Golden TSA

Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment and Net Volume Adjustment Factor Development

PREPARED FOR:

LOUISIANA-PACIFIC CANADA LTD.

PREPARED BY:

Jahraus & Associates Consulting Inc.
Maple Ridge BC

&

Churlish Consulting Ltd.
Victoria BC

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EXECUTIVE SUMMARY

The Vegetation Resources Inventory Strategic Inventory Plan (VSIP) for the Columbia Forest District identified completion of a new Phase I photo-estimated inventory and Phase II ground sampling as two high-priority VRI activities for the Golden TSA. A new VRI Phase I photo-estimated inventory for the Golden TSA was completed in December of 2001, based on 1996/1997 aerial photography. In anticipation of ground sampling activities in the Golden TSA, a detailed project implementation plan (VPIP) was prepared in August of 2003 by Atticus Resource Consulting Inc. This document, entitled *Golden TSA VRI Ground Sampling: Project Implementation Plan*, specified details of ground sampling activities including Net Volume Adjustment Factor (NVAF) sampling.

The objectives of this analysis of the Golden TSA Phase I and Phase II data included:

- compilation of the destructive sampling data and determination of the NVAF values (with appropriate weighting)
- compilation of the Phase II ground sample data, incorporating the NVAF values
- development of statistical adjustment factors based on the Phase II sample data
- adjustment of the inventory files using both VDYP6 and VDYP7 platforms.

The Ministry of Forests & Range (MoFR) is currently in transition between the old VDYP6 yield model and the new VDYP7 model. Concurrently, the database model for the provincial inventory is also in transition between the old INCOSADA and the new VRIMS structure. Once VRIMS is fully operational, it is expected that the VDYP7 adjustment factors that have been produced in this analysis will be able to be loaded directly into the "adjusted area repository" of the new VRIMS database. As a result, the adjusted inventory file produced in this analysis should be considered interim since, at the moment, there is no mechanism to integrate this information into VRIMS.

The Phase II VRI in the Golden TSA involved the establishment of 85 ground samples selected from the population of vegetated treed (VT), operable polygons that were at least 30 years of age. From among these samples, a total of 75 trees were selected for destructive sampling and NVAF development according to current MoFR procedures. Analysis of the destructively sampled tree data yielded the NVAF values in Table 1. The Phase II VRI volumes were compiled based on these NVAF values.

Table 1: NVAF values and 95% sampling errors by stratum for the Golden TSA

NVAF stratum	***n (number of NVAF sample trees)***	***NVAF value***	***Sampling error % (at 95% confidence level)***
Dead trees	5	0.959	11.5%
Immature	10	0.993	4.9%
Mature – FPL	30	1.111	5.2%
Mature – Other species	30	1.025	11.8%

The Phase II sample data and the corresponding Phase I inventory data were used to develop two sets of VRI statistical adjustment factors, one for each of VDYP6 and VDYP7. The VDYP6 adjustment factors were developed according to the MoFR standards and procedures for VDYP6 adjustment using the interim "Fraser Protocol" approach. The methodology for development of the VDYP7 adjustment factors was based on draft standards and procedures (March 14, 2007) and discussions with Forest Analysis and Inventory Branch (FAIB) staff[1].

The factors in Tables 2 and 3 below were used in the final VDYP6 and VDYP7 inventory file adjustments, respectively. These factors were applied to the inventory files for the population of interest defined as all vegetated treed (VT) polygons in the operable portion of the Golden TSA, greater than or equal to 30 years of age. The strata for the VRI statistical adjustment analysis were based on the Phase II sample pre-stratification. Analysis of the residuals showed that further post-stratification was not warranted.

Table 2: VDYP6 height, age and volume adjustment factors for VT, operable polygons, ≥30 years of age in the Golden TSA. (Volume utilization is net dwb; 17.5cm+ dbh except 12.5cm+ dbh for Pl and deciduous leading polygons)

Inventory leading species stratum	***Height adjustment ratio of means***	***Age adjustment ratio of means***	***"Attribute-adjusted" volume adjustment ratio of means***
Cedar/hemlock	0.943	1.214	1.065
Deciduous	0.980	0.732	1.491
Fir/pine	0.954	1.071	1.093
Spruce/balsam	0.867	0.919	1.158

Table 3: VDYP7 height, age, basal area, trees per hectare and volume adjustment factors for VT, operable polygons, ≥30 years of age in the Golden TSA. (Volume utilization is net *dw2*; 12.5cm+ dbh).

Inventory leading species stratum	***Height adjustment ratio of means***	***Age adjustment ratio of means***	***Basal area (7.5cm+ dbh) adjustment ratio of means***	***Trees per hectare (7.5cm+ dbh) adjustment ratio of means***	***"Attribute-adjusted" volume adjustment ratio of means***
Cedar/hemlock	0.942	1.214	0.933	1.826	1.132
Deciduous	0.980	0.737	0.549	0.905	1.076
Fir/pine	0.958	1.075	0.944	2.054	0.964
Spruce/balsam	0.866	0.920	0.951	1.746	1.219

[1] Sam Otukol, Forest Biometrician at FAIB, MoFR was consulted on a regular basis during the development of the VDYP7 adjustment factors. The approach taken was approved at a March 8, 2007 conference call meeting with MoFR staff.

The ground volume was compared with the unadjusted inventory volume for the Phase II samples to provide an estimate of the volume impact of the adjustments. The estimated volume impacts and their associated sampling errors are shown in Table 4. Note that the actual VDYP6 adjustment is based on a utilization that approximates that used for timber supply analysis (i.e. a mixture of 17.5cm+ dbh and 12.5cm+ dbh). For VDYP7, the adjustment is based on 12.5cm+ dbh utilization. For easier comparison between VDYP6 and VDYP7, Table 4 shows the impact of a VDYP6 adjustment based on a 12.5cm+ dbh utilization as well.

Table 4: VDYP6 and VDYP7 estimated volume impacts of an adjustment (and sampling error at a 95% confidence level), based on the Phase II sample data (for VT, operable polygons, ≥30 years of age in the Golden TSA).

Inventory leading species stratum	***n***	***VDYP6 estimated volume impact (17.5cm+ dbh except 12.5cm+ dbh for Pl or Dec leading, net dwb)***	***VDYP7 estimated volume impact (12.5cm+ dbh net dwb)***	***VDYP6 estimated volume impact based on 12.5cm+ dbh net dwb***
Cedar/hemlock	15	0.981 ± 26.0%	1.030 ± 26.8%	0.979 ± 25.8%
Deciduous	8	0.977 ± 84.4%	0.526 ± 86.7%	0.977 ± 84.4%
Fir/pine	31	1.018 ± 13.1%	0.870 ±13.8%	1.038 ± 12.8%
Spruce/balsam	31	0.932 ± 16.7%	0.984 ±17.7%	0.961 ± 16.6%
Overall	*85*	*0.974 ± 9.5%*	*0.935 ± 10.0%*	*0.993 ± 9.4%*

Direct inferences from this data about the performance of the VDYP6 and VDYP7 yield models must be made with caution. The volume impact ratios in Table 4 not only reflect potential bias in the yield models but they also reflect bias in the underlying inventory attributes such as height and basal area that are required inputs for the yield models. Also note that VDYP7 relies, in part, on a different set of input attributes (e.g. basal area) compared with VDYP6 (e.g. crown closure). Hence it is important to be aware that the overall volume bias implied by the impact ratios in Table 4 is influenced by bias in the inventory attributes as well as bias in the yield models.

For both the VDYP6 and VDYP7 adjustments, the sampling error targets specified in the VPIP were met.

The scope of this project also included applying the adjustment factors to the inventory files for the Golden TSA. The adjustment was limited to VT, operable polygons ≥30 years of age. Analysis of the volume impact of the adjustment on the *population* (adjusted total population volume compared with unadjusted total population volume) produced the following results:

Table 5: VDYP6 and VDYP7 volume impacts based on a comparison of the adjusted and unadjusted population files (for VT, operable polygons, ≥30 years of age in the Golden TSA).

Inventory leading species stratum	***VDYP6 population volume impact (12.5cm+ dbh net dwb)***	***VDYP7 population volume impact (12.5cm+ dbh net dwb)***
Overall	0.989	0.933

These compare well with the volume impacts that were estimated from the Phase II samples in Table 4.

Once VRIMS is fully operational it is recommended that the VDYP7 adjustment factors be loaded into the "adjusted area repository" for full implementation of the statistical adjustment of the Golden TSA in the operational inventory. It is also recommended that prior to the operational adjustment, a population verification be carried out to ensure that the adjusted population matches the population of interest specified in the VPIP.

If additional funds become available it is recommended that they be directed toward additional destructive sampling in the "Mature – Other" stratum. This stratum represented a mix of cedar, hemlock, deciduous and other species and had a relatively high sampling error for the NVAF. It is suspected that the NVAF value could be refined and the sampling error reduced if more samples were available in this stratum and/or this stratum was post-stratified.

The sampling error associated with the adjustment of the deciduous stratum was quite high. However, the deciduous leading stratum represented only about 5% of the area in the population of interest in the Golden TSA. Despite this, if the perceived risk associated with the adjustment for deciduous is considered unacceptable then additional sampling in this stratum would likely reduce the sampling error.

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1. INTRODUCTION

1.1 Background

The Vegetation Resources Inventory Strategic Inventory Plan (VSIP) for the Columbia Forest District[2] identified completion of a new Phase I photo-estimated inventory and Phase II ground sampling as two high-priority VRI activities for the Golden TSA. A new VRI Phase I photo-estimated inventory for the Golden TSA was completed in December of 2001, based on 1996/1997 aerial photography. In anticipation of ground sampling activities in the Golden TSA, a detailed project implementation plan (VPIP) was prepared in August of 2003 by Atticus Resource Consulting Inc. This document, entitled *Golden TSA VRI Ground Sampling: Project Implementation Plan*, specified details of ground sampling activities including NVAF[3] sampling.

According to the VPIP, the main objective of the ground sampling was to sample the vegetated treed (VT) portion of the TSA located on crown forest land that was also considered "operable" based on 2002 operability linework[4]. In addition the target population was restricted to stands greater than 30 years of age. The sampling error target was specified as between 10 and 15% for attributes such as height, age and volume, with a 95% confidence interval. A total of 85 timber emphasis samples were determined to be sufficient to meet this target. NVAF destructive sampling was also planned for the Golden TSA, with a total of 75 trees planned for destructive sampling.

Ground sampling activities were carried out in the 2003 and 2004 field seasons[5], and data was made available for analysis in the summer/fall of 2006. The timing of the statistical adjustment analysis coincided with a transition period prior to full implementation of the new Ministry of Forests and Range data management system, VRIMS and perhaps more importantly, the new VDYP7 yield model. As a result, the statistical adjustment analysis was done on both platforms, i.e. VDYP6 and VDYP7.

1.2 Description of the Inventory Unit

The Golden TSA is located in southeastern BC and is part of the Columbia Forest District. The majority of the TSA is within the interior wet belt. The predominant biogeoclimatic zones include the Interior Cedar Hemlock (ICH) zone, the Engelmann Spruce Subalpine Fir (ESSF) zone, the Sub-

[2] *Columbia Forest District (Golden TSA, Revelstoke TSA, TFL 55, and TFL 56): Vegetation Resources Inventory Strategic Plan.* Ministry of Forests, Resources Inventory Branch, March 1999.

[3] Net Volume Adjustment Factor

[4] The VT operable criterion referred to polygons with greater than 10% crown closure that were at least touching the operability line.

[5] A total of 60 timber emphasis ground samples were completed in the 2003 field season. The remaining 25 samples were completed in 2004.

Boreal Spruce (SBS) zone, and the Alpine Tundra (AT) zone. TSA lands (excluding parks) encompass just over 900,000 ha, although significant portions of this area are considered inoperable.

Figure 1: Map of the Golden TSA[6].

1.3 Scope and Objectives

One objective of this project was to analyze the VRI destructive sampling data to determine Net Volume Adjustment Factor (NVAF) values for the Golden TSA. These NVAF values were to be incorporated into the analysis of the ground sample data. Another objective was to provide statistical adjustment factors for the Golden TSA based on the Ministry of Forests & Range (MoFR) old methodological standards for adjustment using the VDYP6 yield model. In addition, a parallel analysis was to be carried out using the draft standards for VRI adjustment using the VDYP7 yield model. Although both sets of adjustment factors will be used to adjust a cut of the population files, it is anticipated that the VDYP7 adjustment will become the official adjustment as the VRIMS data system and VDYP7 become fully operational.

[6] *Golden Timber Supply Area Analysis Report*, Forest Analysis & Inventory Branch, Ministry of Forests & Range, August 2003.

2. METHODS

2.1 Overview of NVAF analysis

Destructive sampling for the NVAF analysis was completed in the 2004 field season and data was made available for analysis in the summer of 2006. The NVAF compilation was completed with input and review from Will Smith, Volume and Decay Sampling Officer, Forest Analysis & Inventory Branch (FAIB), MoFR. The summary description of the NVAF analysis methodology provided below is based on the current MoFR documentation of standards and procedures for NVAF analysis[7].

In general, the first step of the NVAF analysis involves compilation of the actual volume of each NVAF sample tree based on the stem analysis data collected in the destructive sampling process. This was done using the SAS-based FAIB volume and decay tree compiler. In the second step, the estimated volume of each NVAF sample tree is compiled using the VRI plot compiler[8]. Checks for errors and inconsistencies between the data collected in the NVAF sampling and the data collected in the VRI sampling are an important part of this process. The third step in the process is the calculation of a model-based sample weight for each tree. The optimal tree sample weight is derived to minimize the variance of the ratio. Once the model weights are computed for each sample tree, the weighted ratio of actual sample tree volume (from destructive sampling) over the estimated sample tree volume (from taper equation and net factoring) is computed. This ratio is the NVAF value that is used to adjust the net merchantable net factored volume of the VRI ground sample volume. The NVAF value is applied at the species level in the VRI compiler, where it acts as a multiplier of the volume per hectare based on the strata defined for the NVAF values.

In determining the most appropriate post-stratification for the development of the NVAF values, factors such as age and species are most commonly tested. The objective of the post-stratification is to find logical groupings that provide consistent NVAF relationships and reasonable sampling error values for the NVAF ratios.

[7] Net Volume Adjustment Factor: Sampling Standards and Procedures. Version 4.0. MoFR. March 2004.

[8] Based on species, dbh, height (to provide gross merchantable volume) and the cruiser-called net factor (to provide volumes net of decay and waste).

2.2 Data issues related to the NVAF analysis

The NVAF sample trees were originally to be distributed among 23 of the ground samples. Sample #151 replaced sample #78 (which field notes indicated was burned). However, an insufficient number of Douglas-fir trees were available in these samples hence samples #60 and #76 were also changed to NVAF plots.

2.3 Population for Adjustment

The target population of polygons for VRI statistical adjustment were all operable, vegetated treed (VT) polygons greater than or equal to 30 years of age. Vegetated treed was defined as having crown closure greater than 10% and operable was defined as at least touching the operability line as determined by 2002 operability linework. Age was based on the attributes for the rank 1 layer for each polygon. The polygon list generated by these criteria was used for the sample selection process by Atticus Resource Consulting Ltd[9]. The same polygon list was used to define the population for the statistical adjustment. There were 66 polygons from the Atticus list that could not be matched with polygons on the Golden TSA inventory files provided by MoFR. A discussion of differences between population areas on the Atticus file compared with population areas from the inventory file are provided in Appendix G.

2.4 Sample Selection

The Phase II ground samples were selected by Atticus Resource Consulting Ltd. using Probability Proportional to Size With Replacement (PPSWR) procedures. Samples were allocated to strata based on area proportions, with no deliberate over-sampling of any one stratum.

2.5 Data Sources

2.5.1 Phase I photo-interpreted inventory data

The Phase I photo-interpreted data was obtained from the MoFR as a cut from the INCOSADA database[10]. An analysis subset of the Phase I data, corresponding to the list of Phase II sample polygons was then prepared. The resulting dataset is provided in Appendix A.

In preparation for the adjustment analysis, the Phase I data was projected to the year of ground sampling. For the VDYP6 analysis, samples were projected to either 2003 or 2004. For the VDYP7 analysis, all samples were projected to 2003, the year in which the majority of the ground samples

[9] The population database used for sample selection and subsequent adjustment was provided by Patty McKenna of Atticus Spatial Information Management Ltd.

[10] In the new VRIMS system, the data would be obtained as a Personal GeoDataBase (PGDB) from the LRDW.

were established[11]. Note that VDYP6 and VDYP7 use different versions of SINDEX, the site index function used for height projection. As a result, some of the projected heights coming from the two models will differ.

For stands with input age less than 30, projected height is based on estimated site index rather than input height. With the ministry's transition to VDYP7 some of the old projection tools for VDYP6, including one that was helpful in projecting young stands, were no longer accessible. As a result, VDYP7 was used to provide projected heights for the VDYP6 analysis for polygons with input age less than 30 years of age[12].

2.5.2 Phase II ground sample data

Of the total 85 samples, 60 samples were completed in the 2003 field season and the remaining 25 samples were completed in the 2004 field season. The compilation of the Phase II ground sample data incorporated a taper model correction for samples located in the ICHvk subzone. The final compilation data used for the analysis, which included the application of the NVAF values to the compiled volumes, was provided in the file: *"NVAF ground attribute 25FEB07.xls"*.

The important attributes of the Phase I and Phase II data are shown in Appendix A.

2.5.3 Data matching

The data matching, used to determine the appropriate heights and ages upon which to base the ratios, used the standard procedures outlined by the MoFR. The same set of procedures is applicable to both the VDYP6 and VDYP7 analyses. The results have been included in the Appendix A cut of the analysis spreadsheet.

For each VRI sample polygon, the ground sample data was matched with the corresponding inventory data for the same polygon. The ground heights and ages used in the adjustment were based on the average values for the T, S & L[13] trees for the leading species (by basal area at 4cm + dbh utilization) on the ground. Since a VRI inventory was available in the Golden TSA, inventory data (i.e. height and age) was available for both the leading and second species. The objective in the

[11] For VDYP7, the projection had to be done to the entire population file hence processing time did not allow projections to multiple years. It is anticipated that enhancements to VDYP7 may allow this in the future.

[12] Nine polygons were affected. It is suspected that the VDYP6 and VDYP7 heights would have be very close, hence using a VDYP7 height for these polygons in the VDYP6 analysis would have had minimal impact.

[13] T or "top height" tree is the largest DBH in 0.01 ha plot, regardless of species; L or "leading species" tree is the largest DBH in 0.01 ha plot, of leading species; S or "second species" is the largest DBH in 0.01 ha plot, of second species. T and S trees are selected and measured at the IPC only whereas L trees are selected at the IPC and all auxiliary plots. For details, refer to the MSRM document "Vegetation Resources Inventory Procedures and Standards for Data Analysis Attribute Adjustment and Implementation of Adjustment in a Corporate Database Version 2.0", March 2004.

matching process was to choose an inventory height and age (i.e. for either the leading or second species) so that the ground and inventory species "matched". If a match could not be made at the sp0[14] level, conifer-to-conifer matches were allowed. However, conifer-deciduous matches were not considered acceptable. Note that where second species inventory ages and heights were required, these attributes were also projected to the year of ground sampling.

For 43 samples (~51%), the inventory leading species matched the ground leading species at 4cm+ dbh utilization. For a further 21 samples (~25%), the ground leading species matched the inventory second species. Seventeen samples (20%) were matched based on conifer-to-conifer or deciduous-to-deciduous. The remaining 4 samples (nearly 5%) could not be matched and were excluded from the development of the age and height adjustment factors.

2.6 Data issues related to the statistical adjustment (data screening)

Data issues and assumptions made in the analysis were discussed and approved at a conference call meeting on March 8, 2007 that included representatives from the MoFR and the licencee. The issues/questions and their associated resolutions are documented in Appendix B.

2.7 Stocking class determination

In early summer 2004, MoFR discovered a discrepancy between stocking class assignment in FIPUPDATE and BATCHVDYP6. A new procedure for assigning stocking class was developed and MoFR recommended that this procedure be used in the analysis of all VRI analysis projects using VDYP6[15]. This methodology was applied in the VDYP6 analysis of the Golden TSA data.

2.8 Stratification

Four leading species strata, based on area coverage and similar growth characteristics, were identified for sample selection in the VPIP. These included:

- fir/pine (FPL),
- spruce/balsam (SB),
- cedar/hemlock (CH), and
- deciduous (Dec).

These strata were maintained in the analysis for the adjustment. Further post-stratification by age was examined. However, since there were no age-related patterns in the bias of the residuals, age post-stratification was unwarranted.

[14] sp0 refers to the 16 major species codes and is roughly equivalent to the genus level.

[15] For details of the new procedure, please refer to http://srmwww.gov.bc.ca/tib/vri/vri/standards/adjustments/Stocking_class%20_addendum_Aug_04.pdf

2.9 Overview of statistical adjustment

For the VDYP6 analysis, the statistical adjustment followed the MoFR interim process often referred to as the "Fraser Protocol". In this process, the age and height attributes are adjusted first and used as inputs to generate an interim or "attribute-adjusted" VDYP6 volume. This volume is then used to develop a final volume adjustment factor. Hence the adjustment process occurs sequentially in two stages.

The VDYP7 statistical adjustment process is similar in that it is also sequential and involves two stages. However, additional attributes are adjusted at the first stage (age, height, basal area at 7.5cm+ dbh utilization (BA7.5), and trees per hectare at 7.5cm+ dbh utilization (TPH7.5)). Although the process has the flexibility to adjust multiple attributes at the second stage, only volume net decay and waste at the 12.5cm+ dbh utilization will be adjusted at the current time. Within the VDYP7 context, various internal modules of VDYP7 are used to project the polygons, generate additional attributes, and adjust attributes. Hence the VDYP7 model itself takes a much larger role in the statistical adjustment process than did VDYP6.

3. RESULTS AND DISCUSSION

3.1 NVAF analysis

The NVAF sampling plan selected 75 trees for destructive sampling. In the VPIP for the Golden TSA, four strata were identified for NVAF sampling:

- Live immature i.e. ≤120 years (10 trees)
- Live mature (i.e. >120 years) FPL (30 trees)
- Live other mature (30 trees)
- Dead trees.

Other alternative strata were tested in the analysis of the destructively sampled data but using the selection strata produced the best results in terms of consistency and sampling error.

The resulting NVAF values and sampling errors by stratum are shown in the table below.

Table 1: NVAF values and 95% sampling errors by stratum for the Golden TSA

NVAF stratum	*n (number of NVAF sample trees)*	*NVAF value*	*Sampling error % (at 95% confidence level)*
Dead trees	5	0.959	11.5%
Immature	10	0.993	4.9%
Mature – FPL	30	1.111	5.2%
Mature – Other species	30	1.025	11.8%

The most notable result from the analysis was that the taper equations for Douglas-fir consistently underestimated volume by about 12%. The sampling error in the "Mature – Other species" stratum, was slightly higher than is typically achieved in the NVAF analysis, likely due to the fact that this stratum included cedar mixed with hemlock and deciduous. If additional funds for NVAF become available, sampling should be directed to this stratum.

The NVAF values in Table 1 were applied in the VRI compiler to produce Phase II ground sample volumes based on net factoring adjusted with the NVAF values. The Phase II volumes with NVAF applied are shown in Appendix A.

3.2 VDYP6 Adjustment Analysis

3.2.1 Age and height adjustment

There were five samples missing ground ages and/or heights[16]. When the samples without a suitable inventory species match were also excluded, there were 76 samples for age and height that were available for the development of the age and height adjustment factors. In most situations[17], the PPSWR formula for computation of the adjustment ratio of means in each stratum can be simplified to the following:

$$\hat{R}_h = \frac{\bar{y}_h}{\bar{x}_h} \qquad [1]$$

where $\bar{y}_h$ is the mean ground height (or age) in stratum *h* and $\bar{x}_h$ is the mean inventory height (or age) in stratum *h*.

[16] For three samples, neither ages nor heights were available from the ground data. There were two additional samples that had missing age data but available heights and two other samples that had missing height data but available ages.

[17] If the PPSWR pre-stratification is not maintained, sample weights (selection probabilities) must be explicitly calculated and equation [1] becomes considerably more complicated.

This formula was used to compute the adjustment ratios for height and age. Tables 2 and 3 show the mean values and the ratio of means height and age adjustment factors for the VT, operable, greater than or equal to 30 years of age population of interest.

Table 2: Mean heights and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP6 adjustment.

Strata (inventory leading species)	*n*	*Mean ground height (m)*	*Mean inventory height[18] (m)*	*Height adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	12	26.4	28.0	0.943	17.6%
Dec	7	15.2	15.6	0.980	38.0%
FPL	30	23.6	24.7	0.954	5.5%
SB	26	22.7	26.2	0.867	10.4%

Table 3: Mean ages and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP6 adjustment.

Strata (inventory leading species)	*n*	*Mean ground age (years)*	*Mean inventory age (years)*	*Age adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	13	244	201	1.214	14.2%
Dec	7	33	45	0.732	34.4%
FPL	30	107	100	1.071	11.3%
SB	26	138	150	0.919	18.1%

The adjustment ratios in Table 2 indicate that height is generally overestimated in the inventory. For most leading species strata, the height overestimation is less than 6%. However, the sample indicates that heights are overestimated by about 15% (about 3.5 m on average) in the spruce/balsam stratum.

The largest error in inventory ages was observed in the deciduous stratum. However the sample size in this stratum was quite small and the sampling error associated with the age adjustment ratio in the deciduous stratum was high. The sample indicates that inventory age in the cedar/hemlock stratum is underestimated by about 20% on average. The relationship between ground height (and age) and inventory height (and age) by stratum are shown graphically in Appendix C. Plots of the residual[19]

[18] Mean inventory heights and ages are based on the set of values used to develop the adjustment ratios. These may have included second species heights and ages where the second species provided a better "match" with the ground species.

[19] Plots of "residual" values for adjusted attributes (ground value minus the adjusted value) can be used to assess potential bias problems associated with an adjustment model.

values were examined within each stratum for potential trends in adjustment bias (see Appendix C). The residuals did not indicate any issues with the adjustment.

3.2.2 Volume adjustment based on NVAF volumes and VDYP6

The height and age adjustment factors were applied to the rank 1 inventory ages and heights for the samples. These adjusted heights and ages, together with the unadjusted species composition, crown closure, and stocking class, were then input into VDYP v6.6d to produce "attribute-adjusted" inventory volumes[20]. The adjustment ratios for volume were then calculated based on the ratio of ground volume to "attribute-adjusted" VDYP6 inventory volume. The analysis was based on net factored (NF) ground volumes to which the NVAF values had been applied in the compilation.

The volume utilization used in the analysis was live stems 17.5cm + dbh for all polygons except for polygons where the inventory indicated lodgepole pine or deciduous as the leading species; for these polygons the utilization was 12.5cm + dbh. Volumes were calculated net of decay, waste and breakage (dwb). This utilization applied to both inventory and ground volumes and was determined by the inventory leading species for a particular sample. In a "Fraser Protocol"/VDYP6 adjustment, the volume adjustment is typically designed to approximate the utilization that would be used in a timber supply analysis.

Table 4 below presents volume adjustment factors by strata for the VT, operable, ≥ 30 years of age population of interest. For the Phase II ground samples, the "attribute-adjusted" inventory volumes were adjusted using the volume adjustment ratio of means shown in this table. The resulting "final" adjusted inventory volumes were then compared with the ground volumes in each stratum. The plots of the "residual" values (i.e. ground value minus adjusted value) were used to evaluate the volume adjustments. Graphs showing the volume relationships and the residuals are provided in Appendix D.

Table 4: Mean volumes and volume adjustment ratios for the VT, operable, ≥ 30 years of age population of interest. Utilization: 17.5cm+dbh except 12.5cm+dbh if Pl or Dec leading in the inventory. Volumes are net decay, waste & breakage.

Strata (inventory leading species)	*n*	*Mean ground vol/ha*	*Mean attribute-adj'd inventory vol/ha*	*Volume adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	15	358	336	1.065	27.0%
Dec	8	51	35	1.491	101.6%
FPL	31	251	229	1.093	13.1%
SB	31	254	219	1.158	17.1%

[20] As part of MoFR's stocking class assignment procedure, new stocking classes for all samples were determined based on the adjusted ages and heights prior to producing the "attribute-adjusted" volumes.

The values in Table 4 would suggest that even after the height and age attributes have been adjusted, there is still volume underestimation bias associated with either the other remaining unadjusted inventory attributes (e.g. species composition, stocking class, crown closure) and/or the VDYP6 estimates of volume. This bias was particularly notable in the deciduous stratum but also was quite large in the spruce/balsam stratum.

3.2.3 Estimated volume impact for the VDYP6 statistical adjustment

The volume factors in Table 4 represent adjustments to volumes based on inventory heights and ages that have already been adjusted. To provide and estimate of the overall impact of the adjustment process (i.e. the cumulative impact of the age, height and attribute-adjusted volume adjustment) the Phase II sample average ground volume was compared with the unadjusted average inventory volume (i.e. inventory volumes prior to any age, height or volume adjustment). The estimated volume impacts of the adjustment, by stratum and overall, are shown in Table 5.

Table 5: Estimated VDYP6 volume impact by stratum for the VT, operable, ≥ 30 years of age population of interest, based on the Phase II samples. Utilization: 17.5cm+dbh except 12.5cm+dbh if Pl or Dec leading in the inventory. Volumes are net decay, waste & breakage.

Strata (inventory leading species)	*Area (ha)*	*n*	*Mean ground vol/ha*	*Mean unadjusted inventory vol/ha*	*Volume impact*	*Sampling error (based on 95% confidence interval)*
CH	28,036	15	358	365	0.981	26.0%
Dec	10,663	8	51	53	0.977	84.4%
FPL	82,224	31	251	246	1.018	13.1%
SB	84,616	31	254	272	0.932	16.7%

The volume impact estimates in Table 5 are based on the Phase II compiled volumes, which have incorporated the NVAF values. The VRI ground sample data indicates that the largest volume impacts of the adjustments will occur in the spruce/balsam stratum, where the current inventory appears to overestimate volume by about 7%. The volume impact in all other strata is less than 3%.

3.2.4 Sampling error

The VPIP for the Golden TSA specified a target sampling error of between 10% and 15% (at a 95% probability level) for vegetated treed (VT), operable polygons, greater than or equal to 30 years of age. To provide an indication of the sampling error achieved in the VDYP6 adjustment process, a comparison of the overall estimated ground sample volume and the overall estimated unadjusted inventory volume for the sample was made. The overall ratio of these values and its standard error

were computed using the formula for a separate ratio estimate after a pre-stratified PPSWR sample. The result for the VT, operable, greater than or equal to 30 years of age population are summarized in Table 6 below.

Table 6: Estimated adjusted VDYP6 total volume and sampling error for the Golden TSA based on separate ratio estimators (for the VT, operable, ≥ 30 years of age population of interest). Utilization: 17.5cm+dbh except 12.5cm+dbh if Pl or Dec leading in the inventory. Volumes are net decay, waste & breakage.

Volume	*n*	*Total area (ha)*	*Overall estimated total adjusted inventory volume (m^3)*	*Overall estimated total unadj'd inventory volume (m^3)*	*Overall adjustment impact Ratio*	*Sampling error (as % of total adjusted volume))*
Overall	*85*	*205,539*	*52,663,007*	*54,064,998*	*0.974*	*9.5%*

The overall impact of a VDYP6 adjustment was estimated to be 0.974 within a 9.5% sampling error (at the 95% confidence level). This sampling error met the target set in the VPIP.

3.2.5 Inventory file adjustment for the VDYP6 statistical adjustment

The Phase I inventory files for the population of interest were adjusted using the factors in Tables 2 and 3 for height and age respectively and Table 4 for volume. The adjustment procedure followed the "Fraser Protocol" for a VDYP6 adjustment. Since the MoFR is currently transitioning to the VDYP7 platform, it is not expected that this VDYP6 adjusted file will be used operationally. However, it is useful as a comparison with the VDYP7 procedures and adjustment results.

Appendix G shows the volume and area distribution by age class, for the population of interest, before and after the adjustment for both the VDYP6 and VDYP7 adjustments. For VDYP6, the pre- and post-adjustment comparisons are based on an inventory file projected to 2005. Ideally, the population adjustment would have been carried out on a file projected to 2003. However, since two key components of the VDYP6 file projection software were unavailable[21], the adjustment was done on a VIF file that had been projected to 2005 (the closest available projection to the year of ground sampling).

The unadjusted total VDYP6 population volume was compared with the adjusted total VDYP6 population volume[22], after the height, age and "attribute-adjusted" volume factors had been applied to

[21] The TAD and SCOPE projection and adjustment software for VDYP6 has been taken off-line in anticipation of the VDYP7 implementation.

[22] Sum of the polygon volumes/ha times the polygon areas. The population volumes in this comparison were based on net dwb volumes at the 12.5cm+ dbh utilization. Because much of the VDYP6 processing and

all of the VT, operable polygons ≥30 years of age. The ratio of the adjusted to unadjusted VDYP6 volume in the population was 0.989, which was reasonably close to the 0.974 volume impact ratio that was estimated from the sample and shown in Table 6.

3.3 VDYP7 Adjustment Analysis

The Golden TSA VRI statistical adjustment was also performed using VDYP7 and the new process for making adjustments in the VDYP7 context[23]. The Golden TSA population file used for this adjustment was not made available in the standard PGDB format that is required for input into VRIMS. However, the VDYP7 adjustment factors developed in this analysis will be provided in a standard format[24] so that it will be possible to apply them to the operational inventory files once PGDBs are available and VRIMS has been fully implemented.

3.3.1 First stage VDYP7 adjustment: Height, age, basal area & trees per hectare

The VDYP7 adjustment process occurs in two stages, similar in this respect to the VDYP6 adjustment. At the first stage, age and height are adjusted. However, two additional inventory attributes, basal area (BA) and trees per hectare (TPH) at 7.5cm+ dbh utilization are also adjusted. The data matching process for the height and age adjustment is the same for both VDYP6 and VDYP7. The PPSWR formula for computation of the adjustment ratio of means is also the same (see section 3.2.1).

The resulting VDYP7 adjustment factors for height, age, basal area and trees per hectare are shown in Tables 7, 8, 9 & 10 respectively. Scatterplots of the Phase I and II relationships for these attributes are provided in Appendix E.

projection software has been taken off-line in anticipation of the VDYP7 implementation, the comparison had to be done on an inventory file projected to 2005. It is also suspected that being unable to run the inventory file through some components of the standard VDYP6 software (e.g. TAD & SCOPE) may have introduced some error into the VDYP6 adjusted inventory file, particularly for stands that were less than 30 years of age at input age.

[23] Permission was received from Jon Vivian, Manager, Vegetation Resources Inventory, Forest Analysis & Inventory Branch, MoFR to use VDYP7 and the VDYP7 Attribute Adjustment software as a limited beta test.

[24] The adjustment factors will be provided in a "strata.mdb" file which has been specified as input for the VDYP7 Attribute Adjustment software.

Table 7: Mean heights and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP7 adjustment.

Strata (inventory leading species)	*n*	*Mean ground height (m)*	*Mean inventory height[25] (m)*	*Height adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	12	26.4	28.0	0.942	17.7%
Dec	7	15.2	15.6	0.980	38.2%
FPL	30	23.6	24.6	0.958	5.6%
SB	26	22.7	26.2	0.866	10.4%

Table 8: Mean ages and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP7 adjustment.

Strata (inventory leading species)	*n*	*Mean ground age (years)*	*Mean inventory age (years)*	*Age adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	13	244	201	1.214	14.2%
Dec	7	33	45	0.737	33.8%
FPL	30	107	100	1.075	11.23%
SB	26	138	150	0.920	18.1%

Table 9: Mean basal area at 7.5cm+ dbh utilization and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP7 adjustment.

Strata (inventory leading species)	*n*	*Mean ground basal area (m2/ha)*	*Mean inventory basal area (m2/ha)*	*Basal area adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	15	50.5	54.2	0.933	23.1%
Dec	8	12.7	23.1	0.549	70.9%
FPL	31	38.7	41.0	0.944	13.4%
SB	31	34.8	36.6	0.951	15.7%

Table 10: Mean trees per hectare (TPH) at 7.5cm+ dbh utilization and ratio of means adjustment factors, by stratum, for the VT, operable, ≥ 30 years of age population of interest, for the VDYP7 adjustment.

Strata (inventory leading species)	*n*	*Mean ground TPH*	*Mean inventory TPH*	*TPH adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	15	847	464	1.826	52.2%
Dec	8	832	920	0.905	72.4%
FPL	31	1257	612	2.054	25.7%
SB	30	900	516	1.746	34.5%

[25] Mean inventory heights and ages are based on the set of values used to develop the adjustment ratios. These may have included second species heights and ages where the second species provided a better "match" with the ground species.

The age and height adjustment factors for VDYP7 are virtually identical to those for VDYP6. The small discrepancies that are observed are a result of differences in projection year and SINDEX version (see section 2.5.1). From Table 9, it appears that the basal area on the inventory is generally overestimated. Deciduous basal area shows particular bias. However, due to the variability and the small sample size in the deciduous stratum the precision of this estimate in this stratum is quite low. The correlation between the ground and the inventory trees per hectare was weak (see Appendix E). With the exception of the deciduous stratum, all of the adjustment ratios for TPH are well over 1.0 and in the fir/pine stratum, the TPH adjustment factor is over 2.0.

3.3.2 Second stage VDYP7 adjustment: Volume

The adjustment factors for height, age, BA and TPH were input into the VDYP7 model which then produced an expanded output set of inventory attributes. Only one adjustment factor, that for volume net decay & waste2 at the 12.5cm+dbh utilization level, was directly developed from the available attributes. The ratios developed for this particular volume were applied to volumes at other utilizations[26]. Although the VDYP7 software has been designed to also accept second stage adjustment factors for Lorey height and basal area at 12.5cm+ dbh, adjustment factors for these attributes were not computed at this time[27].

Table 11 below shows the VDYP7 volume adjustment factors by strata for the VT, operable, ≥30 years of age population of interest. The ground volumes used to compute the adjustment ratio of means were based on net factored volumes to which the NVAF values had been applied in the compilation. All volumes are net decay and waste2 only, at the 12.5cm+ dbh utilization level for all polygons. Scatterplots showing the volume relationship and the residuals from the adjustment are provided in Appendix F.

[26] VDYP7 produces volumes at numerous utilization levels. Any adjustments input into VDYP7 must be harmonized, that is, care must be taken to ensure that the utilization relationships (e.g. volume at 12.5cm+ always less than or equal to volume at 7.5cm+) are not contorted by the adjustment ratios. As a simple approach to ensure harmonization, only one volume adjustment factor was computed and this factor was applied to all of the other volumes. This approach was approved by Sam Otukol, Forest Biometrician, MoFR.

[27] The VDYP7 adjustment procedures are still under development and are being tested. At the recommendation of Sam Otukol (Forest Biometrician, MoFR), Lorey height and BA at 12.5cm+ dbh were assigned an adjustment factor of 1.0. That is, no adjustment was made for these attributes.

Table 11: Mean volumes and VDYP7 volume adjustment ratios for the VT, operable, ≥ 30 years of age population of interest. Utilization: 12.5cm+dbh. Volumes are net decay & waste only.

Strata (inventory leading species)	*n*	*Mean ground vol/ha*	*Mean VDYP7 attribute-adj'd inventory vol/ha*	*Volume adjustment ratio of means*	*Sampling error (based on 95% confidence interval)*
CH	15	389	343	1.132	27.4%
Dec	8	53	49	1.076	93.7%
FPL	31	272	282	0.964	14.1%
SB	31	281	231	1.219	18.2%

Note that the volumes in Table 11 are not directly comparable to the volumes in Table 4 since the utilization levels differ. VDYP7 does not produce volumes net decay, waste and breakage until after the final (i.e. second stage) volume adjustment have been applied. In addition, whereas the VDYP6 adjustment approach was to make one volume adjustment that best approximated the utilization applied in a timber supply analysis[28], VDYP7 automatically produces adjusted volumes for an entire suite of utilizations.

3.3.3 Estimated volume impact for the VDYP7 statistical adjustment

The VDYP7 process does not output volume net decay, waste & breakage until after the stage two volume adjustment factors have been applied to the net decay & waste volumes. However, a special unadjusted run of VDYP7 was done to provide unadjusted volumes net decay, waste & breakage so that the estimated volume impact of the VDYP7 adjustment and its associated sampling error could be computed. The estimated volume impacts of the adjustment, by stratum and overall, are shown in Table 12.

Table 12: Estimated VDYP7 volume impact by stratum for the VT, operable, ≥ 30 years of age population of interest, based on the Phase II samples. Utilization: 12.5cm+dbh. Volumes are net decay, waste & breakage.

Strata (inventory leading species)	*Area (ha)*	*n*	*Mean ground vol/ha*	*Mean unadjusted inventory vol/ha*	*Volume impact*	*Sampling error (based on 95% confidence interval)*
CH	28,036	15	368	357	1.030	26.8%
Dec	10,663	8	51	98	0.526	86.7%
FPL	82,224	31	266	305	0.870	13.8%
SB	84,616	31	272	276	0.984	17.7%

[28] Often this corresponded to a "mixed" of utilizations (i.e. 12.5cm+ or 17.5cm+) depending on the inventory leading species.

The volume impact estimates in Table 12 are based on the Phase II compiled volume (which have incorporated the NVAF) and an unadjusted inventory volume produced by VDYP7. The VRI ground sample data indicates that the largest volume impacts of the adjustments with the VDYP7 model can be expected in the deciduous stratum. This is related to the overestimation of basal area[29] in deciduous leading stands that was seen in Table 9. Note, however, that the sampling error for the estimated volume impact in the deciduous stratum is quite high and hence the level of confidence in the adjustment for this stratum is weak. The other stratum where the volume impact is estimated to be high is for fir/pine, where unadjusted VDYP7 inventory volumes are expected to decrease by about 13% with the VDYP7 adjustment. The volume impact is estimated to be less than 3% in the cedar/hemlock and spruce/balsam strata.

3.3.4 Sampling error

The VPIP for the Golden TSA specified a target sampling error of between 10% and 15% (at a 95% probability level) for vegetated treed (VT), operable polygons, greater than 29 years of age. To provide an indication of the sampling error achieved in the VDYP7 adjustment process, a comparison of the overall estimated sample ground volume and the overall estimated VDYP7 unadjusted sample inventory volume was made. The overall ratio of these values and its standard error were computed using the formula for a separate ratio estimate after a pre-stratified PPSWR sample. The result for the VT, operable, ≥30 years of age population are summarized in Table 13 below.

Table 13: Estimated adjusted VDYP7 total volume and sampling error for the Golden TSA based on separate ratio estimators (for the VT, operable, ≥ 30 years of age population of interest). Utilization: 12.5cm+dbh. Volumes are net decay, waste & breakage.

Volume	*n*	*Total area (ha)*	*Overall estimated total adjusted inventory volume (m^3)*	*Overall estimated total unadj'd VDYP7 inventory volume (m^3)*	*Overall adjustment impact Ratio*	*Sampling error (as % of total adjusted volume))*
Overall	*85*	*205,539*	*55,713,448*	*59,557,838*	*0.935*	*10.0%*

The overall impact of a VDYP7 adjustment was estimated to be 0.935 with a 10.0% sampling error (at the 95% confidence level). This sampling error met the target set in the VPIP.

[29] Basal area is an important driver of volume in the VDYP7 model.

3.3.5 Inventory file adjustment for the VDYP7 statistical adjustment

The Phase I inventory files for the population of interest (VT, operable, ≥30 years of age) were adjusted using the factors in Tables 7 through 11. The adjustment was performed using MoFR's VDYP7 Attribute Adjustment interface for the VDYP7 model.

Appendix G shows the volume and area distribution by age class, for the population of interest, before and after the adjustment for both the VDYP6 and VDYP7 adjustments. For VDYP7, the pre- and post-adjustment comparisons are based on an inventory file projected to 2003.

The unadjusted total VDYP7 population volume was compared with the final adjusted total VDYP7 population volume[30]. The ratio of the adjusted to unadjusted VDYP7 volume in the population was 0.933, which was very close to the 0.935 volume impact ratio that was estimated from the sample and shown in Table 13.

4. CONCLUSIONS AND RECOMMENDATIONS

The NVAF destructive sampling in the Golden TSA indicated that the taper equations for Douglas-fir consistently underestimated volume by about 12%. The VRI Phase II ground sample indicated that heights are generally overestimated in this unit. In most strata, the height overestimation was less than 6% but in the spruce/balsam stratum, the sample indicated that heights were overestimated by about 13% or 3.5m, on average. Ages were also overestimated by about 8% in this stratum. In the VDYP7 adjustment, it was noted that basal area is consistently overestimated in the Golden TSA inventory, typically between 5-7% in most strata. The exception was the deciduous stratum where the sample indicated that the average inventory basal area was about 80% higher than the average ground sample basal area. Inventory trees per hectare had a very poor correlation with the ground estimated trees per hectare and typically was underestimated by as much as a factor of 2. The exception once again was the deciduous stratum where the average inventory trees per hectare was about 10% higher than the ground sample average trees per hectare.

In the statistical adjustment process for both VDYP6 and VDYP7, volume is adjusted in the second stage of a sequential process, after attributes such as height and age (in the case of VDYP6) and height, age, BA and TPH (in the case of VDYP7) have been adjusted. For the VDYP6 second stage adjustment of volume, the volume adjustment ratios for VDYP6 were all greater than 1.0. This indicates that once ages and heights had been adjusted, VDYP6 was underestimating volume. For the VDYP7 second stage adjustment of volume, the ratios indicate that after the first stage attribute

[30] Sum of the polygon volumes/ha times the polygon areas. The population volumes in this comparison were based on net dwb volumes at the 12.5cm+ dbh utilization.

adjustment, VDYP7 underestimates volume in all strata except fir/pine, where a slight volume overestimation was observed.

The ground volume was compared with the unadjusted inventory volume for the Phase II samples to provide an estimate of the volume impact of the adjustments. The estimated volume impacts and their associated sampling errors are summarized in Table 14 below. Note that the actual VDYP6 adjustment is based on a utilization that approximates that used for timber supply analysis (i.e. a mixture of 17.5cm+ dbh and 12.5cm+ dbh). For VDYP7, the adjustment is based on 12.5cm+ dbh utilization. For easier comparison between VDYP6 and VDYP7, Table 14 also shows the impact of a VDYP6 adjustment based on a 12.5cm+ dbh utilization as well.

Table 14: VDYP6 and VDYP7 estimated volume impacts of an adjustment (and sampling error at a 95% confidence level), based on the Phase II sample data (for VT, operable polygons, ≥30 years of age in the Golden TSA).

Inventory leading species stratum	***n***	***VDYP6 estimated volume impact (17.5cm+ dbh except 12.5cm+ dbh for Pl or Dec leading, net dwb)***	***VDYP7 estimated volume impact (12.5cm+ dbh net dwb)***	***VDYP6 estimated volume impact based on 12.5cm+ dbh net dwb***
Cedar/hemlock	15	0.981 ± 26.0%	1.030 ± 26.8%	0.979 ± 25.8%
Deciduous	8	0.977 ± 84.4%	0.526 ± 86.7%	0.977 ± 84.4%
Fir/pine	31	1.018 ± 13.1%	0.870 ±13.8%	1.038 ± 12.8%
Spruce/balsam	31	0.932 ± 16.7%	0.984 ±17.7%	0.961 ± 16.6%
Overall	*85*	*0.974 ± 9.5%*	*0.935 ± 10.0%*	*0.993 ± 9.4%*

Direct inferences about the performance of the VDYP6 and VDYP7 yield models from this data must be made with caution. The volume impact ratios in Table 14 not only reflect potential bias in the yield models but they also reflect bias in the underlying inventory attributes such as height and basal area that are required inputs for the yield models. Also note that VDYP7 relies, in part, on a different set of input attributes (e.g. basal area) compared with VDYP6 (e.g. crown closure). Hence it is important to be aware that the overall volume bias implied by the impact ratios in Table 14 is influenced by bias in the inventory attributes as well as bias in the yield models.

For both the VDYP6 and VDYP7 adjustments, the sampling error targets specified in the VPIP were met.

The scope of this project also included applying the adjustment factors to the inventory files for the Golden TSA. The adjustment was limited to VT, operable polygons ≥30 years of age. Analysis of the volume impact of the adjustment on the population (adjusted total population volume compared with unadjusted total population volume) produced the following results:

Table 15: VDYP6 and VDYP7 volume impacts based on a comparison of the adjusted and unadjusted population files (for VT, operable polygons, ≥30 years of age in the Golden TSA).

Inventory leading species stratum	*VDYP6 population volume impact (12.5cm+ dbh net dwb)*	*VDYP7 population volume impact (12.5cm+ dbh net dwb)*
Overall	0.989	0.933

These compare well with the volume impacts estimated from the Phase II samples in Table 14.

The Golden TSA population file used for this adjustment was not made available in the standard PGDB format required for input into VRIMS. VRIMS is not yet fully operational and many of its data input and output facilities are not yet fully functional. However, the VDYP7 adjustment factors developed in this analysis will be provided in a standard format[31] so that they will be able to be loaded into the Adjusted Area Repository of VRIMS in preparation for an operational adjustment of the Golden TSA once VRIMS has been fully implemented.

Prior to an operational adjustment of the Golden TSA, it is recommended that the population for adjustment be verified and reconciled with the population of interest as defined in the VPIP.

If additional funds become available it is recommended that they be directed toward additional destructive sampling in the "Mature – Other" stratum. This stratum represented a mix of cedar, hemlock, deciduous and other species and had a relatively high sampling error for the NVAF. It is suspected that the NVAF value could be refined and the sampling error reduced if more samples were available in this stratum and/or this stratum was post-stratified.

The sampling error associated with the adjustment of the deciduous stratum was quite high. However, the deciduous leading stratum represented only about 5% of the area in the population of interest in the Golden TSA. Despite this, if the perceived risk associated with the adjustment for deciduous is considered unacceptable then additional sampling in this stratum should be considered to reduce the sampling error.

[31] The adjustment factors will be provided in a "strata.mdb" file which has been specified as input for the VDYP7 Attribute Adjustment software.

5. APPENDIX A: INVENTORY AND GROUND ATTRIBUTES USED IN THE ADJUSTMENT

INVENTORY (PHASE I) ATTRIBUTES															
VRI Sample	*Mapsheet*	*Poly*	*Poly area (ha)*	*Inventory species composition*	*Analysis stratum*	*Ground sampling year*	*REF_ YR*	*HT_IN*	*AGE _IN*	*S_HT _IN*	*S_AGE _IN*	*CRWN _CLS*	*STKCL_ PR*	*BA*	*TPH_LV*
1	082N063	903	21.58	AT 60 PL 40	Dec	2003	1997	16	25	12	25	60	0	25	1700
3	082N064	1020	22.09	AT 60 AC 20 FD 10 SE 10	Dec	2003	1997	12	30	20	30	50	0	20	850
4	082N064	868	29.9	AT 70 FD 25 SE 5	Dec	2004	1997	13	25	9	25	15	0	4	180
5	082N035	874	22.34	AT 80 SE 10 FD 10	Dec	2004	1991	23	60	23	60	30	0	25	320
6	082N026	544	30.33	AT 70 PL 20 FD 10	Dec	2004	1996	22	72	20	70	50	1	35	525
8	082N008	345	22.06	W 70 SE 10 FD 10 BL 10	Dec	2004	1996	18	30	14	25	80	0	1	800
9	082N081	299	40.78	HW 40 SE 20 CW 20 FD 10 BL 10	CH	2003	1997	20	90	20	90	75	0	40	700
10	082N083	797	29.76	CW 60 HW 40	CH	2003	1979	0.6	6			10	0		
11	083D040	229	14.63	HW 70 CW 30	CH	2003	1997	27	200	27	200	60	1	55	525
12	082N043	219	149.61	HW 30 FD 30 SE 20 BL 20	CH	2003	1996	33	240	35	240	50	1	60	400
13	083D009	3	6.13	CW 70 HW 30	CH	2003	1997	31	200	30	200	20	1	35	100
14	082N043	227	22.71	HW 70 CW 20 SE 10	CH	2003	1996	31	260	28	260	55	1	60	425
15	082N062	231	304.62	CW 40 HW 30 FD 20 SE 10	CH	2003	1979	3	10	3	10	30	0	0	0
16	083D040	572	3.94	CW 55 HW 35 SE 10	CH	2003	1997	24	120	23	120	55	1	45	500
17	082N081	598	47.78	CW 50 HW 30 SE 10 FD 10	CH	2003	1997	39	320	38	320	60	1	95	375
18	083D009	130	12.56	CW 50 SE 30 HW 20	CH	2003	1997	33	260	34	260	55	1	70	400
19	082N053	500	21.81	HW 60 SE 20 CW 10 BL 10	CH	2003	1997	38	260	39	270	60	1	75	375
20	082M100	147	19.36	HW 40 CW 30 SE 25 BL 5	CH	2003	1997	34	240	33	240	60	1	55	425
21	083D018	235	10.94	CW 60 HW 20 FD 15 SE 5	CH	2003	1997	31	240	30	240	60	1	75	475
22	082N043	205	11.71	HW 60 SE 30 CW 10	CH	2003	1996	31	100	33	100	55	0	60	425
23	082N065	424	8.31	CW 55 SE 35 FD 10	CH	2003	1997	31	240	33	240	55	1	65	425
24	082N073	629	23.88	PL 50 SE 30 BL 15 FD 5	FPL	2003	1997	16	70	17	70	55	0	30	700
25	082N046	395	65.39	PL 50 FD 30 AT 10 SE 10	FPL	2003	1996	20	70	21	70	70	0	35	700
26	082N035	690	31.62	FD 60 HW 20 SE 20	FPL	2004	1991	16	60	15	60	70	0	30	850
27	082N009	709	7.06	FD 80 PL 20	FPL	2003	1996	21	160	19	160	40	1	25	475
28	082N064	853	54.93	FD 90 AT 10	FPL	2003	1997	8	31	12	31	70	0	10	1350

31	082N026	863	63.45	FD 60 PL 40	FPL	2004	1996	9	31			30	0		
32	082N035	593	46.87	FD 70 SE 20 PL 10	FPL	2004	1991	13	60	13	60	70	0	25	1000
33	082N045	534	30.19	FD 70 PL 10 PW 10 SE 10	FPL	2003	1991	21	65	21	65	60	0	35	625
34	082N046	582	35.3	FD 95 AT 5	FPL	2003	1996	18	60	14	60	60	0	30	700
35	082N035	400	26.38	FD 60 PL 40	FPL	2003	1991	23	65	21	65	60	0	40	575
36	082N073	507	20.5	FD 60 PL 20 AT 10 SE 10	FPL	2003	1997	28	140	26	140	50	1	40	475
37	082N016	189	29.74	PA 60 SE 20 BL 20	FPL	2004	1996	24	200	24	200	50	1	40	500
38	082K100	179	9.51	PL 80 SE 20	FPL	2003	1996	24	80	25	80	60	1	45	550
39	082N045	234	23.63	PW 60 PL 20 FD 20	FPL	2004	1991	23	65	21	65	50	0	35	500
41	082N043	115	46.98	PL 40 FD 20 HW 20 PW 10 SE 10	FPL	2003	1996	24	70	26	70	60	0	45	550
42	082N009	308	26.61	PL 80 SE 20	FPL	2003	1996	24	80	25	80	65	1	45	550
43	082N026	975	15.29	FD 80 PL 20	FPL	2003	1996	30	103	28	104	45	0	40	350
44	082N027	294	37.68	FD 50 PL 20 SE 20 AT 10	FPL	2004	1996	28	100	26	100	60	0	45	500
45	082N045	688	76.6	FD 50 SE 25 PL 15 AT 10	FPL	2004	1996	33	120	31	120	55	1	55	400
46	082N036	780	26.61	FD 80 PL 20	FPL	2004	1996	29	100	28	100	75	0	55	550
47	082N009	266	32.25	PL 80 SE 10 FD 10	FPL	2003	1996	28	130	30	130	60	1	50	500
48	082N063	537	18.75	PL 70 FD 25 SE 5	FPL	2004	1997	26	120	28	120	70	1	55	575
49	082N075	123	17.8	FD 70 SE 20 CW 10	FPL	2003	1997	33.9	89	33.5	81	65	0	45	525
50	082N054	34	8.27	FD 40 PW 20 SE 20 CW 10 BL 10	FPL	2003	1996	25	100	24	100	70	0	50	600
51	082N008	183	19.84	PL 50 SE 30 FD 20	FPL	2003	1996	28	130	30	130	55	1	45	475
52	082N037	66	21.76	PL 100	FPL	2004	1996	23	100			70	3	50	625
53	082N027	613	21.01	FD 60 SE 20 PL 20	FPL	2003	1996	27	100	27	100	75	0	50	575
54	082N026	1037	10.32	FD 70 SE 30	FPL	2004	1996	33	130	35	130	50	1	55	400
55	082N062	286	11.16	BL 50 SE 30 FD 20	SB	2003	1997	21	80	23	100	60	0	45	625
56	082N046	425	5.14	SE 50 FD 30 BL 15 PL 5	SB	2003	1996	12	40	11	40	50	0	20	850
57	083D019	819	17.57	SE 55 BL 45	SB	2003	1997	22	160	20	160	60	1	40	600
58	082N054	340	99.95	SE 100	SB	2004	1976	0.6	8			10	0		
59	082N061	224	9.31	SE 80 BL 20	SB	2003	1997	21	90	18	90	10	0	10	100
60	082N009	969	31.96	BL 66 SE 34	SB	2003	1996	11	45			30	0		
61	082N093	298	8.82	BL 70 SE 30	SB	2003	1997	18	200	23	220	55	1	35	650
62	082N054	486	116.63	SE 80 FD 20	SB	2004	1976	0.6	10			10	0		
63	082N067	669	31.05	BL 29 SE 24 CW 15 FD 15 E 10 AC 7	SB	2003	1996	6	27			10	0		
64	082N034	53	45.75	SE 60 BL 40	SB	2003	1996	5	30	5	30	10	0	1	350
65	082N075	518	2.06	SE 60 BL 40	SB	2003	1997	20	120	20	120	70	1	35	700

66	083D030	304	16.65	SE 70 BL 30	SB	2003	1997	29	200	25	180	55	1	45	450
67	082K099	480	51.44	SE 40 PL 20 BL 20 FD 20	SB	2003	1996	26	80	24	80	50	0	40	475
68	082N009	100	21.3	BL 70 SE 20 PA 10	SB	2003	1996	26	140	27	140	50	1	50	475
69	082N084	203	19.18	SE 60 HW 30 CW 10	SB	2003	1997	24	120	27	140	60	1	45	550
70	082M090	77	8.46	SE 70 CW 20 HW 10	SB	2003	1997	26	260	34	260	45	1	35	375
71	082N053	610	11.65	SE 50 PA 30 BL 20	SB	2003	1997	28	180	26	180	55	1	45	475
72	082N063	213	87.92	SE 60 HW 20 BL 15 CW 5	SB	2003	1997	22	57	20	57	45	0		
73	082K100	400	5.83	SE 100	SB	2003	1996	29	120			50	1	45	450
74	082M100	151	4.17	SE 50 CW 30 HW 10 BL 10	SB	2003	1997	21	120	33	240	50	1	35	550
75	082N074	1048	12.53	SE 80 BL 20	SB	2003	1997	30	220	26	200	45	1	35	350
76	082N054	88	30.4	SE 55 PL 20 FD 10 BL 10 AC 5	SB	2003	1996	31	120	28	110	60	1	50	500
77	082N092	437	17.24	SE 75 CW 20 AC 5	SB	2003	1997	40	280	36	260	50	1	60	325
79	082N094	799	8.48	SE 80 BL 10 HW 10	SB	2003	1997	34	280	30	250	50	1	50	400
80	082N091	609	36.19	SE 50 CW 20 BL 20 HW 10	SB	2003	1997	36	240	33	260	55	1	50	400
81	082N046	405	27.53	SE 60 CW 20 HW 10 FD 10	SB	2003	1996	28	120	25	120	50	1	45	475
82	082N062	166	3.71	SE 50 HW 30 CW 10 BL 10	SB	2004	1997	34	200	32	250	40	1	45	250
83	082N026	64	7.31	SE 50 FD 40 PL 10	SB	2004	1996	30	90	30	90	55	0	45	450
84	082N056	486	8.63	SE 70 CW 20 BL 5 AC 5	SB	2003	1997	33	240	30	240	50	1	50	400
85	083D010	643	33.08	SE 80 BL 15 CW 5	SB	2003	1997	39	300	33	240	40	1	45	250
86	082N055	948	22.8	AT 30 E 30 SE 20 FD 20	Dec	2004	1995	12.5	28			10	0		
87	082N073	935	1.44	AT 25 FD 22 AC 20 PW 17 HW 16	Dec	2004	1987	3	15			10	0		
109	082N063	313	35.69	FD 100	FPL	2004	1997	21	70			60	0	35	625
110	082N026	327	6.5	FD 80 PL 20	FPL	2004	1996	13.5	42	13	40	50	0	20	770
120	082N091	514	26.14	PL 60 BL 30 FD 10	FPL	2004	1997	21	90	21	90	75	1	45	650
151	082K099	361	19.23	SE 60 PL 40	SB	2004	1996	27	90	25	90	55	0	45	475

INVENTORY (PHASE I) ATTRIBUTES (CONT'D)											
VRI Sample	*STKCL (proj to ground sample year)*	*Ht & Age Case for "matching"*	*Mapage VDYP6 (proj to grd sample year)*	*Mapht VDYP6 (proj to grd sample year)*	*Mapage VDYP7 (proj to 2003)*	*Mapht VDYP7 (proj to 2003)*	*BA7.5 VDYP7 (proj to 2003)*	*TPH7.5 VDYP7 (proj to 2003)*	*VDYP6 (unadjusted) mapvol-dwb 12.5*	*VDYP6 (unadjusted) mapvol-dwb "mixed" util*	*VDYP7 (unadjusted) vol-dwb 12.5*
1	0	1	31	7.0	31	7.0	25	1443	0	0	23.4
3	0	1	36	14.1	36	13.9	26	924	13.3	13.3	93.1
4	0	1	31	13.7	31	13.7	9	354	10.5	10.5	29.3
5	0	4	73	27.1	72	27.3	30	367	134.5	134.5	197.7
6	0	1	80	23.1	79	23.1	37	482	152	152	217.3
8	0	2	32	10.3	32	10.3	31	1474	77.5	77.5	164.1
9	0	3	96	21.0	96	21.0	42	697	279	253.4	229.8
10	0	5	.	.	.	.	16	1477	27.7	0.5	25.1
11	1	1	206	27.3	206	27.4	55	520	354	338.1	287.0
12	1	1	247	33.3	247	33.3	60	396	409.6	408.9	465.5
13	1	1	206	31.3	206	31.5	35	100	408.7	395.4	149.4
14	1	1	.	31.2	.	31.2	60	419	415.8	411.2	360.1
15	0	3	34	5.0	34	5.0	0	0	0	0	0.0
16	1	2	126	23.7	126	23.7	47	490	292.9	273.8	254.2
17	1	1	326	.	326	.	95	375	547.4	544	650.7
18	1	1	266	33.3	266	33.4	70	397	478.5	472.1	458.9
19	1	3	266	.	266	.	75	371	594.1	593.6	589.6
20	1	1	246	34.2	246	34.2	55	421	451.3	445.2	445.7
21	1	2	246	30.2	246	30.2	75	472	463.2	452.6	470.4
22	0	1	107	32.1	107	32.0	61	402	470.7	450.8	501.5
23	1	2	246	33.3	246	33.2	65	423	450.5	441.3	474.0
24	0	3	76	16.9	76	16.8	31	678	141.7	141.7	157.9
25	0	5	.	.	.	.	37	679	197.3	197.3	239.8
26	0	1	73	18.7	72	18.5	36	833	161.8	127.6	166.5
27	1	1	167	21.4	167	21.4	25	479	159.1	147.3	133.9
28	0	1	37	9.8	37	9.8	15	1607	2.1	0	15.1

31	0	3	39	11.7	38	11.3	8	859	34.5	13.7	10.4
32	0	1	73	15.3	72	15.1	31	1020	112.6	79.7	117.2
33	0	1	77	23.8	77	23.8	39	563	215.4	193	254.8
34	0	1	67	19.7	67	19.6	33	689	129.2	105	149.9
35	0	3	77	26.0	77	26.0	44	509	253.1	227.1	321.2
36	1	1	146	28.5	146	28.5	40	466	273.3	268.2	304.4
37	1	2	208	24.6	207	24.4	40	501	289.2	289.2	302.8
38	1	2	87	26.6	87	26.7	46	560	288.7	288.7	403.1
39	0	3	78	27.1	77	26.9	38	431	272.1	272.1	316.5
41	0	2	77	27.8	77	27.8	47	568	280.7	280.7	338.2
42	1	2	87	26.6	87	26.7	46	567	294.7	294.7	392.3
43	0	1	110	31.1	110	31.1	41	322	284.7	276.4	352.5
44	0	3	108	29.2	107	29.1	47	469	292.4	282.8	367.8
45	1	1	128	34.0	127	33.9	56	407	426.3	418.6	513.5
46	0	1	108	30.3	107	30.1	57	514	334.9	328.5	478.4
47	1	1	137	28.4	137	28.3	51	505	391.1	391.1	476.6
48	1	1	127	26.5	126	26.3	55	579	352.6	352.6	471.1
49	0	1	95	35.2	95	35.2	47	501	466.2	459.2	473.2
50	0	3	107	26.0	107	26.0	52	564	303.2	287.3	342.7
51	1	2	137	30.8	137	30.8	45	477	368.9	368.9	439.2
52	3	3	108	23.7	107	23.6	51	637	310.8	310.8	383.2
53	0	1	107	28.0	107	28.0	52	540	372.5	356.7	418.7
54	1	1	138	33.9	137	33.8	55	403	413.8	409.7	532.7
55	0	1	86	22.2	86	22.2	47	609	216.5	198.5	307.2
56	0	1	47	15.0	47	15.3	27	963	106.2	79.8	102.9
57	1	2	166	20.5	166	20.5	40	603	219.4	204.1	242.8
58	0	3	.	.	.	.	0	0	0	0	0.0
59	0	2	96	19.0	96	19.0	10	96	187.2	173.2	66.6
60	0	1	52	13.0	52	13.2	20	1386	89	67.4	57.8
61	1	1	206	18.3	206	18.4	35	652	164.3	148.7	185.7
62	0	3	37	6.4	37	6.4	10	1735	0	0	1.2
63	0	3	.	.	.	.	7	946	3.3	0.4	3.4
64	0	1	37	.	37	.	0	47	8.2	2	0.1
65	1	1	126	20.8	126	20.7	36	685	201.3	183.3	216.5

66	1	1	206	29.4	206	29.3	45	449	323.4	314.1	363.6
67	0	1	87	27.6	87	27.8	41	429	297.7	278.1	329.8
68	1	1	147	26.8	147	26.6	50	470	276.1	266	371.8
69	1	2	146	27.6	146	27.6	46	533	330.5	313	309.1
70	1	2	.	.	.	.	35	373	360.4	351.9	221.6
71	1	3	186	28.5	186	28.4	45	478	353.1	346.5	380.5
72	0	1	63	24.1	63	24.4	34	437	286.1	260.8	220.9
73	1	1	127	29.9	127	29.9	45	421	354	343.3	384.4
74	1	2	.	33.3	.	33.4	36	542	260.3	241.8	197.6
75	1	2	206	26.4	206	26.3	35	348	330.6	323.9	299.9
76	1	5	.	.	.	.	51	473	408.4	400.7	464.6
77	1	2	266	36.3	266	36.3	60	324	582.1	580.7	596.1
79	1	2	256	30.3	256	30.2	50	398	401.3	398.3	435.2
80	1	2	266	33.3	266	33.4	50	397	511.8	509	399.4
81	1	2	127	25.7	127	26.0	46	459	375	361.7	342.1
82	1	1	207	34.4	206	34.3	45	249	460	455.1	345.9
83	0	2	98	31.5	97	31.4	47	410	386	373.4	447.3
84	1	3	246	33.3	246	33.2	50	397	468.2	465.8	410.3
85	1	1	306	39.1	306	39.1	45	249	449.6	449	450.3
86	0	5	.	.	.	.	13	901	25.6	25.6	40.2
87	0	1	31	13.7	31	13.7	13	1413	8.1	8.1	18.6
109	0	1	77	22.5	76	22.3	37	605	171.8	149.4	198.6
110	0	2	47	14.9	47	14.9	24	784	79.6	54.9	89.0
120	1	3	97	21.8	96	21.6	46	656	260.3	260.3	307.9
151	0	1	98	28.5	97	28.5	46	429	359.3	340.5	409.6

INVENTORY (PHASE I) ATTRIBUTES: after Stage 1 adjustment						
VRI Sample	VDYP6 adjusted age	VDYP6 adjusted height	VDYP6 "attribute-adjusted" volume "mixed" util	**VDYP7 loryht_ph1**	**VDYP7 ba125_ph1**	**VDYP7 vldw_ph1**
1	23	6.8	0	0.0	0.0	0.0
3	26	13.8	4.3	14.9	10.6	45.4
4	23	13.4	0	9.4	4.0	10.2
5	53	24.9	105.6	23.9	16.4	121.3
6	59	22.6	128.3	21.3	20.1	134.3
8	29	20.3	27.6	17.7	10.9	71.2
9	116	19.8	224.4	17.9	35.8	207.8
10	36	8.7	0	7.5	0.0	0.0
11	250	25.7	327.8	22.3	49.9	264.5
12	300	31.4	380.9	27.9	55.2	443.0
13	250	29.5	395	26.9	32.7	160.1
14	324	29.4	384.3	25.9	55.2	334.0
15	41	4.7	0	0.0	0.0	0.0
16	153	23.2	264.5	21.1	42.2	240.2
17	396	36.9	481.2	34.9	88.3	672.1
18	323	31.4	419.9	28.5	65.0	456.5
19	323	36	552.2	32.5	69.5	567.0
20	299	32.2	411.8	31.3	50.5	429.0
21	299	29.5	395.5	27.6	69.6	459.6
22	130	30.3	423.8	27.5	56.5	460.3
23	299	29.5	384.6	27.8	60.4	456.1
24	81	16.1	122.4	14.6	25.7	133.4
25	82	20.1	182.6	18.2	32.4	212.0
26	78	17.8	111.5	14.7	27.8	135.3
27	179	20.4	133.9	16.3	21.0	114.0
28	40	9.4	0	8.8	1.5	3.7
31	42	11.2	8.8	10.2	3.3	10.6

32	78	14.6	68	12.2	19.9	79.7
33	82	22.7	178	19.2	34.4	229.7
34	72	18.8	93.8	14.7	27.3	123.2
35	82	24.8	212.3	20.5	40.7	296.2
36	156	27.2	249	22.7	37.1	283.3
37	223	23.1	267.2	19.4	35.8	277.9
38	93	23.8	272.4	21.4	42.6	380.8
39	83	25.9	255.3	22.1	35.1	291.4
41	82	24	269.7	21.1	41.6	326.9
42	93	23.8	278	21.5	43.2	369.5
43	118	29.7	260.1	25.1	38.0	328.3
44	116	27.9	266.5	23.6	43.2	351.1
45	137	32.4	393.3	27.6	52.4	493.1
46	116	28.9	305.8	24.1	52.7	444.6
47	147	27.1	365.5	24.3	47.3	466.7
48	136	25.3	331.5	23.1	51.8	455.6
49	102	33.6	435.8	27.8	43.1	438.5
50	115	24.8	267.5	20.7	46.6	328.2
51	147	27.1	344.4	25.2	42.0	426.7
52	116	22.6	295.1	19.4	47.5	359.2
53	115	26.7	330.8	23.2	47.7	395.9
54	148	32.4	384.6	28.2	51.5	481.4
55	79	19.2	154.9	17.7	42.5	250.3
56	43	13	48.9	10.6	18.8	66.5
57	153	19.6	159.2	15.6	36.0	192.4
58	32	5	0	5.1	0.0	0.0
59	88	19.2	129.9	17.2	9.7	56.0
60	48	11.3	48.6	9.4	5.1	21.3
61	189	15.9	115.3	14.2	29.7	142.9
62	34	5.6	0	5.7	0.0	0.0
63	31	5.5	0	5.9	0.0	0.0
64	34	6.4	0	6.4	0.0	0.0
65	116	18	140.3	15.2	31.1	167.4
66	189	25.5	252.7	20.7	41.8	297.3

67	80	23.9	216.3	21.0	38.4	280.7
68	135	23.2	212.7	19.3	46.7	301.0
69	116	21.5	251	19.0	42.7	260.5
70	245	22.9	288.5	20.8	32.3	191.7
71	171	24.7	275.5	20.5	41.7	316.6
72	58	20.9	208.5	17.8	30.7	186.5
73	117	25.9	272.9	20.8	42.6	307.7
74	116	18.9	189.9	19.4	31.9	169.1
75	208	26.3	261.3	21.5	32.7	245.5
76	117	27.7	315	23.9	47.7	398.4
77	263	34.8	496.5	30.0	56.8	517.4
79	263	29.6	326.3	23.9	46.8	369.0
80	226	31.4	430.8	25.8	46.6	361.5
81	117	25.1	293.8	21.5	43.1	295.6
82	190	29.8	383.9	25.1	42.4	309.1
83	90	27.3	293.9	24.5	44.0	375.4
84	226	28.9	384.6	24.4	47.0	352.3
85	281	33.9	374.4	28.2	42.5	386.4
86	26	15	10.4	12.0	2.8	9.7
87	23	13.4	0	10.0	0.5	2.1
109	82	21.5	135.1	16.7	32.5	172.0
110	54	15.2	48.5	12.1	15.5	59.9
120	104	20.8	243.7	18.4	41.6	283.1
151	90	24.7	260.6	21.1	43.3	337.0

GROUND (PHASE II) COMPILED ATTRIBUTES										
VRI Sample	**SPECIES % by BA** *4 cm+ dbh utilization*	GBA75	GTPH75	GBA125	LHT75	nvl_nw2 @12.5	nvl_nwb @12.5	nvl_nwb @17.5	GTLSage	GTLSht
1	At 52 Pl 35 Fd 13	25.0	2436.9	13.8	7.1	75.0	72.8	13.8	28	14.83
3	At 50 Se 50	2.5	332.8	1.3	8.6	3.0	2.9	0.0	27	11.1
4	At 45 Se 30 Fd 19 Pw 06	8.4	800.5	4.8	7.0	22.8	22.0	0.0	26	15.8
5	Fd 40 Se 40 Bl 20	8.3	219.1	6.7	16.7	53.3	52.2	52.2	36	16.5
6	At 50 Pl 31 Bl 13 Fd 06	26.7	1055.5	25.0	17.3	149.5	145.0	128.1	43	17.4
8	Se 80 Bl 20	6.3	308.8	6.3	10.8	27.1	26.6	6.9	39	14.2
9	Fd 49 Hw 26 Se 13 Cw 08 Bl 04	68.4	2754.6	54.0	13.3	368.0	358.8	339.1	94	27.1
10	Ac 44 Se 20 Cw 19 Hw 13 Fd 03 Bl 01	17.9	1000.7	15.0	7.9	77.9	74.8	48.7	.	.
11	Hw 57 Cw 36 Se 07	67.2	954.3	64.8	28.7	500.8	471.9	471.9	252	25.7
12	Hw 100	15.0	144.1	15.0	14.4	99.2	95.5	95.5	281	19.7
13	Cw 53 Hw 35 Se 12	28.0	953.1	22.8	14.7	132.8	124.2	117.6	248	17.47
14	Hw 45 Cw 36 Se 09 Ac 05 Fd 05	52.8	584.3	50.4	25.0	482.0	456.6	447.0	.	35
15	Pl 100 Fd tr	3.5	520.3	0.5	5.9	3.0	3.0	0.0	31	9.63
16	Hw 36 Bl 27 Cw 18 Se 19	25.7	630.9	25.7	13.0	110.4	105.6	105.6	165	14.3
17	Cw 32 Hw 32 Fd 27 Bl 09	66.0	1897.8	60.0	18.1	524.8	499.6	471.7	313	.
18	Cw 51 Hw 20 Bl 13 Se 11 Fd 05	101.3	828.6	101.3	33.2	877.8	832.7	832.7	303	28.4
19	Cw 78 Hw 22	96.0	956.5	96.0	37.6	828.6	764.5	725.8	407	.
20	Hw 60 Cw 40	60.0	91.8	60.0	23.1	546.4	511.8	511.8	252	37.05
21	Hw 72 Cw 19 Pw 06 Fd 03	67.5	909.8	63.0	26.7	472.6	449.8	432.5	292	27.07
22	Hw 92 Cw 08	48.0	221.2	48.0	29.1	395.5	376.9	376.9	274	34.95
23	Se 67 Cw 33	40.5	258.0	40.5	27.6	410.2	398.4	398.4	265	40.2
24	Bl 71 Se 24 Pl 05	21.3	1445.0	15.0	8.0	116.3	113.9	97.7	166	16.67
25	Ep 38 Pl 27 Se 15 Fd 12 At 08	26.0	881.4	26.0	18.9	166.5	161.9	131.1	.	.
26	Fd 88 Se 06 Cw 06	25.2	775.1	25.2	11.0	159.2	155.7	114.7	68.51428927	20.7
27	Fd 100	29.4	293.9	29.4	23.4	265.6	259.6	259.6	141	19.4
28	Fd 89 At 11	15.0	1569.1	3.3	8.6	15.4	15.0	0.0	30	11.17
31	Se 75 Fd 25	6.7	207.6	6.7	15.2	35.6	34.9	24.8	54	16.4
32	Fd 84 Hw 11 Se 05	39.7	2145.5	30.3	11.1	163.5	160.0	97.1	73	19.2

33	Fd 69 Cw 19 Se 12	35.0	1416.8	28.0	23.9	188.1	183.4	162.8	73	26.15
34	Fd 57 Se 30 Bl 09 Ac 04	21.0	1160.8	16.0	13.2	96.2	94.2	75.0	48	14.33
35	Bl 60 Fd 40	35.0	632.8	35.0	11.5	273.0	267.2	267.2	132	26.7
36	Fd 43 Bl 29 Cw 14 Pl 14	16.3	641.4	14.0	17.6	100.2	98.0	74.4	188	21.3
37	Se 60 Bl 40	32.2	1138.4	29.4	16.1	239.8	234.9	207.2	234	24.2
38	Se 63 Pl 37	33.3	578.6	33.3	28.1	321.9	315.3	304.8	90	25.5
39	Fd 57 Bl 19 Se 19 Pl 05	46.7	2785.5	39.7	17.3	226.9	222.2	131.6	76	20.4
41	Fd 35 Hw 20 Pw 15 Pl 10 Bl 10 Cw 05 Se 05	20.0	702.4	18.0	16.6	113.9	111.2	100.6	81	21.85
42	Se 93 Bl 07	46.8	2183.1	39.6	17.0	264.4	259.0	205.9	94	20.82
43	Fd 80 Pl 10 Se 10	17.5	117.1	17.5	30.7	175.8	172.1	172.1	116	34.9
44	Se 46 Cw 22 Bl 17 Fd 15	68.3	2137.8	64.8	25.9	493.4	480.6	401.6	89	28.57
45	Fd 30 Se 30 Ac 17 Pl 13 Cw 04 At 06	32.2	496.2	32.2	22.3	284.9	277.7	277.7	69	31
46	Fd 91 At 09	40.3	895.2	36.8	27.6	295.6	288.8	288.8	114	29.73
47	Pl 58 Bl 30 Se 12	56.0	2204.8	47.6	19.7	417.9	409.3	358.6	161	20.72
48	Pl 34 Fd 27 Hw 15 Bl 07 Pw 07 Cw 05 Se 05	70.2	2815.3	63.0	21.7	523.0	511.3	445.1	118	27.8
49	Fd 42 Bl 23 Cw 19 Se 16	81.0	1432.9	81.0	22.9	666.3	649.8	626.6	96	32.63
50	Hw 62 Cw 22 Bl 11 Se 05	61.3	2452.6	50.8	20.9	305.3	289.9	220.3	214	22.57
51	Se 59 Bl 17 Fd 10 Pl 07 Cw 07	50.4	1059.2	48.6	22.3	455.4	444.8	427.2	134	27.56
52	Fd 52 Pl 48	41.4	714.9	41.4	26.3	339.1	332.1	332.1	89	27.27
53	Fd 57 Cw 21 Se 22	63.0	1039.1	63.0	23.7	533.3	519.8	503.3	111	28.4
54	Fd 48 Bl 37 Se 11 Pl 04	64.8	1958.4	60.0	20.7	505.9	495.2	448.6	148	29.15
55	Bl 55 Pl 27 Se 18	45.0	2181.9	36.0	11.4	268.6	263.1	203.4	122	23.03
56	Se 100	8.3	196.8	8.3	15.0	53.1	52.0	52.0	53	14.8
57	Bl 71 Se 26 Hm 03	42.0	1218.2	40.6	23.1	330.4	323.6	297.5	197	24.06
58	Pl 52 At 30 Se 18	17.6	1360.9	10.3	8.0	87.7	85.9	85.9	.	.
59	Bl 73 Se 27	22.0	912.5	20.0	8.4	124.6	122.0	91.1	35	11.3
60	Bl 52 Se 48	25.0	1231.7	21.0	15.9	131.9	129.2	102.4	64	15.3
61	Bl 60 Se 40	35.0	513.3	35.0	28.0	337.6	330.6	322.7	111	26.25
62	Pl 91 Fd 06 At 02 Ep 01	11.9	960.6	7.5	9.0	46.2	45.2	0.0	28	13.24
63	Hw 36 Fd 29 Ep 15 At 09 Se 07 Bl 04	8.6	750.5	4.9	8.1	16.3	15.7	8.5	.	.
64	Se 96 Bl 04	4.1	500.3	0.0	2.3	0.0	0.0	0.0	100	.
65	Se 65 Bl 35	80.0	3105.0	72.0	19.0	519.8	509.2	389.7	148	23.33
66	Se 64 Bl 27 Hw 09	25.7	188.4	25.7	29.6	290.3	284.3	284.3	127	28.4
67	Se 75 Fd 19 Pl 06	44.8	1556.1	37.8	16.5	291.5	285.6	258.2	78	22.38

68	Bl 73 Se 27	38.3	1049.3	36.0	20.0	305.8	299.5	275.6	194	23.03
69	Hw 48 Cw 39 Se 06 Pw 03 Bl 04	39.2	1552.5	36.4	14.3	174.4	164.0	119.4	176	16.9
70	Cw 77 Se 15 Ac 08	31.2	59.7	31.2	41.2	349.6	325.9	325.9	.	.
71	Bl 79 Se 21	32.7	740.7	30.3	23.4	273.3	267.6	267.6	182	22.2
72	Bl 37 Se 37 Hw 26	22.5	519.3	21.3	22.9	177.7	173.2	167.1	39	18.95
73	Se 87 Pl 09 Bl 04	40.3	971.7	36.8	23.8	349.9	342.9	335.1	144	28.4
74	Cw 92 Se 08	45.0	314.9	45.0	28.9	453.9	418.9	409.1	.	16.3
75	Bl 67 Se 33	36.0	458.9	36.0	20.8	359.3	351.8	335.7	213	23.9
76	At 38 Ep 17 Fd 17 Se 17 Pl 07 Ac 04	52.2	678.2	52.2	27.2	507.6	492.1	492.1	.	.
77	Cw 64 Bl 18 Se 18	44.0	359.7	44.0	41.8	465.4	438.8	419.7	264	24.2
79	Bl 36 Hw 36 Cw 14 Se 14	42.0	800.6	42.0	24.6	340.5	330.3	294.0	99	27.27
80	Cw 57 Hw 36 Se 07	84.0	649.3	84.0	32.3	747.9	701.8	701.8	307	34.3
81	Cw 59 Hw 24 Bl 17	48.6	2119.5	37.8	18.2	232.9	218.9	207.4	252	22.63
82	Se 46 Hw 38 Cw 12 Bl 04	39.6	650.8	37.8	25.4	381.8	370.3	357.2	156	28.75
83	Fd 85 Se 10 At 05	35.0	507.1	35.0	26.4	299.3	292.6	290.0	105	31.2
84	Pl 67 Fd 13 Se 13 Bl 07	15.0	329.7	15.0	18.6	129.3	126.7	122.6	168	14.1
85	Se 82 Cw 18	30.6	76.0	30.6	34.9	432.5	420.3	420.3	125	32.65
86	Pl 100	1.0	168.2	0.0	7.1	0.0	0.0	0.0	.	.
87	At 56 Pw 19 Pl 13 Ac 06 Bl 06	23.3	1333.7	16.7	13.3	93.2	90.4	49.9	31	16.8
109	Fd 62 Pl 33 Bl 05	36.8	904.3	35.0	15.5	247.9	242.8	228.1	64	20.15
110	Pl 63 Fd 37	14.0	577.5	14.0	12.6	78.3	76.6	54.0	47	17.07
120	Fd 56 Bl 20 Se 12 Cw 08 Hw 04	54.0	1608.0	51.8	17.9	368.1	359.8	312.3	93	24.58
151	Pl 58 Se 42	33.3	1397.3	28.0	21.8	246.1	241.2	222.6	90	23.7

6. APPENDIX B: DATA ISSUES

This table documents questions and responses regarding the Golden TSA VRI data that were made during the course of the analysis.

Sample #	Issue	Action/Resolution
6, 21, 31	UTMs for target IPC and actual IPC differed and placed sample in different polygons: #6 target poly 544; actual 646 #21 target poly 235; actual 236 #31 target poly 863; actual 837	Maps for #21 were examined and showed IPC in target (not actual) polygon. Gary assumed that there had been a typo in recording the actual UTMs. Maps for other 2 samples could not be located so assume same for 6 & 31 i.e. target IPC polygon was correct.
	85 samples in sample plan	all present and accounted for
2	Private land: replaced with 86	
7	Private land: replaced with 87	
29	Private land: replaced with 109	
30	Private land: replaced with 110	
40	Private land: replaced with 120	
78	No data; plot established in burned area; replaced with 151	
17	Map leading Cw, second spp Hw. Ground leading CW=HW. Age only collected on ground for CW; age & ht for HW. However, ground age for Cw much closer to map ages for Cw & Hw.	Decided to use the CW ground info even though the height was missing due to potential influence on age ratios.
72	BL=SE on ground; ht/age for both; SE leading on map	Use SE ground ht/age data
74	CW leading; top height tree was over 600 years old; is this a vet?	Exclude this sample in the age ratio but keep in the height ratio.
8	Map leading species is W. Do not have a projected age/ht for W. Not sure how VDYP6 is estimating volume. Running VDYP6 batch generates an error for volume with this species. Use surrogate spp or delete sample?	Used VIF file 2005 projection for height (ground sample year was 2004 so this will be one year off). To run VDYP6 and get a volume, substituted E for W in VDYP6 batch.

7. APPENDIX C: VDYP6 HEIGHT AND AGE SCATTERPLOTS AND RESIDUALS (STAGE 1 ADJUSTMENT)

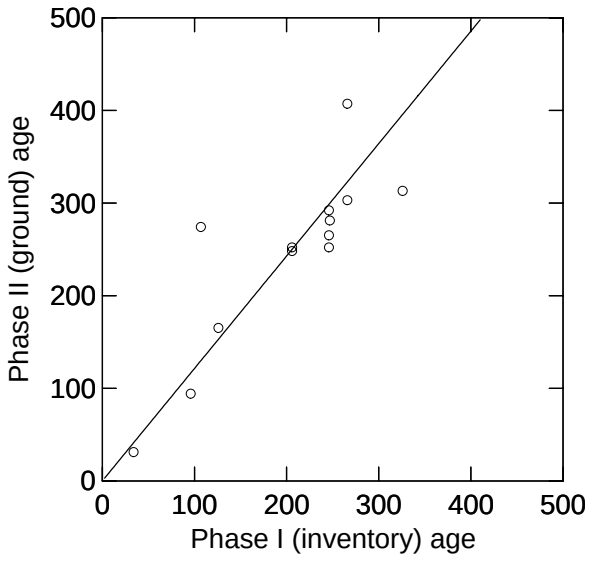

Fig C-1: CH stratum: Phase II (ground) age vs. Phase I (inventory) age. Line is age adjustment ratio R=1.214.

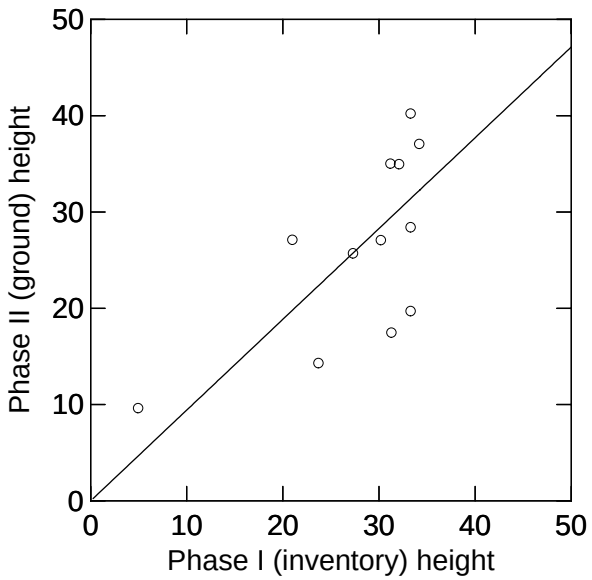

Fig C-2: CH stratum: Phase II (ground) height vs. Phase I (inventory) height. Line is height adjustment ratio R=0.943.

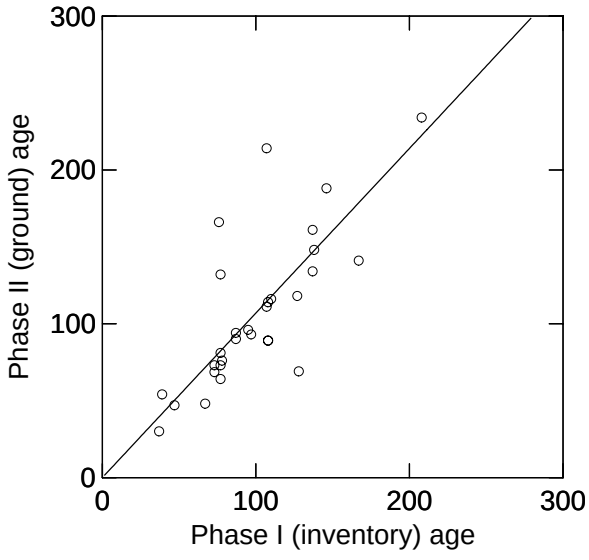

Fig C-3: FPL stratum: Phase II (ground) age vs. Phase I (inventory) age. Line is age adjustment ratio R=1.071.

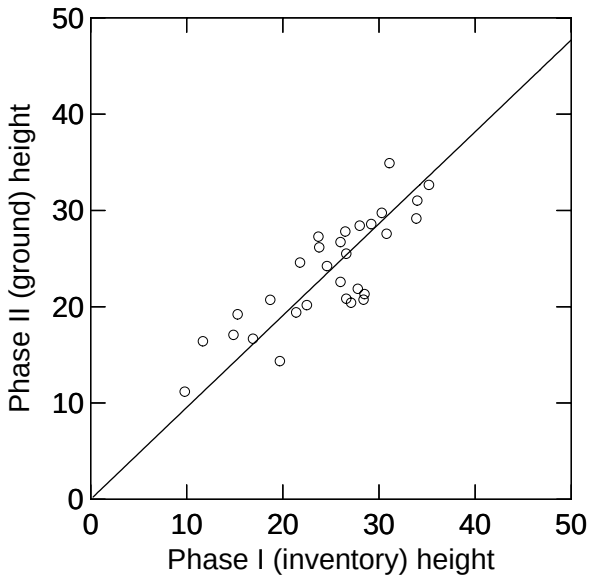

Fig C-4: FPL stratum: Phase II (ground) height vs. Phase I (inventory) height. Line is ht adjustment ratio R=0.954.

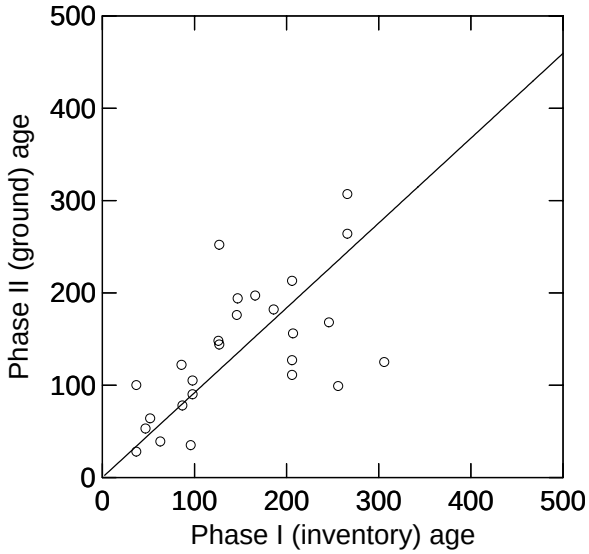

Fig C-5: SB stratum: Phase II (ground) age vs. Phase I (inventory) age. Line is age adjustment ratio R=0.919.

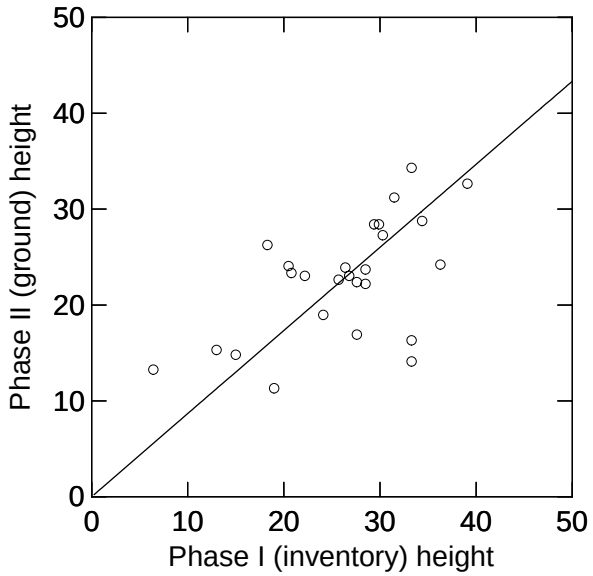

Fig C-6: SB stratum: Phase II (ground) height vs. Phase I (inventory) height. Line is ht adjustment ratio R=0.867.

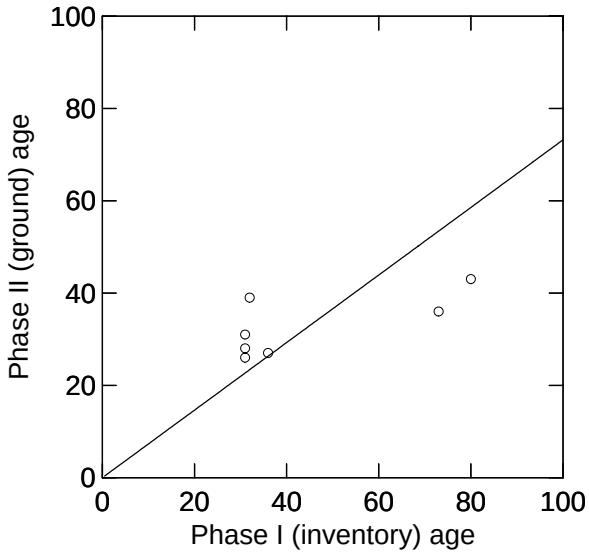

Fig C-7: DEC stratum: Phase II (ground) age vs. Phase I (inventory) age. Line is age adjustment ratio R=0.732.

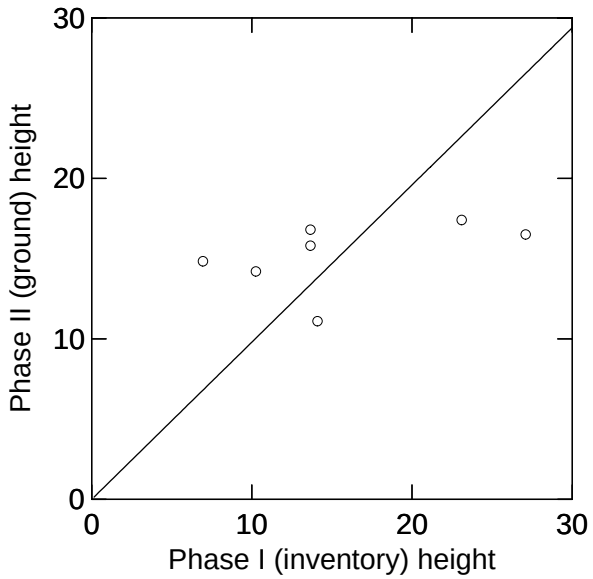

Fig C-8: DEC stratum: Phase II (ground) height vs. Phase I (inventory) height. Line is height adjustment ratio R=0.980.

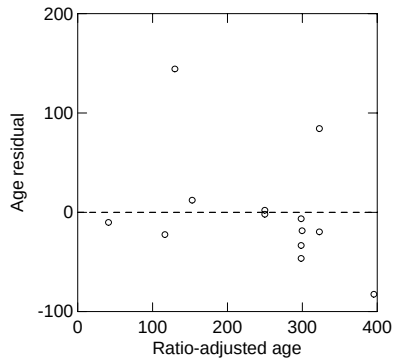

Fig C-9: CH stratum: Age residual vs. ratio-adjusted age.

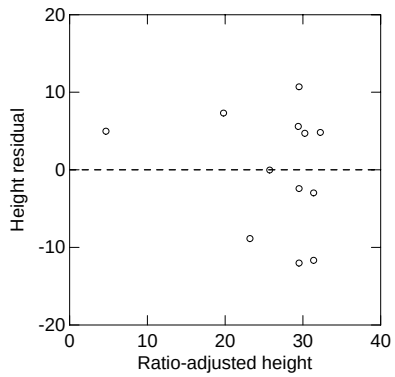

Fig C-10: CH stratum: Height residual vs. ratio-adjusted height.

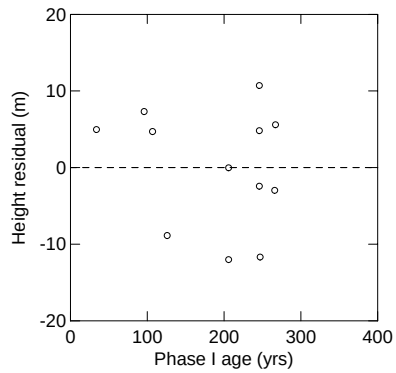

Fig C-11: CH stratum: Height residual vs. inventory age.

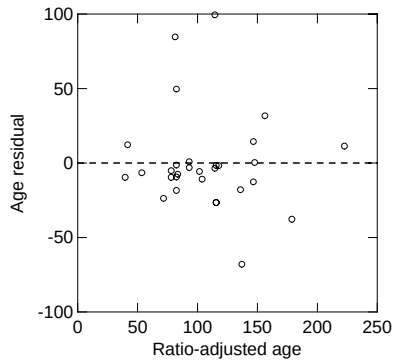

Fig C-12: FPL stratum: Age residual vs. ratio-adjusted age.

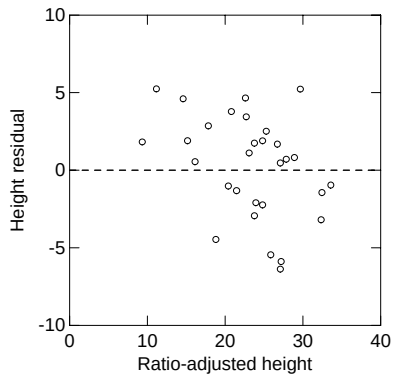

Fig C-13: FPL stratum: Height residual vs. ratio-adjusted height.

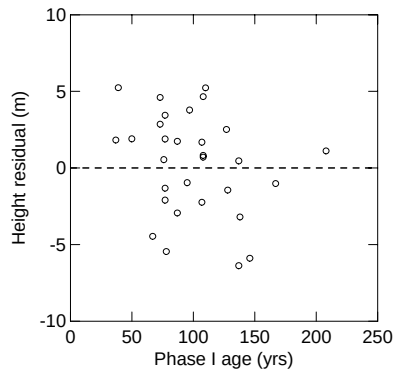

Fig C-14: FPL stratum: Height residual vs. inventory age.

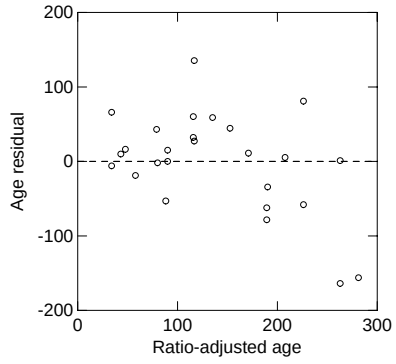

Fig C-15: SB stratum: Age residual vs. ratio-adjusted age.

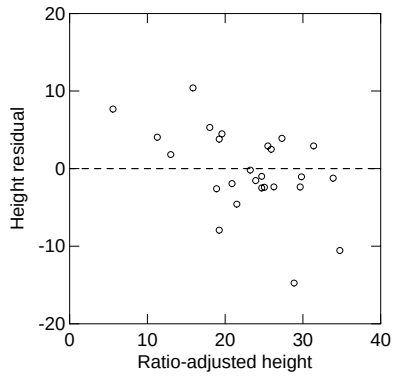

Fig C-16: SB stratum: Height residual vs. ratio-adjusted height.

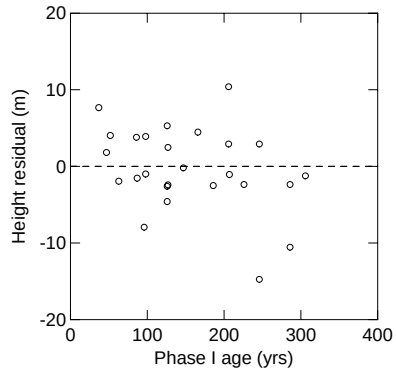

Fig C-17: SB stratum: Height residual vs. inventory age.

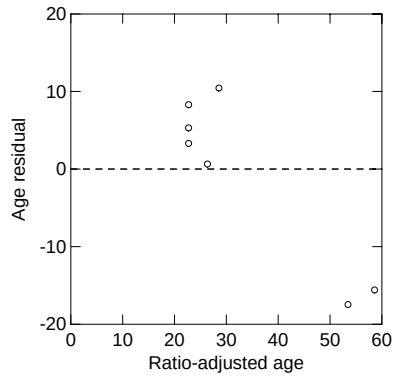

Fig C-18: DEC stratum: Age residual vs. ratio-adjusted age.

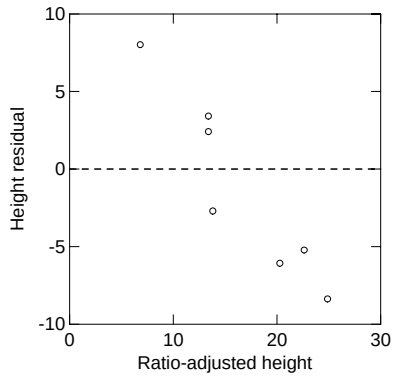

Fig C-19: DEC stratum: Height residual vs. ratio-adjusted height.

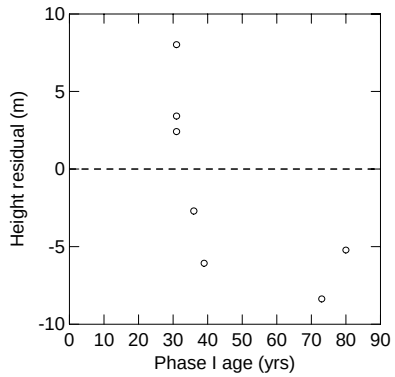

Fig C-20: DEC stratum: Height residual vs. inventory age.

8. APPENDIX D: VDYP6 VOLUME SCATTERPLOTS & RESIDUALS (STAGE 2 ADJUSTMENT)

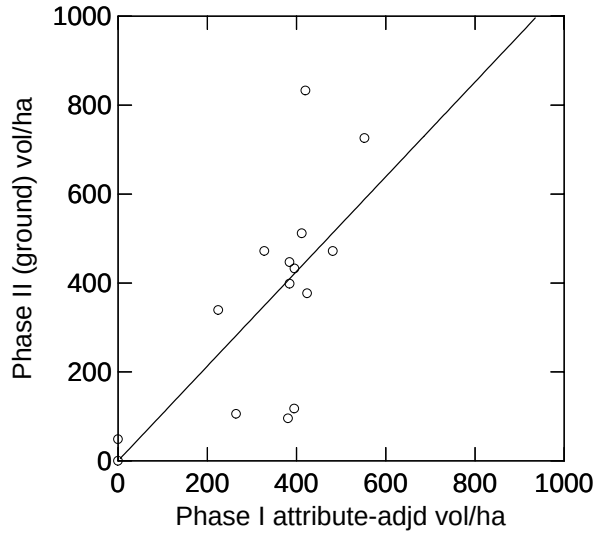

Fig D-1: CH stratum: Phase II (ground) vol/ha (net dwb, mixed utilization, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.065.

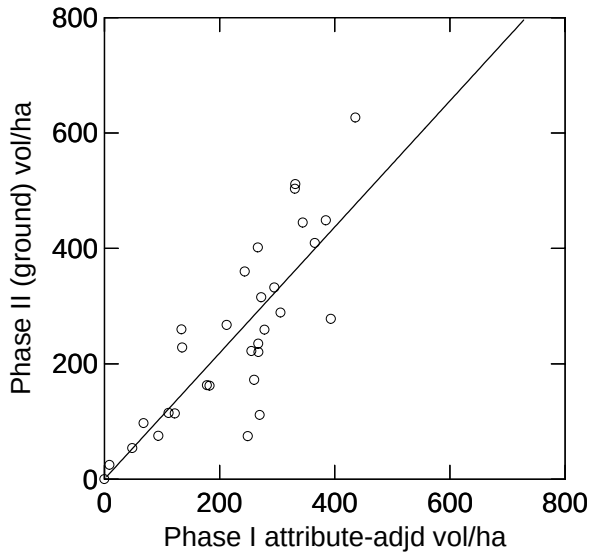

Fig D-2: FPL stratum: Phase II (ground) vol/ha (net dwb, mixed utilization, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.093.

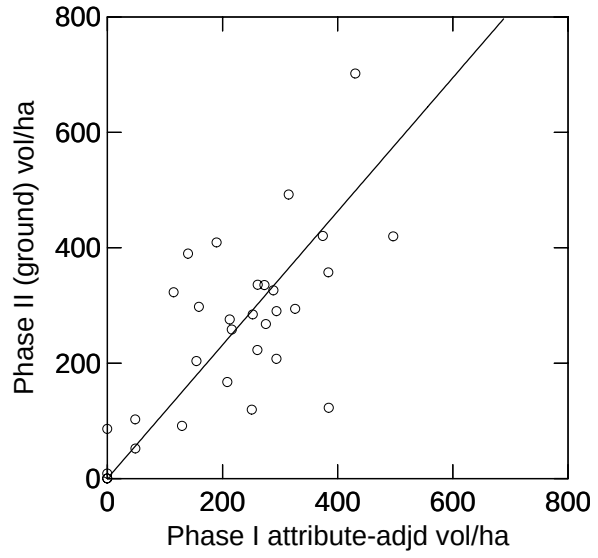

Fig D-3: SB stratum: Phase II (ground) vol/ha (net dwb, mixed utilization, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.158.

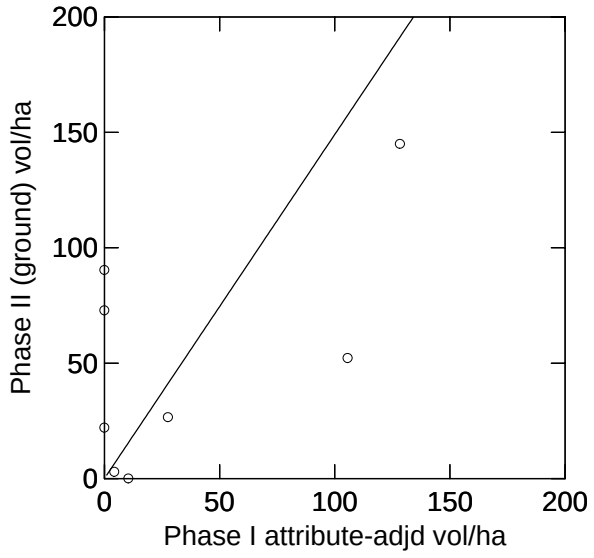

Fig D-4: DEC stratum: Phase II (ground) vol/ha (net dwb, mixed utilization, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.491.

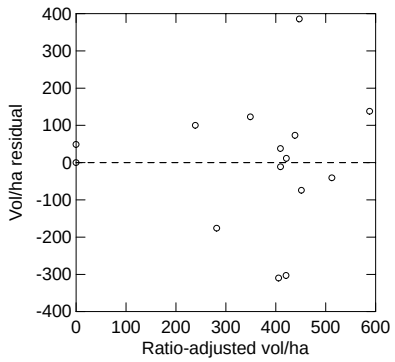

Fig D-5: CH stratum: Volume/ha residual vs. ratio-adjusted volume.

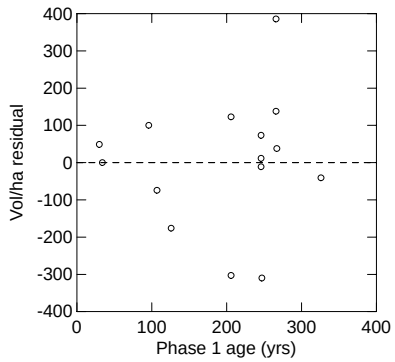

Fig D-6: CH stratum: Volume/ha residual vs. inventory age.

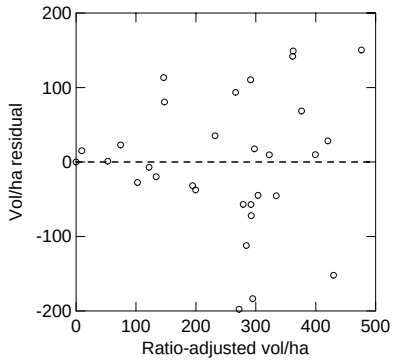

Fig D-7: FPL stratum: Volume residual vs. ratio-adjusted volume.

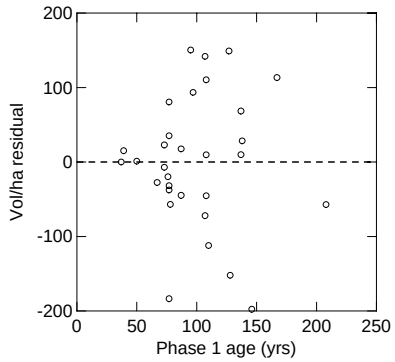

Fig D-8: FPL stratum: Volume/ha residual vs. inventory age.

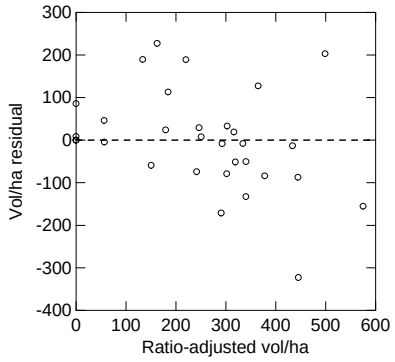

Fig D-9: SB stratum: Volume residual vs. ratio-adjusted volume.

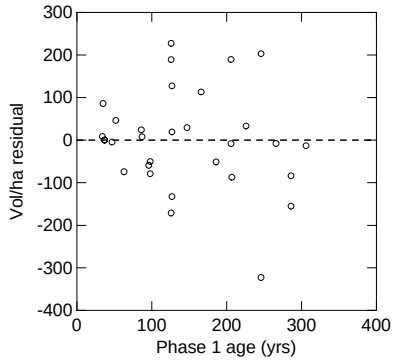

Fig D-10: SB stratum: Volume/ha residual vs. inventory age.

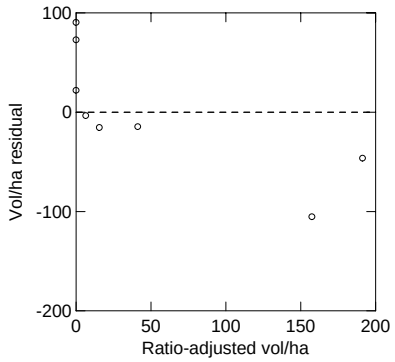

Fig D-11: DEC stratum: Volume residual vs. ratio-adjusted volume.

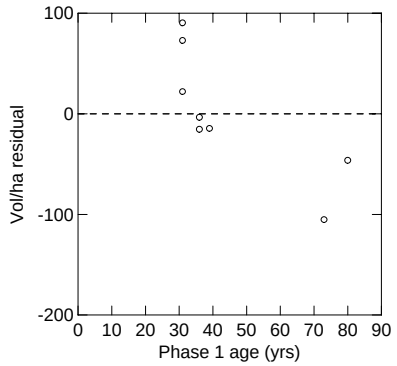

Fig D-12: DEC stratum: Volume/ha residual vs. inventory age.

9. APPENDIX E: VDYP7 SCATTERPLOTS & RESIDUALS FOR BA & TPH[32] (STAGE 1 ADJUSTMENT)

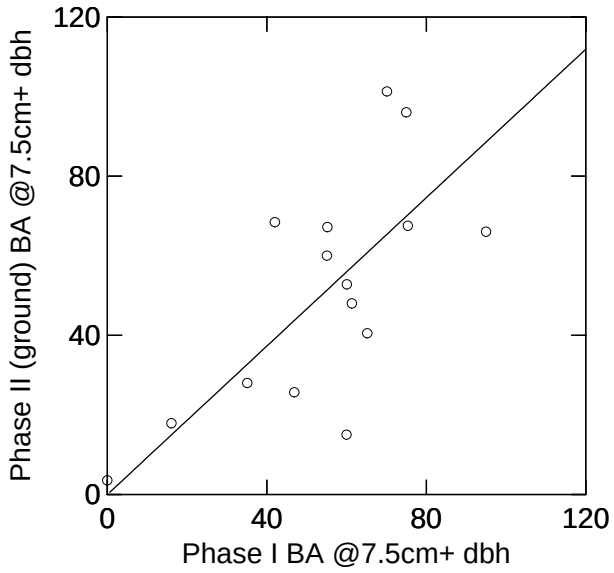

Fig E-1: CH stratum: Phase II (ground) BA@7.5cm+ dbh vs. VDYP7 Phase I (inventory) BA. Line is BA adjustment ratio R=0.933.

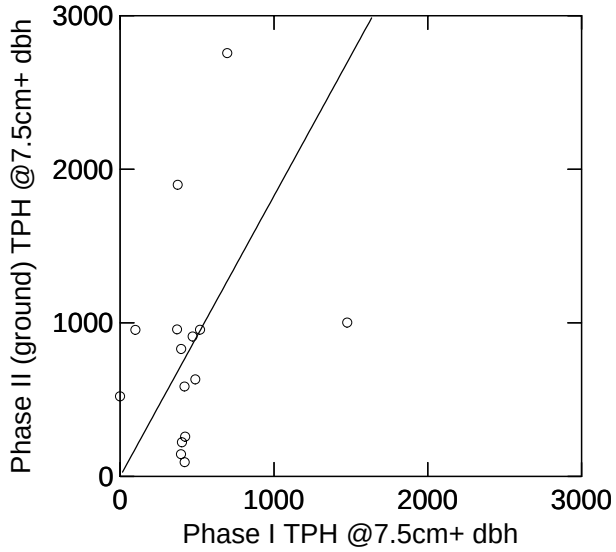

Fig E-2: CH stratum: Phase II (ground) TPH vs. VDYP7 Phase I (inventory) TPH. Line is TPH adjustment ratio R=1.826.

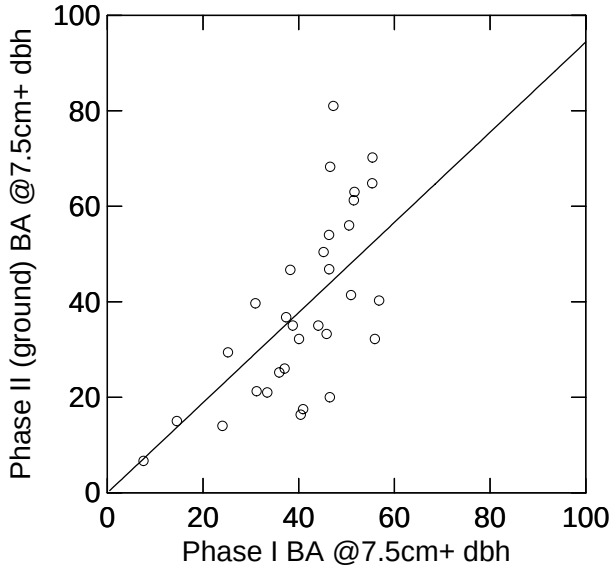

Fig E-3: FPL stratum: Phase II (ground) BA@7.5cm+ dbh vs. VDYP7 Phase I (inventory) BA. Line is BA adjustment ratio R=0.944.

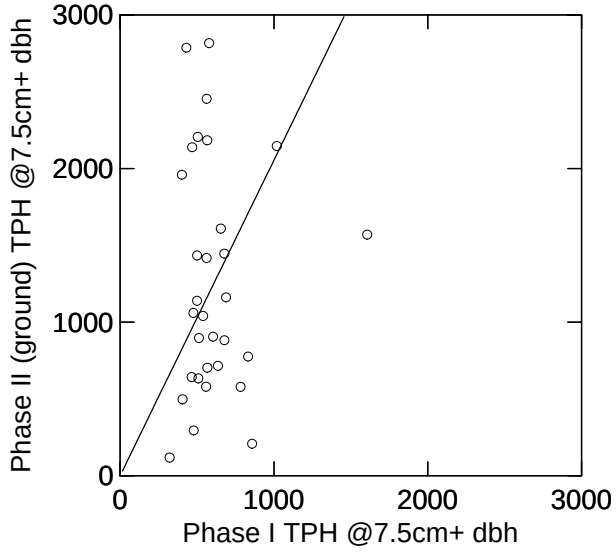

Fig E-4: FPL stratum: Phase II (ground) TPH vs. VDYP7 Phase I (inventory) TPH. Line is TPH adjustment ratio R=2.054.

[32] Age and height scatterplots for the VDYP7 adjustment are virtually the same as for the VDYP6 adjustment hence are not included here.

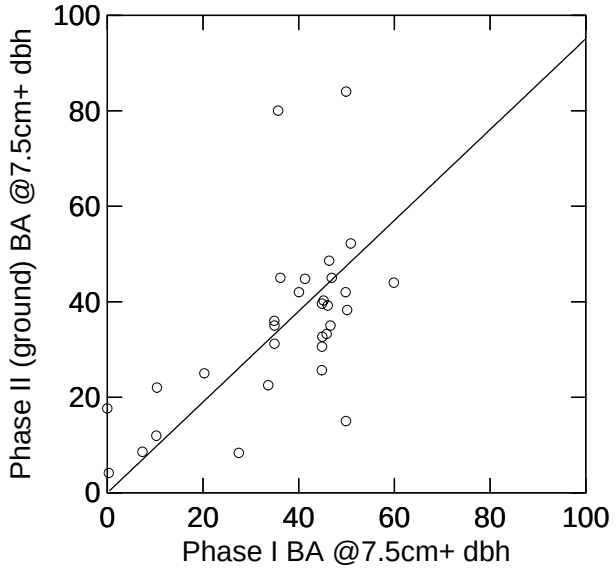

Fig E-5: SB stratum: Phase II (ground) BA@7.5cm+ dbh vs. VDYP7 Phase I (inventory) BA. Line is BA adjustment ratio R=0.951.

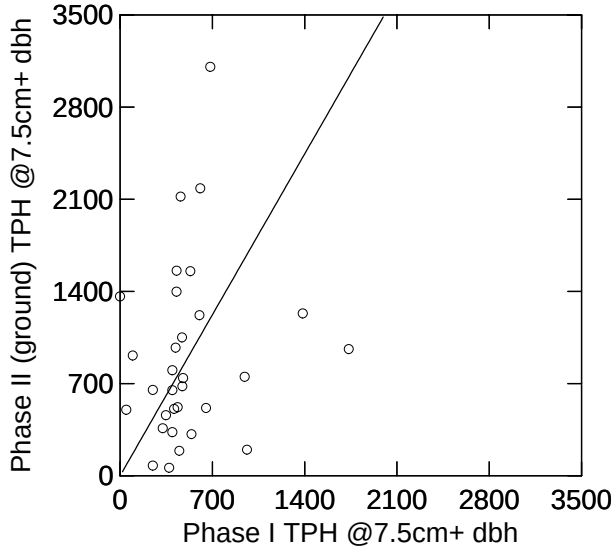

Fig E-6: SB stratum: Phase II (ground) TPH vs. VDYP7 Phase I (inventory) TPH. Line is TPH adjustment ratio R=1.746.

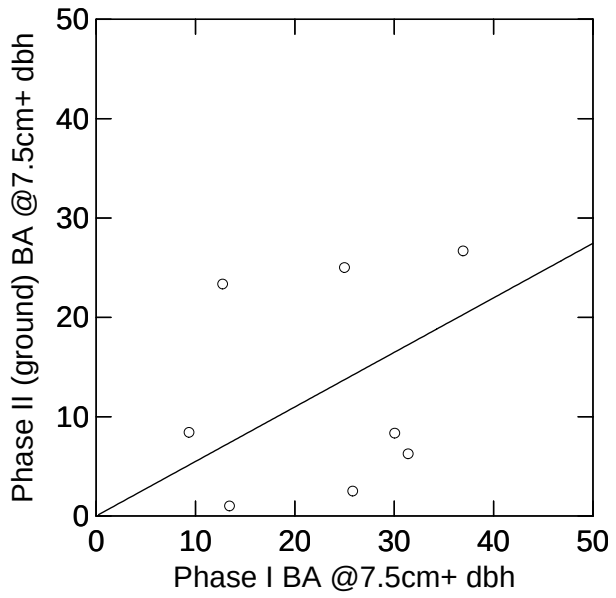

Fig E-7: DEC stratum: Phase II (ground) BA@7.5cm+ dbh vs. VDYP7 Phase I (inventory) BA. Line is BA adjustment ratio R=0.549.

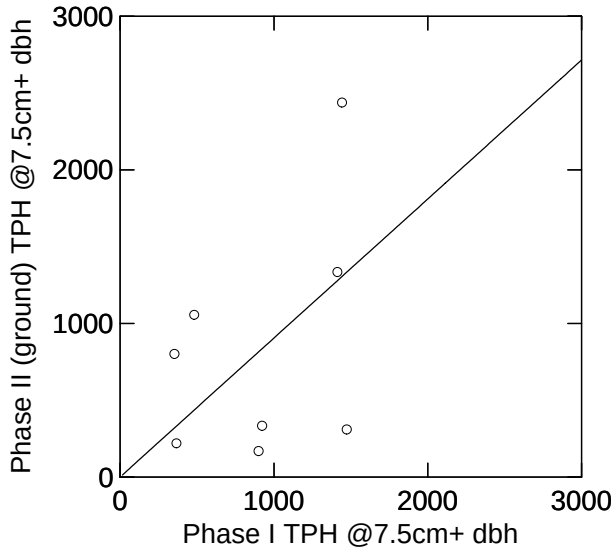

Fig E-8: DEC stratum: Phase II (ground) TPH vs. VDYP7 Phase I (inventory) TPH. Line is TPH adjustment ratio R=0.905.

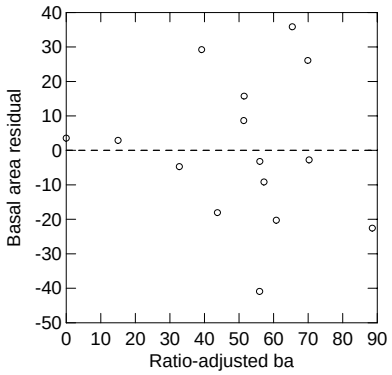

Fig E-9: CH stratum: BA residual vs. ratio-adjusted BA.

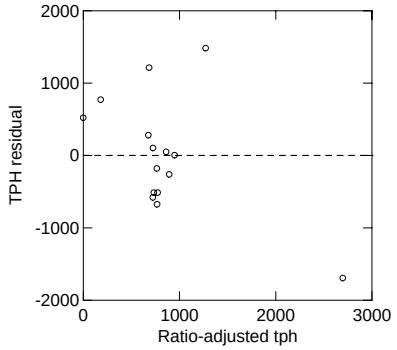

Fig E-10: CH stratum: TPH residual ratio-adjusted TPH.

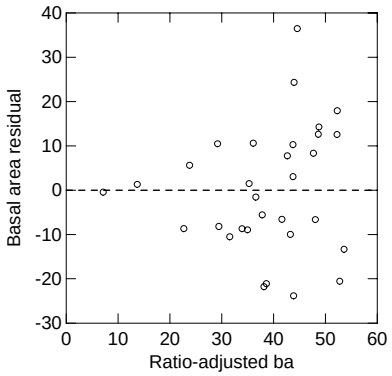

Fig E-11: FPL stratum: BA residual vs. ratio-adjusted BA.

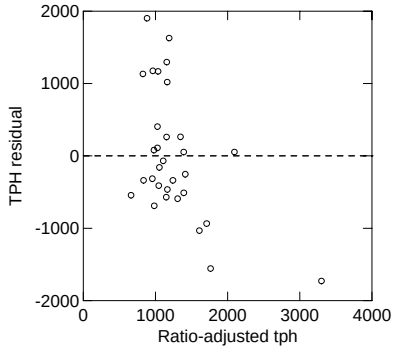

Fig E-12: FPL stratum: TPH residual ratio-adjusted TPH.

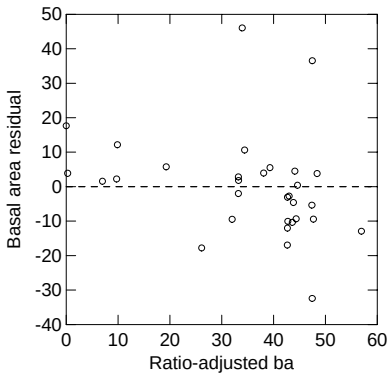

Fig E-13: SB stratum: BA residual vs. ratio-adjusted BA.

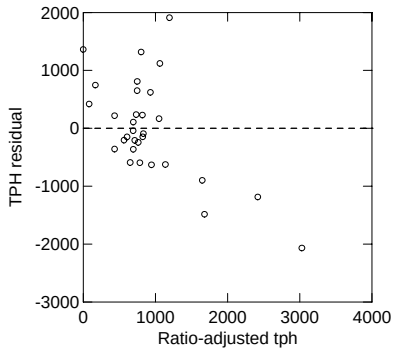

Fig E-14: SB stratum: TPH residual ratio-adjusted TPH.

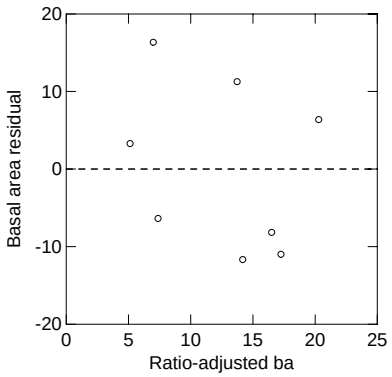

Fig E-15: DEC stratum: BA residual vs. ratio-adjusted BA.

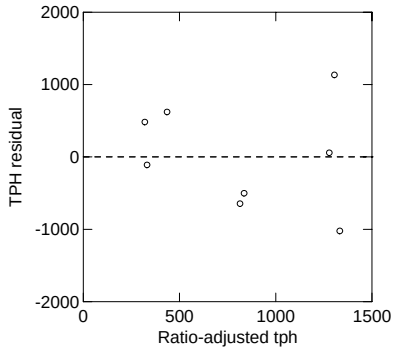

Fig E-16: DEC stratum: TPH residual ratio-adjusted TPH.

10. APPENDIX F: VDYP7 SCATTERPLOTS & RESIDUALS FOR VOLUME (STAGE 2 ADJUSTMENT)

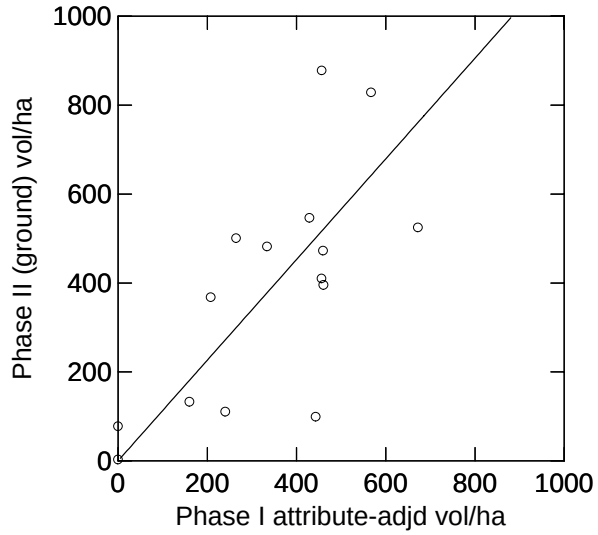

Fig F-1: CH stratum: Phase II (ground) vol/ha (net dw2, 12.5cm+, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.132.

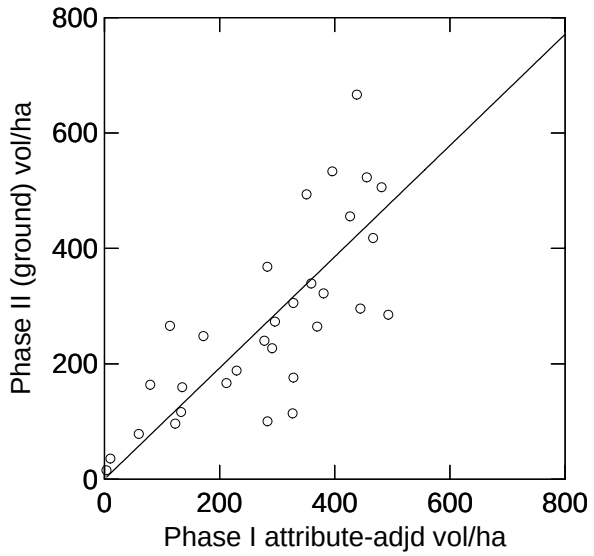

Fig F-2: FPL stratum: Phase II (ground) vol/ha (net dw2, 12.5cm+, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=0.964.

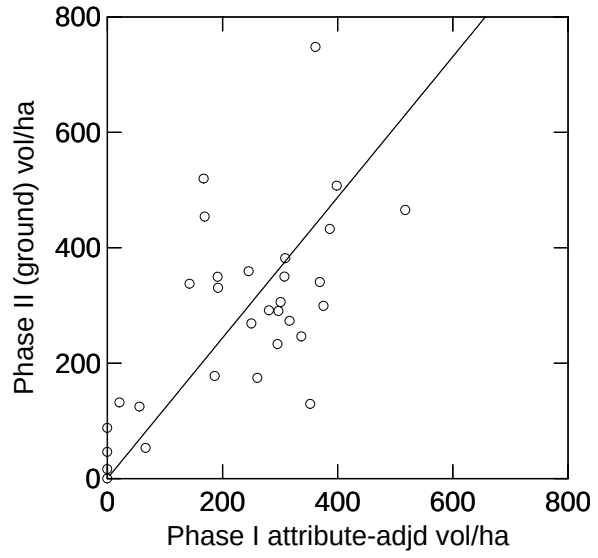

Fig F-3: SB stratum: Phase II (ground) vol/ha (net dw2, 12.5cm+, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.219.

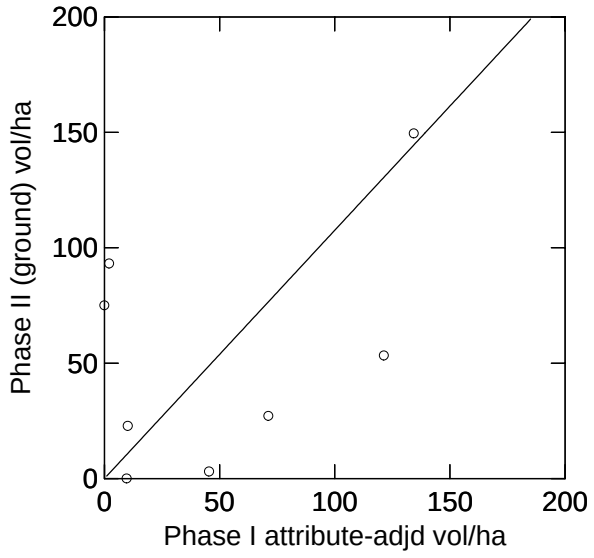

Fig F-4: DEC stratum: Phase II (ground) vol/ha (net dw2, 12.5cm+, NVAF) vs. Phase I (inventory) vol/ha. Line is age adjustment ratio R=1.076.

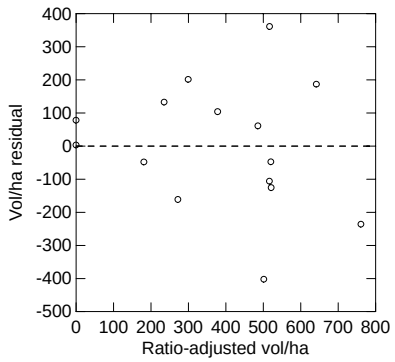

Fig F-5: CH stratum: Volume/ha residual vs. ratio-adjusted volume.

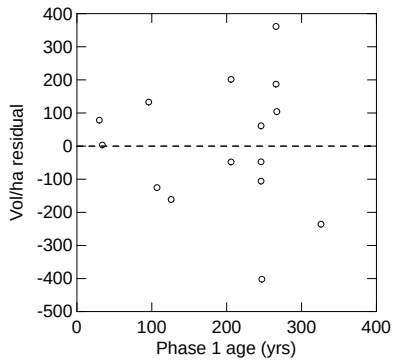

Fig F-6: CH stratum: Volume/ha residual vs. inventory age.

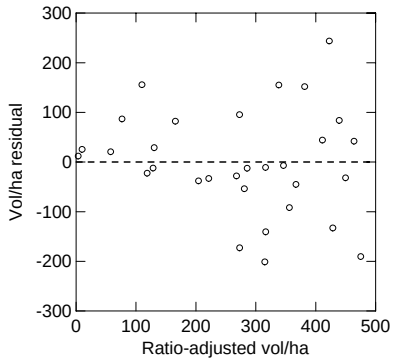

Fig F-7: FPL stratum: Volume residual vs. ratio-adjusted volume.

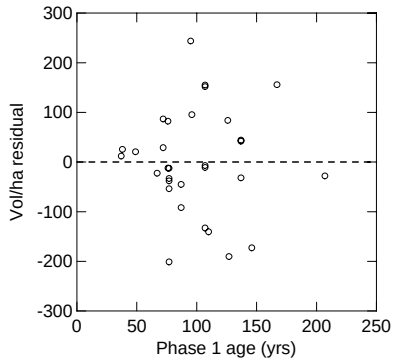

Fig F-8: FPL stratum: Volume/ha residual vs. inventory age.

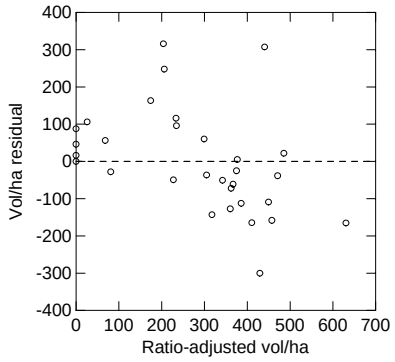

Fig F-9: SB stratum: Volume residual vs. ratio-adjusted volume.

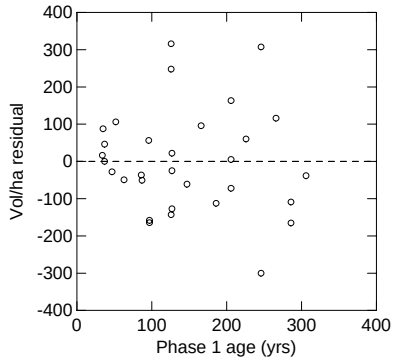

Fig F-10: SB stratum: Volume/ha residual vs. inventory age.

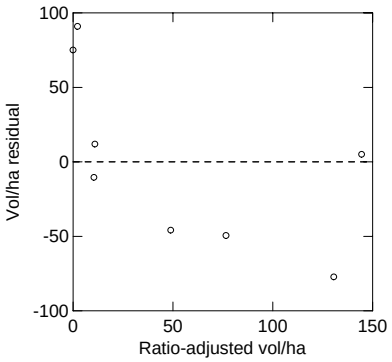

Fig F-11: DEC stratum: Volume residual vs. ratio-adjusted volume.

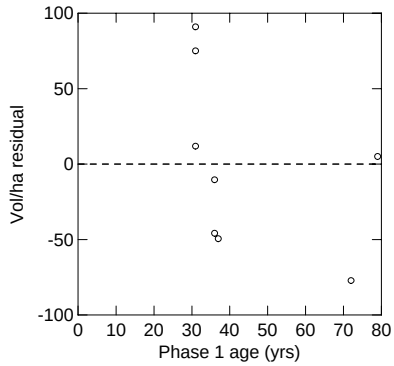

Fig F-12: DEC stratum: Volume/ha residual vs. inventory age.

11. APPENDIX G: POPULATION DISTRIBUTIONS PRE- AND POST-ADJUSTMENT

The pre-adjusted and post-adjusted area and volume by age class distributions for Golden TSA population of polygons that are VT, operable, greater than or equal to 30 years of age are shown in the figures below. Figures G-1 and G-2 correspond with the VDYP6 adjustment and Figures G-3 and G-4 correspond with the VDYP7 adjustment.

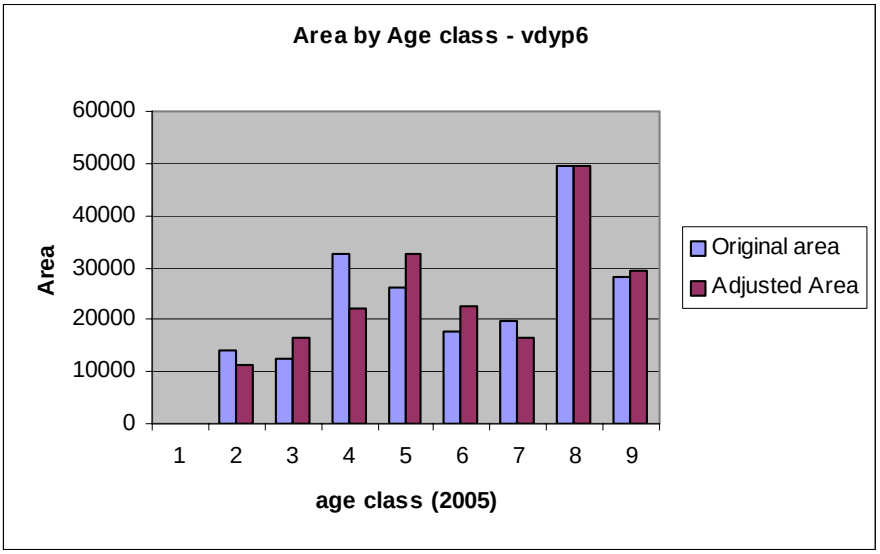

Figure G-1: Age class distribution before and after the VDYP6 adjustment of the VT, operable, ≥30 years of age population of the Golden TSA.

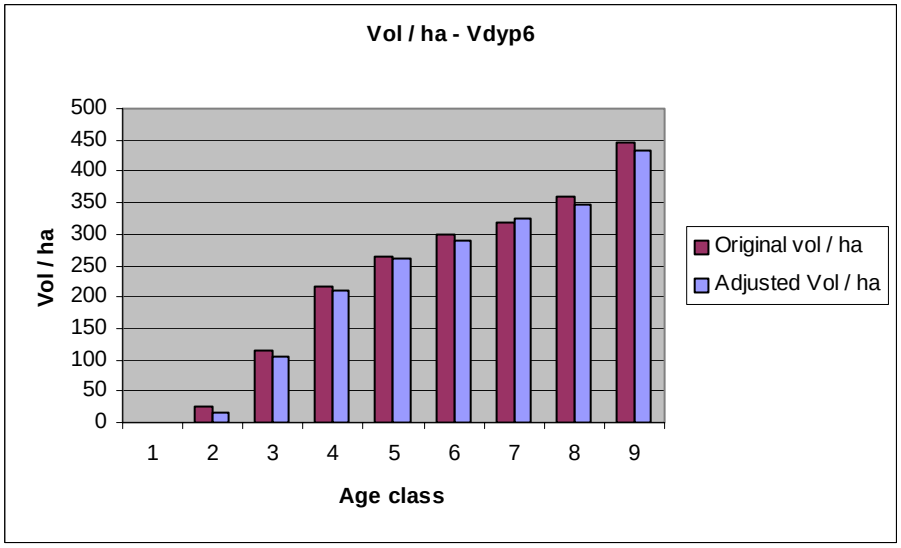

Figure G-2: Volume distribution by age class before and after the VDYP6 adjustment of the VT, operable, ≥30 years of age population of the Golden TSA.

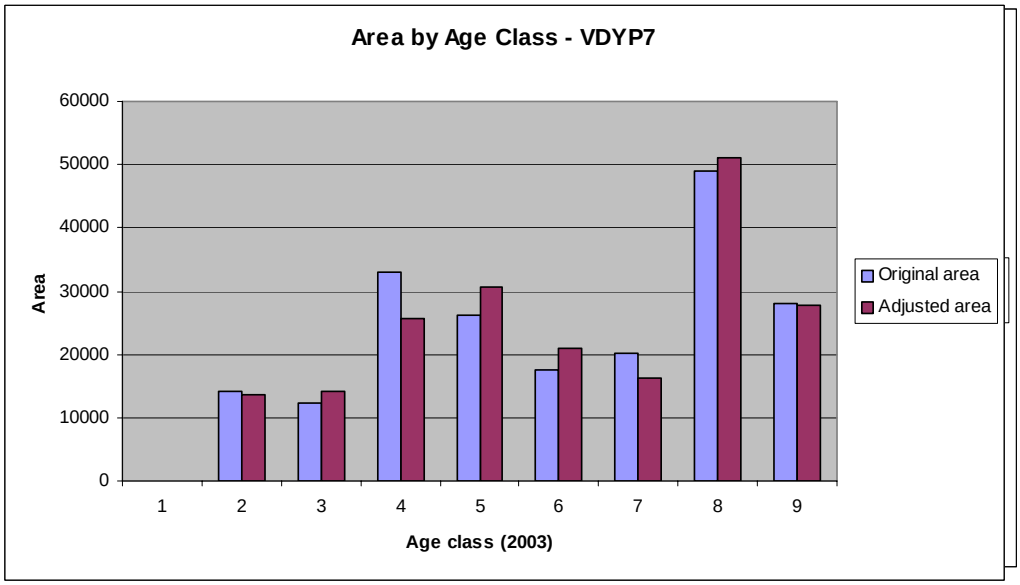

Figure G-3: Age class distribution before and after the VDYP7 adjustment of the VT, operable, ≥30 years of age population of the Golden TSA.

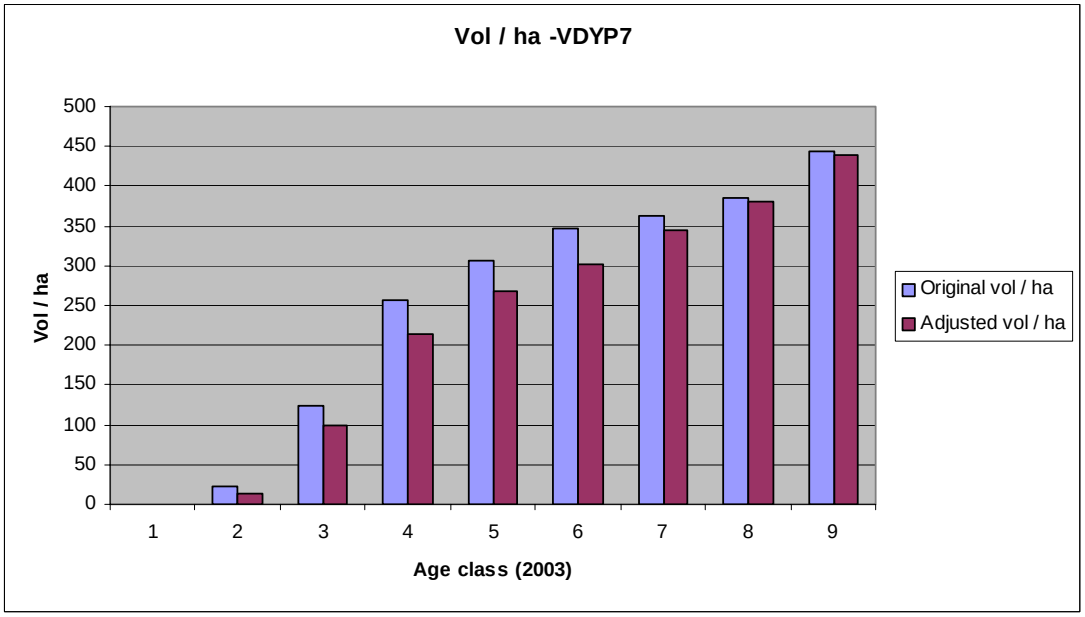

Figure G-4: Volume distribution by age class before and after the VDYP7 adjustment of the VT, operable, ≥30 years of age population of the Golden TSA.

Because VDYP7 and the VRIMS data structure have not yet been fully implemented, the population adjustments made in this analysis have *not* been applied to the operational inventory files. Prior to an operational adjustment of the Golden TSA, it is recommended that the population for adjustment be verified and reconciled with the population of interest as defined in the VPIP. A number of discrepancies in population areas were noted between the population files used for sample selection (provided by Atticus) and the inventory files used for adjustment (provided by MoFR). Details of the discrepancies by mapsheet will be provided to the MoFR to facilitate the verification process.

	Reported in VPIP		**From Provided Population Files**		**From Provided Population >= 30 years**		**Population 30+ with matching polygons in inventory files**		**Area for matched polygons on Inventory files**
Leading species strata	Area (ha)	# of polygons	Area	# of polygons	Area	# of polygons	Area	# of polygons	Area
FPL	93868.5	5817	93908.1	5820	82224.2	5263	82035.4	5238	80356.1
SB	93356.0	6786	93356.0	6786	84616.5	6387	84402.3	6361	82854.7
CH	31662.2	2110	31662.2	2110	28036.1	1933	27959.0	1924	27044.22
DEC	13218.0	804	13218.0	804	10662.7	667	10588.5	663	10433.17
Totals	232104.7	15517	232144.3	15520	205539.5	14250	204985.3	14186	200688.2

12. APPENDIX H: VERSION INFORMATION FOR VDYP7

The following provides details for the version of VDYP7 that was used in this analysis:

VDYP7 Batch Run Started: 2007-Mar-18 13:07:48
VDYP7 Batch Version: 7.26j
VDYP7 Extended Core DLL Version: 7.16f.105
VDYP7CORE DLL Version: 7.15n.28
Supporting Calc Library Version: 7.0g 25OCT04 BETA TESTING ONLY
VRIADJST Calc DLL Version: 1.02f
VDYPBACK Calc DLL Version: 1.02e
FIPSTART Calc DLL Version: 1.02e
VDYP7 Calc DLL Version: 1.02e
VRISTART Calc DLL Version: 1.02e
Calc DLL I/O Support Version: 1.01d
VDYP7 Low Level I/O DLL Version: 1.01i
Site Tools Version Number: 7.6a

13. APPENDIX I: VPIP

GOLDEN TSA
VRI GROUND SAMPLING

PROJECT IMPLEMENTATION PLAN

Prepared for:

LP Engineered Wood Products Ltd.
Wood River Forest
BC Timber Sales

Prepared by:

57B Clipper Street
Coquitlam, B.C.
V3K 6X2

August 30, 2003

Acknowledgements

Atticus Resource Consulting Ltd. would like to thank the following individuals for their assistance during the preparation of this implementation plan:

Carole Dascher for her contract management, ongoing project support and trust in Atticus to complete the sample design and project preparation work to the highest possible standards; Chris Mulvihill for his assistance with project planning and review of this document; and Keith Tudor, Will Smith, Gary Johansen, and Sam Otukol from the MSRM, TIB for their timely review and supportive assistance in the development of the best ground sampling and NVAF approach for the Golden TSA.

R.P.F. Signature

This project has been done to the required standards and completed accurately for the stakeholders of the Golden Timber Supply Area.

_____

Terry Conville, R.P.F.

Table of Contents

1.0 INTRODUCTION

As per the Ministry of Sustainable Resource Management, Terrestrial Information Branch's website, the Vegetation Resources Inventory is designed to answer two questions:

1. Where is the resource located? And,

2. How much of a given vegetation resource (for example, timber resource) is within an inventory unit?

1.1 Overview of VRI Process

The Vegetation Resource Inventory (VRI) is a photo-based inventory that has some of its attributes adjusted by formal ground sampling. The basic steps of the VRI process are as follows:

1) Aerial Photograph Acquisition: Digital softcopy of hardcopy aerial photograph creation and production,

2) Phase I – Photo Interpretation: Aerial photograph interpretation by certified interpreters – the main tasks include delineation and attribution (of a wide range of attributes including land cover type, tree species, height, age, structure, volume, basal area, density, slope position, ecological site unit, etc.),

3) Phase II – Ground Sampling: Implement ground sampling program based on achieving resultant sampling (standard) error of less than 15% for forest stand volume. Complete random ground samples evenly distributed across the target population (obtain detailed ground inventory and tree productivity measurements, forest health measurements, net volume calculations, grading, and potentially collect ecological data),

4) NVAF (Destructive Sampling): Complete destructive sampling of subclass of the ground sampling plots in order to localize and adjust the ground crew estimates of age, height, and gross and net volume,

5) Compilation & Statistical Adjustment: Compilation and adjustment of estimated ground sample cruiser-calls using the actual NVAF information. Then complete the inventory by statistically adjusting the photo based polygon information (continuous variables only – such as age, height, and volume), in order to achieve a statistically defensible and correct answer for the entire administrative unit.

1.2 VRI Responsibility

It is the licensee's responsibility to implement a VRI and the Ministry of Sustainable Resource Managements responsibility to create the standards and ensure potential projects follow proper sampling principles. As well, the MSRM provides some audit functions.

1.3 Document Objectives

The objective of this report is to outline and describe the Vegetation Resources Inventory (VRI) ground sampling activities to be completed within the within the Golden Timber Supply Area (Golden TSA). It provides some basic landbase information, some background information from the previous Annual Allowable Cut (AAC) Rationale document (Jan. 2000), outlines the ground sampling design and methods used. In addition, this report outlines the implementation plan for the field sampling.

1.4 Landbase

The Golden TSA is located in southeastern British Columbia within the Nelson Forest Region. The TSA is bounded by the Selkirk and Purcell Mountains to the west and the Rocky Mountains to the east. It straddles the Rocky Mountain Trench and the upper Columbia River Valley northward to the Big Bend area near Mica Dam. The TSA is bordered by five National Parks (Kootenay, Yoho, Banff, Jasper and Glacier), as well Hamber Provincial Park and Cummins Lakes Provincial Park is located within the TSA boundary (AAC Rationale document, 2000).

Most of the TSA lies within the interior wet belt of the province. The mountainous environment has a varied climate and growing conditions, resulting in diverse forests. In wetter parts of the TSA, lower elevations are occupied predominately with western red cedar, western hemlock and spruce species, with stands of spruce and subalpine fir occupying most of the higher elevations. Some southern parts of the TSA experience a drier climate, with Douglas-fir forests in valley bottoms and lodgepole pine at higher elevations. Throughout the TSA, mountain peaks are covered by large areas of alpine tundra, rock, snow, and ice. Because of the rugged, mountainous landscape, a relatively small portion of the TSA consists of productive forest land (AAC Rationale document, 2000).

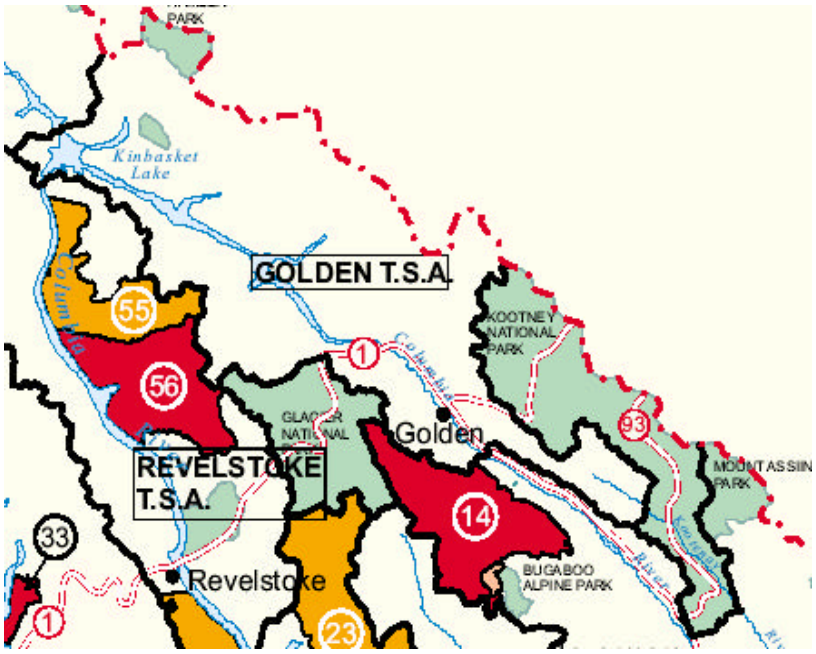

Figure 1: Overview of Golden TSA

The four biogeoclimatic zones located within the TSA include the Interior Cedar Hemlock (ICH) zone, the Engelmann Spruce Subalpine Fir (ESSF) zone, the Sub-Boreal Spruce (SBS) zone, and the Alpine Tundra (AT) zone.

Based on current (May 2003) estimates from the BC Ministry of Forests (MoF), the Golden analysis unit is just over one million (1,185,101) hectares in total area and the TSA area (excluding parks) is just over 900,000 (902,445) hectares.[2] Of this only 186,498 hectares (20 percent) is considered as operable productive forest land, and approximately 153,870 hectares is considered suitable as the Timber Harvesting Land Base (THLB). Table 1 below shows an abbreviated landbase summary as per the May 2003 landbase information. Note that these figures differ to some degree with the VRI database figures in Section 2.4 of this report – as the information below was determined based on historical inventory and operability information.

Table 1: Golden TSA Abbreviated Landbase Summary Estimates (Provided by the Ministry of Forests, Columbia Forest District)

Description	**Area (ha)**
Total Landbase	1,185,101
TSA	902,444
Treed & managed by MoF	351,450
Reductions	*205,281*
Additions	*7,700*
Current Timber harvesting Landbase (THLB)	153,869
Operable Productive Forest Land	*186,498*

The general species breakdown (of the main species within the TSA) of the previous inventory versus the new VRI inventory yields the following comparison (as shown in Table 2).

Table 2: Species Comparison (previous versus VRI inventory)

Previous Inventory		**VRI Inventory**	
Species	**%**	**Species**	**%**
SB	40	SB	40
F	22	F	26
PL	22	PL	14
Cw	9	Cw	6.5
Hw	7	Hw	7
Other	N/a	Other	6.5
Total	100 %	Total	100 %

This breakdown between the inventories shows generally little difference in the leading species except a switch in the amount of Douglas fir versus lodgepole pine and the addition of other (deciduous) species in the VRI inventory.

1.5 Background and Inventory Issues

The original inventory was completed in 1968 and was last updated in 1994. This existing inventory information was used in the January 2000 AAC determination, however, at that time the Nelson Forest Region was also undertaking the new VRI phase I inventory work.

The VRI aerial photo (Phase I) inventory was completed in December 2001 using 1996 and 1997 1:15,000 hard copy aerial photographs. The document photos are currently kept with the Ministry of Sustainable Resource Management (MSRM) Nelson Regional Office.

The AAC rationale stated a number of issues and uncertainties with respect to the inventory and related forest information. The issues related to the classification of the forest land and deal with uncertainty in the existing forest management related to the inventory.

The specific issues outlined in the rationale document which revolve around the inventory, which should be able to be addressed by this current VRI, include:

1) Deciduous stands were previously excluded from the timber supply analysis. These stands should be included as they may also contain valuable conifer species or contribute to future volume in the TSA;

2) For the previous Timber Supply Review (TSR) the 1989 operability line was used to support the AAC determination. A revised operability line was requested before the next TSR;

3) Although the inventory volumes themselves were deemed acceptable in the inventory audit a new inventory was requested in order to reduce uncertainty, particularly for stands older than 140 years of age;

4) There were potentially significant errors in the species composition – especially the species classification for problem forest types;

5) It was recommended that destructive sampling and testing continued in order to assess allowances for decay waste and breakage for cedar and hemlock stands;

6) Correct site productivity estimates is required for both the low volume cedar/hemlock stands and mature low site index spruce leading stands.

2.0 GROUND SAMPLING PLAN

This portion of the report provides information on the sampling plan prepared for the Golden TSA.

2.1 Ground Sampling Objectives

The main objective of the ground sampling timber emphasis inventory is to install an adequate number of VRI sample clusters in order to statistically adjust the photo interpreted timber inventory attributes (such as height, age, and volume), within the TSA vegetated-treed areas to achieve a sampling (standard) error between 10 and 15 percent with a 95% confidence level.

2.2 Target Population

The target population for the proposed ground sampling inventory is the vegetated treed portion of the TSA located on crown forest land, that is also considered "operable" – as defined by the 2002 operability linework.

LP Engineered Wood Products Ltd. has substantially revised the operability over the last two years – and has stated that the operable area is quite stable. As with other areas in the Province, the operable area within the Golden TSA was considered for ground sampling as it provides for cost effective VRI ground sampling and focuses sampling activities in the portion of the landbase that is particularly important to the stakeholders.

In addition, stands younger than 30 years of age were to be excluded from the ground sampling inventory. The volume estimates for these stands are problematic; as well age and height information is often available from silviculture survey information.

The selection of the target population consisted of first identifying "Vegetated and Treed" polygons (greater than 10 percent crown closure) that are at least touching the operability line. This selection method at least allows for a buffer of potentially operable or borderline high elevation polygons along the designated operability 'line'.

2.3 Sample Size

The sample size for the Golden TSA is determined based on a combination of the sampling error (SE) objective (10-15%) and the expected net volume coefficient of variation (CV) of the population, as determined from the latest inventory audit information. The previous operable inventory volume coefficient of variation (as determined by the 1999 Golden TSA inventory audit) is estimated to be 52 percent. Based on this information, and historical inventories in the region, the Nelson Regional Vegetation Resources Inventory Forester, Chris Mulvihill, R.P.F., estimated that 85 samples might be suitable to meet the sampling error target.

In addition, by using the sample size estimate calculations 85 samples are predicted to yield a sampling error of approximately eleven (11) percent. However, the coefficient of variation of the new inventory will be revised and re-calculated once the initial year of ground sampling is completed – then the proposed sampling error estimates can be better refined.

The preliminary figures for determining the number of samples conducted within the Golden TSA are shown by the calculations below:

Sample Size Estimate

NOTE: CV is from VRI Ratio-of-Means
(ground volume/unadjusted inventory volume)

where n = t^2 * CV^2 / PE^2 (t at alpha/2, n-1)
if t=2 is assumed (for alpha=0.05), n = 4 * CV^2 / PE^2

Sample size for a given CV and PE:

CV= 52.0%
alpha= 0.05 t=2

Error %	**Sample size**
PE	N
10%	108
15%	48

Sample size for a given CV and n:

CV= 52.0%
alpha= 0.05

Sample size	Error %
n	PE
50	14.8%
80	11.6%
86	**11.1%**

100	10.3%
120	9.4%
130	9.0%
150	8.4%

2.4 Sample Selection

The method used for selecting polygons was that of probability of selection proportional to size with replacement (PPSWR). The selection process for Golden TSA followed the procedures outlined in the document, "Sample Selection Procedures for Ground Sampling", which was produced by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, in December 2002.

The data files used for the selection process included the most recent:

1) Golden TSA VRI Phase I inventory database and graphic files (approved by the MSRM in 2002),
2) Administrative boundary coverage (obtained from the Columbia Forest District, MoF, 2002), and
3) Operability overlay linework (2001/2002) obtained from LP Engineered Wood Products Ltd.

The VRI data files were used for preparing the sampling plan for the VRI ground field verification sampling. Most of the information in this database was projected to 2001/2002. A few mapsheets were also obtained from the MSRM that had new inventory information in 2003. Once collated the database files were verified to be clean and free of errors and a 1:1 link with the spatial files was confirmed, then a seamless VRI database (for the entire TSA) was produced. From this database specific attributes were used for the selection process. The attributes used (from the VRI database) for this procedure included:

1) MAP_ID
2) POLY_ID
3) SPECIES_ID
4) SPECIES_CD
5) CROWN_CLOSURE
6) FOR_COVER_RANK_CD
7) SPECIES_PERCENT
8) BASAL_AREA
9) VOLUME, and
10) PROJ_AGE

The qualifying vegetated-treed polygons cover 232,104.7 hectares of the Golden TSA (approx. 25 percent). These polygons were divided into four dominant strata based on the area coverage and similar growth characteristics of the leading tree species. As well, the strata were developed in an attempt to address some of the previous inventory issues.

Once the strata were defined, the standards required that each of the strata be further separated in sub-strata, based on volume. The target was less than 15 substrata overall with a maximum of three substrata (low to high volume), per main species strata. Table 3 shows a summary of the area, percent coverage, and number of polygons within each strata class. As well the proposed number of ground sampling plots are shown for each strata and the number of substrata classes are presented.

Table 3: Golden TSA Sampling Strata

SPECIES	AREA	PERCENT	# POLYGONS	# Plots per strata	# of Substrata
FPL	93,868.5	40.4%	5,817	31	3
SB	93,356.0	40.2%	6,786	31	3
CH	31,662.2	13.6%	2,110	15	2
Dec	13,218.0	5.7%	804	8	1
Total	**232,104.7**	**100.0%**	**15,517**	**85**	**9**

The justification for the separate and smaller deciduous sample is to isolate the impacts of these deciduous leading polygons on the other strata – and to attempt to keep the other strata somewhat homogenous. The deciduous polygons tend to have less accurate information, and when compared to the ground information, they produce more extreme adjustment factors. As well, at this time the deciduous strata has limited inventory significance, therefore a disproportionate allocation of samples is proposed (per. Comm. S. Otukol, MSRM, 2003).

Once the substrata were determined, the individual substrata polygon areas were accumulated and then individual polygons were randomly selected from this list according to the proportional area of each substratum.

2.5 Quality Assurance Process

Once the potential ground sampling polygons were selected the proposed target sample was compared against the entire Golden TSA population. This comparison is critical to ensure that the selected samples represent the range of inventory attributes that exist in the population. For this comparison a number of attributes were used, including strata (species) group, volume class, age class, height class, and site index (see Figures 2 through 6 respectively).

Figure 2: Species Group Comparison/Summary

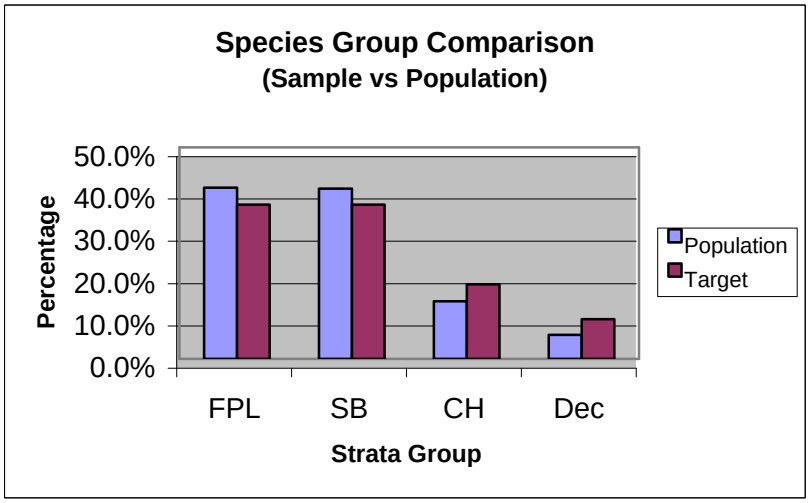

Figure 3: Volume Comparison

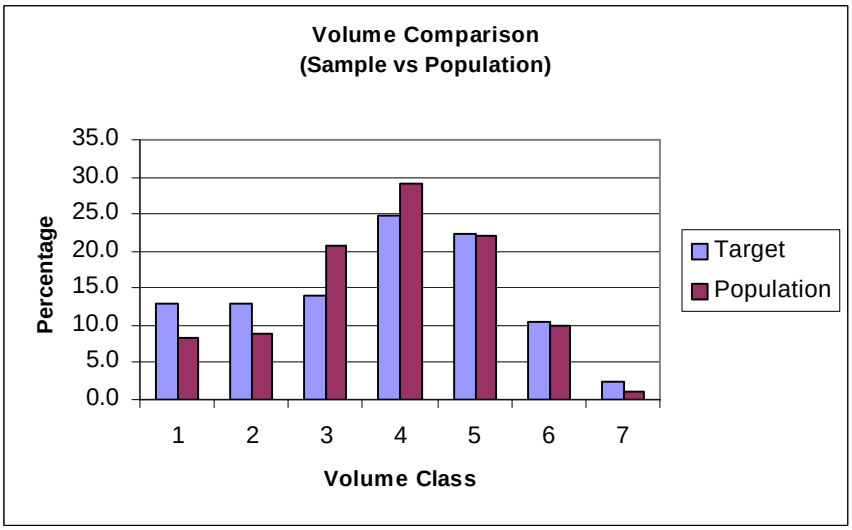

Table 4: Volume Class Codes

Volume Class	Values (m^3)
1	0 to 50
2	51 to 150
3	151 to 250
4	251 to 350
5	351 to 450
6	451 to 550
7	551+

Figure 4: Height Class Comparison

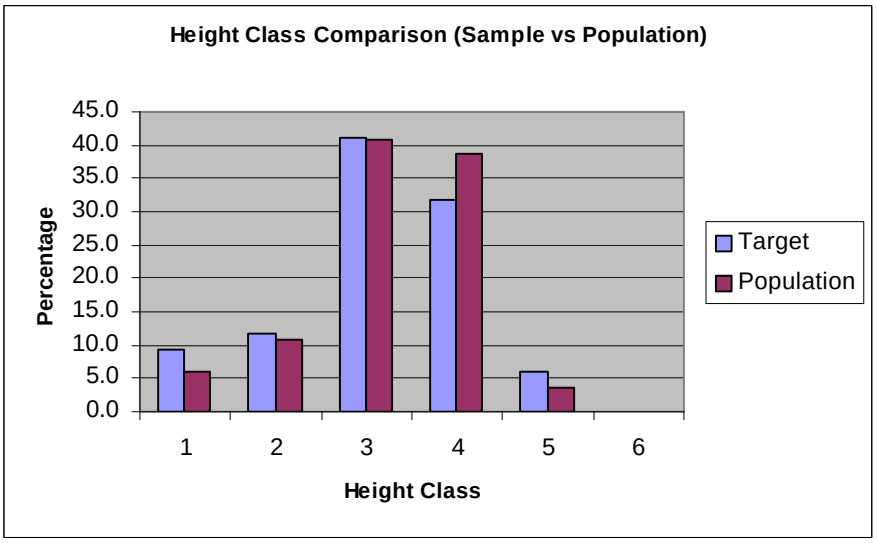

Figure 5: Age Class Comparison

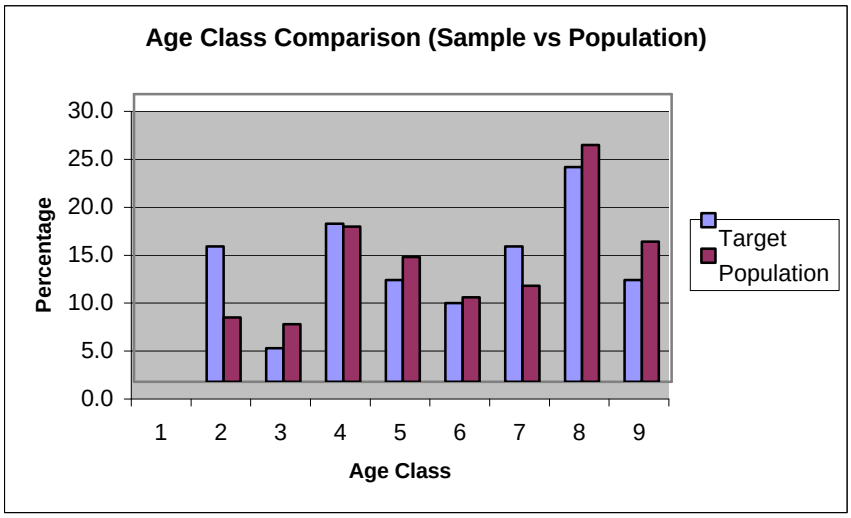

Figure 6: Site Index Comparison

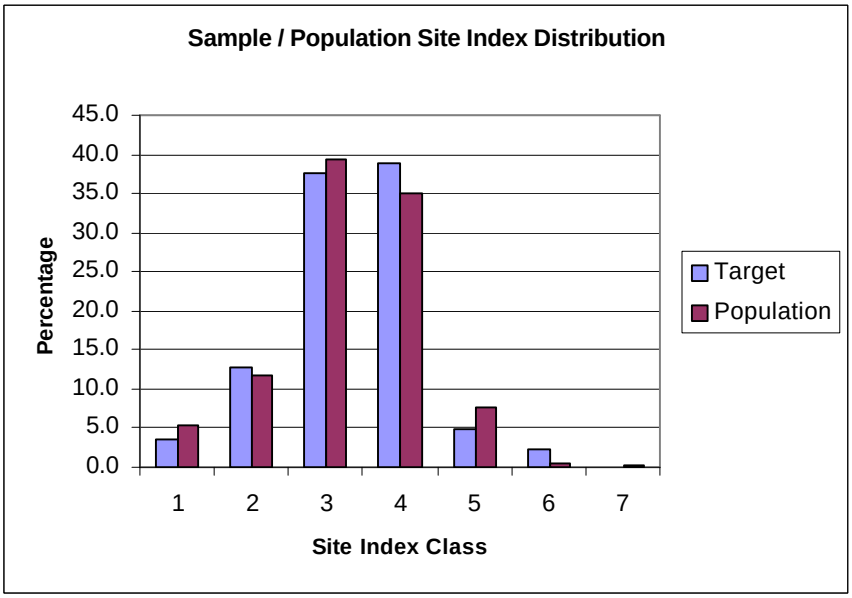

Table 5: Site Index Codes

SI Class	Values
1	0 to 10.0
2	10.1 to 12.5
3	12.6 to 17.5
4	17.6 to 22.5
5	22.6 to 27.5
6	27.6 to 30.0
7	30.1+

2.6 Sample Point Selection

Once the polygons were chosen then the sample point within each target polygon was selected. The official provincial 100-meter grid was digitally overlaid over each selected polygon, and then every grid point within each selected polygon was retained. After which, a random point generator was used to select the sample point location for each of the selected polygons.

2.7 Sampling Approach

Due to Forest Investment Account (FIA) budget limitations the ground sampling activities will be completed over two years beginning in the fall of 2003, with completion scheduled for the summer of 2004. Both the regular timber emphasis sampling and the net volume adjustment factor (NVAF) enhanced cruising will be conducted. It is anticipated that the NVAF ground samples be given priority so they can be used to develop the NVAF destructive sampling contract in early 2004. In this way the NVAF destructive sampling can then also be completed in the summer/fall of 2004 – thereby allowing the stakeholders to potentially complete the final inventory adjustment work in the fall/winter of 2004/2005 for the Golden TSA.

2.8 Sample Type

The ground sampling for this inventory will use Timber Emphasis Plots (TEPs) with selected enhanced cruising of selected auxiliary plots for the purpose of future NVAF destructive sampling.

The inventory sample design is a five-point cluster consisting of an Integrated Plot located at the centre of the cluster, and up to four auxiliary plots located in cardinal directions around the main integrated plot center. The integrated plot center is the location around which the detailed sample information will be collected. All attributes are attached to the plot centre point. Data is collected on the following major items:

- tree attributes – including mensuration, damage, loss, gross and net volume, and grades (variable and/or fixed area)
- site tree information (fixed area - 5.64 m radius)
- wildlife tree attributes (variable or fixed area)
- small trees and stumps (fixed area - 2.50 m radius)

Plot type for each of the proposed ground samples have already been determined and (as per the standards) are either variable or fixed radius plots.

2.9 Measurements

The data collection for each attribute will follow the current VRI ground sampling standards: “Vegetation Resources Inventory, Ground Sampling Procedures”, version 4.3 prepared by Ministry of Sustainable Resources Management, Terrestrial Information Branch, March 2002.

For the TEP’s, the measurements will be recorded using either the VRI field cards 1-3 and 8-11 or handhelds; in either case, the digital data will be submitted in an acceptable and clean format (TIMVEG or VIDE formats) to the MSRM.

For the NVAF cruising 23 samples (and 60 auxiliaries) will be sampled. VRI field card number 11 (or alternatively cards 8 and 9) will be used for data collection.

VRI certified timber emphasis samplers will conduct all measurements – and all sampling will meet or exceed current VRI standards.

2.10 NVAF Activities

As per the MSRM standards, the net volume adjustment factor (NVAF) sampling is mandatory for the inventory. 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; it will be used to statistically adjust the estimate of net merchantable volume of VRI ground samples.

The objective of the NVAF portion of the inventory is to complete destructive tree sampling and obtain local information for hidden decay, waste, and stem taper in order to statistically adjust the cruiser calls for net volume.

In the ground sampling phase of the NVAF process, ground sampling crews will provide detailed enhanced cruising (net factoring and call grading) of all the trees (live, dead, standing or fallen) within the selected auxiliaries at the same time as they are conducting regular timber emphasis sampling within the TSA. Once the enhanced data is collected then the NVAF enhanced tree data will be compiled in a tree matrix and a sample design for selected trees will be developed.

All NVAF planning and implementation will follow the Net Volume Adjustment Factor Sampling Standards and Procedures, MSRM, Version 3.0, March 2002

The ground sampling NVAF selection process for the Golden TSA is described below in the following steps:

Step 1) Gather the information of selected (85) ground samples:

Sample tree stratification is based on polygon attributes (polygon age, leading species)

Step 2) Stratify the ground samples by age group:

Immature: equal or less than 120 years old.

Mature: greater than 120 years old.

For this inventory there are 45 immature samples & 40 mature samples.
MATURE - 40 samples

Step 3) Determine the number of NVAF sample trees – both overall and by strata:

The NVAF requires that a minimum of 10 immature and 5 dead trees be destructively sampled, in addition to a minimum of 30 live mature trees per stratum. Therefore, after careful consideration, it was recommended that 75 trees would likely may be an appropriate balance between the number of sample trees required while minimizing overall and individual stratum sampling error.

In summary the NVAF destructive sampling stratum will include -

- *Immature = 10 trees*
- *FPL mature = 30 trees*
- *Other mature = 30 trees*
- *Dead trees = 5 trees*
  TOTAL = 75 trees

Step 4) Select the NVAF samples from the 85 ground samples for each NVAF stratum:

For each stratum sort by leading species, then by sample number
Dead trees will be randomly selected in the field from the selected enhanced auxiliaries.

Step 5) Random auxiliary selection:

In an effort to balance time and NVAF sample size only up to three auxiliaries would be selected per NVAF selected sample. See Table 6 for a listing of the ground samples and randomly selected

Table 6: Selected NVAF Samples and Auxiliaries

Sample #	Auxiliaries
15	N, E, S
53	N
64	S
61	N, E, S
13	E, S, W
17	N, E, S
21	E, S, W
27	N, E, S
45	N, E, W
11	N, E, S
14	N, S, W
20	N, W
47	N, E, S
51	N, S, W
65	S, W
69	E, S, W
71	S, W
73	N, S, W
75	N, W
77	N, E, W
79	N, S
81	N, E, S
84	E, S, W

3.0 IMPLEMENTATION PLAN

This section of the document outlines the activities needed to implement the proposed ground sampling project.

3.1 Scheduling

The Golden TSA ground sampling activities are scheduled over two years. In the first year (fall 2003) it is expected that approximately 50 ground samples will be established. However, all of the planned NVAF enhanced plots (23) will be completed in this first year to allow for NVAF destructive sampling to occur in the summer of 2004.

After the first year of sampling the coefficient of variation (CV) will be re-calculated based on the standard error of regression for net volume. This will help direct the amount of sampling to complete in 2004. Table 7, shown below, provides a list of activities and the proposed completion date.

Table 7: Schedule of Activities for the Golden TSA

ACTIVITY	Completion Date
Project development	Jun-03
Sample plan preparation	Jul-03
Package preparation	Jul-03
VPIP	Aug-03
Ground sampling (GS) RFP	Aug-03
GS Contract initiation	Sep-03
Ground sampling (~50 samples) - yr 1	Oct-03
GS QA (10%)	Oct-03
GS data compilation	Dec-03
NVAF sample matrix	Jan-04
Preliminary analysis (re-calculate CV)	Jan-04
NVAF destructive sampling RFP	Jun-04
NVAF contract initiation	Jun-04
Ground sampling (~35 samples) - yr 2	Jul-04
GS QA (10%)	Jul-04
NVAF destructive sampling	Aug-04
NVAF QA	Aug-04
GS data compilation	Sep-04
NVAF data compilation	Nov-04
Final inventory adjustment	Jan-05

3.2 Sample Packages

Atticus prepared the sample packages for all 85 samples, with each package containing:

- copies of Phase I document photos
- 1:10,000 scale orthophoto sample location maps
- 1:20,000 scale forest cover maps with the most recent Forest Development Plan information included.

Pioneer Forest Consulting will provide the successful contractor with the packages plus overview maps (at 1:60,000 scale) for the entire Golden TSA area.

3.3 Roles and Responsibilities

3.3.1 Project Coordination

Pioneer Forest Consulting provides the overall project coordination of the Golden TSA ground sampling inventory. Atticus Resource Consulting Ltd. was responsible for developing all the phases of the sampling plan, from data assembly and design to sample packages preparation. Sample size was developed based on information provided by Chris Mulvihill, R.P.F., the Nelson Regional Vegetation Resources Inventory Forester (MSRM). The MSRM, TIB staff is responsible to review the Vegetation Project Implementation Plan (VPIP), and eventually approve the plan before ground sampling commences. As well, they have provided valuable insight and assistance with various sections of the sampling plan preparation.

Ground sampling crews have not yet been selected for this work. The request for proposals will be sent to eligible VRI contractors. The chosen contractor will be responsible for all phases of the ground sampling work and will ensure that every aspect of the ground sampling phase will be completed to the latest VRI standards. The contractor will be responsible for the overall sampling logistics and delivery of the project to Carole Dascher, R.P.F., of Pioneer Forest Consulting Ltd.

3.3.2 Project Support

Atticus will provide the sample list to Pioneer Forest Consulting, which will include: sample number, mapsheet, polygon number, UTM coordinated (Northing and Easting) as well as Lat/Long coordinates and basic access information. A backup sample list will also be provided.

Pioneer Forest Consulting Ltd will provide sample packages, including copies of document photos and field maps to the contractor. It is expected that the successful contractor will provide the plot supplies (field cards, aluminum stakes, paint, ribbon, and drinking straws for tree cores) in enough quantities to complete 85 ground samples.

3.3.3 Fieldwork

The fieldwork will be completed with VRI certified crews following the VRI measurement protocols as detailed by Vegetation Resources Inventory Ground Sampling Procedures Version 4.3 – March 2002. The fieldwork will include locating and completing a VRI timber emphasis cluster sample. At each plot the crew will record the field data either on a TIMVEG handheld computer program or on standard VRI data cards provided by the MSRSM. In addition, each crew will collect GPS information (where possible), take 35mm photographs of the plots, and collect tree ages for microscopic office age counting.

The sample plots will be completed in batches suitable for quality assurance checking by a third party.

3.3.4 Quality Assurance

Following the latest MSRM standards, a separate (third party) contractor will complete the Quality Assurance (QA) of at least 10 percent of the ground samples. It is expected that the minimum number of QA samples will be 9, however, it is likely that at least 10 samples would be completed (based on an initial batch of only 5 samples for each crew – if three crews were being used on the project). It is unknown at this time if the MSRM, Nelson Regional Vegetation Resources Inventory Forester (Chris Mulvihill), will be available to complete the QA portion of this work.

The Vegetation Resources Inventory Ground Sampling Quality Assurance Standards Version 1.1 will be followed.

3.3.5 Data Compilation, Analysis and Adjustment

The selected contractor will complete data entry, GPS corrections, and microscopic office age counts immediately after the field season. All final data and materials will then be provided to Pioneer Forest Consulting.

At the end of the first year of field sampling new coefficient of variations (CV's) will be calculated and will be used to adjust and direct sampling efforts in 2004.

The final compilation of the inventory data including statistical analysis and data adjustment will be conducted in the fall/winter of 2004/2005 after the NVAF destructive sampling is completed in the summer of 2004, subject to budget approval. The analysis will follow the minimum standards as stated in the "VRI Inventory Attribute Adjustment procedures, version 4.4", MSRM, 2002.

Final ground sample and adjusted digital data will be submitted to MSRM, TIB in an acceptable and approved format.

4.0 SAMPLE LIST

4.1 List of Selected Samples

The following table provides a list of the proposed 85 VRI ground samples to be completed for the Golden TSA.

Table 8: List of Selected VRI Ground Samples

Sample	Sample Type	Mapsheet	Polygon	BGC	UTM_X	UTM_Y	Sp1	Sp2	AGE	HT	Vol/ ha	Access Type
1	Timber	082N063	903	ICHmw1	470505.9	5721985.2	AT	PLI	31	6.5	0.1	TRUCK
2	Timber	082N045	216	IDFdm2	495178.3	5696630.6	AT	SE	47	19.8	76.8	TRUCK
3	Timber	082N064	1020	ICHmw1	472463.6	5717599.3	AT	ACT	36	13.6	9.6	TRUCK
4	Timber	082N064	868	ICHmw1	476844.1	5717944.1	AT	FDI	31	12.8	4.3	TRUCK
5	Timber	082N035	874	ICHmk1	492310.3	5692361.6	AT	SE	72	25.1	129.7	TRUCK
6	Timber	082N026	544	MSdk	502316.1	5677666.0	AT	PLI	79	22.8	147.8	TRUCK
7	Timber	082N045	284	MSdk	497602.8	5698234.4	AT	PLI	97	37.7	234.4	TRUCK
8	Timber	082N008	345	ICHmw1	533515.2	5660844.5	W	SE	37	19.8	134.5	TRUCK/HELI
9	Timber	082N081	299	ICHwk1	437483.4	5746796.8	HW	SE	96	20.8	276.3	TRUCK/ATV
10	Timber	082N083	797	ICHmw1	468268.5	5739114.6	CW	HW	30	8.8	22.1	TRUCK
11	NVAF	083D040	229	ICHwk1	427052.7	5799987.5	HW	CW	206	27.2	352.2	HELI
12	Timber	082N043	219	ICHwk1	467541.3	5703610.3	HW	FDI	247	33.2	408.7	TRUCK
13	NVAF	083D009	3	ICHwk1	405122.7	5772933.4	CW	HW	206	31.2	407.2	HELI
14	NVAF	082N043	227	ICHwk1	471822.0	5703968.1	HW	CW	267	31.2	416.0	TRUCK/ATV
15	NVAF	082N062	231	ESSFwc2	452330.3	5725730.2	CW	HW	34	5.9	0.1	TRUCK
16	Timber	083D040	572	ICHwk1	424901.8	5795016.6	CW	HW	126	24.3	289.2	HELI
17	NVAF	082N081	598	ICHwk1	442622.8	5739682.7	CW	HW	326	39.2	547.6	TRUCK
18	Timber	083D009	130	ICHwk1	411185.2	5770643.8	CW	SE	266	33.2	477.6	HELI
19	Timber	082N053	500	ICHmw1	464226.3	5713917.6	HW	SE	266	38.1	593.4	TRUCK
20	NVAF	082M100	147	ICHvk1	421887.3	5759689.5	HW	CW	246	34.2	450.8	HELI
21	NVAF	083D018	235	ICHmw1	402874.2	5780586.1	CW	HW	246	31.2	461.4	HELI
22	Timber	082N043	205	ICHmw1	465046.0	5703023.2	HW	SE	107	31.8	469.0	TRUCK
23	Timber	082N065	424	ICHmw1	488895.7	5723050.7	CW	SE	246	31.2	448.8	TRUCK
24	Timber	082N073	629	ESSFwc2	466551.9	5730459.9	PLI	SE	76	16.7	138.3	TRUCK
25	Timber	082N046	395	ICHmk1	502823.1	5701192.5	PLI	FDI	77	20.8	193.7	TRUCK
26	Timber	082N035	690	ICHmw1	491757.7	5690416.3	FDI	HW	72	18.2	153.3	ATV
27	NVAF	082N009	709	MSdk	548621.0	5658391.2	FDI	PLI	167	21.2	158.4	TRUCK (ATV)
28	Timber	082N064	853	ICHmw1	472936.9	5718143.5	FDI	AT	37	9.5	0.1	TRUCK
29	Timber	082N016	429	IDFdm2	511166.1	5669671.9	FDI		77	21.2	136.6	TRUCK
30	Timber	082N026	510	MSdk	507520.8	5676592.9	FDI	AT	77	22.2	119.4	TRUCK
31	Timber	082N026	863	MSdk	501269.3	5679716.1	FDI	PLI	38	11.1	24.9	TRUCK
32	Timber	082N035	593	ICHmw1	491978.7	5689782.9	FDI	SE	72	14.8	106.1	TRUCK (ATV)
33	Timber	082N045	534	ICHmk1	489785.5	5700953.9	FDI	PLI	77	23.5	211.3	TRUCK
34	Timber	082N046	582	ICHmk1	511230.5	5703841.1	FDI	AT	67	19.3	125.4	HELI
35	Timber	082N035	400	ICHmk1	497850.0	5687616.3	FDI	PLI	77	25.7	249.1	TRUCK
36	Timber	082N073	507	ICHmw1	463885.8	5730903.1	FDI	PLI	146	28.5	272.7	TRUCK

37	Timber	082N016	189	ESSFwm	505812.4	5667236.3	PA	SE	207	24.2	288.8	TRUCK
38	Timber	082K100	179	MSdk	556800.0	5646100.0	PLI	SE	87	24.8	288.9	TRUCK
39	Timber	082N045	234	ICHmk1	490877.9	5697687.8	PW	PLI	77	26.5	263.0	TRUCK
40	Timber	082N027	657	MSdk	517641.1	5680027.8	PLI	FDI	79	22.2	229.0	TRUCK
41	Timber	082N043	115	ICHmw1	466742.3	5702099.7	PLI	FDI	77	25.1	277.8	TRUCK
42	Timber	082N009	308	ICHmk1	545537.6	5653245.4	PLI	SE	87	24.7	291.8	TRUCK
43	Timber	082N026	975	MSdk	505341.2	5680805.1	FDI	PLI	110	30.8	282.2	TRUCK
44	Timber	082N027	294	ICHmk1	522065.8	5676030.1	FDI	PLI	107	28.8	288.3	TRUCK
45	NVAF	082N045	688	ICHmw1	494964.7	5702808.6	FDI	SE	127	33.7	422.3	TRUCK
46	Timber	082N036	780	ICHmk1	501351.4	5692106.0	FDI	PLI	107	30.1	328.2	TRUCK
47	NVAF	082N009	266	ESSFdk	555963.6	5652806.2	PLI	SE	137	28.2	389.6	TRUCK
48	Timber	082N063	537	ICHmw1	467610.7	5720642.7	PLI	FDI	126	26.2	347.3	TRUCK
49	Timber	082N075	123	ICHmw1	489526.6	5736584.5	FDI	SE	95	35.1	462.0	TRUCK
50	Timber	082N054	34	ICHmw1	472323.5	5705517.0	FDI	PW	107	25.7	300.8	TRUCK
51	NVAF	082N008	183	MSdk	541367.2	5658420.4	PLI	SE	137	28.2	367.5	TRUCK
52	Timber	082N037	66	ICHmk1	516408.3	5685328.2	PLI		107	23.6	305.8	ATV
53	NVAF	082N027	613	ICHmk1	516547.2	5679362.2	FDI	SE	107	27.8	370.2	TRUCK
54	Timber	082N026	1037	ESSFwm	508108.1	5681154.6	FDI	SE	137	33.7	410.2	TRUCK
55	Timber	082N062	286	ESSFwc2	446555.2	5720016.9	BL	SE	86	22.1	213.9	TRUCK
56	Timber	082N046	425	ESSFwm	512213.5	5701294.5	SE	FDI	47	14.6	99.8	HELI
57	Timber	083D019	819	ESSFvv	409186.9	5774733.3	SE	BL	166	22.5	218.1	HELI
58	Timber	082N054	340	ICHmw1	477776.8	5715000.7	SE		35	5.5	0.1	TRUCK
59	Timber	082N061	224	ESSFvc	435718.3	5718078.4	SE	BL	96	22.1	184.4	ATV
60	Timber	082N009	969	ESSFwm	545320.0	5651560.0	BL	SE	52	12.6	89.4	TRUCK (ATV)
61	NVAF	082N093	298	ESSFwc2	465822.2	5756979.0	BL	SE	206	18.2	164.0	TRUCK/HELI
62	Timber	082N054	486	ICHmw1	480913.0	5714295.2	SE	FDI	37	6.1	0.1	TRUCK
63	Timber	082N067	669	ICHmw1	518256.7	5718465.4	BL	SE	34	6.6	4.5	TRUCK (ATV)
64	NVAF	082N034	53	ESSFwm	484853.3	5691606.4	SE	BL	37	7.1	6.8	ATV
65	NVAF	082N075	518	ESSFwc2	488215.5	5734231.7	SE	BL	126	20.7	199.8	TRUCK
66	Timber	083D030	304	ESSFwc2	422761.3	5789338.2	SE	BL	206	29.2	322.4	HELI
67	Timber	082K099	480	MSdk	551500.0	5648500.0	SE	PLI	87	27.3	293.9	HELI
68	Timber	082N009	100	ESSFwm	544622.8	5650843.7	BL	SE	147	26.7	274.4	TRUCK/ATV
69	NVAF	082N084	203	ICHmw1	481661.2	5747580.8	SE	HW	126	24.7	328.4	ATV
70	Timber	082M090	77	ICHwk1	430066.4	5747949.3	SE	CW	266	26.2	359.0	HELI
71	NVAF	082N053	610	ESSFwc2	462555.2	5715039.7	SE	PA	186	28.3	351.2	TRUCK
72	Timber	082N063	213	ICHmw1	462080.6	5721554.4	SE	HW	326	35.1	280.1	TRUCK
73	NVAF	082K100	400	MSdk	557000.0	5647100.0	SE		127	29.8	353.8	TRUCK
74	Timber	082M100	151	ICH wk1	422434.4	5760022.9	SE	CW	126	21.7	258.2	HELI
75	NVAF	082N074	1048	ESSFwc2	480876.8	5728922.3	SE	BL	226	30.2	330.5	TRUCK/ATV
76	Timber	082N054	88	ICHmk1	485069.6	5707408.3	SE	PLI	127	31.7	405.3	TRUCK
77	NVAF	082N092	437	ICHwk1	447119.8	5756656.2	SE	CW	286	40.1	582.4	TRUCK
78	Timber	082N065	223	ESSFwc2	492158.3	5726463.4	SE	FDI	206	32.2	381.4	TRUCK
79	NVAF	082N094	799	ICHmw1	478446.1	5750818.2	SE	BL	286	34.2	401.0	TRUCK
80	Timber	082N091	609	ICHwk1	436580.2	5755486.2	SE	CW	246	36.2	511.3	TRUCK
81	NVAF	082N046	405	ICHmk1	505104.4	5700898.9	SE	CW	127	28.7	372.7	TRUCK
82	Timber	082N062	166	ICHmw1	450285.0	5726295.1	SE	HW	206	34.2	457.9	TRUCK
83	Timber	082N026	64	ICHmk1	505372.6	5672433.9	SE	FDI	97	31.2	379.6	TRUCK
84	NVAF	082N056	486	ICHmk1	510293.9	5712230.2	SE	CW	246	33.2	466.7	TRUCK
85	Timber	083D010	643	ICHmw1	419494.9	5764636.3	SE	BL	306	39.1	449.9	HELI

4.2 List of Back-up Samples

The following table provides a list of the proposed additional back-up VRI ground samples for the Golden TSA.

Table 9: List of Back-up VRI Ground Samples

SAMPLENO	P_LABEL	UTM_X	UTM_Y	BECLABEL	ZONE	SUBZONE	VARIANT
86	082N055.948	487443.17880	5708615.70510	ICH mw 1	ICH	mw	1
87	082N073.935	458637.47477	5730870.89607	ICH mw 1	ICH	mw	1
88	082N026.819	503741.67124	5680910.11007	IDF dm 2	IDF	dm	2
89	082N035.230	499974.97239	5685326.56633	MS dk	MS	dk	
90	082N036.104	500490.54244	5683848.81545	MS dk	MS	dk	
91	082N073.263	461408.78676	5735961.19774	ICH mw 1	ICH	mw	1
92	082N045.649	498919.44030	5702198.98663	ICH mk 1	ICH	mk	1
93	082N054.467	479851.70088	5712314.01349	ICH mw 1	ICH	mw	1
94	082N072.556	456370.38264	5728136.36968	ICH mw 1	ICH	mw	1
95	082N053.420	467507.26517	5711983.80761	ICH mw 1	ICH	mw	1
96	082N063.722	460776.06135	5724747.19813	ICH mw 1	ICH	mw	1
97	082N064.408	479780.31115	5720390.37580	ICH mw 1	ICH	mw	1
98	082N063.142	463657.85848	5722057.82724	ICH mw 1	ICH	mw	1
99	083D018.418	396435.52857	5777576.54991	ICH wk 1	ICH	wk	1
100	083D009.264	417502.11284	5766404.75441	ICH mw 1	ICH	mw	1
101	082N043.152	464387.16884	5702603.68303	ICH mw 1	ICH	mw	1
102	082N067.493	516966.39080	5721757.87418	ICH mw 1	ICH	mw	1
103	082N081.375	440358.54047	5745621.23532	ICH wk 1	ICH	wk	1
104	083D010.728	420981.10534	5763638.85385	ICH mw 1	ICH	mw	1
105	082N072.21	448426.15211	5738534.94750	ICH wk 1	ICH	wk	1
106	082N062.294	450681.52430	5722311.27543	ICH wk 1	ICH	wk	1
107	083D009.216	415382.17285	5767180.71592	ICH mw 1	ICH	mw	1
108	082N053.587	465332.91631	5714683.07132	ICH mw 1	ICH	mw	1
109	082N063.313	462344.71046	5718898.59807	ICH mw 1	ICH	mw	1
110	082N026.327	504799.18984	5675027.83299	MS dk	MS	dk	
111	082N056.99	507758.00549	5707413.98709	ICH mk 1	ICH	mk	1
112	082N056.548	512581.40157	5713549.13360	ICH mk 1	ICH	mk	1
113	082N084.817	473420.64330	5739965.68734	ICH mw 1	ICH	mw	1
114	082N063.313	461624.79521	5718789.32770	ESSFwc 2	ESSF	wc	2
115	082N018.377	528553.94843	5666927.58683	ESSFwm	ESSF	wm	
116	082N046.439	503859.15907	5702974.99101	ICH mk 1	ICH	mk	1
117	082N026.872	505040.70094	5680037.23538	IDF dm 2	IDF	dm	2
118	082N036.272	504204.08567	5685286.43373	MS dk	MS	dk	
119	082N054.336	476368.03944	5716593.48311	ICH mw 1	ICH	mw	1
120	082N091.514	433269.70164	5756415.02084	ICH mw 1	ICH	mw	1
121	082N084.753	479942.03261	5742052.63251	ICH mw 1	ICH	mw	1

122	082N035.562	497321.57736	5688994.90543	ICH mk 1	ICH	mk	1
123	082N084.1026	484141.91205	5740201.64551	ICH mw 1	ICH	mw	1
124	082N026.610	501497.21142	5677569.74989	ICH mk 1	ICH	mk	1
125	082N072.439	452470.66771	5730754.60955	ICH mw 1	ICH	mw	1
126	082N026.973	504995.52936	5681252.79889	MS dk	MS	dk	
127	082N073.213	463596.99098	5737293.94476	ICH mw 1	ICH	mw	1
128	082N056.420	507225.74641	5711112.62106	ICH mk 1	ICH	mk	1
129	082N056.219	508394.42373	5708441.25287	ICH mk 1	ICH	mk	1
130	082N082.544	447841.22427	5741837.43227	ICH mw 1	ICH	mw	1
131	082N062.161	449575.13757	5725478.55808	ICH wk 1	ICH	wk	1
132	082N054.166	482422.46872	5709563.58280	ICH mw 1	ICH	mw	1
133	082N009.879	544376.94893	5660652.72869	MS dk	MS	dk	
134	082N084.846	479059.00974	5741460.09882	ICH mw 1	ICH	mw	1
135	082N009.738	547632.82489	5659325.21668	MS dk	MS	dk	
136	082N062.67	447542.53833	5726142.66259	ICH mw 1	ICH	mw	1
137	082N055.167	498229.73982	5707026.81728	ESSFwm	ESSF	wm	
138	082N053.88	461808.69400	5706867.02529	ICH wk 1	ICH	wk	1
139	082N009.491	549145.38021	5656206.72913	MS dk	MS	dk	
140	082K099.269	554000.00000	5645100.00000	ESSFdk	ESSF	dk	
141	082N067.348	524540.44781	5723404.20869	ESSFwm	ESSF	wm	
142	082N055.406	492714.76897	5711971.28942	ESSFwm	ESSF	wm	
143	082N051.14	440630.72139	5706054.35241	ESSFvc	ESSF	vc	
144	082N046.531	510619.66654	5703012.23414	ESSFwm	ESSF	wm	
145	082N063.672	472227.93325	5721259.83772	ICH mw 1	ICH	mw	1
146	082N093.732	466408.53991	5750549.06821	ESSFwc 2	ESSF	wc	2
147	083D019.819	409311.54713	5774919.14997	ESSFwc 2	ESSF	wc	2
148	082N027.50	526666.10295	5672614.49792	ICH mk 1	ICH	mk	1
149	082N018.289	530665.18931	5664538.51022	ICH mw 1	ICH	mw	1
150	083C012.174	449000.00000	5773700.00000	ESSFwc 2	ESSF	wc	2
151	082K099.361	554300.00000	5646900.00000	MS dk	MS	dk	
152	082N075.505	487162.41770	5734669.66060	ESSFwc 2	ESSF	wc	2
153	082N037.89	514949.30047	5686524.27425	ICH mk 1	ICH	mk	1
154	082K099.159	555900.00000	5643900.00000	MS dk	MS	dk	
155	083D040.182	419083.17616	5800000.27462	ESSFwc 2	ESSF	wc	2
156	082N045.614	488549.90992	5702322.68655	ICH mw 1	ICH	mw	1
157	083D030.498	424616.79113	5787284.26976	ESSFwc 2	ESSF	wc	2
158	082N009.876	544971.84684	5660575.94116	MS dk	MS	dk	
159	082K100.236	557300.00000	5647700.00000	MS dk	MS	dk	
160	082K099.348	553100.00000	5646500.00000	MS dk	MS	dk	
161	083D020.249	421527.26671	5779709.98407	ESSFwc 2	ESSF	wc	2
162	082N073.426	472233.53391	5733865.15182	ESSFwc 2	ESSF	wc	2
163	082N081.439	440689.27121	5744267.62409	ICH wk 1	ICH	wk	1
164	082N051.20	439910.88189	5705944.95665	ESSFvc	ESSF	vc	
165	082N074.571	474886.86167	5733322.58475	ICH mw 1	ICH	mw	1
166	082N072.111	450222.28777	5737598.53093	ICH wk 1	ICH	wk	1
167	082N009.867	546088.09020	5660633.45468	MS dk	MS	dk	

168	082N009.1089	550261.89205	5659388.96317	MS	dk	MS	dk	
169	082N044.236	474112.52867	5699035.83751	ESSF	wm	ESSF	wm	
170	083C002.446	453100.00000	5763400.00000	ICH	wk 1	ICH	wk	1

5.0 SIGN-OFF SHEET

I have read and agree that the procedures outlined in this proposal meet current MSRM minimum standards.

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Manager, Vegetation Resources Inventory
Terrestrial Information Branch
Ministry of Sustainable Resource Management

I have read and agree that the activities and products outlined in this proposal will meet Ministry of Forests business needs.

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Manager, Development and Policy
Timber Supply Branch, Ministry of Forests