling error for timber volume) and then determine the approximate sample size corresponding to this desired result. This process would, for example, involve the following steps:

- 1. Set the target accuracy for the overall inventory unit accuracy to *E* for timber volume (i.e., the sampling error, or half the confidence interval associated with a given probability, e.g., $\pm 15\%$ at the 95% probability level). The number of samples should be adequate to meet the target precision.
- 2. Estimate the population coefficient of variation (CV_{sample}) of the attribute of interest based on a small sample. This CV_{sample} is defined as a relative measure of the average difference between a polygon ground measurement (assumed the true value) and its corresponding estimate from the inventory.
- 3. The following formula would then be used to estimate sample size:

$$n = \left[\frac{t * CV_{sample}}{E}\right]^2$$

where *t* is the "*t*-value" associated with a given probability and degrees of freedom, and CV_{sample} is a sample-based estimate of the population CV.

The sample size calculations suggested here are general guidelines, not exact requirements. The sample size used in practice is usually a trade-off between the calculated sample size and the expected cost, timing, credibility, flexibility, and comparability of the inventory. The size of the population is usually large enough that it does not affect sample size. The calculated sample size may be increased arbitrarily to allow for post-stratification, increased credibility, more flexibility, and a better starting point for growth projections.

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 within a management 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 management unit.

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 sampling error

Target sampling error expresses the desired accuracy of the attribute of interest (e.g., timber volume). It is usually expressed as a percentage value at a given probability level (e.g., ± 15 at the 95% probability level). This means that 95% of the time we are confident that the volume estimates are within 15% of the actual volume. Target sampling error is used to calculate the minimum sample size for subsequent ground sampling; see *Sample Size*.





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.
- 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.









Figure 4. Species distribution in the target population and sample list.



Figure 5. Net merchantable volume distribution in the target population and sample list.







Figure 6. Age distribution in the target population and sample list.



Figure 7. Height distribution in the target population and sample list.







Figure 8. Inventory Site Index distribution in the target population and sample list.





APPENDIX III – SAMPLE LIST

Table 11. Sample list for the TFL 47 VRI Phase II (Batch #1).

| Management Unit | Stratum | Substratum | TNRGVRI_ID | Mapsheet | Polygon | UTM Zone | UTM Easting | UTM Northing | Leading species | Projected height (m) | Projected age (yr) | Site Index (m) | Projected net merch | NVAF Stratrum | NVAF Enhanced |
|-----------------|--|--|--|---|--|--|--|---|--|---|---|---|---|--|--|
| Bonanza | >100_H | Low_vol | 5846 | 092L047 | 322 | 9 | 665445 | 5590819 | HM | 26 | 301 | 10 | 364 | Mature | Y |
| Johnstone | <=100_H | High_vol | 3836 | 092K042 | 857 | 10 | 305195 | 5587015 | HW | 45 | 81 | 35 | 910 | Immature | Ν |
| Bonanza | <=100_H | Low_vol | 2104 | 092L037 | 451 | 9 | 661120 | 5576742 | HW | 24 | 31 | 37 | 293 | Immature | Y |
| Johnstone | <=100_H | High_vol | 5609 | 092K041 | 249 | 10 | 295168 | 5593823 | HW | 35 | 61 | 33 | 513 | Immature | Ν |
| Johnstone | <=100_H | Low_vol | 7980 | 092L058 | 324 | 9 | 680276 | 5599927 | HW | 17 | 31 | 28 | 145 | Immature | Υ |
| Johnstone | <=100_H | High_vol | 4580 | 092K043 | 377 | 10 | 317308 | 5589723 | HW | 39 | 81 | 30 | 748 | Immature | Ν |
| Johnstone | <=100_H | Low_vol | 3093 | 092K033 | 44 | 10 | 323627 | 5585265 | HW | 20 | 51 | 22 | 221 | Immature | Ν |
| Bonanza | >100_H | Low_vol | 5244 | 092L047 | 261 | 9 | 661166 | 5587844 | HM | 18 | 221 | 7.7 | 167 | Mature | Ν |
| Johnstone | <=100_Others | High_vol | 983 | 092K024 | 20 | 10 | 331561 | 5573841 | FDC | 42 | 86 | 33 | 709 | Immature | Y |
| Johnstone | <=100_H | Low_vol | 6095 | 092K043 | 567 | 10 | 327637 | 5595303 | HW | 19 | 31 | 31 | 177 | Immature | Y |
| Johnstone | >100_H | High_vol | 5726 | 092K042 | 281 | 10 | 307767 | 5593712 | HW | 28 | 276 | 11 | 486 | Mature | Y |
| Johnstone | <=100_Others | Low_vol | 7337 | 092L060 | 42 | 9 | 712508 | 5599436 | DR | 23 | 51 | 23 | 221 | Immature | Ν |
| Johnstone | <=100_H | High_vol | 2485 | 092K033 | 278 | 10 | 323334 | 5582977 | HW | 32 | 86 | 24 | 597 | Immature | Ν |
| Johnstone | <=100_Others | Low_vol | 6509 | 092K043 | 130 | 10 | 323085 | 5596489 | DR | 19 | 41 | 21 | 172 | Immature | Ν |
| Bonanza | >100_Others | Low_vol | 4365 | 092L047 | 442 | 9 | 666643 | 5585968 | YC | 19 | 221 | 9.6 | 207 | Mature | Ν |
| Johnstone | >100_H | High_vol | 5174 | 092K041 | 507 | 10 | 298802 | 5592175 | HW | 36 | 271 | 15 | 575 | Mature | Y |
| Johnstone | <=100_Others | High_vol | 112 | 092K014 | 383 | 10 | 338809 | 5555447 | FDC | 37 | 71 | 33 | 594 | Immature | Ν |
| Johnstone | <=100_Others | High_vol | 4452 | 092K044 | 8 | 10 | 332717 | 5589894 | FDC | 30 | 81 | 25 | 466 | Immature | Y |
| Johnstone | >100_H | High_vol | 4117 | 092K044 | 163 | 10 | 339062 | 5588535 | HW | 28 | 201 | 13 | 404 | Mature | Υ |
| Johnstone | <=100_H | Low_vol | 459 | 092K014 | 25 | 10 | 335322 | 5563088 | HW | 20 | 46 | 24 | 244 | Immature | Υ |
| Bonanza | >100_H | High_vol | 4489 | 092L036 | 12 | 9 | 653876 | 5585145 | HW | 37 | 301 | 15 | 605 | Mature | Ν |
| Johnstone | <=100_H | High_vol | 6306 | 092K043 | 23 | 10 | 318151 | 5595690 | HW | 35 | 81 | 27 | 613 | Immature | Ν |
| Johnstone | <=100_H | High_vol | 4701 | 092K042 | 560 | 10 | 302041 | 5590644 | HW | 27 | 66 | 24 | 444 | Immature | Ν |
| Johnstone | <=100_H | High_vol | 6170 | 092K041 | 98 | 10 | 290435 | 5595515 | HW | 30 | 81 | 23 | 474 | Immature | Y |
| Bonanza | >100_Others | High_vol | 5805 | 092L047 | 300 | 9 | 664175 | 5590067 | BA | 36 | 221 | 15 | 661 | Mature | Y |
| Johnstone | <=100_H | Low_vol | 8606 | 092K051 | 286 | 10 | 290077 | 5606434 | HW | 9.3 | 36 | 15 | 0.1 | Immature | Ν |
| Bonanza | <=100_Others | Low_vol | 1562 | 092L037 | 173 | 9 | 669512 | 5574484 | BA | 13 | 71 | 12 | 75 | Immature | Ν |
| Johnstone | <=100_H | High_vol | 6139 | 092K043 | 78 | 10 | 321147 | 5595568 | HW | 34 | 81 | 26 | 609 | Immature | Υ |
| Johnstone | <=100_H | High_vol | 822 | 092K024 | 272 | 10 | 335361 | 5571386 | HW | 27 | 56 | 27 | 432 | Immature | Ν |
| Johnstone | <=100_H | High_vol | 7664 | 092K052 | 226 | 10 | 310165 | 5601017 | HW | 33 | 81 | 25 | 583 | Immature | Ν |
| Johnstone | >100_H | High_vol | 7533 | 092K053 | 88 | 10 | 316441 | 5600361 | HW | 45 | 151 | 25 | 744 | Mature | Y |
| Bonanza | >100_H | High_vol | 4434 | 092L047 | 423 | 9 | 665449 | 5585819 | HW | 32 | 351 | 12 | 475 | Mature | Y |
| Bonanza | >100_H | Low_vol | 6541 | 092L047 | 213 | 9 | 663449 | 5593138 | HM | 22 | 301 | 8.4 | 335 | Mature | Y |
| Johnstone | <=100_H | High_vol | 6647 | 092K041 | 31 | 10 | 290212 | 5597425 | HW | 30 | 81 | 23 | 451 | Immature | Y |
| Johnstone | >100_Others | Low_vol | 3913 | 092K042 | 707 | 10 | 313723 | 5587668 | FDC | 26 | 251 | 15 | 351 | Mature | Ν |
| Johnstone | <=100_Others | Low_vol | 89 | 092K014 | 480 | 10 | 338598 | 5555156 | FDC | 22 | 76 | 19 | 171 | Immature | Ν |
| Johnstone | >100_H | High_vol | 6043 | 092K042 | 292 | 10 | 309110 | 5594758 | HW | 30 | 271 | 12 | 506 | Mature | Ν |
| Johnstone | >100_H | Low_vol | 2186 | 092K034 | 143 | 10 | 342686 | 5581786 | HW | 24 | 201 | 11 | 329 | Mature | Y |
| Johnstone | <=100_Others | High_vol | 5100 | 092K043 | 280 | 10 | 323509 | 5592171 | FDC | 39 | 81 | 32 | 642 | Immature | Ν |
| Johnstone | >100_Others | High_vol | 8440 | 092K051 | 252 | 10 | 294922 | 5605037 | FDC | 38 | 101 | 28 | 706 | Immature | Y |
| Johnstone | <=100_H | Low_vol | 915 | 092K024 | 98 | 10 | 335302 | 5572388 | HW | 13 | 36 | 20 | 58 | Immature | Ν |
| Johnstone | <=100_H | Low_vol | 2075 | 092K034 | 321 | 10 | 339047 | 5580835 | HW | 12 | 41 | 17 | 47 | Immature | Y |
| Bonanza | >100_Others | High_vol | 3178 | 092L037 | 280 | 9 | 657043 | 5581075 | BA | 33 | 301 | 12 | 547 | Mature | Y |
| Johnstone | <=100_H | High_vol | 7775 | 092K052 | 216 | 10 | 311480 | 5601363 | HW | 33 | 81 | 25 | 482 | Immature | Ν |
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| Sample Number | Management Unit | Stratum | Substratum | TNRGVRL_ID | Mapsheet | Polygon | UTM Zone | UTM Easting | UTM Northing | Leading species | Projected height (m) | Projected age (yr) | Site Index (m) | Projected net merch | VOULD (ILLUMA) NVAF Stratrum | NVAF Enhanced |
|---------------|-----------------|--------------|------------|------------|----------|---------|----------|-------------|--------------|-----------------|----------------------|--------------------|----------------|---------------------|---------------------------------|---------------|
| 45 | Johnstone | <=100_Others | High_vol | 708 | 092K024 | 332 | 10 | 336168 | 5566653 | FDC | 40 | 86 | 31 | 756 | Immature | Ν |
| 46 | Johnstone | >100_Others | High_vol | 6065 | 092K043 | 77 | 10 | 321326 | 5595061 | FDC | 40 | 101 | 29 | 742 | Immature | Y |
| 47 | Johnstone | >100_H | High_vol | 5149 | 092K042 | 447 | 10 | 309300 | 5592049 | HW | 25 | 271 | 10 | 426 | Mature | Y |
| 48 | Johnstone | <=100_H | High_vol | 331 | 092K014 | 186 | 10 | 334919 | 5558105 | HW | 32 | 76 | 26 | 605 | Immature | Ν |
| 49 | Johnstone | <=100_Others | Low_vol | 852 | 092K024 | 59 | 10 | 332195 | 5572215 | CW | 25 | 81 | 20 | 286 | Immature | Ν |
| 50 | Johnstone | >100_Others | Low_vol | 7104 | 092K053 | 204 | 10 | 324364 | 5598437 | CW | 25 | 221 | 13 | 353 | Mature | Y |
| 51 | Johnstone | <=100_H | Low_vol | 2649 | 092K033 | 103 | 10 | 329377 | 5584030 | HW | 23 | 51 | 25 | 313 | Immature | Y |
| 52 | Johnstone | >100_Others | Low_vol | 4465 | 092K042 | 637 | 10 | 305204 | 5589715 | FDC | 24 | 251 | 13 | 302 | Mature | Y |
| 53 | Johnstone | <=100_H | Low_vol | 4277 | 092K043 | 370 | 10 | 315993 | 5589376 | HW | 25 | 76 | 20 | 385 | Immature | Ν |
| 54 | Johnstone | >100_Others | Low_vol | 2106 | 092K034 | 368 | 10 | 343053 | 5580971 | CW | 25 | 251 | 12 | 341 | Mature | Y |
| 55 | Bonanza | >100_H | Low_vol | 7021 | 092L047 | 71 | 9 | 658712 | 5594044 | HM | 28 | 301 | 11 | 373 | Mature | Y |
| 56 | Bonanza | >100_H | High_vol | 1513 | 092L027 | 132 | 9 | 665939 | 5573839 | HM | 34 | 301 | 13 | 524 | Mature | Ν |
| 57 | Johnstone | <=100_H | Low_vol | 8906 | 092K061 | 41 | 10 | 297202 | 5609447 | HW | 27 | 51 | 29 | 376 | Immature | Y |
| 58 | Bonanza | >100_Others | High_vol | 2497 | 092L037 | 311 | 9 | 656854 | 5578367 | BA | 40 | 351 | 14 | 650 | Mature | Ν |
| 59 | Johnstone | <=100_Others | Low_vol | 3128 | 092K033 | 39 | 10 | 321818 | 5585039 | FDC | 27 | 36 | 38 | 302 | Immature | Ν |
| 60 | Johnstone | <=100_Others | High_vol | 6964 | 092K041 | 33 | 10 | 291435 | 5597976 | CW | 38 | 85 | 29 | 564 | Immature | Y |
| | | | | | | | | | | | | | | | | |





Table 12. Sample list for the TFL 47 VRI Phase II (Batch #2). Note, batch #2 samples may be subject to change following review of batch 1 CV and targeted sampling intensity by strata.

| Sample Number | Management Unit | Stratum | Substratum | TNRGRES_ID | Mapsheet | Polygon | UTM Zone | UTM Easting | UTM Northing | Leading species | Projected height (m) | Projected age (yr) | Site Index (m) | Projected net merch volume (m3/ha) |
|---------------|-----------------|--------------|------------|------------|----------|---------|----------|-------------|--------------|-----------------|----------------------|--------------------|----------------|---------------------------------------|
| 61 | Johnstone | >100_Others | High_vol | 5992 | 092K042 | 191 | 10 | 301525 | 5595166 | FDC | 45.1 | 151 | 28.2 | 839 |
| 62 | Johnstone | <=100_Others | Low_vol | 1844 | 092K035 | 63 | 10 | 344664 | 5578805 | DR | 26.2 | 51 | 26.2 | 227 |
| 63 | Johnstone | <=100_H | Low_vol | 295 | 092K014 | 226 | 10 | 338213 | 5557971 | HW | 25.4 | 56 | 25 | 392 |
| 64 | Johnstone | <=100_H | High_vol | 7151 | 092K052 | 272 | 10 | 302062 | 5598545 | HW | 33.3 | 81 | 25.4 | 497 |
| 65 | Bonanza | >100_H | High_vol | 2221 | 092L037 | 22 | 9 | 665772 | 5577932 | HW | 34 | 251 | 14.3 | 569 |
| 66 | Bonanza | <=100_H | Low_vol | 2187 | 092L037 | 458 | 9 | 661391 | 5577453 | HW | 22.7 | 31 | 35.8 | 282 |
| 67 | Johnstone | <=100_H | Low_vol | 422 | 092K014 | 100 | 10 | 335149 | 5561295 | HW | 20.4 | 46 | 24.2 | 256 |
| 68 | Bonanza | <=100_H | Low_vol | 1875 | 092L037 | 541 | 9 | 662599 | 5574802 | HW | 25.8 | 31 | 38.9 | 290 |
| 69 | Johnstone | <=100_Others | Low_vol | 7732 | 092K052 | 120 | 10 | 306370 | 5601171 | DR | 29.1 | 61 | 27.8 | 295 |
| 70 | Bonanza | <=100_Others | Low_vol | 7759 | 092L046 | 167 | 9 | 647825 | 5596098 | DR | 30.2 | 46 | 31.1 | 319 |
| 71 | Johnstone | <=100_H | High_vol | 2530 | 092K034 | 265 | 10 | 330455 | 5583486 | HW | 36.3 | 86 | 26.8 | 661 |
| 72 | Johnstone | <=100_H | High_vol | 5525 | 092K043 | 305 | 10 | 320670 | 5593687 | HW | 33.3 | 81 | 25.4 | 600 |
| 73 | Bonanza | <=100_H | Low_vol | 2175 | 092L037 | 468 | 9 | 663192 | 5577426 | HW | 22.7 | 31 | 35.8 | 281 |
| 74 | Johnstone | >100_H | High_vol | 2764 | 092K033 | 151 | 10 | 327592 | 5584403 | HW | 32 | 251 | 13.4 | 481 |
| 75 | Bonanza | <=100_H | Low_vol | 7735 | 092L046 | 24 | 9 | 650978 | 5594827 | HW | 24.6 | 39 | 31.8 | 376 |
| 76 | Johnstone | <=100_H | Low_vol | 2073 | 092K035 | 108 | 10 | 346810 | 5579917 | HW | 25.2 | 91 | 17.6 | 340 |
| 77 | Johnstone | <=100_H | High_vol | 8679 | 092K051 | 102 | 10 | 299327 | 5607560 | HW | 32.3 | 81 | 24.5 | 494 |
| 78 | Bonanza | >100_Others | Low_vol | 6345 | 092L047 | 112 | 9 | 657691 | 5592102 | YC | 22 | 221 | 11 | 325 |
| 79 | Johnstone | <=100_Others | Low_vol | 6128 | 092K043 | 150 | 10 | 324817 | 5594818 | DR | 18.2 | 41 | 19.5 | 124 |
| 80 | Johnstone | <=100_H | High_vol | 6947 | 092K052 | 381 | 10 | 313834 | 5597766 | HW | 35.3 | 81 | 27 | 569 |
| 81 | Bonanza | >100_Others | High_vol | 1212 | 092L027 | 191 | 9 | 663861 | 5570854 | YC | 27 | 221 | 13.5 | 451 |
| 82 | Johnstone | >100_H | High_vol | 2098 | 092K034 | 328 | 10 | 339750 | 5580906 | HW | 27 | 231 | 11.5 | 413 |
| 83 | Johnstone | <=100_H | Low_vol | 6005 | 092K043 | 30 | 10 | 317935 | 5595299 | HW | 18.5 | 36 | 26.9 | 161 |
| 84 | Johnstone | <=100_H | High_vol | 3009 | 092K032 | 190 | 10 | 307698 | 5584613 | HW | 38.3 | 81 | 29.6 | 770 |
| 85 | Johnstone | <=100_Others | Low_vol | 6238 | 092K043 | 125 | 10 | 323572 | 5596169 | DR | 18.2 | 41 | 19.5 | 124 |
| 86 | Johnstone | >100_Others | Low_vol | 4464 | 092K042 | 621 | 10 | 304010 | 5589863 | FDC | 33 | 271 | 17.6 | 392 |
| 87 | Bonanza | <=100_H | Low_vol | 2030 | 092L037 | 454 | 9 | 661952 | 5575976 | HW | 23.7 | 31 | 37.2 | 301 |
| 88 | Bonanza | >100_Others | High_vol | 1492 | 092L027 | 248 | 9 | 669724 | 5574193 | BA | 34.1 | 301 | 12 | 405 |
| 89 | Johnstone | <=100_H | High_vol | 451 | 092K014 | 27 | 10 | 336208 | 5562752 | HW | 35.3 | 76 | 28.2 | 671 |
| 90 | Johnstone | <=100_H | Low_vol | 2675 | 092K034 | 263 | 10 | 329844 | 5583211 | HW | 19.3 | 51 | 20.9 | 225 |
| 91 | Johnstone | <=100_H | High_vol | 808 | 092K024 | 220 | 10 | 332662 | 5571396 | HW | 30.6 | 85 | 22.7 | 523 |
| 92 | Bonanza | >100_H | High_vol | 7394 | 092L046 | 101 | 9 | 654489 | 5594571 | HW | 27 | 221 | 11.7 | 465 |
| 93 | Johnstone | <=100_H | Low_vol | 8606 | 092K051 | 286 | 10 | 290652 | 5605811 | HW | 9.3 | 36 | 14.7 | 0.1 |
| 94 | Johnstone | <=100_H | High_vol | 5977 | 092K043 | 188 | 10 | 328008 | 5594588 | HW | 38.3 | 81 | 29.6 | 626 |
| 95 | Johnstone | <=100_Others | Low_vol | 6949 | 092K041 | 50 | 10 | 294539 | 5598050 | DR | 28.1 | 71 | 26 | 265 |
| 96 | Johnstone | <=100_H | Low_vol | 4601 | 092K041 | 370 | 10 | 296736 | 5590558 | HW | 19.5 | 41 | 25 | 220 |
| 97 | Johnstone | <=100_Others | High_vol | 8892 | 092K061 | 48 | 10 | 299396 | 5609258 | FDC | 36.2 | 81 | 29.4 | 584 |
| 98 | Johnstone | >100_H | Low_vol | 2097 | 092K034 | 310 | 10 | 338269 | 5581367 | HW | 25 | 231 | 10.6 | 359 |
| 99 | Bonanza | >100_H | High_vol | 1821 | 092L037 | 25 | 9 | 665794 | 5574933 | HW | 33 | 301 | 13 | 533 |
| 100 | Johnstone | <=100_Others | Low_vol | 8810 | 092K051 | 533 | 10 | 301073 | 5608690 | DR | 25.1 | 61 | 24.1 | 217 |
| | | | | | | | | | | | | | | |





APPENDIX IV – ADDITIONS TO STANDARD VRI METHODS

In order to provide data that better meets TimberWest's inventory needs, additional field data collection are proposed beyond provincial VRI standards. The intent is that these data may aid future plot remeasurements. The additions to current VRI methods include:

- Recording the distance plot centre-tree on auxiliary plots.
- Recording borderline trees that are outside the prism plot.

Recording the distance plot centre-tree on auxiliary plots

Tree distances are only recorded on the Integrated Plot Centre (IPC). We propose recording this attribute on all auxiliary plots to increase the information on tree distances.

Recording borderline trees outside the prism plot

Recording borderline trees will decrease the likelihood of missing a tree. In the current system, trees are dropped from compilation if the tree was mistakenly recorded as an in tree, but it is impossible to know if missed trees should have been included.



