ARROW TSA
VRI GROUND SAMPLING

PROJECT IMPLEMENTATION PLAN

Prepared for:

ARROWIFPA
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Acknowledgements

This report is prepared following the standards set by the Ministry of Sustainable Resource Management located at http://srmwww.gov.bc.ca/risc. In preparing this plan for the Arrow Forest Licence Group, Atticus Resource Consulting Ltd followed the requirements and guidelines set out in, i) 'The Guidelines for Preparing a Project Implementation Plan for Ground Sampling" (February 2003), and ii) the 'Sample Selection Procedures for VRI Ground Sampling (version 3.3, December 2002) – both prepared for the Resource Inventory Standards Committee (RISC) by the Ministry of Sustainable Resource Management (MSRM), Terrestrial Information Branch.

We would like to thank Atco Lumber Ltd. (Diane Wunder), Canadian Forest Products (Jane Miller), and Timberline Forest Inventory Consultants (David Myers) for their assistance in the acquisition and data gathering phases required for this project implementation plan. As well, we would like to thank the MSRM staff (Chris Mulvihill, Sam Otukol, Gary Johansen, and Will Smith) for their timely assistance in the preparation of this plan.

VPIP Professional Sign-off

This project has been done to the required standards and completed accurately for the stakeholders of the Arrow Forest Licence Group.

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1.0 INTRODUCTION

This Vegetation Resource Inventory (VRI) Project Implementation Plan (VPIP) is prepared for the Arrow Forest Licence Group (AFLG) for VRI ground sampling activities to be conducted on the Arrow Timber Supply Area (Arrow TSA) over 2004 and 2005.

The document is required to be prepared and submitted following MSRM's most recent standards, signed and sealed by the Registered Forest Professional, and reviewed and then signed by the Ministry of Forest's authorized representative. The document provides a brief overview of the process and the administrative unit upon which the VRI ground sampling will be carried out and outlines the sample design methods, selection criteria, results of the sample design, and the roles and responsibilities for the ground sampling activities.

1.1 Overview of VRI Process

The Vegetation Resource Inventory (VRI) is a photo-based inventory that has some of its quantitative attributes (polygon height, age, and volume) 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 percent 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 randomly selected, but representative, trees from the ground sampling population database. The detailed tree data will be used to localize and adjust the ground cruiser net factor call grades for increased accuracy of key attributes like species net volume estimates and stem taper, and height;

5) Compilation and Statistical Adjustment: Compilation and adjustment of estimated ground sample cruiser-calls using the actual NVAF information. Next 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 (MSRM) 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 Arrow Timber Supply Area (Arrow TSA). It provides some basic landbase and background information from existing Annual Allowable Cut (AAC) reports, outlines the ground sampling design and methods used, and outlines the implementation plan for the field sampling.

1.4 Landbase

The Defined Forest Area Management (DFAM) of the Arrow Timber Supply Area (Arrow TSA) is represented by five forest companies that operate in the former Arrow TSA portion of the Arrow Boundary Forest District of southern British Columbia. The five major licensees with operations are Atco Lumber Limited (Ltd.), Bell Pole Co. Ltd., Kalesnikoff Lumber Co. Ltd., Riverside Forest Products Ltd., and Canadian (formerly Slocan) Forest Products Ltd. Collectively this group is known as the Arrow Forest Licence Group (AFLG) and was formed in 1998 under an Innovative Forestry Practices Agreement with the British Columbia Ministry of Forests (as per Section 59.1 of the British Columbia Forest Act).

The Arrow TSA comprises approximately 605,640 hectares in the West Kootenays, where is extends north from the British Columbia-United States border (Figure 1). The TSA lies within the British Columbia Forest Service (BCFS) Southern Interior Forest Region and is administered from the Arrow-Boundary Forest District office in Castlegar. The Arrow TSA is adjacent to several other management units, including the Boundary, Okanagan, Revelstoke and Kootenay Lake TSAs and juxtapose to Tree Farm Licences (TFLs) 3 and 23. There are several parks or protected areas either within or adjacent to the TSA including Kokanee Glacier and Valhalla Parks and the protected areas Syringa Creek, Goat Range, Gladstone and Granby (Pedersen, 2001).

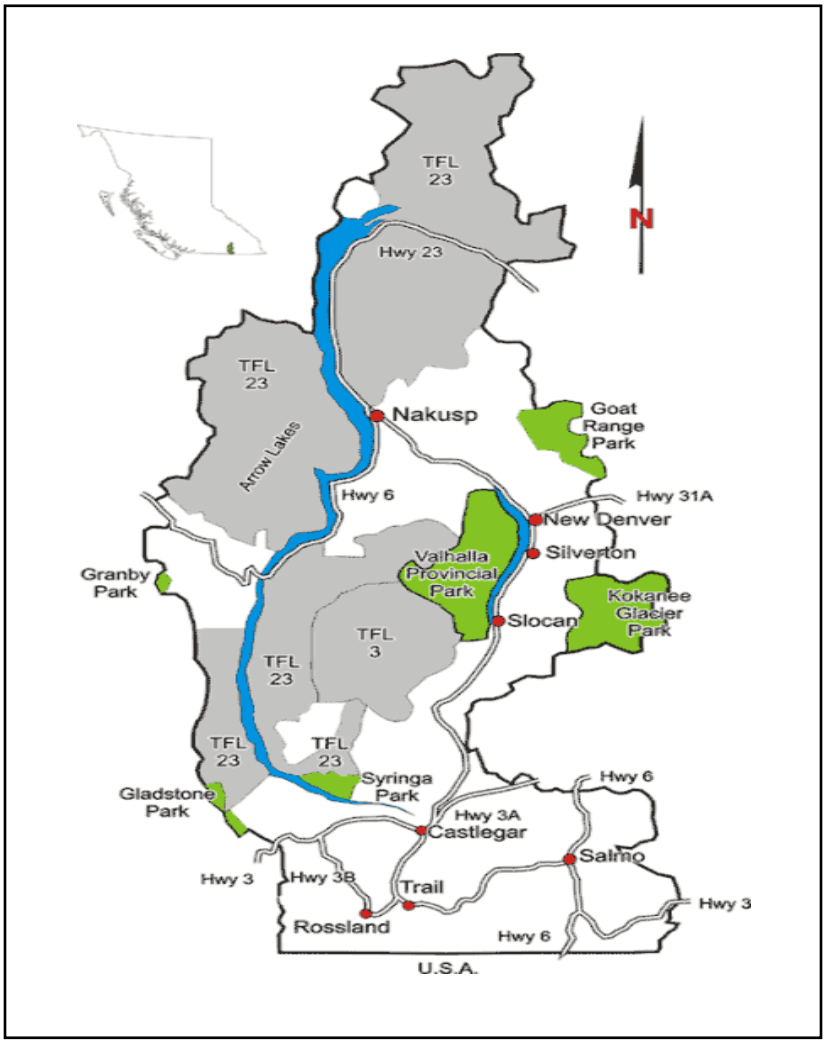


Figure 1: Overview of Arrow TSA (Arrow TSA Analysis Report (MoF, 2000)

The biogeoclimatic zones located within the TSA including the Interior Cedar Hemlock (ICH) zone, the Engelmann Spruce Subalpine Fir (ESSF) zone, the Interior Douglas-fir zone, and the Alpine Tundra (AT) zone. The recent Predictive Ecosystem Mapping (PEM) project revised the Biogeoclimatic Ecosystem Classification (BEC) units and areas, but the existing Ministry of Forests BEC unit breakdown is as follows:

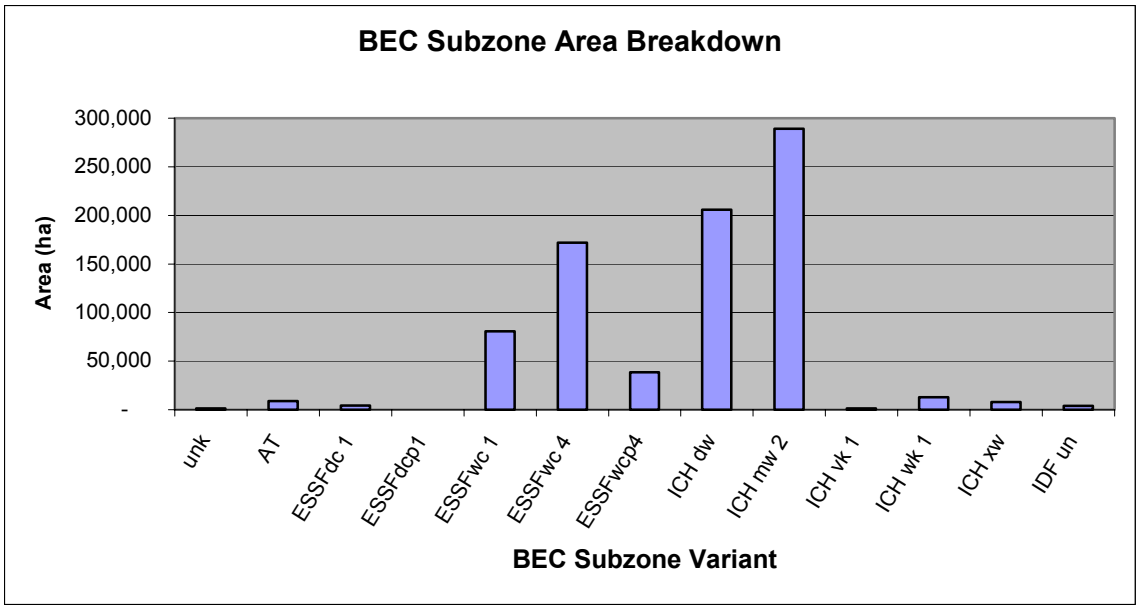


Figure 2: Arrow TSA - BEC Subzone Area Breakdown (Ministry of Forests, 2003)

Based on current (June 2004) information provided by Timberline Forest Inventory Consultants Limited (Timberline), the Arrow TSA analysis unit is just over six hundred thousand (605,600) hectares in total area. Approximately 493,267 hectares (81 percent) is considered as productive forest land, but only 42.8% is considered suitable as the Timber Harvesting Land Base (THLB). Table 1 below shows an abbreviated landbase summary as per this June 2004 report.

Table 1: Arrow TSA Abbreviated Landbase Summary Estimates (Source: Arrow TSA 20032004 Analysis Report version 3.1)

General Description	Area (ha)
Total TSA Area	**605,600**
Productive Forest Land (81%)	**493,267**
Inoperable (41.6%)	*(205,199)*
Other reductions (15.8%)	*(77,936)*
Current Timber harvesting Landbase (THLB)	**210,132**

The Arrow TSA is ecologically complex, and its lower elevation forests have one of the greatest diversity of tree species in the province, including Douglas-fir, western larch, lodgepole pine, spruce, subalpine fir (balsam), western red cedar and western hemlock. (Pedersen, 2001). Douglas-fir dominates the TSA's species profile. For example, Figure 3 (below) shows the leading species proportional area coverage, for i) all vegetated treed VRI polygons that have at least 10 percent cover and that are more than 30 years old, and also ii) the same breakdown for those polygons that were within the targeted VRI sample population are also shown for comparison purposes. For more information on the selection process, refer to Section 2.4.

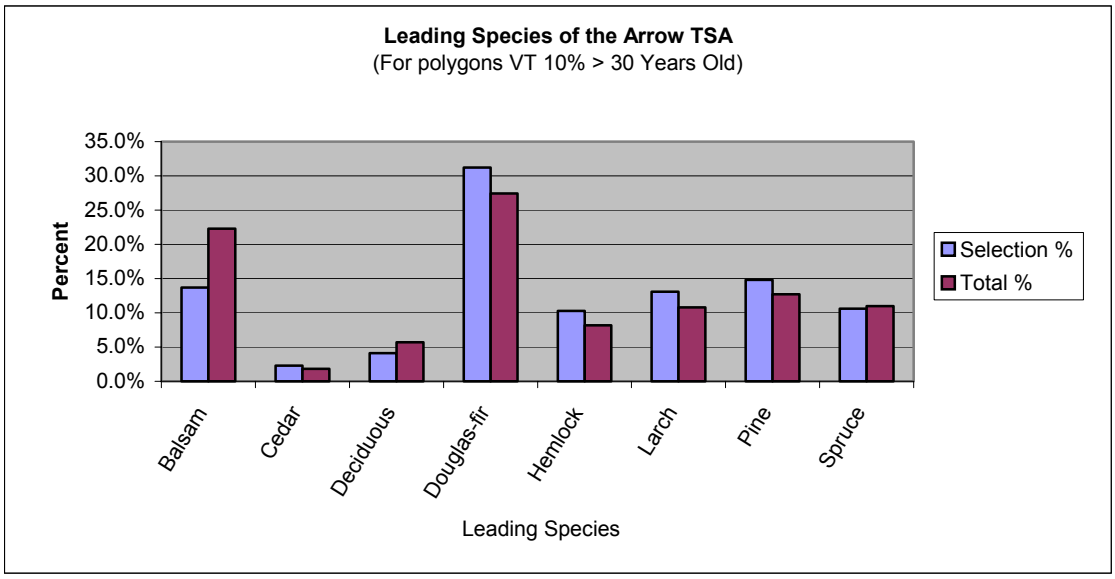


Figure 3: Leading Species Breakdown

1.5 Background and Inventory Issues

The current annual allowable cut (AAC) in the Arrow TSA, as set in April, 2001 is 550,000 cubic meters per year (m^3/yr). This was reduced from the previous AAC set in 1995. In 2001, part of the reduction was attributed to an overestimation of operable areas and problem forest types, as well as operational constraints and concern over the looming age class gap. Conversely, the existing site productivity estimates (of the day may have been underestimated from reality. In addition, the Chief Forester expressed concern over the uncertainty of the existing forest inventory information. The inventory audit of 1995 showed, that although the audit volume measurements (when compared to the photo interpreted polygon volumes) were within acceptable standards, there were issues related to the estimated site index identified and also with respect to the non-forest inventory classification.

Since that time the Arrow Forest Licence Group (AFLG) was formed (1998) and new inventory information has been obtained for incorporation into the existing data package preparation and AAC analysis (June 2004). The new inventories include:

- Vegetation Resource Inventory (VRI)
- Localized Biogeoclimatic Ecosystem Classification (BEC)
- Predictive ecosystem Mapping (PEM), and
- Site Productivity Estimates using site index correlated to ecosystems (SIBEC)

ARC Alpine Resource Consultants Ltd. completed the VRI (Phase I) photo interpretation for the entire Arrow TSA in 2002. The ground sampling portion and the subsequent adjustment phase was not completed by the AFLG. The localized BEC work was completed around the same time as the PEM, which was completed in 2003 by JMJ Holdings Ltd. As well, JMJ Holdings Ltd. also completed the SIBEC work in 2001. The new site productivity estimates derived from using the SIBEC method has shown the managed stand site productivity to be significantly higher than natural (unmanaged) stands (Timberline, 2004). In their June 2004 analysis report, Timberline has reported that this increase in site productivity is two and a half (2 ½) times greater in managed stands than the unmanaged stands. However, the inventory audit data of the new VRI Phase I inventory showed that the natural productivity estimates were significantly underestimated, while the managed stand productivity estimates may have been slightly overestimated. Therefore, the new VRI ground sampling information and adjustment will prove to be very important in order to get correct stand volume and productivity estimates for the Arrow TSA. It is anticipated that, when complete, the second phase of the inventory is likely to correct the underestimation observed in stand productivity of the unmanaged stands and potentially result in an upward pressure on the timber supply (Timberline, 2004).

2.0 GROUND SAMPLING PLAN

This portion of the report provides information on the sampling plan prepared for the Arrow 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 using a 0.5 alpha value.

2.2 Target Population

The target population for the proposed ground sampling inventory is the vegetated treed portion of the Arrow TSA located on crown forest land. In addition, in order to obtain the best possible information to meet the needs of the inventory it was decided to focus the sampling on the productive forest landbase that was at least marginally physically operable – as defined by the data provided by Timberline from the June 2004 TSR3 data package.

As with other areas in the Province, the potentially operable area within the Arrow 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 the VRI photo interpreted polygon that was "Vegetated and Treed" (with greater than 10 percent crown closure), then overlaying these polygons with the physically operable and productive forest land coverages provided by the AFLG via Timberline. The final target population was those VRI polygons that we either wholly operable, or were at least touching the operability linework (but not located in parks or located on private land). This selection method provided for a buffer of potentially or marginally operable polygons throughout the population. Thus if administrative units change or harvesting technology is revised, then there is greater potential for the target population to adequately represent the changes. However, it is important to note that the only population that will be able to be

adjusted in the inventory is that within this defined target population – even if the line work changes in the future (pers comm. A. Nussbaum, 2004).

2.3 Sample Size

The sample size for the Arrow TSA is determined based on a combination of the sampling error (SE) objective (targeting between 10 and 11% up to a maximum allowed of 15 percent) and the expected net volume coefficient of variation (CV) mean volume of the selected population. The preliminary CV used to select the number of samples is initially determined from the most recent inventory audit information. The previous mature operable inventory volume coefficient of variation (as determined by the MSRM 1995 Arrow TSA inventory audit) is estimated to be approximately 41 percent. The coefficient of variation (CV) as pointed out by S. Otukol (pers. Comm. 2003), may actually be higher in reality than the inventory audit CV for two reasons:

1) The VRI covers VT stands 30+ in age, while the audit covered stands 60+ in age.
2) The VRI ground sample cluster covers a smaller proportion of a polygon than the audit sample cluster did.

Overall MSRM calculations shows that when comparing the results of the audit CVs to the VRI project CVs, the trend was the VRI CV may be anywhere from 3 to 10 percent higher than the audit CV (S. Otukol). Therefore, based on this information, we used a conservative CV estimate of 50% rather than 41% for the sample size calculation. From this, we estimated that 80 samples should be suitable to meet the sampling error target of between 10-11 percent with 95% confidence interval using alpha of 0.5.

It should be noted, that in our preliminary sample size calculations, even if the CV were increased to 60 percent, then 80 samples would potentially yield about a 13.5% percent sampling error for volume.

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, and a more accurate estimate of the number of samples actually required to meet this sampling error requirement will be made.

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

Sample Size Estimate

Arrow TSA - VRI Ground Sample Project (2004)

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

Insert or adjust values in orange

Sample size for a given CV and PE:

CV= 50.0%
alpha= 0.05

Error % PE	Sample size n	***Change this value until it is the same as n at left***
10%	98	**98**
15%	45	**45**

CV= 50.0%
alpha= 0.05 t=2

Error % PE	Sample size n
10%	100
15%	44

Sample size for a given CV and n:

CV= 50.0%
alpha= 0.05

Sample size n	Error % PE
50	14.2%
78	11.3%
83	10.9%
100	9.9%
120	9.0%
130	8.7%
150	8.1%
175	7.5%

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 Arrow 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 spatial and non-spatial digital data files provided by Timberline (July, 2004). These data files are the same ones used for the 2004 Arrow TSA Timber Supply Analysis work being carried out for the AFLG. A complete set of the ArcInfo data along with associated metadata is provided along with the deliverables for this project. At a minimum they included:

1) Arrow TSA VRI Phase I inventory database and graphic files (previously approved by the MSRM), and already organized and seamless for analysis (by Timberline 2003/2004).
2) Arrow TSA administrative boundary coverage; and
3) The Timber Harvesting Land Base resultant data layer (which included Provincial parks, non-forest land, private land, and physical operability coverages).

In addition the following background documents were reviewed in preparation of this report:

- TSR2 Arrow AACRationale.pdf (MoF, 2001)
- Arrow20032004 Analysis Report v1.3.pdf (Timberline, 2004)
- Arrow20032004 Data Package v4.0.pdf (Timberline, 2004)

The VRI data files were used for preparing the sampling plan for the VRI ground field verification sampling. Once collated the VRI database files were verified to be clean and free of errors and a 1:1 link was established between the ArcInfo spatial files and the seamless VRI database. From this database specific attributes were used for the selection process. The attributes used (from the VRI database) for this procedure included:

P_LABEL
POLYGON_HA
ADJ_CROWN
SP1
SP1_PER

SP2
SP2_PER
SP3
SP3_PER
SP4
SP4_PER
SP5
SP5_PER
SP6
SP6_PER
NETAIRVOLU
ADJ_BASA
PRJAGECLS
PRJAGE
PRJHEIGHT

The qualifying polygons cover 370,975 hectares of the Arrow TSA (approx. 75 percent of the productive forest land and approximately 60 percent of the entire TSA landbase). These polygons were divided into five 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 2 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 2: Arrow TSA Sampling Strata

STRATA SUMMARY / BREAKDOWN						
Species	**Percent**	**Number of Polygons**	**Area (ha)**	**Proportional Plots Per Strata**	**Adjusted Plots Per Strata**	**Number of Substrata**
CH	12.5%	2,494	46,530	10	**15**	2
F	31.15%	5,441	115,552.42	25	22	3
LP	27.94%	4,622	103,658.92	22	20	3
SB	24.3%	3,943	90,096	20	18	3
DEC	4.08%	776	15,138.10	3	**5**	1
TOTALS	**100.0%**	**17,276**	**370,975**	**80**	**80**	**8**

The Cedar-Hemlock strata is proportionally smaller than the other coniferous strata, however, given it's significance and impact on net volume in the inventory we assigned the minimum number of plots (15) to this strata. The justification for the separate and smaller (below standard) 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, it is believed that the deciduous strata has limited inventory significance, therefore a disproportionate allocation of samples is proposed (and approved by S. Otukol, MSRM, 2004).

Since these strata were not drawn entirely proportionally, then in the analysis there will be a need to weight the samples should they be combined or stratified differently when completing the final analysis. In this way the NVAF samples would also need to be weighted (G. Johansen, 2004)

Figure 4, below displays the overall summary of percent coverage of the main strata within the Arrow TSA VRI target population.

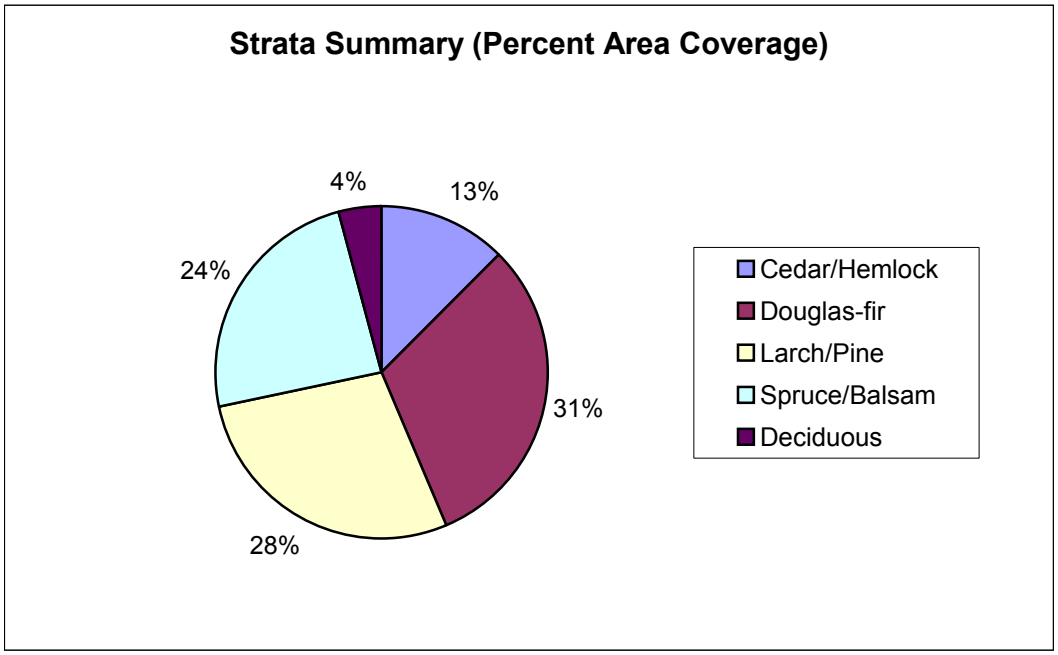


Figure 4: Strata Area Percentage Summary

Following MSRM standards, individual 'qualifying' polygon volume was used to determine the substrata within each of the selected strata (i.e. Douglas-fir or 'F' Strata). Within each of the strata, all the qualifying polygons were sorted by volume (from lowest to highest). Then (as shown in Table 2 below), the number of polygons was further selected for each substrata simply by dividing the total number of polygons for the strata by the number of substrata chosen. The result is an even number of VRI ground samples across the substrata, strata, and population proportional to its occurrence.

Once the substrata population was 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 (following standards). Table 3 below shows the number of plots selected 'proportionally' within each strata, by substrata.

Table 3: Substrata Plot Assignment

SUBSTRATA BREAKDOWN / PLOTS BY SUBSTRATA				
STRATA	**# Polygons**	**Accum. Area**	**% of Total**	**# of Plots**
CH				
SubStratum_1	1,247	22,060.5	47%	7
SubStratum_2	1,247	24,469.1	53%	8
Subtotal	**2,494**	**46,529.6**	**100%**	**15**
F	**# Polygons**	**Accum. Area**	**% of Total**	**# of Plots**
SubStratum_1	1,812	33,187.3	29%	6
SubStratum_2	1,812	40,363.1	35%	8
SubStratum_3	1,812	42,002.0	36%	8
Subtotal	**5,436**	**115,552.4**	**100%**	**22**
LP	**# Polygons**	**Accum. Area**	**% of Total**	**# of Plots**
SubStratum_1	1,540	32,468.3	31%	6
SubStratum_2	1,541	35,759.9	34%	7
SubStratum_3	1,541	35,430.7	34%	7
Subtotal	**4,622**	**103,658.9**	**100%**	**20**
SB	**# Polygons**	**Accum. Area**	**% of Total**	**# of Plots**
SubStratum_1	1,314	29,262.5	32%	6
SubStratum_2	1,314	32,456.6	36%	6
SubStratum_3	1,315	28,376.6	31%	6
Subtotal	**3,943**	**90,095.6**	**100%**	**18**
DEC	**# Polygons**	**Accum. Area**	**% of Total**	**# of Plots**
SubStratum_1	**776**	**15,138.1**	**100%**	**5**

2.5 Quality Assurance Process

Once the potential ground sampling polygons were selected the proposed target sample was compared against the entire Arrow 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, crown closure class, volume class, height class, and age class (see Figures 5 through 9 respectively).

Figure 5: Species Group Comparison/Summary

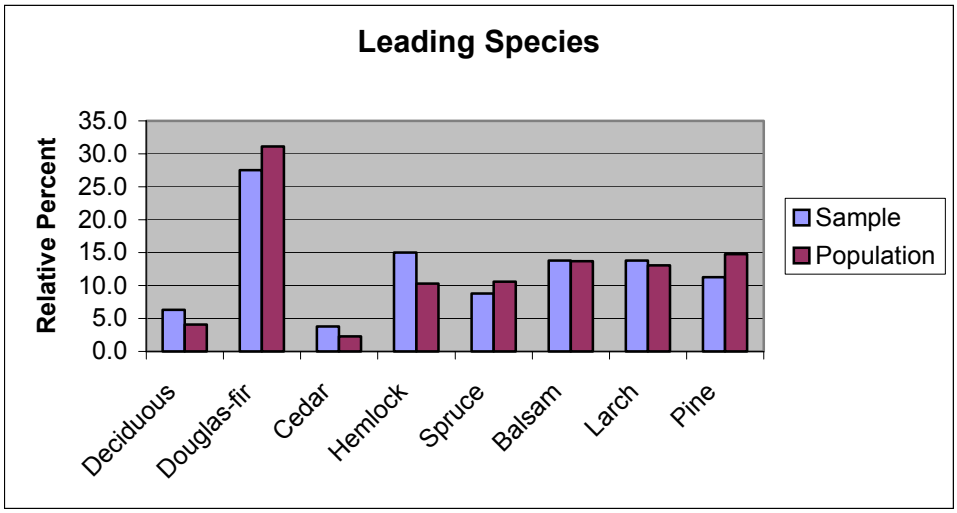


Figure 6: Crown Closure Class Comparison

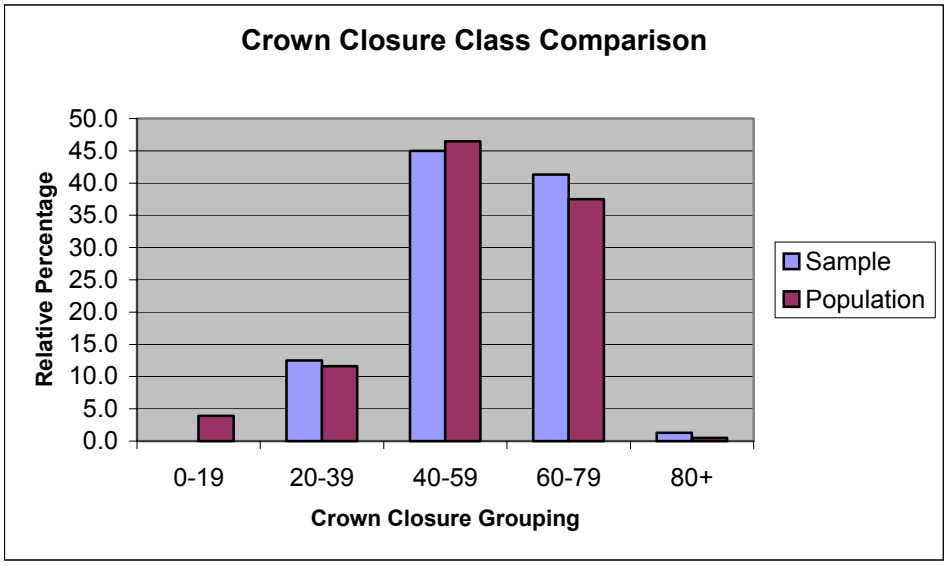
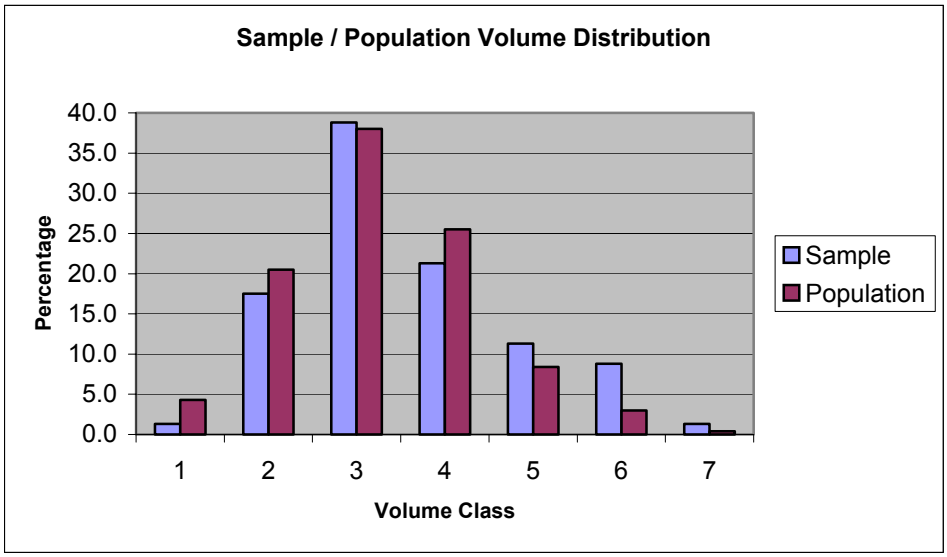


Figure 7: Volume Comparison



Volume Class	Values
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+

Table 4: Volume Class Codes

Figure 8 Height Class Comparison

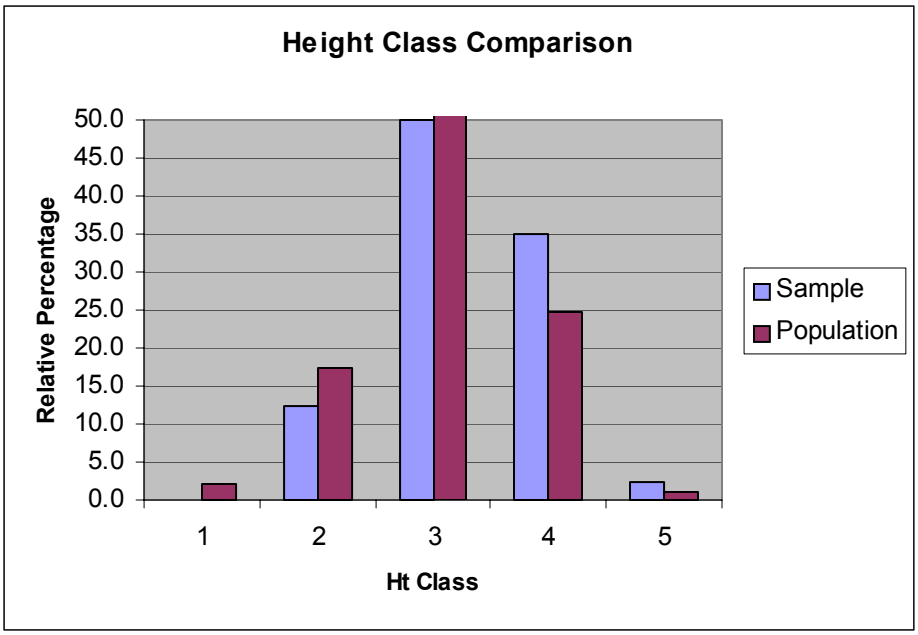


Figure 9: Age Class Comparison

The charts show that overall the selected samples are a true and good representation of the overall population available for VRI ground sampling. All attributes and associated classes of the target VRI sample (plots) are within 10 percent range of the population.

However a few attributes and their associated classes are of concern – and thus were discussed with Chris Mulvihill and Sam Otukol of the MSRM. For example, the ground samples will slightly under represent volume classes 1 and 4 and over represent volume classes 5 and 6. Height class 4 will also be over sampled relative to the population. Furthermore, age class categories 4 and 5 will be slightly under represented, while the ground sample plots will over represent age class 6 and 8.

The over sampling of height class 4 and of age class 8 was of particular concern, however, in discussion with MSRM, this will potentially be a good – as more information will be obtained for this portion of the population that has a large impact on the inventory as a whole.

2.6 Sample Point Selection

Once the polygons were chosen then the sample point within each target polygon was selected. A standard 100-meter grid was prepared and 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 it is anticipated that the ground sampling activities for the Arrow TSA will be completed over two years beginning in the summer of 2004, with completion scheduled for the summer of 2005.

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 will be given priority in 2004, to allow for NVAF planning (tree selection) in the winter of 2004/2005. The completed NVAF samples will then be used to develop the NVAF destructive sampling contract in early 2005. In this way the NVAF destructive sampling can then also be completed in the summer/fall of 2005 – thereby allowing the stakeholders to potentially complete the final inventory adjustment work in the fall/winter

of 2005/2006 for the Arrow TSA. It is imperative that funding is secured for 2005 work; otherwise, this approach will result in an incomplete inventory and biased ground sample information for the Arrow 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 center 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 center 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 4.5 prepared by Ministry of Sustainable Resources Management, Terrestrial Information Branch, March 2004.

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 enhanced cruising 19 samples will be sampled (4 immature samples and 15 mature samples). VRI field card number 11 (plus card 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 by species or species group for the entire inventory.

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 currently follow the Net Volume Adjustment Factor Sampling Standards and Procedures, MSRM, April 2004

Note that at this time Tree Farm Licence 3 (TFL 3) is under going the implementation of the NVAF destructive sampling. Based on the regional location and similarities between TFL 3 and the Arrow TSA, it was decided to plan the NVAF sampling for the Arrow TSA following the same design (ie. same number of trees, strata, and age cut-off, etc.). Even if the enhanced cruising is completed in the Arrow TSA this year (2004) there may still be some logical arguments and methods for combining the NVAF results from TFL 3 and the Arrow TSA – thereby limiting the amount of destructive sampling required in the Arrow TSA for the NVAF in 2005. This will be discussed and investigated once this summer's fieldwork is completed.

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

NOTE: This NVAF selection uses Scenario 2, NVAF Manual, April 2004 Page 14
(NVAF Selection prior to VRI ground sampling)
Therefore no tree data is available at time of NVAF sample selection

Step 1
Gather the information: 80 samples - sample tree stratification is based on polygon age

Step 2
Stratify the qualifying ground samples by age group:
Immature: equal or less than 100 years old.
Mature: greater than 100 years old.
Eliminate unsuitable VRI ground samples: no auxiliary plots (0 samples).

IMMATURE - 31 samples
MATURE - 49 samples

Step 3
Number of sample trees by strata:
IMMATURE - 10 TREES
MATURE - Fir, Pine, Spruce, Larch (MAT-FPSL) - 25 TREES
MATURE - Balsam, Cedar, Hemlock, Deciduous (MAT-BCHD) - 20 TREES
TOTAL MATURE - 45 TREES
DEAD - 5 TREES
TOTAL = 60 trees

Step 4
Selecting the ground samples from the list
A. Immature
Select samples using interval and random start number. Interval (k) = Stratum Size / Sample Size
First sample = k * Random Number (Values rounded to next whole number)
Second Sample..Sample Size = Previous Sample + Interval (k)
10 trees needed: 10 divided by 3 = 4 ground samples needed (Selection of Polygons, page 14 of April, 2004 Standards)
Sort 31 ground samples by leading species

B. Mature
Select samples using interval and random start number. Interval (k) = Stratum Size / Sample Size
First sample = k * Random Number (Values rounded to next whole number)
Second Sample..Sample Size = Previous Sample + Interval (k)
45 trees needed: 45 divided by 3 = 15 ground samples needed (Selection of Polygons, page 14 of April, 2004 Standards)
Sort 49 ground samples by leading species

Step 5
Selecting auxiliaries that need to be enhanced (NVAF cruised):
3 auxiliaries in each ground sample will be randomly selected in the field and NVAF cruised (if 3 are available)
See below for further explanation

Tree selection will be done after the ground sampling is completed and tree data is compiled

Step 6

Selecting NVAF sample Trees

A Tree Sampling Frame will be compiled, including only trees from selected NVAF Samples
Trees will be sorted into Live (Mat-FPSL, Mat-BCHD, Imm) and Dead matrices.
Within each Live matrix, the trees will be grouped by Species or Species Group, then sorted by DBH.

Table 5: Selected NVAF Samples

SELECTED IMMATURE SAMPLES

SAMPLE	MAPSHEET	POLY	AGE	SPECIES
16	082K004	141	70	AT
88	082E010	168	50	FD
85	082F042	413	80	HW
45	082F015	1315	100	LW

SELECTED MATURE SAMPLES

SAMPLE	MAPSHEET	POLY	AGE	SPECIES
65	082F024	145	110	BL
71	082F025	78	160	BL
69	082K072	164	220	BL
87	082F073	2115	120	FD
36	082K003	252	120	FD
35	082E040	250	130	FD
42	082K002	135	240	FD
2	082K023	359	140	HW
82	082F041	403	220	HW
55	082F022	651	120	LW
60	082E079	81	140	LW
43	082F032	532	110	PL
62	082E089	242	180	PL
80	082F015	1097	180	SE
79	082F084	870	240	SE

In order to try and provide crews with an opportunity to complete one sample each day, for the NVAF enhanced cruising plots, crews will sample up to a maximum of three auxiliaries per cluster, where available. In order to do this, crews have to have some way to select auxiliaries when there are four (4) auxiliary plots.

Therefore, ground sampling crews will use the standard VRI random number tables to select which of the auxiliaries to sample. For each sample they will look up the sample number (i.e. sample # 1), and then find the corresponding random bearing from this table (i.e. random bearing 23 degrees for sample # 1), then either use this bearing (if a cardinal

bearing) or rotate clockwise to the next cardinal bearing and select the 3 auxiliaries to sample using this method (i.e. for sample # 1 NVAF enhance cruising will be carried out on the east, south, and west auxiliaries). See Figures 10 and 11 – copies of the VRI Random Number tables, located on the following pages.

Vegetation Resources Inventory - Random Number Table

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Seeds 1 to 50	Random Bearing	Random Bearing + 90	Randomized numbers 1 - 20 (left to right)																				Randomized numbers from 1 to 100 (top to bottom)
01	23	113	14	12	18	8	20	7	19	3	10	15	11	13	16	5	1	17	6	2	9	4	58
02	155	245	1	11	17	13	16	8	5	20	9	2	14	6	12	15	10	4	19	7	3	18	7
03	350	80	4	5	7	19	17	20	2	9	11	14	18	3	6	10	1	8	12	13	15	16	38
04	296	26	1	7	4	15	6	10	20	13	2	17	12	18	19	5	16	14	3	9	8	11	85
05	8	98	17	1	5	19	8	11	9	15	4	13	6	12	10	7	3	18	20	2	16	14	36
06	304	34	18	7	2	1	14	3	5	4	11	15	8	9	20	17	10	12	19	16	6	13	33
07	351	81	10	6	1	13	9	8	11	17	19	3	16	20	5	4	15	18	2	12	7	14	53
08	158	248	19	4	16	20	2	11	10	8	5	13	12	1	14	15	9	6	17	18	7	3	78
09	139	229	14	11	5	2	18	7	19	16	13	1	20	3	4	6	9	17	12	10	8	15	40
10	33	123	17	15	14	18	5	1	7	19	2	6	3	8	9	4	10	20	13	16	12	11	56
11	264	354	15	3	11	20	1	10	19	4	12	5	16	7	18	6	14	2	17	8	9	13	32
12	278	8	5	8	16	6	7	17	11	9	15	14	19	20	10	3	2	12	4	13	18	1	87
13	137	227	2	10	5	15	12	20	17	4	1	13	14	18	9	16	19	8	11	3	6	7	83
14	243	333	14	5	3	4	1	10	15	13	19	20	2	12	11	7	16	6	8	18	17	9	67
15	176	266	15	7	19	11	9	6	8	3	12	10	14	1	2	4	18	5	16	13	17	20	18
16	267	357	19	16	3	7	17	1	20	2	12	15	18	8	11	9	4	14	6	13	10	5	31
17	214	304	6	7	12	14	3	16	8	13	1	20	19	2	5	9	10	15	18	11	4	17	75
18	229	319	13	8	12	18	14	10	15	3	5	20	4	11	1	17	16	6	9	2	19	7	79
19	257	347	17	5	19	12	8	18	3	2	15	16	4	6	20	14	9	10	13	11	7	1	89
20	324	54	14	8	15	4	6	19	16	1	12	2	17	3	10	11	20	5	9	13	18	7	96
21	98	188	10	16	19	15	1	8	18	14	9	11	4	2	12	7	13	17	5	6	20	3	12
22	70	160	15	19	14	1	6	18	12	4	2	5	9	17	20	16	3	10	11	7	13	8	14
23	161	251	9	10	14	18	17	15	4	2	11	16	7	12	6	8	20	1	19	13	5	3	6
24	199	289	5	4	12	1	7	10	20	14	19	9	15	11	16	18	3	13	8	2	17	6	72
25	329	59	14	9	7	3	17	15	18	1	4	16	6	10	12	20	19	2	5	8	13	11	63
26	110	200	20	11	9	13	15	6	2	8	7	10	4	14	19	12	3	17	18	16	1	5	45
27	127	217	5	4	9	15	18	2	19	16	17	11	1	20	8	13	3	12	10	6	7	14	41
28	253	343	3	2	10	14	15	19	6	13	18	5	4	20	8	1	9	16	7	12	17	11	69
29	314	44	5	3	18	14	1	6	2	13	10	20	4	8	15	9	16	19	11	17	12	7	66
30	285	15	20	10	11	14	15	18	17	9	2	7	1	3	5	19	8	13	16	4	12	6	48
31	87	177	5	6	13	7	12	1	20	4	2	14	11	15	9	3	16	17	19	8	18	10	27
32	277	7	2	1	8	14	18	9	7	12	20	15	19	4	6	3	5	17	16	10	11	13	47
33	109	199	14	5	20	2	10	4	18	15	13	9	16	19	1	11	3	17	12	6	7	8	26
34	332	62	7	13	10	9	18	16	11	2	3	6	5	4	20	14	15	8	1	12	17	19	99
35	67	157	3	10	11	15	2	14	7	8	19	18	16	5	17	13	12	6	1	4	20	9	74
36	74	164	2	10	13	6	14	1	5	7	12	19	18	3	17	11	4	15	8	20	16	9	73
37	283	13	16	13	19	14	1	15	12	18	6	7	5	20	9	17	2	3	4	8	10	11	10
38	32	122	18	16	20	10	17	5	12	4	15	14	11	9	7	1	2	3	6	13	8	19	59
39	270	0	5	12	19	20	11	7	10	2	15	3	14	17	4	6	8	16	13	9	18	1	77
40	339	69	13	3	15	2	18	10	11	12	17	16	7	14	4	20	19	9	6	1	5	8	46
41	300	30	10	16	1	12	17	4	19	8	15	20	5	18	14	13	6	7	3	2	11	9	57
42	17	107	16	2	4	1	3	8	9	7	5	12	17	15	19	20	11	6	10	13	14	18	93
43	144	234	6	2	20	19	17	15	12	5	3	18	14	4	9	8	16	1	13	7	11	10	16
44	271	1	16	4	7	1	10	19	8	14	17	13	6	9	11	20	18	5	15	12	2	3	61
45	248	338	20	13	19	5	15	2	10	16	6	12	18	1	3	14	17	8	11	4	7	9	68
46	77	167	2	3	13	20	15	11	17	1	4	7	18	5	6	19	14	9	8	16	12	10	42
47	43	133	11	2	14	12	10	17	18	20	13	15	5	8	4	7	19	3	9	1	16	6	37
48	223	313	7	16	4	20	15	3	2	18	6	11	19	13	1	8	10	12	9	17	5	14	2
49	122	212	10	1	5	7	9	3	16	18	8	13	11	17	19	12	15	20	2	6	14	4	50
50	66	156	19	2	5	17	16	12	8	15	4	14	18	1	11	20	13	3	7	6	9	10	11

HOW TO USE THIS TABLE: The last two digits of your sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, commence at the beginning of the list for 'each' new selection.

Vegetation Resources Inventory - Random Number Table

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Seeds 1 to 50	Random-Bearing	Random Bearing + 90	Randomized numbers 1 - 20 (left to right)																				Randomized numbers from 1 to 100 (top to bottom)
51	45	135	14	17	12	1	10	7	20	16	15	3	6	4	5	13	11	9	8	18	19	2	91
52	27	117	12	7	11	13	8	6	16	20	3	10	14	5	4	1	2	18	9	15	17	19	94
53	13	103	19	12	18	8	5	3	15	10	20	16	1	17	7	2	6	14	4	9	13	11	39
54	25	115	11	1	9	19	16	10	4	20	18	2	6	13	3	14	8	12	5	15	17	7	97
55	49	139	9	6	7	17	15	11	18	5	3	2	8	19	14	4	13	10	16	1	20	12	23
56	328	58	2	12	19	8	6	4	16	7	18	14	1	13	3	10	15	5	9	11	20	17	76
57	247	337	19	16	14	7	17	9	4	6	15	20	3	12	11	13	10	1	18	2	8	5	82
58	334	64	14	11	3	20	12	2	5	6	13	10	4	15	19	8	18	9	1	16	17	7	20
59	21	111	20	12	11	1	14	4	19	7	9	18	15	5	8	16	6	17	13	2	10	3	49
60	232	322	2	4	16	14	20	13	11	3	17	7	6	10	9	15	18	1	19	5	8	12	81
61	125	215	13	16	5	9	14	7	17	2	15	18	3	8	12	6	10	4	1	19	20	11	1
62	234	324	4	2	11	18	13	9	5	20	19	16	17	7	1	10	8	15	3	6	14	12	34
63	180	270	20	19	18	3	1	9	15	5	14	2	17	6	10	7	16	11	12	8	4	13	86
64	212	302	20	12	4	3	5	15	2	9	13	14	10	1	19	8	16	11	7	6	18	17	29
65	141	231	4	7	18	14	3	9	16	20	2	5	8	19	13	11	15	12	6	10	17	1	55
66	38	128	17	10	3	5	13	12	19	11	9	2	7	20	16	18	6	14	15	8	1	4	80
67	249	339	7	19	18	13	17	5	16	20	1	4	15	12	3	11	10	8	9	14	6	2	30
68	15	105	17	9	2	13	1	4	20	19	8	18	10	5	3	7	12	11	14	15	6	16	8
69	317	47	8	7	12	14	16	4	17	15	18	10	3	19	11	13	5	2	20	6	9	1	88
70	196	286	16	12	7	20	2	11	5	3	9	15	13	18	4	1	17	19	10	6	14	8	92
71	337	67	17	18	14	5	15	7	19	20	3	13	2	10	11	9	1	12	16	4	6	8	28
72	150	240	7	10	14	2	17	20	19	12	13	8	16	9	11	5	3	18	4	1	6	15	98
73	305	35	5	8	4	3	2	16	9	10	7	15	6	1	19	20	13	11	14	12	18	17	70
74	303	33	17	19	6	1	14	8	12	9	18	20	11	13	15	16	5	4	7	2	10	3	52
75	208	298	6	5	10	1	18	16	3	9	12	19	13	15	2	14	11	17	4	7	20	8	60
76	115	205	12	11	7	3	10	18	1	19	13	20	15	4	9	14	17	8	16	6	5	2	9
77	143	233	1	7	18	8	2	11	19	5	14	12	13	9	10	15	16	17	4	3	20	6	43
78	37	127	15	11	1	8	10	20	9	14	18	17	5	6	4	13	2	16	12	7	19	3	5
79	250	340	18	12	4	15	16	8	14	19	13	2	5	3	11	10	1	9	17	20	6	7	3
80	356	86	10	15	8	19	14	17	4	16	13	9	18	1	11	2	7	6	3	5	20	12	64
81	326	56	12	8	10	15	19	1	20	13	14	18	16	7	2	6	5	9	17	11	4	3	15
82	162	252	2	4	12	17	3	10	1	15	5	18	6	8	19	16	20	11	13	9	14	7	19
83	352	82	7	17	8	2	1	16	3	20	15	18	14	6	12	9	10	4	19	11	13	5	22
84	266	356	6	15	12	17	7	16	8	19	13	4	10	18	14	11	5	1	2	20	3	9	84
85	81	171	15	14	19	1	4	17	10	20	7	11	13	8	5	18	3	12	9	6	2	16	95
86	235	325	9	5	12	19	3	16	14	15	2	20	10	1	7	6	17	18	13	8	11	4	4
87	205	295	2	1	12	10	19	13	16	17	6	18	11	3	14	8	5	15	7	9	4	20	17
88	335	65	5	19	2	14	8	6	13	3	15	12	16	18	4	9	11	17	1	20	10	7	21
89	56	146	6	11	3	12	1	4	5	18	20	14	13	7	17	16	10	15	8	2	19	9	65
90	308	38	13	19	7	18	10	1	4	11	17	12	9	3	5	16	15	8	2	14	20	6	54
91	76	166	14	11	3	1	15	12	18	10	6	9	13	5	16	19	2	17	20	8	7	4	13
92	36	126	13	15	14	19	10	12	1	8	11	4	5	17	18	2	20	9	7	3	16	6	62
93	227	317	12	2	19	11	14	10	16	9	15	3	20	17	18	1	6	7	5	4	13	8	25
94	342	72	20	4	19	11	6	8	9	10	15	16	5	13	7	12	2	14	17	1	18	3	35
95	16	106	19	1	13	9	15	14	5	11	10	16	18	6	17	3	2	20	8	7	12	4	51
96	204	294	13	9	5	7	1	10	17	14	11	8	20	15	18	4	12	16	19	2	3	6	24
97	290	20	19	5	18	8	2	9	3	14	10	4	7	6	1	13	11	15	17	20	12	16	71
98	239	329	11	12	17	13	10	1	14	20	15	6	2	19	8	16	4	9	3	7	18	5	100
99	5	95	10	8	15	1	16	2	12	9	14	5	3	13	11	17	18	4	7	20	19	6	44
00	181	271	1	12	8	14	3	10	6	11	19	20	7	16	2	9	15	4	5	13	18	17	90

HOW TO USE THIS TABLE: The last two digits of your sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, commence at the beginning of the list for 'each' new selection.

3.0 IMPLEMENTATION PLAN

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

3.1 Scheduling

The Arrow TSA ground sampling activities are scheduled over two years. In the first year (summer 2004) it is expected that approximately half of the ground samples will be established. However, of these, the NVAF enhanced plots (19) will be targeted for completion in this first year to allow for NVAF tree selection in the winter of 2004/05, and destructive sampling to occur in the summer of 2005.

After the first year of sampling the coefficient of variation (CV) should be re-calculated based on the standard error of regression for net volume. This will help direct the amount of sampling to complete in 2005. Table 6, shown below, provides a list of activities and the proposed completion date.

Table 6: Schedule of Activities for the Arrow TSA

ACTIVITY	Completion Date
Project development	Jun-04
Sample plan preparation	Jul-04
Package preparation	Jul-04
VPIP	Aug-04
Ground sampling (GS) RFP	Aug-04
GS Contract initiation	Aug-04
Ground sampling (~40 samples; incl. NVAF) - yr 1	Nov-04
GS QA (10%)	Nov-04
GS data compilation	Dec-04
NVAF sample tree selection	Jan-05
Preliminary analysis (re-calculate CV)	Jan-05
Ground sampling (~35 samples) - yr 2	Jun-05
GS QA (10%)	Jul-05
NVAF destructive sampling RFP	Jun-05
NVAF contract initiation	Jun-05
NVAF destructive sampling	Jul-05
NVAF QA	Aug-05
GS data compilation	Nov-05
NVAF data compilation	Nov-05
Final inventory adjustment	Jan-06

3.2 Sample Packages

Atticus prepared the sample packages for all 80 samples, with each package containing:

- 1:10,000 scale orthophoto sample location maps
- 1:20,000 scale forest cover maps with the most recent Forest Development Plan information included
- Representational orthophotographs with sample locations (approx. 1:20K scale)
- 1:100,000 scale overview maps (3 covering the Arrow TSA)

3.3 Roles and Responsibilities

3.3.1 Project Coordination

The AFLG provides the overall project coordination of the Arrow TSA ground-sampling inventory. Atco Lumber Ltd. administered the VPIP and sample preparation activities, and Canfor (Slocan Division) is administering the ground sampling activities. 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 the AFLG.

3.3.2 Project Support

Atticus provided the sample list to the AFLG, which includes: sample number, mapsheet, polygon number, UTM coordinated (Northing and Easting) as well as Lat/Long coordinates and detailed polygon and access information. A backup sample list is also provided.

The AFLG will provide sample packages 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 80 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 4.5 – March 2004. 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 (which is assumed to be Chris Mulvihill, R.P.F. of the MSRM).

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 8, 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 two crews were being used on the project). All QA reports will need to be sent directly to Chris Mulvihill of the MSRM for review.

The Vegetation Resources Inventory Ground Sampling Quality Assurance Standards Version 3.0, March 2004 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 the AFLG.

At the end of the first year of field sampling new coefficient of variations (CV's) should be calculated and will be used to adjust and direct sampling efforts in 2005.

The final compilation of the inventory data including statistical analysis and data adjustment will be conducted in early 2006. The analysis will follow the minimum standards as stated in the "VRI Inventory Attribute Adjustment procedures, version 4.4", MSRM, 2002.

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

There are some concerns that need to be addressed in the adjustment process. They include:

1) The adjustment process should consider age trends in the final analysis to separate out younger stands from older stands. The intent is to limit the impact of these volume estimates on the readily available volume that will be harvested in the short term (pers. Comm.. A. Nussbaum, 2004),

2) The strata for the ground sampling was not drawn proportionally between strata, and although our stratification makes sense the result will be some weighting of both the ground sample and NVAF samples during the adjustment process (pers. Comm. G. Johansen, 2004).

4.0 SAMPLE LIST

4.1 List of Selected Samples

The following table provides a list of the proposed 80 VRI ground samples to be completed for the Arrow TSA (MSRM project number **DAR1)**. A more comprehensive sample list is also provided to the AFLG along with this report. Note below (*), the sample numbers go up to 95, as some of the originally selected samples were already replaced internally in this process. See section 4.2 for more information.

Table 7: List of Selected VRI Ground Samples

#	Type	Mapsheet	Poly	BGC	UTM_X	UTM_Y	Vol/ ha	SP1	SP2	AGE	HT	Access Type
2	Q	082K023	359	ESSFwc 1	466205.8	5564519.5	239.2	HW	BL	140	21.0	TRUCK
3	N	082K022	489	ICH mw 2	454305.8	5565019.5	245.7	HW	CW	80	21.0	TRUCK
4	Q	082K022	106	ICH mw 2	451305.8	5571019.5	314.4	HW	FD	110	25.0	TRUCK
5	Q	082F015	1215	ESSFwc 1	490305.8	5445619.5	321.3	CW	BL	130	27.0	TRUCK
8	Q	082K012	747	ESSFwc 4	451405.8	5552119.5	408.7	HW	SE	160	28.0	TRUCK
9	Q	082K071	100	ICH mw 2	442805.8	5622419.5	416.0	HW	CW	200	31.0	TRUCK
10	Q	082K003	91	ICH mw 2	462605.8	5549219.5	421.3	HW	FD	140	32.0	TRUCK
12	Q	082K012	793	ICH mw 2	443405.8	5550519.5	499.4	HW	SE	260	32.0	TRUCK
14	Q	082F021	537	ICH mw 2	439705.8	5452519.5	539.9	HW	SE	300	34.0	TRUCK/ATV
15	Q	082K083	2016	ICH vk 1	459805.8	5637719.5	628.7	CW	HW	200	41.0	TRUCK
16	N	082K004	141	ICH mw 2	482305.8	5548119.5	82.8	AT	HW	70	19.0	TRUCK/ATV
18	Q	082F003	339	ICH xw	470305.8	5434419.5	100.6	AT	FD	60	24.0	TRUCK
19	Q	082E099	264	ICH mw 2	412505.8	5533819.5	207.1	AC	AT	120	31.0	TRUCK
20	Q	082F011	783	ICH dw	430305.8	5439119.5	243.2	AC	CW	120	33.0	TRUCK/ATV
21	Q	082F004	114	ICH dw	485005.8	5438119.5	48.1	FD	EP	40	14.0	TRUCK
22	Q	082F001	502	ICH dw	437605.8	5432919.5	85.5	FD	LW	40	16.0	TRUCK
23	Q	082F022	110	ICH dw	455905.8	5459819.5	92.7	FD	PL	60	18.0	TRUCK
25	Q	082F043	198	ICH dw	463005.8	5473819.5	116.9	FD	LW	100	19.0	TRUCK
26	Q	082E040	40	ICH dw	422605.8	5471019.5	150.5	FD	PL	100	23.0	TRUCK
27	Q	082E080	166	ICH dw	416305.8	5510519.5	197.0	FD	LW	100	24.0	TRUCK
28	Q	082F001	326	ICH dw	440805.8	5430819.5	200.1	FD	LW	79	25.8	TRUCK
31	Q	082K031	20	ICH mw 2	432805.8	5577719.5	230.5	FD	LW	93	29.3	TRUCK
33	Q	082F023	309	ICH mw 2	464905.8	5455019.5	239.1	FD	PL	120	26.0	TRUCK
34	Q	082F052	206	ICH dw	454205.8	5490319.5	244.7	FD	PL	130	26.0	HELI
35	N	082E040	250	ICH mw 2	421905.8	5467719.5	282.8	FD	LW	130	30.0	TRUCK
36	N	082K003	252	ICH mw 2	469205.8	5546719.5	287.5	FD	LW	120	28.0	TRUCK
38	Q	082F031	120	ICH mw 2	428505.8	5461419.5	322.7	FD	LW	130	31.0	TRUCK
39	Q	082K004	465	ICH mw 2	475505.8	5542419.5	358.3	FD	HW	120	29.0	HELI
41	Q	082K011	169	ICH mw 2	442005.8	5550819.5	395.4	FD	HW	200	33.0	TRUCK

42	N	082K002	135	ICH mw 2	450705.8	5548219.5	511.8	FD	HW	240	35.0	TRUCK (HELI)
43	N	082F032	532	ICH mw 2	446805.8	5462119.5	126.3	PL	FD	110	17.0	HELI (TRUCK)
45	N	082F015	1315	ICH dw	487805.8	5443319.5	136.1	LW	FD	100	21.0	TRUCK
47	Q	082F005	356	ICH mw 2	491205.8	5433019.5	163.4	LW	PL	60	22.0	TRUCK
48	Q	082F022	198	ICH dw	455905.8	5457619.5	165.4	LW	FD	70	26.0	HELI
49	Q	082E050	119	ICH mw 2	426005.8	5479919.5	173.8	PL	FD	80	19.0	HELI (TRUCK/ATV)
50	Q	082E040	245	ESSFwc 1	423105.8	5465619.5	187.8	PL	LW	60	20.0	TRUCK/ATV
51	Q	082E010	88	ICH mw 2	424805.8	5433919.5	191.3	PL	LW	70	19.0	HELI
52	Q	082F015	1520	ICH mw 2	488605.8	5440719.5	195.8	LW	FD	140	27.0	HELI
53	Q	082E040	157	ICH mw 2	425405.8	5467619.5	204.1	PL	LW	60	22.0	TRUCK/ATV
54	Q	082F031	200	ICH dw	431305.8	5464519.5	210.3	LW	FD	100	25.0	TRUCK
55	N	082F022	651	ICH dw	456205.8	5452019.5	227.1	LW	FD	120	27.0	TRUCK
56	Q	082F031	278	ICH dw	430305.8	5462819.5	264.6	LW	FD	135	31.7	TRUCK
57	Q	082F052	373	ICH mw 2	451605.8	5486119.5	268.8	PL	FD	110	22.0	TRUCK/ATV
58	Q	082F023	381	ICH dw	458405.8	5452219.5	270.8	LW	PL	120	28.0	TRUCK
59	Q	082F091	24	ICH mw 2	441105.8	5530819.5	319.4	LW	FD	90	32.9	TRUCK
60	N	082E079	81	ICH mw 2	410305.8	5512819.5	333.5	LW	PL	140	30.0	TRUCK
61	Q	082E089	300	ICH mw 2	407505.8	5518519.5	352.2	PL	SE	140	27.0	TRUCK
62	N	082E089	242	ICH mw 2	410305.8	5520519.5	507.5	PL	LW	180	36.0	TRUCK
63	Q	082K003	349	ESSFwc 4	461505.8	5545819.5	92.0	BL	HW	43	12.0	TRUCK
64	Q	082F042	116	ESSFwc 4	445705.8	5480119.5	100.6	BL	SE	135	15.0	TRUCK (HELI)
65	N	082F024	145	ESSFwc 4	478605.8	5459119.5	106.6	BL	SE	110	15.0	TRUCK/ATV
66	Q	082E089	537	ICH mw 2	412305.8	5520719.5	153.3	BL	SE	95	18.0	TRUCK
67	Q	082K014	116	ESSFwc 4	479005.8	5551619.5	158.1	BL	SE	140	18.0	TRUCK/ATV
68	Q	082F092	163	ESSFwc 4	446505.8	5537319.5	164.4	BL	LW	100	20.0	TRUCK
69	N	082K072	164	ICH wk 1	447405.8	5618519.5	187.0	BL	SE	220	21.0	TRUCK (HELI)
70	Q	082F042	76	ESSFwc 4	447605.8	5481519.5	204.9	BL	SE	180	22.0	TRUCK (HELI)
71	N	082F025	78	ESSFwc 4	491105.8	5459819.5	215.3	BL	PW	160	21.0	TRUCK
73	Q	082F062	32	ESSFwc 4	454605.8	5496719.5	238.4	SE	BL	160	25.0	HELI
74	Q	082F084	99	ICH mw 2	478205.8	5517919.5	268.3	BL	SE	100	25.0	TRUCK
75	Q	082F025	75	ESSFwc 1	490405.8	5459119.5	323.7	SE	BL	180	29.0	TRUCK
76	Q	082F063	2216	ESSFwc 1	469305.8	5500219.5	332.7	SE	BL	150	30.0	TRUCK
77	Q	082E099	33	ICH mw 2	408505.8	5538719.5	338.2	SE	PL	140	27.0	TRUCK
78	Q	082F022	361	ESSFwc 1	443405.8	5457519.5	375.7	SE	HW	200	30.0	TRUCK/ATV
79	N	082F084	870	ESSFwc 4	479305.8	5524319.5	409.7	SE	BL	240	36.0	TRUCK
80	N	082F015	1097	ESSFwc 1	488805.8	5449019.5	468.7	SE	HW	180	34.0	TRUCK/ATV
81*	Q	082F092	337	ICH mw 2	444205.8	5536419.5	465.2	HW	CW	260	33.0	TRUCK
82	N	082F041	403	ESSFwc 1	439205.8	5477319.5	505.0	HW	SE	220	32.0	TRUCK
83	Q	082F094	175	ICH mw 2	485205.8	5536419.5	253.6	FD	CW	90	25.0	TRUCK
84	Q	082F094	649	ICH mw 2	476305.8	5535119.5	289.5	FD	CW	120	27.0	TRUCK
85	N	082F042	413	ESSFwc 1	443705.8	5475219.5	226.3	HW	BL	80	18.0	TRUCK
86	Q	082E040	430	ESSFwc 4	423205.8	5461819.5	114.5	LW	BL	60	18.0	TRUCK

87	N	082F073	2115	ICH dw	467305.8	5514819.5	198.0	FD	PL	120	25.0	TRUCK
88	N	082E010	168	ICH dw	426105.8	5430119.5	93.2	FD	LW	50	16.0	TRUCK
89	Q	082K012	28	ICH mw 2	449005.8	5560419.5	244.2	HW	CW	80	21.0	TRUCK
90	Q	082F051	4	ESSFwc 4	429005.8	5489019.5	248.8	BL	SW	200	26.9	HELI (TRUCK)
91	Q	082F011	621	ICH dw	429205.8	5442119.5	99.0	EP	LW	70	20.0	TRUCK/ATV
92	Q	082F032	115	ESSFwc 1	455705.8	5470219.5	122.2	LW	BL	165	17.0	TRUCK/ATV
93	Q	082K014	79	ICH mw 2	472405.8	5553019.5	268.8	HW	CW	80	23.0	TRUCK/ATV
94	Q	082F073	2572	ICH mw 2	468305.8	5514519.5	206.8	FD	PL	120	25.0	TRUCK
95	Q	082F053	35	ICH dw	460805.8	5493719.5	229.9	FD	PL	125	25.0	TRUCK/ATV (HELI)

4.2 Back-up Samples

In this process, Atticus selected approximately 50% or 42 additional backup samples following the steps and procedures outlined in the VRI Sample Selection Procedures for Ground Sampling, December 2002, Version 3.3 (Pages 7 – 14).

During the original selection process, fifteen of the originally selected (80) samples fell just within either private land or Provincial Parks (as following our protocol, these samples were just 'touching' the operable land base). Therefore, following the methods outlined below we replaced the original samples from the randomly back-up list. Note that the replacement samples (shown below) were randomly selected from the same substrata population as each of the original sample (to ensure and maintain adequate representation throughout the target samples).

Original Selected Polygons			Replacement Backup Polygons	
P_LABEL	Substrata		P_LABEL	Substrata
082K022_229	CH_2*	---------->	082F092_337	CH_2
082K013_138	CH_2	---------->	082F041_403	CH_2
082F094_883	F_3	---------->	082F094_175	F_3
082F084_788	F_3	---------->	082F094_649	F_3
082F083_2163	CH_1	---------->	082F042_413	CH_1
082F073_2133	LP_1	---------->	082E040_430	LP_1
082F073_2193	F_2	---------->	082F073_2115	F_2
082F052_141	F_1	---------->	082E010_168	F_1
082F042_671	CH_1	---------->	082K012_28	CH_1
082F034_361	SB_2	---------->	082F051_4	SB_2
082F014_374	DEC	---------->	082F011_621	DEC
082F014_542	LP_1	---------->	082F032_115	LP_1
082F015_1397	CH_1	---------->	082K014_79	CH_1
082F013_562	F_2	---------->	082F073_2572	F_2
082F004_51	F_2	---------->	082F053_35	F_2

** The Substrata coding is as follows: The letters represent the strata (i.e. CH = cedar-hemlock), and the integer represents the substrata, from lowest volume to highest volume substrata (i.e. CH_2 = middle volume class)*

If required, additional back-up VRI ground samples for the Arrow TSA are included in the following table. These polygons have also been selected randomly by substrata.

Table 8: List of Back-up VRI Ground Samples

P_LABEL	NETVOL	POLYGON_HA	SP1	SP1 PER	SP2	SP2 PER	PRJAGE	PRJHT	PRJAGE CLS	STRATA
082K014_126	107	54.9	HW	60	AT	20	46	20.6	3	CH_1
082K003_305	555	24.29	HW	70	CW	20	266	38.2	9	CH_2
082K032_271	394.5	14.03	HW	50	FD	30	246	28.3	8	CH_2
082F043_139	241.8	5.84	AT	30	FD	30	76	29	4	DEC
082F052_229	328.8	10.73	AC	85	SE	10	122	39.2	7	DEC
082F013_132	148.9	42.43	FD	60	PL	20	106	21.7	6	F_1
082F031_139	102.5	44.99	FD	70	EP	20	106	21.7	6	F_1
082F001_326	200.1	6.34	FD	60	LW	15	86	27.3	5	F_2
082F031_120	322.7	23.05	FD	60	LW	20	136	31.7	7	F_3
082F031_204	276.9	45.99	FD	50	PL	30	126	27.7	7	F_3
082E099_259	158.5	38.89	PL	80	FD	20	86	17.7	5	LP_1
082E030_292	194.4	37.76	PL	70	LW	20	86	21.8	5	LP_2
082E050_146	230.4	53.19	PL	50	FD	25	126	23.4	7	LP_2
082F021_463	234.9	75.73	PL	60	BL	20	107	24.6	6	LP_2
082F063_2205	221.9	37.42	LW	40	FD	30	122	26.2	7	LP_2
082F011_603	259	52.84	LW	50	SE	10	106	28.9	6	LP_3
082F022_66	242.1	42.21	LW	40	PL	30	126	25.6	7	LP_3
082F024_563	294.3	21.12	PL	50	FD	45	146	27.3	8	LP_3
082F031_233	269.8	50.07	PL	60	LW	30	116	25.5	6	LP_3
082F024_145	106.6	17.16	BL	65	SE	35	116	15.6	6	SB_1
082K003_349	92	33.37	BL	88	HW	6	49	13.9	3	SB_1
082K014_116	158.1	23.64	BL	80	SE	20	146	18.5	8	SB_1
082F032_654	213.7	64.72	SE	70	BL	30	181	23.6	8	SB_2
082F033_648	260	27.69	SE	60	BL	40	216	27.4	8	SB_2
082F001_538	302.8	16.16	SE	40	FD	30	136	28.7	7	SB_3
082K002_261	348.4	12.64	SE	40	FD	30	206	29.4	8	SB_3
082K033_689	546.4	10.91	SE	40	HW	30	306	40.1	9	SB_3

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