

# **Mackenzie Timber Supply Area**

## **TSA16**

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### **Vegetation Resources Inventory Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling**

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# Executive Summary

This Vegetation Resources Inventory (VRI) Project Implementation Plan (VPIP) is the 'operational' planning document that will be used as a guide for the Mackenzie Timber Supply Area (TSA) VRI ground sampling project. The critical work undertaken and recorded in this plan for the Mackenzie TSA includes: netting down the land base to establish the Vegetated Tree land base for sampling; completing the sample selection for ground sampling and Net Volume Adjustment Factor (NVAF) destructive sampling; identifying each sample's location; providing documentation of the sample selection; and finalizing details regarding the sampling protocols.

This Project Implementation Plan has been prepared following both the VRI Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling (Version 3.1) **and** the guideline Streamlining VRI Ground Sampling Volume Audit (VA) Sampling.

The Volume Audit Sampling guideline identifies some 'standardized' items on which to build the VRI ground sampling plan for a management unit. These include:

1. Establishing the 'Vegetated Treed' (VT) portion of the TSA as the land base for sample selection.
2. Focusing the VA sampling on two different age populations in the management unit. The populations, termed Mature and Immature, are defined by the following criteria:
  - i) Mature – 51 years and older, and
  - ii) Immature – 15 to 50 years.
3. Establishing the number of samples that will be established in each population. Fifty (50) samples will be established in the Mature category and 20 samples in the Immature category.
4. Referencing that the Sample list development and identification of sample locations within the selected polygons will be completed according to the *Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling*. Draft Version 4.0 is the most current edition of this Standard. According to the Standard, details of this work are provided in the Appendices of this plan.

This Project Implementation Plan for the Mackenzie TSA also includes the following decisions:

1. In establishing the VRI sampling populations, the following exclusions were made to the TSA16 land base: private land, parks and Indian Reserves.
2. As part of the development of the sample list, Landsat imagery for the Mackenzie TSA has been used to identify if the Integrated Plot Centre (IPC) has been logged or burned for each sample. Samples were replaced during the sample selection process if this occurred.
3. An additional group of samples have been selected as 'replacement samples'. Exactly 30 samples in the Mature and 15 in the Immature age populations are included in the project's sample list in Appendix A.

4. VRI certified field crews will be establishing the 50 samples in the Mature age population following the protocol for a Timber Emphasis (TEP) plot type. Coarse Woody Debris (CWD) data will be collected on these samples according to the VRI procedures.
5. Sample establishment methodology for the 20 samples in the Immature age population will follow the Change Monitoring Procedures and Quality Assurance (QA) Standard.
6. Net Volume Adjustment Factor destructive sampling will be carried out in the Mature age population only. The NVAF-enhanced samples are a 21 sample sub-set of the original 50 samples.
7. To 'complete' the Mackenzie TSA VRI project, once this field data collection phase is finished, a VRI Analysis should be undertaken to verify the accuracy of volumes and some key attributes of the 'new' Phase I inventory. This analysis will follow protocols which are under development at the time of the writing of this plan.

In the Mature age population, ground sample selection has been completed based on four strata. The strata were developed after analysing the leading species representation in the project land base, greater than 50 years. The number of samples in each stratum is proportional to the species or species grouping's representation.

- Stratum 1: Balsam
- Stratum 2: Spruce
- Stratum 3: Pine
- Stratum 4: Deciduous species and Larch

Each stratum in the Mature age population has been subdivided into 3 volume classes, or "sub-stratum" (1-low, 2-medium, and 3-high). The number of samples assigned to each sub-stratum is proportional to their area representation in the stratum.

The Immature age population has not been stratified. It has been sub-stratified by leading species. The strata are as follows:

- Sub-Stratum 1: Pine-Douglas fir
- Sub-Stratum 2: Spruce
- Sub-Stratum 3: Balsam
- Sub-Stratum 4: Deciduous species

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# 1.0 Introduction

The Vegetation Resources Inventory (VRI) is the inventory standard for forest cover inventory in the province of British Columbia (BC). It follows a set of Procedures with associated Standards, administered by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). The VRI was designed to answer two questions: “Where is the resource located?” and “How much of given vegetation resource is within an inventory unit?”<sup>1</sup>

The Vegetation Resources Inventory is a photo based, 2-phased program. Phase 1 or photo interpretation delineates polygons of homogenous land cover types and provides estimates of the vegetation attributes for each polygon. Phase 2 is ground sampling to verify the accuracy of volumes and some of the key Phase 1 vegetation attributes.

The VRI planning process creates the foundation for the implementation of a successful VRI project. The ‘phase’ of the VRI detailed in the Project Implementation Plan (VPIP), photo interpretation or ground sampling, will be dependent on the assessment of a unit’s current inventory. “A VPIP is a working document that details the specific operational activities associated with implementation and documentation of an inventory project.”<sup>2</sup>

A revised version of the Mackenzie Timber Supply Area (TSA) Strategic Inventory Plan (VSIP) appears on the VRI planning website, dated 2005<sup>3</sup>. It proposed continuing the undertaking of a Phase I VRI over the whole TSA, a project that was started following an earlier VSIP. It also recommended a Phase II project on the Vegetated treed land base when the Phase I has been completed.

In 2006, a VPIP for a Phase I photo interpretation project was prepared for the Mackenzie TSA<sup>4</sup>. This plan references VRI Phase I work already done on the TSA and details additional photo interpretation to be completed.

As of 2010, a summary of the Mackenzie TSA inventory shows two thirds of the TSA has been delivered to VRI Standard and the remaining one-third (primarily in the north) has been updated to VRI Standard. This Project Implementation Plan will detail the undertaking of a follow up project on the Mackenzie TSA inventory, VRI Phase II Ground Sampling and NVAF Sampling.

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<sup>1</sup> From the MFLNRO, Forest Analysis & Inventory Branch, Vegetation Resources Inventory website – Overview - <http://www.for.gov.bc.ca/hts/vri/intro/index.html>

<sup>2</sup> From the Executive Summary of the VRI Standard – Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling.

<sup>3</sup> [http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa\\_vsips/mackenzietsa\\_vri\\_vsip.pdf](http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa_vsips/mackenzietsa_vri_vsip.pdf) The website does not contain a VSIP from 2000. The 2005 VSIP Executive Summary referenced a Stakeholders’ Meeting in 2000 and recommended VRI activities that the 2006 VPIP indicates were initiated between 2001 and 2006.

<sup>4</sup> [http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa\\_vpips/mckenzietsa\\_vripi\\_vpип.pdf](http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa_vpips/mckenzietsa_vripi_vpип.pdf)

## 1.1 Document Objectives

The objectives of preparing this Project Implementation Plan are two-fold. This document provides a record of the decisions made to develop this VRI ground sampling project. It also serves as a guide for those undertaking the project. Specific details identified in this plan include: sampling population, decisions made in the development of sample lists, VRI plot data collection methodology for both the Immature and Mature age populations, and deliverables for the Phase II project.

The Mackenzie TSA VPIP for Phase II Ground Sampling and NVAF Sampling will be stored on the Ministry of Forests, Lands & Natural Resource Operations VRI planning website.<sup>5</sup>

## 1.2 Project Land base<sup>6</sup>

The Mackenzie TSA is located in the northeast interior of British Columbia. The TSA is in the Northern Interior Forest Region of the Ministry of Forests, Lands and Natural Resource Operations. The TSA is administered by the Mackenzie Forest District Office located in Mackenzie. It comprises approximately 6.41 million hectares. About 71 percent of the Mackenzie TSA land base is considered Crown productive forest land (approximately 4.5 million hectares). This includes 1.78 million hectares of zones where timber harvesting is not permitted. At the time of the preparation of documentation for TSR2, about 32 percent of the Crown productive forest land or 23 percent of the total TSA land base was considered to be available for harvesting.

Table 1 shows the land base summary developed from the data provided by the MFLNRO during the writing of this VRI plan.

**Table 1: Mackenzie TSA Land Base**

Land Classification	Area	% of TSA
Total Area	6,410,665	
Net Downs	905978	14.1%
Indian Reserve	356	0.0%
Parks	897,029	14.0%
Private	8,593	0.1%
Net Area	5,504,687	85.9%
Non-vegetated	720,950	11.2%
Vegetated	4,783,738	74.6%
Non-treed	1,141,025	17.8%
Treed	3,642,712	56.8%

<sup>5</sup>[http://www.for.gov.bc.ca/hts/vri/reports&pub/vri\\_vripub.html](http://www.for.gov.bc.ca/hts/vri/reports&pub/vri_vripub.html)

<sup>6</sup> Text adapted from the Mackenzie TSA Rationale for Allowable Annual Cut (AAC) – December 1, 2001.

The topography of the Mackenzie TSA is variable. The gently sloping Rocky Mountain Trench runs from north to south through the centre of the TSA. The rugged Rocky Mountains border the trench along the eastern side while to the west is the more rounded Omineca Mountains. Williston Lake, a narrow 360 kilometre long lake created by the WAC Bennett Dam on the Peace River, is one of the most prominent geographical features in the area.

There are five (5) biogeoclimatic zones<sup>7</sup> (BGC) in the TSA including Engelmann Spruce-Subalpine Fir (ESSF), Spruce-Willow-Birch (SWB), Sub-boreal Spruce (SBS), Boreal Black and Boreal White (BWBS) and Boreal Altai Fescue Alpine (BAFA, a new alpine unit from the old AT). The main tree species are subalpine fir (balsam), spruce, lodgepole pine, cottonwood and white birch. Approximately 67% of the Vegetated Treed (VT) population 15 years plus is greater than 120 years of age. Twenty-six per cent (26%) of this land base has been classified to be between 51 and 120 years.

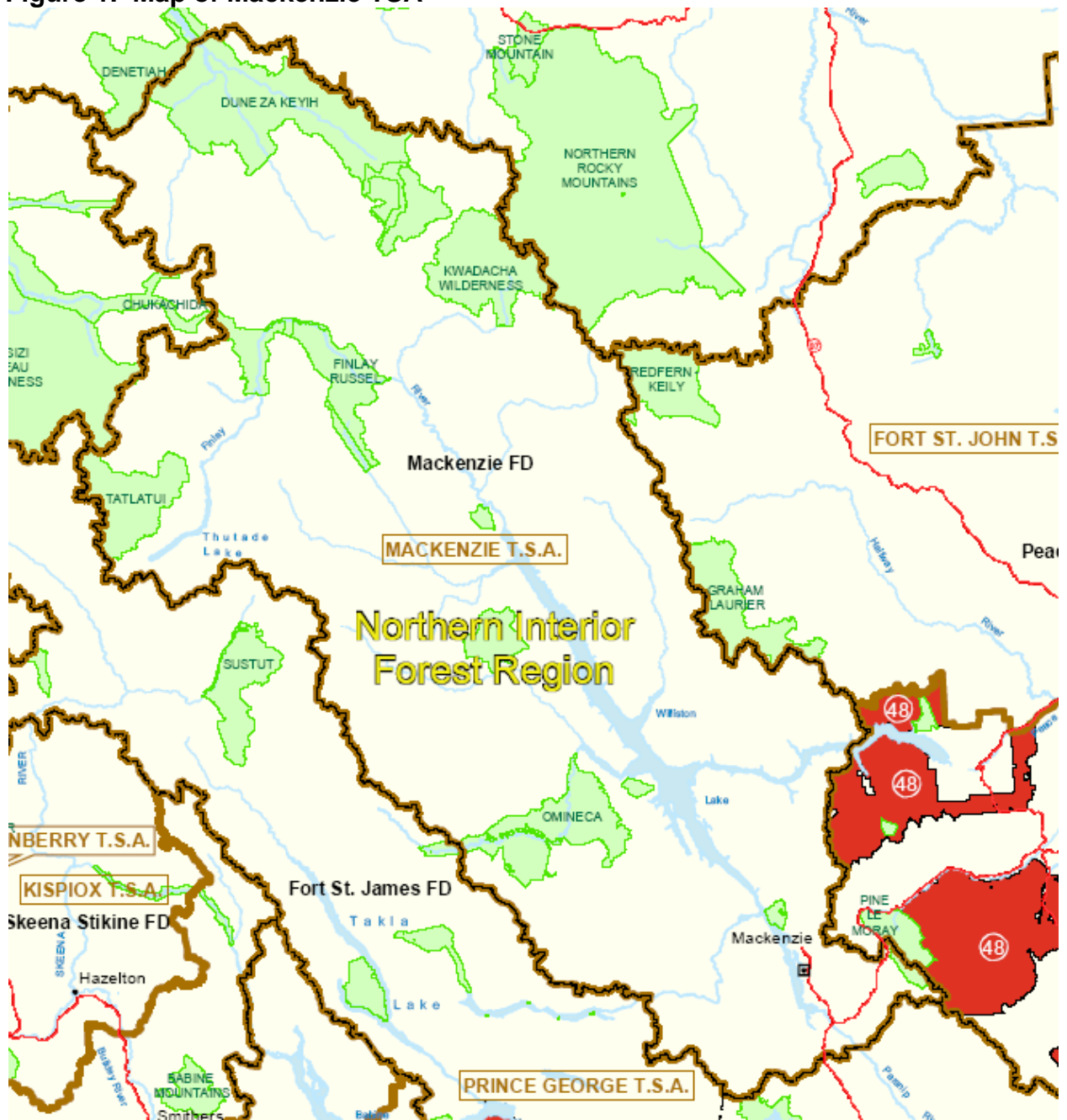
The Kwadacha and the Tsay Keh Dene First Nations are almost entirely located within the TSA, including their main communities of Fort Ware and Tsay Keh, respectively. An area of the Mackenzie TSA has been excluded for the McLeod Lake First Nation. Portions of the traditional territories of the Takla Lake, Nak'axdli, West Moberly and Halfway River First Nations overlap the Mackenzie TSA.

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<sup>7</sup> In the VT population, age 15+, the BGC zone breakdown is as follows: ESSF-45%, SWB-21%, SBS-19%, BWBS-14% and BAFA-1%.



Figure 1. Map of Mackenzie TSA<sup>8</sup>



The land base figures provided below in Tables 2, 3, 4 and 5 have supported decision-making in this plan, such as stratification of the population. Together, the Immature and Mature age populations in the Vegetated Treed portion of the B.C. Land Cover

<sup>8</sup> Map adapted from BC government website:

<http://www.for.gov.bc.ca/ftp/hth/external/!publish/web/timber-tenures/tfl-regions-tsas-districts-map-150-dpi-sep-13-2007.pdf>

Classification 15 years of age and greater total approximately 3,597,937 hectares.<sup>9</sup>

**Table 2: Species Distribution – Mackenzie TSA Total Vegetated Treed Land base, Ages 15-50**

<b>Species</b>	<b>Area (ha)</b>	<b>%</b>
PL	108,257	43.84%
S	70,894	28.72%
Ac	28,443	11.52%
BI	25,783	10.44%
EP	12,878	5.22%
W	583	0.24%
FD	50	0.02%
<b>Total</b>	<b>246,888</b>	<b>100.00%</b>

**Table 3: Species Distribution – Mackenzie TSA Total Vegetated Treed Land base, Age 51+**

<b>Species</b>	<b>Area (ha)</b>	<b>%</b>
BI	1,443,976	43.09%
S	907,868	27.09%
PL	860,775	25.69%
Ac	127,884	3.82%
EP	10,313	0.31%
W	124	0.00%
L	109	0.00%
<b>Total</b>	<b>3,351,049</b>	<b>100.00%</b>

**Table 4: Age class Distribution, All Species – Mackenzie TSA Total Vegetated Treed Land base, Ages 15 - 50**

<b>Age Class</b>	<b>Ages</b>	<b>Area (ha)</b>	<b>%</b>
1	15-20	47,921	19%
2	21-40	118,144	48%
3	41-50	80,823	33%
<b>Total</b>		<b>246,888</b>	<b>100%</b>

<sup>9</sup> Numbers related to identifying the sampling population are the result of analytical work completed by Nona Phillips Forestry Consulting using current MFLNRO provided data files and documented in the sample selection report provided to the government, following the VRI Sample Selection Standard.

**Table 5: Age class Distribution, All Species – Mackenzie TSA Total Vegetated Treed Land base, Age 51+**

<b>Age Class</b>	<b>Ages</b>	<b>Area (ha)</b>	<b>%</b>
3	51-60	84,635	3%
4	61-80	185,458	6%
5	81-100	300,500	9%
6	101-120	377,814	11%
7	121-140	542,610	16%
8	141-160	1,747,906	52%
9	161+	112,126	3%
<b>Total</b>		<b>3,351,049</b>	<b>100%</b>

### 1.3 State of the Inventory

The current VRI (a combination of ‘new’ Phase I inventory in the south and inventory updated to VRI Standard in the north) will be the basis for this Volume Audit (VA) sampling project. Discussion of earlier inventories and the provincial ‘Inventory Audit’ program included in both the Mackenzie TSA VSIP and the VPIP for Photo Interpretation will not be in this plan as they are not relevant to the current Mackenzie TSA inventory that is the foundation of the land base and sample selection for this project.

## 2.0 Ground Sampling Plan

### 2.1 Sampling objectives

A VRI Phase II ground sampling and NVAF sampling project was identified to follow the Phase I. Specific TSA Stakeholders’ objectives for this project included obtaining:

- A statistically valid analysis of the Phase I inventory time volumes on the Vegetated, Treed land base.
- An assessment of the loss factors and taper equations especially in balsam leading stands and taper equations in small pine stands.
- Information on unsalvaged losses e.g. from forest health issues like Mountain Pine Beetle (MPB) and other insect and disease issues
- Immature stand data e.g. volume estimates, to check TIPSYS
- Details on deciduous leading stands.

A Phase II VRI ground sampling and NVAF sampling project is being addressed in this plan. The sampling objective for this project is to verify the accuracy of volumes and other key attributes in the inventory. A sampling error of 15% (net volume) is the target set for the Mature age population. No sampling error target will be set for the Immature age population.

## 2.2 Target Population

The population of interest for this project is the Vegetated Treed land classification, 15 years of age and greater.

The exclusions from the land base have included Private land, parks and Indian Reserves. Community Forests and Woodlots have been retained in the Mackenzie TSA land base.

The Volume Audit sampling guideline identifies the focus for sampling to be two different age populations. The two populations are:

1. 15 to 50 years (Immature age population)
2. 51 years and older (Mature age population)<sup>10</sup>

In the Mackenzie TSA, the target population in the Immature age population encompasses a total area of 246,888 hectares and the Mature age population land base is 3,351,049 hectares.

## 2.3 Sample Size

Following the document '*Streamlining VRI Ground Sampling Volume Audit Sampling*', a total of 70 ground samples will be established in the Immature and Mature age populations. Sample establishment in the Vegetated Treed land base of the TSA will be as follows:

- 20 samples in the Immature age population, and
- 50 samples in the Mature age population.

## 2.4 Strata

### 2.4.1 Ground Sampling

#### Mature Age Population Land base

The Mature age population has been stratified into species and species groupings as follows:

- Stratum 1: Balsam
- Stratum 2: Spruce
- Stratum 3: Pine

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<sup>10</sup> The two different age populations for the overall Phase II sampling will be termed the Immature and Mature age populations throughout this plan. This should help to keep these populations in the overall project separate from the 'Mature and Immature' divisions in the NVAF sample population.

- Stratum 4: Other - Deciduous species and Larch

The development of these strata was based on distributing the samples proportional to species representation. Each stratum was further divided into 3 sub-strata based on volume classes with equal numbers of polygons to ensure a good distribution of samples. The criteria for this sub-stratification are described in Appendix D.

Immature Age Population Land base

There is only one stratum in the immature population. It was divided into 4 sub-strata by species composition. The sub-strata are:

- Sub-Stratum 1: Pine-Douglas fir
- Sub-Stratum 2: Spruce
- Sub-Stratum 3: Balsam
- Sub-Stratum 4: Other - Deciduous species

Table 6 shows the distribution of ground samples

**Table 6: Distribution of Ground Samples**

Land base	Stratum	Population Area (ha)	% of area	Number of samples	Number of hectares represented by each sample
<b>Mature age class</b>	Balsam	1,443,976	43	21	68,761
	Spruce	907,868	27	14	64,848
	Pine	860,775	26	13	66,213
	Other-Deciduous Spp. & Larch	138,430	4	2	69,215
	<b>Total</b>	<b>3,351,049</b>	<b>100</b>	<b>50</b>	
<b>Immature age class</b>	Immature	<b>246,888</b>	<b>100</b>	<b>20</b>	12,344

Table 7 shows the division of the Mature age population stratum into sub-strata based on 3 volume classes.

**Table 7. Mature age Population in VT - Sample breakdown by Volume Class**

Vol class	BI	S	PI	Decid spp & L
1	6	4	4	1
2	6	5	4	1
3	9	5	5	--
<b>Total</b>	<b>21</b>	<b>14</b>	<b>13</b>	<b>2</b>

For the Immature age population areas, the single stratum has been divided into sub-strata based on 4 species groupings as shown in Table 8.

**Table 8. Immature age Population in VT - Sample breakdown by Sub-strata**

<b>Sub-strata</b>	<b>Area</b>	<b>%</b>	<b>Samples</b>
Pine-Douglas fir	108,308	44	9
Spruce	70,893	29	6
Balsam	25,783	10	2
Deciduous species	41,904	17	3
<b>All species</b>	<b>246,888</b>	<b>100</b>	<b>20</b>

Appendix D shows how strata and volume class sub-stratum are defined and how samples were distributed among them.

#### **2.4.2 NVAF**

For NVAF sampling, the Mature age population is divided into two age classes, Immature (age 51+ to 120) and Mature (121+). In the Mackenzie TSA, the Mature age population of the Vegetated Treed land base is 29% Immature and 71% Mature. Table 9 (below) shows the distribution of ground samples for NVAF-enhancement by age class.

**Table 9: NVAF Ground Sample Distribution**

<b>Land base</b>	<b>Age Class (years)</b>	<b>NVAF Samples</b>
Mature age population (All VT,51+)	Immature 51-120	4
Mature age population (All VT,51+)	Mature 121+	17
	<b>Total</b>	<b>21</b>

## **2.5 Sample Selection**

The Standard '*VRI Sample Selection Procedures for Ground Sampling*' outlines the process for sample selection in detail and Draft Version 4.0 has been used as a guideline for this plan. Documentation of the Sample Selection process followed is included in Appendix D.

### **2.5.1 Ground Sampling**

The initial step was to identify the population of the Mackenzie TSA for both the Immature and Mature age population land base. Appendix D details the process of identifying the population areas, developing strata and sub-strata, and how samples were distributed within these.

A sample list was developed for each of the two populations. The lists contain the initial samples and replacement samples available in the likely event that some of the initial samples are rejected in the field. The reasons could include safety

concerns, logged plot centre etc., following field reconnaissance. There are 50 initial samples and 30 replacement samples in the Mature age population (51+). The Immature age population (15-50) has 20 initial and 15 replacement samples.

Sample polygons were selected according to procedures outlined in 'Vegetation Resources Inventory –*Draft Version 4.0 - Sample Selection Procedures for Ground Sampling*-Section 3.0'. That is by "probability proportional to size with replacement" (PPSWR). Sample points were located randomly within the sample polygon using ARCMAP 10 GIS techniques and random numbers generated by Excel. Sample locations were reviewed against recent Landsat imagery. Where a sample fell within a recent disturbance area (e.g. Cutover) the sample was replaced with a replacement polygon/sample from the same stratum or strata and sub-stratum.

Where there is a need to replace a sample in the field the replacement should also be from the same stratum or strata and sub-stratum.

Appendix A includes the sample list and identifies which initial samples were replaced at the sample location stage and the reason why.

### **2.5.2 NVAF**

The NVAF samples are a subset of the VRI sample selection. Ministry of Forests, Lands and Natural Resource Operations staff have been involved in initial decisions related to the NVAF sample selection. Based on their direction, a list of 21 samples has been derived from the 'final' ground sample list, following Section 3.4 of the *Draft VRI Sample Selection Procedures for Ground Sampling*.

The samples that are to be enhanced to the NVAF standard are identified in this Project Implementation Plan. The details of NVAF sample selection and the complete NVAF profile can be found in Appendix C.

Enhancement of auxiliary plots will be completed at the time of the establishment of the ground samples according to the NVAF Sampling Standards and Procedures. Following the NVAF Standard, all four auxiliary plots will be enhanced, with all live and dead trees 12.5 cm dbh or greater included in the data collection. Also following this protocol, a tally of dead fallen trees will be included at only one auxiliary plot per sample. This data collection will occur on the north auxiliary only.

### **2.6 Sample Type**

The protocols developed for the ground sampling enable forest managers to select from several options to collect timber and ecology data, dependent on their objectives. The ground samples established for the Mackenzie TSA project in the Mature age population will follow 'Timber Emphasis' procedures as completed by certified VRI Timber contractors. The following additional data will be collected at each sample:

- Coarse Woody Debris (CWD)

The sampling methodology for the 20 samples in the Immature age population will follow the Change Monitoring (CMI) Procedures and Quality Assurance (QA) Standard. VRI certified Timber crews will collect timber data on a 11.28 m fixed radius plot at the Integrated Plot Centre (IPC). Coarse Woody Debris data will also be completed but the samples will not have ecology data collection.

## **3.0 Project Implementation**

### **3.1 Sample Packages**

Based on the samples selected in this Mackenzie TSA Project Implementation Plan for Phase II activities, sample packages will be prepared for each sample. They will include tools that support the field crews in their efforts to navigate to, and establish each sample in the correct location. They will be prepared according to the document *Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling*.

### **3.2 Standards**

The most recent edition of the Vegetation Resources Inventory Standards and Procedures will be followed to complete this project. The current Standards relevant to this project are listed in this document, following the Bibliography. The Ministry of Forests, Lands and Natural Resource Operations maintains the following website. When the project is initiated, the participants should access this site to confirm that they are using the latest version of each Standard.

**<http://www.for.gov.bc.ca/hts/vri/standards/index.html>**

### **3.3 Sample List**

A complete sample list is provided in Appendix A. A description of how samples were distributed across the population is included in Appendix D.

### **3.4 Project Files**

The original population files used to determine the selection will be kept on file by the Forest Analysis and Inventory Branch.



### 3.5 Project Analysis

A statistical analysis will be conducted after the field portions of the project have been completed.

## Bibliography

1. British Columbia Ministry of Forests, Resources Inventory Branch. 1996 (revised). Mackenzie TSA Inventory Audit, 1993 and 1996.
2. British Columbia Ministry of Forests & Range. Timber Supply Branch. June 16, 2004. Mackenzie Timber Supply Area – TSR Section 8 (3.1) Postponement Order. Larry Pedersen, Chief Forester, Victoria.
3. British Columbia Ministry of Forests. Timber Supply Branch. December 1, 2001. Mackenzie Timber Supply Area - Rationale for Allowable Annual Cut (AAC) Determination. Larry Pedersen, Chief Forester, Victoria. (TSR2)
4. British Columbia Ministry of Forests. Timber Supply Branch. July 15, 1996. Mackenzie Timber Supply Area - Rationale for AAC Determination for TSR1. Larry Pedersen, Chief Forester, Victoria.
5. Ministry of Forests, Lands and Natural Resource Operations website for VRI - [http://www.for.gov.bc.ca/hts/vri/reports&pub/vri\\_vripub.html#top](http://www.for.gov.bc.ca/hts/vri/reports&pub/vri_vripub.html#top)
6. Ministry of Forests, Lands and Natural Resource Operations, 2011, Streamlining VRI Ground Sampling -Volume Audit Sampling.
7. Ministry of Forests & Range, Forest Analysis & Inventory Branch. October 18, 2005. Mackenzie Timber Supply Area VRI Strategic Inventory Plan. (Revision)
8. Phillips, Nona, Nona Phillips Forestry Consulting. Cranbrook TSA and TFL18 Vegetation Resources Project Implementation Plans. February 2011 (Cranbrook) and March 2011 (TFL18).
9. Hancock, Darin, Abitibi Consolidated Company of Canada. June, 2006. Mackenzie Timber Supply Area VRI Project Implementation Plan for Photo Interpretation.
10. Various. Personal Communication with MFLNRO staff including Chris Mulvihill, Sam Otukol, Gary Johansen and Matt Makar regarding issues related to the preparation of the Mackenzie TSA VPIP.

# VRI Standards & Procedures

The list of VRI Standards and Procedures that have been followed in the preparation of this plan and project to date and that must be followed to complete the Mackenzie TSA VRI Phase II ground sampling and NVAF sampling project is provided below. The most 'current' edition should be used when this project is undertaken. They will be found at the website:

<http://www.for.gov.bc.ca/hts/vri/standards/index.html>

## **Plan Preparation and Project Delivery:**

Preparing a VRI Strategic Inventory Plan (VSIP) for Ground Sampling and Photo Interpretation, January 2005

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 3.1, March 2010

VRI Phase 2 Post-Project Documentation and Deliverables, June, 2007

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling DRAFT Version 4.0 May 2011

## **Ground Sampling, including Phase II Sampling, NVAF and CMI Sampling:**

Vegetation Resources Inventory Ground Sampling Procedures Version 4.9, March 2010

Ground Sampling Procedure Appendices Version 4.6, March 2010

Vegetation Resources Inventory Ground Sampling Quality Assurance Procedures and Standards for VRI Ground Sampling Version 3.1, March 2008

Vegetation Resources Inventory Ground Sampling Data Collection Procedures for Inaccessible Samples Version 1.0, March 2003

Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.4, March 2010

National Forest Inventory B.C. Change Monitoring Procedures for Provincial and National Reporting. Version 1.4, March 2005

National Forest Inventory B.C. Change Monitoring Procedures for Provincial and National Reporting Appendices. Version 1.4, March 2005

Change Monitoring Inventory Ground Sampling Quality Assurance Procedures. Version 1.1, March 2002

Change Monitoring Inventory Ground Sampling Standards. Version 2.1 May 2007

### **VRI – Analysis and Adjustment**

At the time of the writing of this plan, the section under the Standards for the Data Analysis and Adjustments stated the following:

“The Forest Analysis and Inventory Branch is currently updating procedures for the analysis of VRI ground sample data. New procedures will be posted later in the 2010/11 fiscal year. In the interim, all analyses for new and ongoing projects will be evaluated on a case-by-case basis to determine the most appropriate option.”

# **Appendix A**

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## **Sample Lists for Mackenzie TSA Ground Samples**

## Sample List

The following are sample lists for each of the two populations. Each list contains initial samples for data collection (S) and replacement samples (R) in the event that some of the initial samples need to be replaced during the data collection phase. For the 15-50 population there are 20 initial samples and 15 replacement samples. No samples in this population were dropped at the sample locating stage.

For the 51+ population there are 50 initial samples and 30 replacement samples. Only 1 sample was rejected in the sample location stage and was replaced at that time. Details of this replacement are included in the Sample Selection Report.

Samples can be rejected at the field sampling stage if they are in an unsafe location or in a cutover. When replacing samples they must be from the same stratum and sub-stratum. The project manager must be consulted if samples are rejected.

The shapefiles for each of the populations include all of the original VRI data.

**Note: S= initial samples and R= replacement samples**

Sample List for Immature Population

Samp_no	Type	Substrat	Map	Polygon	Zone	East	North	Sp1	S1%	Sp2	S2%	Sp3	S3%	Age	Ht	BA	Vol/ha	Stems/ha	Area
51	S	P-F	094C038	1038	10	409824	6241796	PL	88	AT	9	S	2	34	10.0	6	6	687	4
53	S	P-F	094C075	1202	10	366698	6289662	PL	55	AT	45		0	45	13.0	15	34	1256	5
52	S	P-F	093O071	36722599	10	440065	6176267	PL	31	SX	26	EP	23	21	9.0	3	2	384	69
54	S	P-F	094F023	72028387	10	350591	6342960	PL	90	SX	5	SB	5	49	16.0	28	74	2568	31
55	S	P-F	094C095	22294123	10	375424	6317532	PL	85	AT	10	AC	5	20	7.0	5	0	2500	4
56	S	P-F	093O033	78525244	10	462000	6129122	PL	50	SW	30	BL	20	38	12.0	14	25	1329	26
57	S	P-F	093O041	75333824	10	445335	6144767	PL	55	S	25	BL	15	40	12.0	14	26	1209	65
58	S	P-F	094C074	1049	10	354214	6288300	PL	95	AT	5		0	38	11.0	22	6	3327	21
59	S	P-F	094C067	1180	10	389914	6275224	PL	70	S	30		0	33	9.0	7	5	783	19
101	R	P-F	094C082	91537162	10	335913	6307434	PL	100		0		0	49	7.0	15	0	2500	13
102	R	P-F	094C064	243	10	355120	6279145	PL	70	AT	20	SW	10	41	16.0	19	71	1340	13
104	R	P-F	094C018	1215	10	404251	6222002	PL	40	S	30	AT	20	37	10.0	6	7	572	14
103	R	P-F	094C017	1023	10	396989	6218607	PL	70	S	20	BL	10	27	7.0	1	0	1700	13
105	R	P-F	094C037	1055	10	388678	6242015	PL	50	S	40	BL	10	27	7.0	2	0	3000	8
106	R	P-F	094B017	79351900	10	517413	6222768	PL	70	AT	15	SW	15	49	9.0	4	3	325	3
107	R	P-F	094F082	1004	10	342521	6409901	PL	50	BL	30	AT	15	39	8.0	4	2	403	9
60	S	S	094B006	10843629	10	505372	6210768	SW	41	BL	34	PL	11	21	2.0	0	0	0	375
61	S	S	093O016	16317325	10	502057	6114087	SX	89	BL	9	PL	2	35	11.0	13	14	1509	50
62	S	S	093O063	14094957	10	469629	6162173	SX	60	BL	20	AT	10	27	5.0	0	0	0	2
63	S	S	094C018	3749822	10	401846	6224412	SW	75	PL	15	BL	8	39	7.0	5	0	2000	81
64	S	S	093O061	74870722	10	446340	6172993	SX	100		0		0	15	2.0	0	0	1500	6
65	S	S	094B025	45627084	10	494986	6232543	SW	65	AC	20	AT	15	26	5.0	10	0	1800	51
108	R	S	094C067	86122882	10	401759	6280325	SX	50	PL	40	AT	10	17	2.0	0	0	2466	11
109	R	S	093O032	61930681	10	459685	6138148	SX	39	PL	30	BL	19	20	3.0	1	0	2037	70
110	R	S	094C024	1006	10	353754	6236213	S	51	BL	27	PL	22	18	2.0	1	0	2137	1
111	R	S	093O015	55173600	10	491464	6107914	SX	46	BL	20	AT	17	29	5.0	9	0	0	13

66	S	B	094C091	17718427	10	323305	6310093	BL	100		0		0	39	2.0	2	0	6000	17
67	S	B	093O026	74984351	10	512462	6125465	BL	100		0		0	45	4.0	2	0	2600	5
112	R	B	094F082	832	10	344735	6412408	BL	100		0		0	34	4.0	2	0	300	46
113	R	B	094L009	52	09	654296	6438776	B	70	SW	30		0	49	16.0	28	85	1753	267
68	S	Oth	094C068	12999885	10	406032	6274929	AT	45	PL	20	EP	20	29	14.0	38	60	2272	37
69	S	Oth	094C085	29582818	10	375480	6298102	AT	45	SW	40	PL	15	21	7.0	25	0	11589	74
70	S	Oth	094C058	1111	10	402077	6264488	EP	40	S	20	AT	20	38	12.0	13	28	967	54
114	R	Oth	094C074	554	10	357239	6288670	AT	40	SX	30	EP	20	38	14.0	12	0	2200	17
115	R	Oth	094B031	32460151	10	442000	6240020	EP	60	SW	15	PLI	10	44	8.0	2	1	260	3

**Sample List For Mature Population**

Samp_no	Type	Strat/Sub_strat	Map	Polygon	Zone	E	N	Sp2	S1%	Sp2	S2%	Sp3	S3%	Age	PROJ_HEIGH	BA	Vol/ha	Stems/ha	Area	NVAF?
1	S	B-1	094E017	299	9	640397	6338256	BL	100		0		0	111	2.0	5	0	700	6	y
2	S	B-1	094F058	353	10	413121	6380682	BL	95	SX	5		0	166	7.0	14	0	2500	9	
3	S	B-1	094F011	914	10	320913	6335445	BL	90	SX	10		0	141	8.0	1	1	64	2	
4	S	B-1	094F059	71	10	416757	6374518	BL	100		0		0	161	7.0	14	0	2500	5	y
5	S	B-1	094D075	72621370	9	613318	6295405	BL	100		0		0	152	10.0	7	4	811	5	y
6	S	B-1	093N046	18403817	10	384572	6146676	BL	95	SX	5		0	125	8.0	3	1	535	17	
7	S	B-2	094C060	57697118	10	430544	6269464	BL	100		0		0	144	13.0	3	11	163	18	
8	S	B-2	093O092	28857149	10	456928	6200198	BL	100		0		0	205	13.0	8	22	403	5	y
9	S	B-2	094C028	173	10	404478	6238933	BL	80	SX	20		0	176	19.0	6	30	220	78	
10	S	B-2	094D095	62522029	9	610936	6313235	BL	90	SX	10		0	167	13.0	21	50	683	4	
11	S	B-2	093N079	31321236	10	421868	6174946	BL	100		0		0	185	11.0	8	11	797	10	
12	S	B-2	094C026	8	10	376903	6240820	BL	60	PL	25	SX	15	159	17.0	7	32	344	22	y
13	S	B-3	093O033	97430922	10	466013	6138575	BL	80	SX	20		0	134	17.0	38	162	1458	5	y
14	S	B-3	094C050	69059476	10	431769	6256089	BL	85	SX	15		0	194	22.0	30	172	801	6	

15	S	B-3	094E006	303	9	624143	6327433	BL	75	SX	25		0	231	16.0	25	75	744	29	y
16	S	B-3	094B061	24585886	10	443178	6283752	BL	70	SW	30		0	204	16.0	32	145	1001	52	y
17	S	B-3	093O036	52737329	10	509075	6130624	BL	90	SX	10		0	205	18.0	35	153	752	15	
18	S	B-3	093O051	44588140	10	440385	6151704	BL	70	SX	30		0	155	19.0	39	182	1368	42	y
19	S	B-3	094F017	26687123	10	394272	6338647	BL	65	SX	30	PL	5	165	17.0	30	148	654	35	
20	S	B-3	094F034	22809043	10	360470	6360452	BL	70	SX	20	PL	10	124	17.0	19	83	778	14	
21	S	B-3	094C067	86004953	10	401901	6283529	BL	40	PL	30	SX	20	134	18.0	25	141	684	15	
22	S	S-1	094F082	369	10	341553	6417551	SX	55	BL	45		0	209	18.0	15	45	511	26	
23	S	S-1	094F012	267	10	339824	6339522	SX	65	BL	35		0	121	18.0	16	74	368	8	y
24	S	S-1	094L044	85	9	599598	6474548	S	60	SB	40		0	237	18.0	8	22	373	1	
25	S	S-1	094E044	605	9	607569	6367667	SX	45	BL	35	PL	20	251	17.0	10	29	834	15	
26	S	S-2	094C099	209	10	421420	6315734	SX	70	BL	30		0	161	21.0	38	192	871	20	
27	S	S-2	094D096	55261823	9	626748	6313717	SX	80	BL	20		0	199	21.0	25	122	649	3	
28	S	S-2	094F064	94514631	10	356639	6387256	SX	85	BL	15		0	151	21.0	36	194	1159	16	y
29	S	S-2	094C081	97034093	10	319383	6302902	SX	60	AC	40		0	134	21.0	21	119	503	0	y
30	S	S-2	094F010	814	10	434337	6322689	SX	90	BL	10		0	221	18.0	32	106	1375	22	
31	S	S-3	093N059	16293152	10	418969	6161035	SW	80	PL	20		0	155	29.0	55	438	879	13	y
32	S	S-3	093O085	45861493	10	493430	6188802	SX	55	BL	30	AT	15	155	26.0	65	413	1208	46	
33	S	S-3	093N030	13643819	10	433988	6127916	SX	65	PL	35		0	134	26.0	30	233	689	15	
34	S	S-3	094C014	413	10	358741	6226375	SX	75	AT	15	PL	10	172	27.0	36	258	630	7	
35	S	S-3	093N067	87918269	10	397535	6170775	SX	60	PL	15	SB	15	155	28.0	45	356	731	14	y
36	S	P-1	094C064	183	10	360992	6282895	PL	75	SX	20	AT	5	125	23.0	10	82	217	22	
37	S	P-1	094L026	70	9	626944	6455493	PL	60	S	40		0	237	17.0	24	99	1120	23	y
38	S	P-1	094F045	66682569	10	368038	6366230	PL	60	BL	30	SX	10	124	16.0	19	70	1195	31	
39	S	P-1	094E067	309	9	638091	6395537	PL	100		0		0	101	15.0	9	48	416	16	
40	S	P-2	094C006	274	10	383165	6216498	PL	65	BL	30	SX	5	186	24.0	35	223	752	15	
41	S	P-2	093N100	66104602	10	428742	6197298	PL	100		0		0	134	20.0	35	218	1231	6	y
42	S	P-2	094C004	802	10	362312	6211687	PL	55	SX	35	BL	10	183	24.0	26	200	608	13	
43	S	P-2	093O022	76513992	10	461803	6126828	PL	60	SX	40		0	204	27.0	30	242	392	2	
44	S	P-3	094F006	48218698	10	380165	6325238	PL	40	SX	35	BL	15	160	25.0	35	282	642	10	y



45	S	P-3	094F007	69509333	10	401002	6325334	PL	60	AT	20	SX	10	99	23.0	36	272	956	19	y
46	S	P-3	093O032	50355115	10	457387	6129022	PL	80	SX	20		0	124	24.0	47	387	1067	4	
47	S	P-3	093N060	9041629	10	434566	6157864	PL	55	SW	45		0	139	23.0	44	348	1055	9	
48	S	P-3	094C036	334	10	376496	6247654	PL	95	SW	5		0	124	27.0	54	505	906	9	y
49	S	Oth-1	094F062	50	10	336877	6397736	AT	60	BL	40		0	61	6.0	2	0	750	11	y
50	S	Oth-2	094C068	51043690	10	413019	6281241	AT	60	PL	25	SX	15	84	26.0	36	253	865	23	y
71	R	B-1	093N092	151	10	337007	6208271	BL	100		0		0	147	6.0	1	0	450	5	
72	R	B-1	094E019	43	9	661135	6342770	BL	100		0		0	136	6.0	5	0	850	2	
73	R	B-1	094C014	349	10	355481	6227517	BL	95	SX	5		0	122	7.0	3	0	400	9	
74	R	B-2	094E009	72044977	9	663307	6320626	BL	100		0		0	156	10.0	10	11	862	2	
75	R	B-2	094E016	293	9	624862	6338478	BL	50	SX	45	PL	5	121	9.0	14	24	986	9	
76	R	B-2	093O093	21750110	10	472753	6204730	BL	100		0		0	165	11.0	10	21	659	3	
77	R	B-2	093O041	97164701	10	448975	6145619	BL	100		0		0	154	16.0	2	9	109	4	
78	R	B-3	094B051	77103399	10	450563	6262093	BL	95	SW	5		0	114	16.0	22	85	458	3	
79	R	B-3	093O031	77286720	10	445210	6132545	BL	85	SX	10	PL	5	124	13.0	29	85	1270	35	
80	R	B-3	094C100	267	10	432624	6313150	BL	90	SX	10		0	161	15.0	34	83	2391	8	
81	R	B-3	093J093	17860314	10	467122	6086504	BL	50	SX	35	PL	10	214	21.0	33	203	599	11	
82	R	B-3	094C024	329	10	356411	6239704	BL	85	SX	15		0	147	21.0	31	157	826	23	
83	R	S-1	094C095	75434718	10	367573	6318977	SB	90	PL	10		0	159	14.0	15	39	1079	9	
84	R	S-1	094E006	318	9	625498	6326289	SX	50	BL	50		0	116	14.0	16	52	426	4	
85	R	S-2	094F043	75626232	10	352904	6372800	SX	60	SB	30	PL	10	141	18.0	27	131	700	6	
86	R	S-2	094E079	323	9	654927	6404182	SX	40	PL	30	BL	30	161	24.0	33	206	950	17	
87	R	S-2	093N048	42055297	10	405807	6148674	SW	75	BL	25		0	174	20.0	33	159	1047	5	
88	R	S-3	093N040	90694365	10	430417	6128872	SX	50	BL	30	PL	15	84	21.0	51	298	1144	10	
89	R	S-3	093O005	38778223	10	488073	6098942	SX	85	AC	10	BL	5	165	34.0	40	375	299	20	
90	R	S-3	093O031	79221027	10	445705	6139443	SX	35	SB	30	PL	20	129	24.0	40	270	777	6	
91	R	P-1	094E028	1058	9	649910	6342880	PL	85	SX	10	BL	5	86	16.0	17	102	564	14	
92	R	P-1	093O012	61652877	10	458504	6108225	PL	90	SX	9	AC	1	64	15.0	31	126	812	6	
93	R	P-2	094E068	781	9	653301	6391096	PL	100		0		0	161	18.0	28	161	964	4	

94	R	P-2	094C025	169	10	374693	6240618	PL	100		0		0	117	17.0	47	188	2629	70	
95	R	P-2	094F005	406575	10	371899	6321596	PL	60	AT	25	SX	15	127	22.0	26	188	678	24	
96	R	P-3	094C092	61708890	10	330935	6310461	PL	50	SX	50		0	144	23.0	46	378	1029	13	
97	R	P-3	093J094	10363516	10	483047	6091313	PL	100		0		0	79	22.0	43	301	870	4	
98	R	P-3	093N059	10080624	10	417476	6156693	PL	100		0		0	115	22.0	40	294	1038	11	
99	R	Oth-1	094L018	87	9	650833	6451542	AT	100		0		0	67	10.0	5	5	399	275	
100	R	Oth-2	094C040	60181340	10	429307	6243169	AC	75	SX	20	SB	5	124	31.0	42	275	488	13	

# **Appendix B**

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## **Comparison of the Sample Characteristics to the Population**

## Sample/Population Comparison

The following tables show how the sample distribution compares to the population distribution for leading species, age class, and volume class. Sample and populations compare reasonably close in most cases.

The biggest difference is in the immature population age class comparison where, for whatever reason, 75% of the samples ended up in age class 2 which only represents 48% of the area of the population. Perhaps the sub-stratification of the population by species groupings did not well represent age class distribution. Pine and spruce, the two biggest sub-strata have, respectively, 45% and 53% of their area in age class 2.

### **Immature Population Age Class Comparison**

<b>Age Class</b>	<b>Pop Area</b>	<b>Pop%</b>	<b>Samples</b>	<b>Samp%</b>
1	47,921	19%	2	10%
2	118,144	48%	15	75%
3	80,823	33%	3	15%
Total	246,888	100%	20	100%

### **Mature Population Age class Comparison**

<b>Age Class</b>	<b>Population Area</b>	<b>Pop %</b>	<b>Samples</b>	<b>Samp %</b>
3	84635	3%		0%
4	185458	6%	1	2%
5	300500	9%	2	4%
6	377814	11%	2	4%
7	542610	16%	13	26%
8	1747906	52%	31	62%
9	112126	3%	1	2%
Total	3351049	100%	50	100%

### **Immature Population Height Class Comparison**

<b>Height Class</b>	<b>Population Area</b>	<b>Pop %</b>	<b>Samples</b>	<b>Samp %</b>
1	177311	72%	12	60%
2	67252	27%	8	40%
3	2240	1%		0%
4	86	0%		
Total	246889	100%	20	100%

### Mature Population Height Class Comparison

Height Class	Population Area	Pop %	Samples	Samp%
1	527876	16%	7	14%
2	1391861	42%	22	44%
3	1293469	39%	20	40%
4	136943	4%	1	2%
5	901	0%		0%
Total	3351049	100%	50	100%

### Immature Population Leading Species Comparison

Species	Population Area	Pop %	Samples	Samp %
AT	28443	12%	2	10%
BL	25783	10%	2	10%
EP	12878	5%	1	5%
FD	50	0%		0%
PL	108258	44%	9	45%
SX	70893	29%	6	30%
W	583	0%		0%
Total	246888	100%	20	100%

### Mature Population Species Comparison

Species	Population Area	Pop %	Samples	Samp%
Aspen	127,884	4%	2	4%
BL	1,443,976	43%	21	42%
EP	10,313	0%		0%
L	109	0%		0%
PL	860,775	26%	13	26%
SX	907,868	27%	14	28%
W	124	0%		0%
	3,351,049	100%	50	100%

**Immature Population Sub-strata Comparison**

<b>Sub-strata</b>	<b>Area</b>	<b>%</b>	<b>Samples</b>	<b>%</b>
1-PI and FD	108,308	44%	9	44%
2-S	70,893	29%	6	29%
3-BL	25,783	10%	2	10%
4-Other	41,904	17%	3	17%
<b>Total</b>	<b>246,888</b>	<b>100%</b>	<b>20</b>	<b>100%</b>

**Mature Population Strata Comparison**

<b>Strata</b>	<b>Area</b>	<b>%</b>	<b>Samples</b>	<b>Samp %</b>
1-BL	1,443,976	43%	21	42%
2-S	907,868	27%	14	28%
3-PL	860,774	26%	13	26%
4-Other	138,430	4%	2	4%
<b>Total</b>	<b>3,351,048</b>	<b>1</b>	<b>50</b>	<b>1</b>

# Appendix C

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**NVAF Profile - NVAF Sample Selection Process and Methodology for Mackenzie TSA**

## NVAF Sample Selection

Based on the document outlining the 'streamlined' approach to *VRI Ground Sampling Volume Audit Sampling* and supplementary direction provided by the MFLNRO, 21 of the samples from the Mature age population were selected from the original 50 to be completed as part of the Net Volume Adjustment Factor sampling. As specified in the Draft Schedule A of the Invitation to Quote, samples were divided between 2 strata as follows:

Age Class	# of samples
>51<120	4
>120	17
<b>TOTAL</b>	<b>21</b>

The following 2 tables show how the NVAF samples were chosen. The process was as specified in *Sample Selection Procedures for Ground Sampling Draft Version 4.0* section 3.4. The table of selected VRI samples for each Age Class grouping was sorted by leading species then by volume. The NVAF sample selection interval (K) was determined ( $K = (\text{number of VRI samples in the grouping} / \text{number of NVAF samples})$ ). A random number between 1 and K was generated using Excel and this was the first VRI sample on the sorted list chosen for NVAF sampling. The next NVAF sample was K samples down the list -and so on until all of the NVAF samples were selected.

The following two lists show how NVAF samples were selected.

### VRI Sample List for Choosing NVAF Samples-51-120 Yrs

Samp_no	Sub_strat	Map	Polygon	Species	Volume	Area (ha)	NVAF?
49	Oth-1	094F062	50	AT	0.00	11	NVAF
50	Oth-2	094C068	51043690	AT	253.25	23	NVAF
1	B-1	094E017	299	BL	0.00	6	NVAF
39	P-1	094E067	309	PL	48.37	16	
45	P-3	094F007	69509333	PL	271.83	19	NVAF

$$K = 47/17 = 2.6$$

Rand=1

### VRI Sample List For Choosing NVAF Samples -121+ Years

Samp_no	Sub_strat	Map	Polygon	Species	Volume	Area (ha)	NVAF?
2	B-1	094F058	353	BL	0.00	9	
4	B-1	094F059	71	BL	0.00	5	NVAF
3	B-1	094F011	914	BL	0.56	2	
6	B-1	093N046	18403817	BL	0.63	17	
5	B-1	094D075	72621370	BL	4.32	5	NVAF



7	B-2	094C060	57697118	BL	10.77	18	
11	B-2	093N079	31321236	BL	11.05	10	
8	B-2	093O092	28857149	BL	22.24	5	NVAF
9	B-2	094C028	173	BL	30.27	78	
12	B-2	094C026	8	BL	32.42	22	NVAF
10	B-2	094D095	62522029	BL	49.83	4	
15	B-3	094E006	303	BL	74.99	29	NVAF
20	B-3	094F034	22809043	BL	83.13	14	
21	B-3	094C067	86004953	BL	140.64	15	
16	B-3	094B061	24585886	BL	144.52	52	NVAF
19	B-3	094F017	26687123	BL	148.10	35	
17	B-3	093O036	52737329	BL	153.08	15	
13	B-3	093O033	97430922	BL	162.11	5	NVAF
14	B-3	094C050	69059476	BL	171.64	6	
18	B-3	093O051	44588140	BL	182.19	42	NVAF
38	P-1	094F045	66682569	PL	69.93	31	
36	P-1	094C064	183	PL	82.47	22	
37	P-1	094L026	70	PL	99.47	23	NVAF
42	P-2	094C004	802	PL	200.01	13	
41	P-2	093N100	66104602	PL	217.75	6	NVAF
40	P-2	094C006	274	PL	222.78	15	
43	P-2	093O022	76513992	PL	242.33	2	
44	P-3	094F006	48218698	PL	281.63	10	NVAF
47	P-3	093N060	9041629	PL	348.17	9	
46	P-3	093O032	50355115	PL	386.84	4	
48	P-3	094C036	334	PL	504.81	9	NVAF
24	S-1	094L044	85	S	22.44	1	
31	S-3	093N059	16293152	SW	438.19	13	NVAF
25	S-1	094E044	605	SX	29.00	15	
22	S-1	094F082	369	SX	44.65	26	
23	S-1	094F012	267	SX	74.16	8	NVAF
30	S-2	094F010	814	SX	105.66	22	
29	S-2	094C081	97034093	SX	118.61	0	NVAF
27	S-2	094D096	55261823	SX	121.95	3	
26	S-2	094C099	209	SX	192.03	20	
28	S-2	094F064	94514631	SX	194.25	16	NVAF
33	S-3	093N030	13643819	SX	232.98	15	
34	S-3	094C014	413	SX	257.69	7	
35	S-3	093N067	87918269	SX	356.10	14	NVAF
32	S-3	093O085	45861493	SX	412.77	46	

K=47/17=2.6

Rand=2

The following tables show the list of NVAF samples for the two age groups.

#### NVAF Sample List For 51-120 Strata

Samp_no	Sub_strat	Map	Polygon	Species	Volume	Area (ha)
1	B-1	094E017	299	BL	0.00	6
45	P-3	094F007	69509333	PL	271.83	19
49	Oth-1	094F062	50	AT	0.00	11
50	Oth-2	094C068	51043690	AT	253.25	23

#### NVAF Sample List for 121+ Strata

Samp_no	Sub_strat	Map	Polygon	Species	Volume	Area (ha)
4	B-1	094F059	71	BL	0.00	5
5	B-1	094D075	72621370	BL	4.32	5
8	B-2	093O092	28857149	BL	22.24	5
12	B-2	094C026	8	BL	32.42	22
13	B-3	093O033	97430922	BL	162.11	5
15	B-3	094E006	303	BL	74.99	29
16	B-3	094B061	24585886	BL	144.52	52
18	B-3	093O051	44588140	BL	182.19	42
23	S-1	094F012	267	SX	74.16	8
28	S-2	094F064	94514631	SX	194.25	16
29	S-2	094C081	97034093	SX	118.61	0
31	S-3	093N059	16293152	SW	438.19	13
35	S-3	093N067	87918269	SX	356.10	14
37	P-1	094L026	70	PL	99.47	23
41	P-2	093N100	66104602	PL	217.75	6
44	P-3	094F006	48218698	PL	281.63	10
48	P-3	094C036	334	PL	504.81	9

# Appendix D

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## Sample Selection Process and Methodology for Mackenzie TSA

## Sampling Process and Methodology for Mackenzie TSA

The sample selection process followed the Standard *Sample Selection Procedures for Ground Sampling, Draft Version 4.0, May 2011* produced by the MFLNRO.

The VRI shapefiles, clipped to the Mackenzie TSA boundary were provided by Chris Mulvihill (MFLNRO Inventory Forester, Nelson). A GIS process of clipping and erasing reduced the land base. The following table summarizes this “net-down” process.

Land Type	Code	Area (ha)
All	All	6,410,665
Parks	51, 63, 67	897,029
Private	40	8,593
Indian Reserve	52	356
Total area removed		906,288

Woodlots and Community Forests were left in the sample population.

The ‘Volume Audit’ (VA) sampling will focus on two different age population units. The two populations will be:

1. ‘Mature’ age class, 51 years and older (50 samples), and
2. ‘Immature’ age class, 15 years to 50 years (20 samples).

Based on discussions with Chris Mulvihill, the Mature population was divided into 4 strata as shown in the table below.

Strata	Description
Immature	All species
Mature-1	All Balsam
Mature-2	All Spruce
Mature-3	All Pine
Mature-4	Other (deciduous)

The Immature population is not divided into strata.

Some statistics for the strata are shown below:

	All	Immat	Mature Balsam	Mature Spruce	Mature Pine	Mature Other
Polygons	263,957	12,207	112,250	66,938	61,764	10,798
Area (ha)	3,597,936	246,888	1,443,976	907,868	860,774	138,430
% area	100	7	40	25	24	4
Mean Age	139.5	37.3	151.5	160.7	122.0	98.6
Mean Ht	16.9	8.8	12.4	22.0	20.2	21.5

The samples in the Mature population were distributed across the 4 stratum proportional to their size. The table below illustrates the strata proportions and the distribution of samples selected across the populations/strata.

**Mature Strata Sample Distribution**

Strata	Area (ha)	%	Samples	Replacements
1-BL	1443976	43	21	12
2-S	907868	27	14	8
3-PL	860774	26	13	8
4-Other	138430	4	2	2
Total	3351048	100	50	30

As specified in the *Sample Selection Procedures for Ground Sampling* stratum 1 to 3 of the mature stratum was further subdivided into 3 sub-strata based on volume classes. Sub-stratum 4 was only divided into 2 sub-strata because of its small size and low number of samples attributed to it. The procedure also indicates that the strata will be divided into sub-strata with approximately equal numbers of polygons. This was the procedure used in this project. The table below describes the volume criteria defining the sub-strata for the mature population.

**Criteria for Sub-stratification of the Mature Population Strata**

Strata	Number of Polygons	Divided by 3 (2 for stratum 4)	Sub Strata	Polygon List no.	Volume Range criteria
1-BI	112250	37417	1	1 to 37417	≤8.673
			2	37418 to 74835	> 8.673 and ≤64.325
			3	74836 to 112250	>64.325
2-S	66938	22313	1	1 to 22313	≤103.439
			2	22314 to 44627	>103.439 and ≤230.949
			3	44628 to 66938	>230.949
3-PI	61764	20588	1	1 to 20588	≤143.116
			2	20589 to 41177	>143.116 ≤253.360
			3	41178 to 61764	>253.360
4-Oth	10798	5399	1	1 to 5399	≤169.701
			2	5400 to 10798	>169.701

Sample distribution in the mature population was based on area representation of the sub-strata. The table below shows this distribution.

### Sample Distribution in the Mature Population Sub-strata

Stratum	Sub-strat	Area	%	Samples	Replacements
1-BI	1	411928	28	6	3
	2	441739	31	6	4
	3	590309	41	9	5
	Total	1443976	100	21	12
2-S	1	266294	29	4	2
	2	312024	35	5	3
	3	329550	36	5	3
	Total	907868	100	14	8
3-PI	1	269299	31	4	2
	2	291436	34	4	3
	3	300039	35	5	3
	Total	860774	100	13	8
4-Oth	1	70682	51	1	1
	2	67748	49	1	1
	Total	138430	100	2	2
<b>Total All Strata</b>		<b>3351048</b>		<b>50</b>	<b>30</b>

The immature population was subdivided into species grouping at the direction of MFLNRO. The table below describes the sub-strata for the immature population. The sample distribution again was based on area representation,

### Immature Sub-strata

Sub-strata	Area	%	Samples	Replacements
1-PI and FD	108308	44	9	7
2-S	70893	29	6	4
3-BL	25783	10	2	2
4-Other	41904	17	3	2
Total	246888	100	20	15

A sample list was developed for each of the two populations. The lists include the initial samples as well as replacement samples to be used in the event that some of the initial samples need to be replaced for reasons identified in the field. There are 50 initial and 30 replacement samples in the list for the mature population. The sample list for the immature population includes 20 initial and 15 replacement samples.