

# **Kamloops Timber Supply Area – TSA 11**

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## **Vegetation Resources Inventory Project Implementation Plan Including Volume Audit Sampling and Air Calls**

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# Executive Summary

This Vegetation Resources Inventory (VRI) Project Implementation Plan (VIP) is the planning document that will be used as a guide for VRI Volume Audit (VA) and Air Calls sampling projects in the Kamloops Timber Supply Area (TSA). The area of interest is the entire Kamloops TSA. The details recorded in this plan regarding these two activities include:

- an outline of the land base including the netting down process;
- documentation of the sample selection;
- a listing of all sample locations; and
- confirmation of the sampling protocols for each planned VRI activity.

This Project Implementation Plan has been prepared following the documents:

- *Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling v4.0 DRAFT*
- *VRI Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling (Version 3.1)*
- *Streamlining VRI Ground Sampling - Volume Audit Sampling*

The Volume Audit and the Air Call samples were selected from the Kamloops TSA's Vegetated Treed (VT) land base. The VA samples were selected from the population greater than 50 years while the Air Calls were selected from the VT area greater than 30 years. The following exclusions occurred to net down the VT land base during the sample selection process for each activity:

- private land, parks, and federal lands including Indian Reserves and Military Reserve.

The Volume Audit ground sample selection has been completed based on an initial stratification of the population by leading species representation. The strata are:

- Stratum 1: Douglas fir
- Stratum 2: Spruce
- Stratum 3: Balsam
- Stratum 4: Other

The VA strata have been further stratified into three (3) sub-strata, based on basal area. The VA sample list is made up of seventy (70) initial samples and thirty (30) alternates.

A separate sample selection process was completed for a set of one hundred (100) Air Calls. There was no stratification of this population.

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# 1.0 Introduction

The Vegetation Resources Inventory (VRI) is the 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 or 'the Ministry'). 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 VRI is a photo based, 2-phase program. Phase 1 involves photo interpretation, delineating polygons of homogenous land cover types and providing estimates of the vegetation attributes for each polygon. Phase 2 includes ground sampling activities. The Volume Audit (VA) activity samples a random subset of polygons to verify the confidence in the accuracy of the Phase I volumes as well as some of the other key vegetation attributes. It provides detailed information on tree size and condition.

This project follows the delivery of a VRI Phase 1 re-inventory in this TSA. This Project Implementation Plan (VPIP) has been prepared to outline the details of a Volume Audit sampling project for the entire Kamloops Timber Supply Area (TSA). Additionally, this plan identifies the location of a set of Air Call samples to be completed.

## 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 the Volume Audit and Air Calls sample lists. It also serves as a guide for those undertaking these projects.

Specific details provided in this VPIP include the identification of:

- decisions made in the development of the sampling population and sample lists;
- the sampling population;
- sample lists for the Volume Audit and Air Calls activities;
- VRI data collection methodology for the VA and Air Call sampling; and
- deliverables for each project.

## 1.2 Project Land base<sup>2</sup>

The Kamloops TSA is located in south central British Columbia. It covers approximately 2.77 million hectares. The TSA boundary coincides with the Thompson Rivers Forest District boundary, administered from the Ministry of Forests, Lands and Natural Resource Operations' office in Kamloops. It is part of the Thompson/Okanagan Region.

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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/overview.html>

<sup>2</sup> Text adapted from the Kamloops TSA Rationale for Allowable Annual Cut (AAC) Determination – June 2008.

The TSA ranges from Logan Lake in the south to Wells Gray Park in the northwest, including the Blue River area, and is bounded by the Columbia mountains to the east and the Cariboo Regional District to the west.

The topography of the Kamloops TSA is diverse, ranging from hot, dry grasslands in the valley bottoms in the south to wet rugged mountains in the north. It is bisected by the North Thompson River which joins the South Thompson River at Kamloops.

The dominant Biogeoclimatic (BEC) zones in the TSA include Interior Douglas-Fir (IDF) and Engelmann Spruce-Subalpine Fir (ESSF), followed by Interior Cedar-Hemlock (ICH) and Montane Spruce (MS). A recently completed Phase 1 inventory for the TSA shows the dominant species in stands greater than 50 years in the Timber Harvesting Land Base (THLB) to be Douglas fir, spruce, balsam and pine.

The major population centres in the TSA are Kamloops, Clearwater, Logan Lake, Chase, Barriere, Cache Creek and Ashcroft. Smaller communities include Vavenby, Little Fort and Blue River.

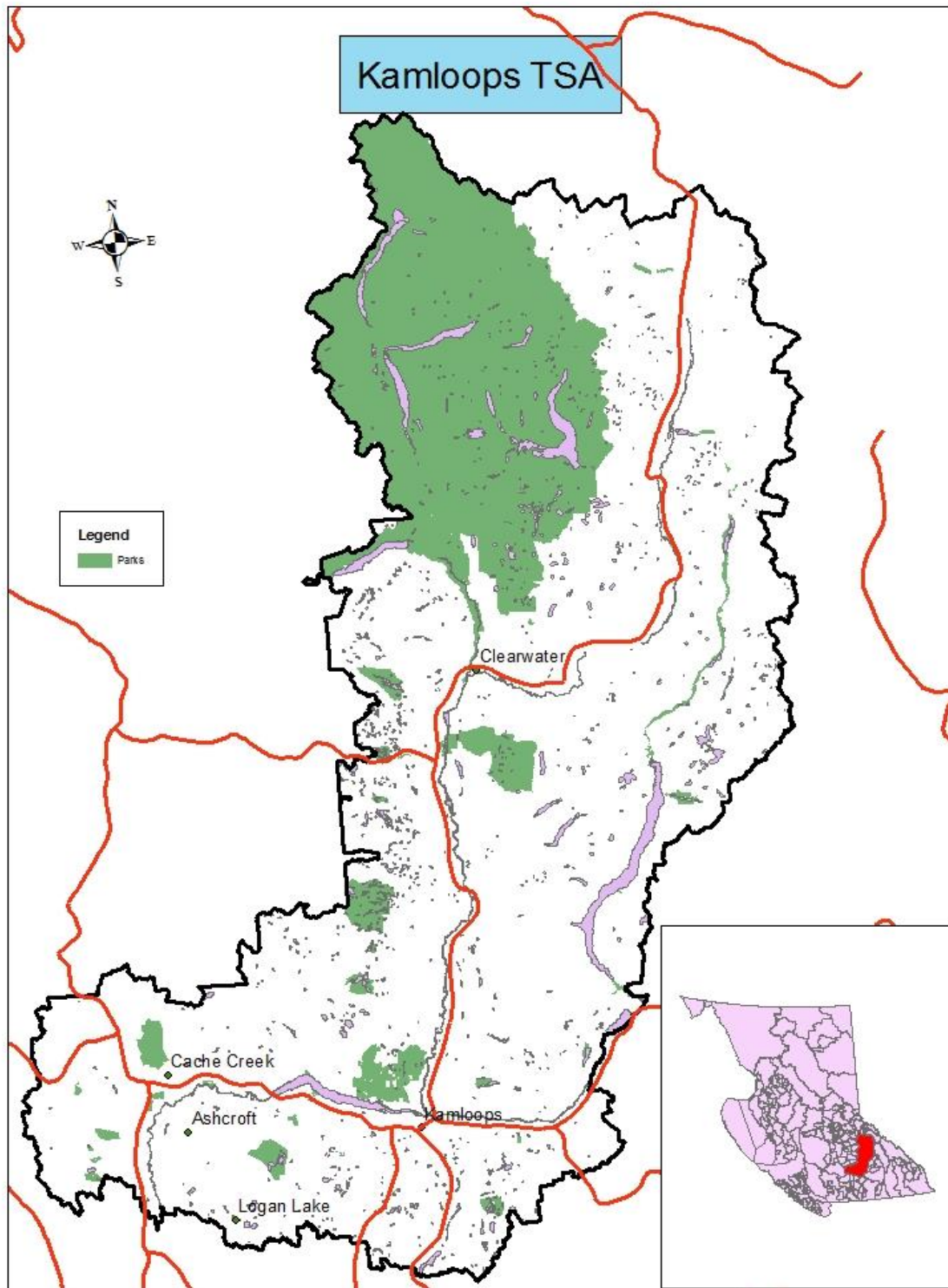
Table 1 show the land base distribution in the entire TSA.

**Table 1: Kamloops TSA Land base Summary**

<b>Land Classification</b>	<b>Area (ha)</b>	<b>% of Proj Area</b>
Total TSA Area	2,655,823	100
Net-downs	836,432	31.49%
Parks	624,691	23.52%
Private	177,715	6.69%
Federal	34,026	1.28%
<b>Net Area</b>	<b>1,819,391</b>	<b>68.51%</b>
Non Vegetated	114,142.00	4.30%
Vegetated	1,705,249.00	64.21%
Non-Treed	238,900.00	9.00%
Treed	1,466,349.00	55.21%

Figure 1 provides an overview map of the TSA.

Figure 1. Overview map of the Kamloops TSA



### 1.3 State of the Inventory

Previous to the creation of the Thompson Rivers District, the area of the TSA was comprised of the former Kamloops and Clearwater Forest Districts. The FC1 for both Districts was based on separate re-inventory projects in each District completed in the 1990s. Following this, a portion of the Kamloops Forest District was re-inventoried to the new VRI inventory standards while the remainder of the older FC1 mapping in the TSA was transferred into the new VRI data structure. In the early 2000s, a ground sampling project occurred in Kamloops Forest District with the objective of verifying then adjusting the new VRI retrofit project.

The May 2012, Project Implementation Plan for Photo Interpretation presented a plan to undertake the project in the Kamloops TSA. Photos were flown in the TSA in 2011. The Phase I delivery was made to the Ministry in early 2014 in two blocks (north and south) outlined in the VPIP.

The inventory files used for this project's sample selection reflect the following updates:

- harvest and reforestation updates current to 2014
- ages projected to 2014

## 2.0 Ground Sampling Plan

### 2.1 Sampling objectives

The Kamloops TSA inventory was driven, in part, by the fact that it was one of the older inventories in the province and there had been many changes in the TSA. The 2012 VRI Phase 1 VPIP pointed out that:

“Since the last inventory the Kamloops TSA has experienced three big fire seasons, the Mountain Pine Beetle (MPB) outbreak and increased harvest level to respond to the pest and fire impacts, resulting in changes to forests in the TSA.”<sup>3</sup>

With the Phase 1 project delivered, this plan outlines the undertaking of a Volume Audit sampling project to verify the accuracy of volumes and other key attributes in this re-inventory. It will provide a statistically valid analysis of the volumes in the mature population. A sampling error of 15% (net volume) is the target set for the Volume Audit population.

The supplementary Air Call sampling project also outlined in this plan will be undertaken to review the overall attribute calls on a set of randomly selected polygons.

Additionally, information regarding a number of issues identified in the Timber Supply Review and VRI planning processes may be supported through the VRI projects, including:

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<sup>3</sup> Johnston, K. Kamloops TSA VRI Photo Interpretation Project VPIP. Page 1

1. Short term timber supply – sustainability of ‘post MPB epidemic wood supply’.
2. Mid-term timber supply.
3. Alternative timber supply / harvest flow with shortfalls in pine e.g. cedar-hemlock, deciduous species, Douglas fir-spruce-balsam.
4. Inventory Attribution errors and missing information observed in the 2008 Timber Supply review process.
5. Site Index – Improved height estimates so site index would better estimate local growth rates.
6. Merchantability and ‘shelf life’ in the dead standing pine.
7. Biodiversity/habitat management attributes collected in the VRI.

## 2.2 Target Population

The two activities outlined in this plan will occur on the Vegetated Treed (VT) land base. Netdowns from the VT land base include area in private land, parks and federal lands including military reserves and Indian reserves. Community Forests and Woodlots have been retained.

Based on the VT land base, the target populations for each activity differ as follows:

1. Volume Audit sampling will occur in stands aged 51 years and older.
2. The Air Calls project population includes stands aged 31 years and older.

Tables 2 and 3 provide land base figures for the Volume Audit population.<sup>4</sup> Figures in Table 2 have formed the basis for the decisions regarding the stratification of the population.

**Table 2: Species Distribution – VA Population - VT Land base, Ages 51+**

<b>Species</b>	<b>Area</b>	<b>%</b>
FD	484,012	42.2%
SX	262,084	22.8%
B	209,997	18.3%
P	72,081	6.3%
HW	49,944	4.4%
CW	35,244	3.1%
AT	22,799	2.0%
EP	11,855	1.0%
XC	14	0.0%
XH	10	0.0%
JR	3	0.0%
<b>Total</b>	<b>1,148,043</b>	<b>100.0%</b>

<sup>4</sup> Numbers related to identifying the sampling population are the result of analytical work completed by Nona Phillips Forestry Consulting, using current data files provided by the Ministry. All work has followed the *VRI Sample Selection Standard* and has been documented in a Sample Selection Report provided to the government.



**Table 3: Age class Distribution, All Species – Volume Audit Population, Ages 51+**

<b>Age Class</b>	<b>Area</b>	<b>%</b>
3	40,811	4%
4	96,451	8%
5	201,698	18%
6	153,302	13%
7	199,280	17%
8	391,880	34%
9	64,622	6%
Total	1,148,043	100%

In summary, in the Kamloops TSA, the land base in the Volume Audit population is 1,148,043 hectares while the Air Calls population encompasses a total area of 1,235,749 hectares.

## **2.3 Sample Size**

For the Kamloops TSA VPIP preparation, the contract *Schedule A* stated that a total of 70 ground samples would be established in the Volume Audit population. The sample list includes the original 70 samples selected plus an additional 30 Volume Audit samples, to be available as alternates if required.

The Air Calls sampling project population was determined using the same methodology as the Volume Audit population. A total of 100 samples were selected.

## **2.4 Strata**

### **2.4.1 Kamloops TSA - Air Call Population**

There was no pre-stratification of the Air Call population in the sample selection process.

### **2.4.2 Kamloops TSA -- Volume Audit Population**

The Volume Audit population has been stratified based on species distribution. An analysis of Table 2 resulted in four species groupings as follows:

- Stratum 1: Douglas fir
- Stratum 2: Spruce
- Stratum 3: Balsam
- Stratum 4: Other

Each stratum was further divided into 3 sub-strata with roughly equal numbers of polygons, based on Basal Area. Table 4 below describes the criteria used for sub-stratification of the population into basal area classes. Appendix C discusses how the strata and Basal area class sub-stratum are defined and how samples were distributed among them.

**Table 4: Criteria for Sub-stratification of Volume Audit Population**

Strata	# of Polygons	Div by 3	Sub Strat	Target Polygon Range	BA	Actual no of Polygons
Fd	32532	10844	1	0-10844	0-16	11044
			2	10844-216881	17-30	10718
			3	216881+	31+	10770
Spruce	189974	6325	1	0-6325	0-20	6493
			2	6326-12651	23-36	6303
			3	12652+	37+	6177
Balsam	13313	4438	1	0-4438	0-14	4162
			2	4439-8877	15-29	4378
			3	8878+	30+	4501
Other	13823	4608	1	0-4608	0-15	4621
			2	4609-9217	16-38	4639
			3	9217+	39+	4563

Table 5 shows the distribution of samples in the Volume Audit population.

**Table 5: Volume Audit population - Distribution of Ground Samples**

Stratum	Population Area	% of Area	# of samples	# of Hectares represented by each plot	Replacement samples
Fd	484,012	42.2%	29	16,690	13
Spruce	262,084	22.8%	16	16,380	7
Balsam	209,997	18.3%	13	16,154	5
Other	191,950	16.7%	12	15,996	5
<b>Total</b>	<b>1,148,043</b>	<b>100.0%</b>	<b>70</b>		<b>30</b>

Table 6 shows the division of the Volume Audit population stratum into sub-strata based on 3 Basal Area classes.

**Table 6: Volume Audit Population – Sample Distribution by Sub-Strata**

Strata	Sub-strata	Area	%	Samples	Replacements
FD	1	148,981	31%	9	4
	2	159,047	33%	10	4

	3	175,985	36%	10	5
<b>Total</b>		<b>484,013</b>	<b>100%</b>	<b>29</b>	<b>13</b>
Spruce	1	65,517	25%	4	2
	2	87,741	33%	5	2
	3	108,827	42%	7	3
<b>Total</b>		<b>262,085</b>	<b>100%</b>	<b>16</b>	<b>7</b>
Balsam	1	50,878	24%	3	1
	2	66,438	32%	4	2
	3	92,682	44%	6	2
<b>Total</b>		<b>209,998</b>	<b>100%</b>	<b>13</b>	<b>5</b>
Other	1	51,619	27%	3	1
	2	55,944	29%	4	2
	3	84,387	44%	5	2
<b>Total</b>		<b>191,950</b>	<b>100%</b>	<b>12</b>	<b>5</b>
<b>Grand Total</b>		<b>1,148,046</b>		<b>70</b>	<b>30</b>

## 2.5 Sample Selection – Ground Sampling (including Air Calls)

The initial step in preparing this plan was to define the land base for the two sampling populations. Appendix C outlines the sample selection process used for both activities. It details the identification of the population areas, development of the strata and sub-strata for the Volume Audit population, and the distribution of the VA samples.

For the Volume Audit sampling, the list contains the initial samples and replacement samples available in the event that some of the initial samples are rejected in the field. In the Kamloops TSA, there are 70 initial samples and 30 replacement samples in the Volume Audit population.

For the Volume Audit population, 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. No samples fell within recent cutover.

The Volume Audit samples are numbered 1 to 70. The alternates included in the list are numbered 71 to 100. Where there is a need to replace a sample in the field, the replacement should be from the same stratum or strata and sub-stratum.

Also in the Kamloops TSA Air Call samples were identified. The population for Air Call samples was not stratified and only polygons were selected for sampling. (That is, specific locations were not identified within the sample polygons.) The Air Calls sample **polygons** were selected in the same manner used for the VA sample polygons, using

the PPSWR method. One hundred (100) polygons were selected and are numbered 101 to 200. Sample locations were not identified within the polygons.

The sample lists for each activity are provided in Appendix A.

## **2.6 Sample Establishment Methodology**

The ground samples established for the Kamloops TSA in the Volume Audit population will be completed by certified VRI Timber samplers following 'Timber Emphasis' procedures. Coarse Woody Debris (CWD) data will not be collected at each sample.

The Air Call sampling will follow a procedure similar to the protocol listed in the most current edition of the Ministry Standards *Air and Ground Calibration – VRI Field Calibration Procedures for Photo Interpretation*. Again the work will be completed by certified personnel, in this case the samplers will be certified VRI Photo Interpreters. Final decisions on methodology and delivery will be outlined in the bidding process and contract with the Ministry.

# **3.0 Project Implementation**

## **3.1 Sample Packages**

Sample packages will be prepared following Ministry direction for all samples selected in this Kamloops TSA Project Implementation Plan for Volume Audit and Air Calls. They will include tools that support the field crews in their efforts to navigate to, and establish each sample in the correct location.

## **3.2 Standards**

The current edition of the appropriate Ministry Standard will be followed to complete this project for each sampling activity. The Standards relevant to this project are listed in this document, following the Bibliography. When the project is initiated, the participants should access the Forest Analysis and Inventory Branch website to confirm that they are using the latest version of each Standard.

## **3.3 Sample List**

A complete sample list for the VA sampling and the Air Call sampling is provided in Appendix A. A description of how samples were distributed across their population is included in Appendix C.

### 3.4 Project Files

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

### 3.5 Project Analysis

Statistical analysis projects will be conducted on all of the data collected. Other sampling occurring in the area may be used in the analysis projects as well.

## Bibliography

1. British Columbia Ministry of Forests & Range, Timber Supply Branch. Kamloops TSA - Rationale for Allowable Annual Cut (AAC) Determination – Jim Snetsinger, Chief Forester. June 1, 2008. Victoria, B.C.
2. BC Ministry of Forests & Range, Resources Inventory Branch, Kamloops and Clearwater Inventory Plan, June 1998.
3. BC Ministry of Forests, Lands and Natural Resource Operations. A Framework for Implementing Young Stand Growth Monitoring in British Columbia. 2012.
4. BC Ministry of Forests, Lands and Natural Resource Operations. Streamlining VRI Ground Sampling -Volume Audit Sampling. 2011.
5. BC Ministry of Forests, Lands and Natural Resource Operations website for VRI - [www.for.gov.bc.ca/hts/VRI/](http://www.for.gov.bc.ca/hts/VRI/)
6. Kevin Johnston. Kamloops TSA Vegetation Resources Inventory Project Implementation Plan for Photo Interpretation for Kamloops TSA. May, 2012.
7. Nona Phillips Forestry Consulting. Cranbrook TSA, TFL18, Mackenzie TSA, TFL53, Kootenay Lake, Morice and Williams Lake TSA Vegetation Resources Inventory Project Implementation Plans. February 2011 (Cranbrook), March 2011 (TFL18), June 2011 (Mackenzie), July 2011 (TFL53), July 2011 and March, 2012 (Kootenay Lake), March 2012 (Morice), March 2013 (Williams Lake), March 2014 (Prince George).
8. Various. Personal Communication with Ministry of Forests, Lands & Natural Resource Operations staff members Chris Mulvihill and Matt Makar regarding issues related to the preparation of the Kamloops 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 Kamloops TSA VRI ground sampling projects is provided below. The most current edition should be used when this project is undertaken. They will be found at the VRI website:

<http://www.for.gov.bc.ca/hts/VRI/>

## **Planning and Sample Selection:**

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, Vegetation Resources Inventory (VRI):**

Vegetation Resources Inventory Ground Sampling Procedures Version 4.9.1, June 2012

Ground Sampling Procedures' 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

## **VRI – Data Analysis**

VRI Sample Data Analysis Procedures and Standards. Version 1.0, June 2011

## **Photo Interpretation**

Air and Ground Calibration – VRI Field Calibration Procedures for Photo Interpretation. Version 1.4, April 2014

# Appendix A

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## Sample Lists for Kamloops TSA Ground Samples

1. Volume Audit Samples
2. Air Calls Samples

The following are sample lists for each of the two populations. Only the Volume Audit list contains initial samples for data collection and alternate samples in the event that some of the initial samples need to be replaced during the data collection phase.

For the Volume Audit population (ages 51+) there are 70 initial samples and 30 alternate samples. The initial samples are number 1 to 70. The alternates are numbered 71 to 100.

For the Air Calls (ages 31+) there are 100 samples. These are numbered 101 to 200.

The shapefiles for each of the populations include all of the data fields from the originally supplied VRI database.

In the Volume Audit population, 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 (basal area class). The project manager must be consulted if samples are rejected.

Below is a description of the strata, for reference.

### PGTSA Volume Audit Population Strata Definition

Strata	Leading Species
1	Douglas fir
2	Spruce
3	Balsam
4	Other

## Kamloops VA Sample List

Sample	Type	Sub Strata	Mapsheet	POLYGON_NU	Zone	East	North	Lead Sp	Sp%	Age	Ht	BA	Stems/ha
1	I	FD1	092P004	092P00494777973	10	614832	5651958	FDI	100	142	22	10	100
2	I	FD1	092I074	092I07405942931	10	615623	5626608	FDI	100	152	20	15	250
3	I	FD1	092I054	092I05463645739	10	624318	5596816	FDI	90	172	16	2	100
4	I	FD1	092I093	092I09347890952	10	606326	5640522	FDI	100	162	25	5	100
5	I	FD1	082M063	082M06300198766	11	324038	5730428	FDI	70	82	18	15	250
6	I	FD1	092I096	092I09601857936	10	650091	5650410	FDI	60	122	25	15	300
7	I	FD1	082L061	082L06175787868	11	288051	5613702	FDI	100	92	16	16	500
8	I	FD1	092I054	092I05477211558	10	627045	5606499	FDI	100	152	25	8	200
9	I	FD1	092I060	092I06010400755	10	700480	5602039	FDI	100	152	19	8	120
10	I	FD2	092I095	092I09530885939	10	637955	5647541	FDI	90	112	21	25	300
11	I	FD2	092I093	092I09301673554	10	598828	5645252	FDI	100	152	24	25	300
12	I	FD2	092I064	092I06475036268	10	626888	5614308	FDI	99	112	18	22	650
13	I	FD2	092I083	092I08349645169	10	606294	5630618	FDI	90	112	20	18	350
14	I	FD2	092I083	092I08339227593	10	604966	5634578	FDI	100	92	15	18	400
15	I	FD2	092P010	092P01044691875	10	708730	5654516	FDI	95	127	28	20	300
16	I	FD2	082M011	082M01183109147	11	295887	5666033	FDI	80	112	23	30	600
17	I	FD2	092I080	092I08038386054	10	706486	5627688	FDI	100	165	36	23	250
18	I	FD2	082M002	082M00272586653	11	310452	5660052	FDI	100	152	26	28	350
19	I	FD2	082M042	082M04247793202	11	311895	5705548	FDI	40	137	30	30	375
20	I	FD3	082M001	082M00186962367	11	295123	5654435	FDI	50	72	23	35	850
21	I	FD3	082L081	082L08187202852	11	293223	5638647	FDI	90	137	32	55	450
22	I	FD3	092I068	092I06852234262	10	673968	5608825	FDI	100	132	20	32	600
23	I	FD3	092I049	092I04937657264	10	687848	5597001	FDI	95	121	28	40	450
24	I	FD3	082M031	082M03171551760	11	296733	5687806	FDI	75	152	30	45	450
25	I	FD3	092I063	092I06391823302	10	612895	5610023	FDI	100	132	24	36	650
26	I	FD3	082M064	082M06421483840	11	343522	5719472	FDI	60	102	30	70	600
27	I	FD3	092I080	092I08054046361	10	709179	5628139	FDI	100	172	35	42	350
28	I	FD3	092I068	092I06871834068	10	677554	5608465	FDI	50	77	20	31	800
29	I	FD3	092I059	092I05914700137	10	684254	5601664	FDI	100	202	28	39	350



30	I	Spruce1	092P007	092P00701692762	10	667535	5657847	SX	85	132	21	11	225
31	I	Spruce1	092P028	092P02862929592	10	679085	5685868	SE	70	162	22	15	325
32	I	Spruce1	082M095	082M09575436571	11	357614	5756410	SX	60	72	17	20	150
33	I	Spruce1	082M061	082M06150827099	11	298285	5730979	SE	40	81	24	5	50
34	I	Spruce2	092P008	092P00809012309	10	668685	5656695	SE	95	132	22	32	580
35	I	Spruce2	092P028	092P02820129361	10	672073	5685778	SX	90	162	31	25	325
36	I	Spruce2	083D015	083D01545062883	11	355876	5784679	SX	70	202	32	35	200
37	I	Spruce2	092P060	092P06000986849	10	703973	5714209	SX	50	82	26	30	300
38	I	Spruce2	092I065	092I06521743076	10	634747	5608761	SX	95	177	26	25	275
39	I	Spruce3	082M071	082M07156441862	11	299615	5738276	SE	80	71	14	40	800
40	I	Spruce3	082M071	082M07120242444	11	294593	5740831	SX	60	82	24	45	600
41	I	Spruce3	083D034	083D03485279393	11	347330	5796770	SX	65	252	28	50	400
42	I	Spruce3	082M065	082M06573224362	11	352356	5719154	SX	40	82	24	45	700
43	I	Spruce3	082M002	082M00294146404	11	313750	5659028	SE	90	212	31	42	450
44	I	Spruce3	082M093	082M09302668221	11	328558	5762739	SE	80	232	33	55	400
45	I	Spruce3	082M051	082M05142909126	11	295227	5717246	SE	65	172	28	40	500
46	I	Balsam1	082M085	082M08581187629	11	356296	5741345	BL	50	52	10	5	150
47	I	Balsam1	082M051	082M05151545695	11	296109	5711485	BL	55	222	23	10	75
48	I	Balsam1	083D054	083D05479235858	11	349169	5824592	BL	55	127	10	1	75
49	I	Balsam2	092P050	092P05023930416	10	707198	5703349	BL	85	202	22	24	550
50	I	Balsam2	082M034	082M03416558191	11	339378	5693276	BL	40	52	11	20	500
51	I	Balsam2	083D014	083D01459141044	11	340677	5783391	BL	90	182	17	20	125
52	I	Balsam2	082L081	082L08138654526	11	302069	5640047	BL	85	62	16	17	850
53	I	Balsam3	082M076	082M07646205701	11	367205	5736724	BL	90	142	15	35	475
54	I	Balsam3	082M074	082M07422461218	11	345202	5731866	BL	60	222	24	45	300
55	I	Balsam3	083D015	083D01534239953	11	352808	5779626	BL	70	202	22	35	300
56	I	Balsam3	083D054	083D05430774149	11	341180	5822886	BL	90	152	18	40	275
57	I	Balsam3	082M024	082M02433521976	11	340805	5682305	BL	60	182	22	40	600
58	I	Balsam3	082M044	082M04441167138	11	345402	5707735	BL	70	102	22	30	275
59	I	Other1	092I057	092I05797397749	10	664103	5598459	PLI	75	137	23	15	250
60	I	Other1	092I094	092I09450311472	10	624134	5640443	PLI	85	137	18	10	200
61	I	Other1	092I056	092I05619348784	10	650999	5600740	AT	80	89	12	0	400
62	I	Other2	092I090	092I09034950275	10	705862	5635124	EP	97	70	20	30	600

63	I	Other2	092I100	092I10049136790	10	709046	5645892	AT	85	92	24	22	400
64	I	Other2	083D004	083D00499791441	11	345561	5766320	HW	50	302	35	30	150
65	I	Other2	082M055	082M05518158707	11	358919	5708937	HW	35	92	16	35	550
66	I	Other3	082M074	082M07462370478	11	334689	5731693	EP	50	71	23	40	550
67	I	Other3	082M075	082M07576511759	11	354421	5731396	HW	50	82	22	60	800
68	I	Other3	083D004	083D00463880396	11	339474	5765281	HW	40	227	33	70	275
69	I	Other3	082M052	082M05252088659	11	313738	5714489	HW	80	277	37	60	285
70	I	Other3	083D024	083D02485025727	11	346246	5790652	CW	40	252	30	70	300
71	R	FD1	092I066	092I06631358609	10	653321	5617045	FDI	90	132	19	6	130
72	R	FD1	092P016	092P01694496900	10	649448	5665352	FDI	100	62	17	10	500
73	R	FD1	082M013	082M01343325071	11	323751	5672679	FDI	85	147	32	10	100
74	R	FD1	092I085	092I08531607415	10	637223	5633164	FDI	100	227	25	5	175
75	R	FD2	082M031	082M03177703050	11	297754	5689491	FDI	40	127	27	25	300
76	R	FD2	082M032	082M03257266791	11	312156	5694116	FDI	85	137	28	25	300
77	R	FD2	092I086	092I08606998324	10	650267	5633990	FDI	100	92	19	24	250
78	R	FD2	092P040	092P04001194886	10	702870	5693827	FDI	40	162	31	30	600
79	R	FD3	092P070	092P07002485976	10	704801	5729498	FD	90	117	27	45	800
80	R	FD3	082M065	082M06592957432	11	356388	5723885	FDI	40	72	24	50	575
81	R	FD3	092P048	092P04811616046	10	670876	5697245	FDI	95	142	32	40	350
82	R	FD3	092I063	092I063933341786	10	612790	5607625	FDI	90	192	32	42	400
83	R	FD3	082M032	082M03232614860	11	307075	5691434	FDI	80	127	31	40	400
84	R	Spruce1	082M055	082M05524680474	11	360266	5711588	SE	60	252	28	15	150
85	R	Spruce1	083D034	083D03453180663	11	342061	5799763	SE	85	92	15	5	75
86	R	Spruce2	092P007	092P00704933526	10	668096	5659224	SX	90	142	25	21	300
87	R	Spruce2	092I092	092I09284574527	10	595902	5646981	SX	60	122	22	25	400
88	R	Spruce3	092P059	092P05909874162	10	688385	5710492	SX	75	128	38	56	650
89	R	Spruce3	083D043	083D04392557737	11	333455	5812974	SX	70	252	33	45	275
90	R	Spruce3	082M055	082M05551673632	11	348644	5718517	SX	50	102	28	70	700
91	R	Balsam1	082M053	082M05333051919	11	327397	5717996	BL	50	82	17	5	145
92	R	Balsam2	083D034	083D03469630960	11	344829	5800118	BL	100	142	17	20	200
93	R	Balsam2	083D065	083D06523460619	11	357771	5831868	BL	75	142	15	20	400
94	R	Balsam3	082M083	082M08398269409	11	326016	5748333	BL	60	182	24	45	350
95	R	Balsam3	082M051	082M05128797433	11	292578	5714657	BL	60	142	22	40	500

96	R	Other1	092I065	092I06597083832	10	630511	5610248	PLI	100	92	17	15	500
97	R	Other2	082M002	082M00287334174	11	312404	5655569	AT	50	82	20	22	550
98	R	Other2	092I065	092I06511576298	10	633201	5614531	PLI	100	91	22	38	800
99	R	Other3	082M065	082M06592037095	11	356027	5723425	HW	40	72	26	65	600
100	R	Other3	083D035	083D03513785996	11	353542	5807482	CW	50	352	33	85	175

### Kamloops Air Call Sample List

Sample	Mapsheet	POLYGON_NU	Area	BA	Stems/ha	Lead Spp	Sp%	AGE	Ht
101	092I089	092I08962893347	38.47	23	600	FDI	100	102	21
102	082L091	082L09123630581	45.51	7	600	BL	65	42	12
103	083D024	083D02446376351	7.00	60	180	CW	50	302	37
104	092I048	092I04883292704	23.41	22	1657	PLI	80	52	13
105	092P060	092P06003096268	30.50	25	250	FDI	40	92	24
106	092I096	092I09691976949	4.44	10	250	SX	45	82	21
107	092I047	092I04719112613	6.42	10	300	PLI	75	62	16
108	092I094	092I09403441338	18.94	20	450	FDI	90	112	16
109	083D055	083D05599803277	41.89	20	300	BL	85	127	10
110	092I094	092I09446477496	23.89	30	400	FDI	70	142	25
111	082L082	082L08267703677	1.54	9	650	EP	50	32	9
112	092I086	092I08631778441	8.90	30	175	FDI	100	152	27
113	092P059	092P05990398947	13.86	44	625	SX	55	128	33
114	092P006	092P00605434976	13.03	25	400	FDI	90	152	25
115	082M054	082M05476193105	0.94	45	375	BL	60	232	29
116	082L052	082L05290385766	9.51	32	400	FDI	95	142	27
117	083D044	083D04418879768	4.68	40	350	BL	85	177	19
118	082M041	082M04197488482	5.16	20	375	BL	85	137	22
119	092P059	092P05910405877	52.15	44	675	BL	64	188	28
120	082M033	082M03340805572	8.92	60	450	CW	45	252	35
121	083D054	083D05480486293	14.27	10	200	BL	95	177	17
122	082M063	082M06301424851	4.80	38	750	FD	50	78	28
123	092I082	092I08292784613	143.24	22	400	FDI	100	152	17
124	092P029	092P02901440020	10.37	7	150	BL	75	102	17

125	092I093	092I09311730995	19.37	10	600	PLI	60	72	14
126	092I065	092I06533987738	110.81	10	225	FDI	65	92	20
127	082M033	082M03343483827	5.74	45	650	FDI	60	122	28
128	092P059	092P05917918379	49.84	40	375	FDI	75	137	37
129	092P069	092P06960210319	7.94	25	350	SE	50	123	26
130	082M013	082M01340795942	3.72	27	400	FDI	80	92	28
131	082M094	082M09444165557	3.34	15	1200	BL	60	37	9
132	082L052	082L05298035639	3.14	15	900	PLI	100	42	14
133	082M062	082M06220597824	2.13	25	300	ACT	60	42	24
134	082M044	082M04414915213	15.00	65	475	SX	40	202	29
135	092I066	092I06607228459	20.09	27	700	FDI	100	72	16
136	092I070	092I07005096897	4.33	2	60	FDI	100	112	21
137	082M033	082M03331918808	11.85	35	550	BL	70	132	14
138	082M053	082M05344422121	38.93	20	4414	BL	70	35	9
139	092I073	092I07360673157	6.81	14	450	FDI	100	72	13
140	082M054	082M05491040276	20.26	45	600	SE	40	92	23
141	082M042	082M04281242925	15.60	20	450	SE	80	137	24
142	092I060	092I06023123151	8.68	37	500	FDI	97	122	24
143	082M042	082M04216422029	35.58	10	175	BL	85	137	21
144	092I095	092I09507197816	12.13	15	400	PLI	90	82	14
145	082L082	082L08267035914	4.14	42	400	FDI	75	132	29
146	092I090	092I09093278428	2.72	5	250	FDI	100	87	15
147	092I095	092I09519743289	4.99	1	200	SX	90	62	15
148	092P049	092P04942651840	94.29	46	350	FDI	100	122	34
149	092P089	092P08953857320	1.83	30	675	PLI	50	142	23
150	083D003	083D00320650840	18.55	40	325	BL	75	162	20
151	082M053	082M05393321008	2.27	6	385	BL	60	122	15
152	082M045	082M04523015411	9.04	65	500	CW	50	127	27
153	092I082	092I08279648372	7.10	25	500	PLI	95	112	19
154	082M061	082M06168292975	2.37	10	40	SX	70	142	30
155	092I060	092I06042242078	8.98	40	440	FDI	100	122	23
156	082M093	082M09383403504	42.61	40	800	SX	40	62	23
157	092P004	092P00496359938	21.28	5	900	FDI	90	77	9

158	092P058	092P05847934983	12.65	40	500	SE	85	143	29
159	082M012	082M01252575321	8.25	14	650	SX	85	52	16
160	082M095	082M09532014402	24.34	35	250	BL	80	202	25
161	092I049	092I04926931952	0.25	28	400	FDI	100	112	22
162	092P088	092P08802896884	19.05	60	650	FDI	70	163	35
163	082L081	082L08191400492	2.74	8	175	FDI	100	158	24
164	082M094	082M09408516195	7.67	45	500	SX	50	132	23
165	092I064	092I06461592135	36.60	16	600	FDI	100	112	15
166	092I083	092I08346795363	4.60	30	400	FDI	90	152	21
167	083D056	083D05678076877	6.04	25	300	SE	55	352	21
168	092P007	092P00758309401	7.66	5	150	PLI	70	92	18
169	082M023	082M02333132626	4.68	60	550	FDI	40	122	28
170	092P099	092P09989780537	27.84	55	650	FDI	50	163	33
171	092I048	092I04893253928	24.09	28	1500	PLI	60	52	13
172	082M073	082M07321252216	13.58	45	650	FDI	40	102	26
173	092P016	092P01613027325	5.90	2	40	AT	80	122	26
174	082M064	082M06407939954	7.41	10	900	SX	50	32	9
175	082M075	082M07575521512	32.94	50	400	SE	60	202	29
176	083D026	083D02689217224	22.13	25	700	BL	75	92	14
177	082M041	082M04101611030	9.83	20	450	BL	75	147	18
178	082M054	082M05401139940	76.10	60	600	FDI	40	92	26
179	082M033	082M03323744218	54.10	20	800	CW	30	37	13
180	082M043	082M04370295486	4.51	42	600	FDI	90	97	24
181	092P029	092P02996658674	9.51	6	700	SX	100	32	10
182	082L081	082L08114973047	35.94	20	650	BL	70	82	18
183	092I073	092I07335730449	18.38	15	400	FDI	100	82	18
184	082M042	082M04287073109	13.25	27	400	SE	60	187	27
185	082M083	082M08332867030	1.37	3	50	BL	60	162	20
186	082M043	082M04396562066	29.67	12	200	SE	60	107	23
187	092I100	092I10013988948	8.35	24	450	FDI	80	117	24
188	082M093	082M09391858426	47.68	55	425	SE	80	232	33
189	083D035	083D03520743980	12.78	30	360	SX	45	202	24
190	092P009	092P00941923216	3.24	13	850	EP	85	67	15

191	092I075	092I07513292006	4.72	1	600	FDI	100	32	5
192	092I067	092I06782797787	21.70	31	600	FDI	100	112	20
193	082L081	082L08115311272	40.83	20	800	BL	60	72	16
194	083D005	083D00563352837	0.37	60	250	CW	60	302	31
195	092I055	092I05583637330	18.89	6	450	FDI	100	72	15
196	083D023	083D02399112946	7.63	20	150	BL	70	142	22
197	092P048	092P04829507725	6.99	35	450	FDI	60	92	23
198	082M093	082M09305203833	17.23	40	500	SE	50	102	23
199	092P040	092P04079432335	0.07	16	1039	EP	60	42	14
200	083D006	083D00615724939	5.18	30	175	SE	60	222	22

# Appendix B

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## Comparison of the Sample Characteristics to the Population

The following tables show how the sample distribution compares to the population distribution for age class, height class, leading species, and (for Volume Audit only) strata. Sample and populations compare quite closely.

**Table 1: Volume Audit Age Class Comparison**

Age Class	Area	%	Samples	%
3	40,811	4%	2	3%
4	96,451	8%	7	10%
5	201,698	18%	11	16%
6	153,302	13%	6	9%
7	199,280	17%	12	17%
8	391,880	34%	28	40%
9	64,622	6%	4	6%
Total	1,148,043	100%	70	100%

**Table 2: Volume Audit Height Class Comparison**

Height Class	Population Area	Pop %	Samples	%
1	28,469	2%	2	3%
2	314,348	27%	16	23%
3	575,333	50%	38	54%
4	217,804	19%	14	20%
5	12,081	1%	0	0%
6	9	0%	0	0%
Total	1,148,043	100%	70	100%

**Table 3: Volume Audit Species Comparison**

Species	Population Area	%	Samples	%
FD	484012	42.2%	29	41%
SX	262084	22.8%	16	23%
B	209997	18.3%	13	19%
PL	71998	6.3%	2	3%
HW	49944	4.4%	5	7%
CW	35244	3.1%	1	1%
AT	22799	2.0%	2	3%
EP	11855	1.0%	2	3%

PY	48	0.0%		0%
PW	25	0.0%		0%
XC	14	0.0%		0%
PA	10	0.0%		0%
XH	10	0.0%		0%
JR	3	0.0%		0%
<b>Total</b>	<b>1148043</b>	<b>100.0%</b>	<b>70</b>	<b>100%</b>

**Table 4: Volume Audit Strata Comparison**

Stratum	Population Area	% of Area	No of Samples	%
FD	484,012	42.2%	29	41%
Spruce	262,084	22.8%	16	23%
Balsam	209,997	18.3%	13	19%
Other	191,950	16.7%	12	17%
<b>Total</b>	<b>1,148,043</b>	<b>100.0%</b>	<b>70</b>	<b>100%</b>

**Table 5: Air Call Age Class Comparison**

Age Class	Population Area	%	Samples	%
2	54,957	4%	7	7%
3	73,560	6%	7	7%
4	96,451	8%	11	11%
5	201,698	16%	14	14%
6	153,302	12%	12	12%
7	199,280	16%	18	18%
8	391,880	32%	27	27%
9	64,622	5%	4	4%
<b>Total</b>	<b>1,235,749</b>	<b>100%</b>	<b>100</b>	<b>100%</b>

**Table 6: Air Call Height Class Comparison**

Ht Class	Population Area	%	Samples	%
1	71,652	6%	8	8%
2	358,607	29%	31	31%
3	575,597	47%	46	46%
4	217,804	18%	15	15%
5	12,081	1%	0	0%
6	9	0%	0	0%
<b>Total</b>	<b>1,235,749</b>	<b>100%</b>	<b>100</b>	<b>100%</b>



**Table 7: Air Call Species Comparison**

<b>Species</b>	<b>Population Area</b>	<b>%</b>	<b>Samples</b>	<b>%</b>
FD	500,400	40%	38	38%
S	286,270	23%	22	22%
B	232,105	19%	21	21%
P	85,096	7%	9	9%
H	53,046	4%		0%
CW	38,816	3%	5	5%
AT	25,439	2%	2	2%
EP	14,473	1%	3	3%
LW	76	0%		0%
XC	14	0%		0%
XH	11	0%		0%
JR	3	0%		0%
<b>Total</b>	<b>1,235,749</b>	<b>100%</b>	<b>100</b>	<b>100%</b>

# Appendix C

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## Sample Selection Process and Methodology for Kamloops TSA

## Sampling Process and Methodology for Kamloops TSA

### 1) Data assembly Process

All the shapefile data was obtained from Chris Mulvihill, the project coordinator with Ministry of Forests, Lands & Natural Resource Operations ('the Ministry'). This included VRI data in the VRIMS format in two separate files; north and south. Matt Makar provided an Access Query database to extract Rank 1 Layer data from the VRIMS data.

### **Exclusions:**

The following process was undertaken to net down the land base.

- Created Shapefiles for all the removals. Selected for Private (code 40), Parks (codes 51, 63, and 67), IR (code 52), and any other ownerships specified by the contract. Called this **Landbase\_exclusions**.
- Dissolved the above file to make the erase from the land base more efficient and called it **Landbase\_Exclusions\_Dissolved**.
- Erased the Netdown\_dissolve shape from the TSA Boundary file. Created a new shapefile called **TSA\_Net**.
- The Ministry also provided "selection blocks" for the VRI provided separately for the north and south areas of the TSA. These blocks were clipped to the TSA\_Net boundary (called these North\_Block\_Clip and South\_Block\_Clip).
- Clipped each of the VRI Shapefile to the respective block clips. (Called these VRI\_North\_Clip and VRI\_South\_Clip)
- Conducted a "Repair Geometry" on the file.
- Added a new field for each called New\_Area and calculated the field.
- Eliminated polygons less than .01ha and create a new file (called this VRI\_Poly\_North\_Net and VRI\_Poly\_South\_Net).

The table below is a summary of the area of the TSA.

**Table 1: Kamloops TSA Land base Summary**

<b>Land Classification</b>	<b>Area (ha)</b>	<b>% of Proj Area</b>
Total TSA Area	2,655,823	100
Net-downs	836,432	31.49%
Parks	624,691	23.52%
Private	177,715	6.69%
Federal	34,026	1.28%

<b>Net Area</b>	<b>1,819,391</b>	68.51%
Non Vegetated	114,142.00	4.30%
Vegetated	1,705,249.00	64.21%
Non-Treed	238,900.00	9.00%
Treed	1,466,349.00	55.21%

- Extracted Rank 1 Layer data from the VRIMS using Matt Makar’s Access Query. Exported this new file to Excel (provided more reliable results when joining to the shape than the Access format).
- Created a new shapefile of the VRI data by joining the Excel tables to VRI\_Poly\_North\_Net and VRI\_Poly\_South\_Net (call these VRI\_North\_Net and VRI\_South\_Net).
- Merged these two files and called the new file Kamloops\_VRI\_Net
- Created a new field called Proj\_Ht and calculated.
- Created new fields for height class and Age Class and calculated.

## **2) Creation of Population Shapefiles**

- From Kamloops\_VRI\_net selected for VT and Projec\_age≥51 and created a new file (call it Kamloops\_VA). The total area of the volume audit population is 1,148,043 ha or 78% of the VT.
- Selected for VT>30 and called this Air\_Call\_Pop. The total area of the air call population is 1,235,749 ha or 84% of the VT.

## **3) Sample Selection for the Volume Audit Population**

### **3.1 Stratification**

In order to make decisions about stratification, a summary by leading species was run. This provided the leading species distribution shown below.

**Table 2: Kamloops Volume Audit Species Distribution**

<b>Species</b>	<b>Area</b>	<b>%</b>
FD	484012	42.2%
SX	262084	22.8%
B	209997	18.3%
PL	71998	6.3%
HW	49944	4.4%
CW	35244	3.1%
AT	22799	2.0%

EP	11855	1.0%
PY	48	0.0%
PW	25	0.0%
XC	14	0.0%
PA	10	0.0%
XH	10	0.0%
JR	3	0.0%
<b>Total</b>	<b>1148043</b>	<b>100.0%</b>

**Table 3: Volume Audit Age Class Summary**

Age Class	Area	%
3	40,811	4%
4	96,451	8%
5	201,698	18%
6	153,302	13%
7	199,280	17%
8	391,880	34%
9	64,622	6%
Total	1,148,043	100%

Based on this information, the Ministry staff identified the following strata for the Kamloops TSA VA ground sampling project.

**Table 4: Volume Audit population Strata Definition**

Strata	Leading Species
1	Douglas Fir
2	Spruce
3	Balsam
4	Other

Shapefiles were created for each stratum.

The number of samples for the Volume Audit population was specified by the Ministry in the Contract Schedule A document. They specified that there would be 70 initial samples and 30 replacements in the Volume Audit population.

**Table 5: Distribution of Ground Samples -Volume Audit Population**

Stratum	Population Area	% of Area	No of Samples	# of Hectares Represented by each plot	Replacement Samples
FD	484,012	42.2%	29	16,690	13
Spruce	262,084	22.8%	16	16,380	7
Balsam	209,997	18.3%	13	16,154	5

Other	191,950	16.7%	12	15,996	5
<b>Total</b>	<b>1,148,043</b>	<b>100.0%</b>	<b>70</b>		<b>30</b>

### 3.2 Sub-stratification

For the Volume Audit population sub-stratification was carried out the same way for all 4 strata. The process is described below.

- Exported the attribute table from each of the stratum shapefiles
- In these new worksheets, sorted data by BA
- Determined the number of polygons in each stratum
- Divided total number of polygons by 3 to determine the number of polygons (approx) that should be in each sub-stratum.
- Used the “number of polygons per sub-strata” figure determined above in the table sorted by BA to find the BA figure that would be used to divide the sub-strata (see Peter Ott email of March 13, 2013)

The table below shows the criteria defining the sub-strata.

**Table 6: Criteria for Sub-stratification of Volume Audit Population**

Strata	# of Polygons	Div by 3	Sub Strat	Target Polygon Range	BA	Actual no of Polygons
FD	32532	10844	1	0-10844	0-16	11044
			2	10844-216881	17-30	10718
			3	216881+	31+	10770
Spruce	189974	6325	1	0-6325	0-20	6493
			2	6326-12651	23-36	6303
			3	12652+	37+	6177
Balsam	13313	4438	1	0-4438	0-14	4162
			2	4439-8877	15-29	4378
			3	8878+	30+	4501
Other	13823	4608	1	0-4608	0-15	4621
			2	4609-9217	16-38	4639
			3	9217+	39+	4563

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

**Table 7: Distribution of Samples in VA Sub-strata**

Strata	Sub-strata	Area	%	Samples	Replacements
FD	1	148,981	31%	9	4
	2	159,047	33%	10	4
	3	175,985	36%	10	5
Total		484,013	100%	29	13
Spruce	1	65,517	25%	4	2
	2	87,741	33%	5	2
	3	108,827	42%	7	3
Total		262,085	100%	16	7
Balsam	1	50,878	24%	3	1
	2	66,438	32%	4	2
	3	92,682	44%	6	2
Total		209,998	100%	13	5
Other	1	51,619	27%	3	1
	2	55,944	29%	4	2
	3	84,387	44%	5	2
Total		191,950	100%	12	5
Grand Total		1,148,046		70	30

### 3.3 Sample Polygon Selection

Volume audit samples were chosen using the probability proportional to size with replacement technique (PPSWR).

- An Excel random number spreadsheet was obtained from the Ministry that creates random numbers from a “seed”. Random numbers between 0 and the total area of each sub-stratum were produced for samples and replacement samples in each of the sub-stratum. As well, one extra random number per stratum was produced for a contingency sample in the event that a sample was eliminated during the sample location stage.
- Accumulated area tables were produced for each of the sub-stratum. This was done by selecting for the sub-strata criteria in the strata shapefiles and exporting the table.
- Two new columns were added to the accumulated area table for recording the samples that were chosen (I for initial, R for replacement and C for contingency) and sample number. The accumulated volume table was then sorted by I/R and then by sample number. All other rows were deleted (saved as Samp list full – sub-stratum). Another table was created from this with just mapsheet, polygon, selection, and area columns (called Samp list part-sub-strat). Using the random numbers generated for each sub-stratum, polygons were selected. A polygon

was selected from the accumulated area table if the random number was larger than the accumulated area of the polygon immediately preceding it and less than or equal to its accumulated area.

- Initial Sample Polygons were selected first followed by replacement sample polygons then by contingency samples.

Initial sample numbers were numbered 1 to 70 and alternate samples were numbered 71-100.

### 3.4 Location of Samples within Polygons

For each population, samples were located within selected polygons using an Arcmap 10.1 GIS program as follows:

- A new shapefile was created for samples with the following fields:

FID_1	Sample_no	Strata	Sub-strat	X	Y

\*FID\_1 is to link with the Objectid field in the immature VRI shapefile for joining these two files later on.

- The population, 100m grid (obtained from the Ministry), and Landsat shapefiles were displayed on an Arcview map.
- Sample polygons were displayed using the selection tool in the population attribute table.
- For each polygon to be sampled, random numbers were generated (with a range between 1 and the total number of dots in the polygon) for each selected polygon using “=Randbetween(1,X)” function in an Excel spreadsheet. The random numbers were recorded in a new column in this spreadsheet.
- The sample was located at the location of the randomly selected dot.
- The location was then checked against the Landsat image to see if any samples fell in a recent cutover. No samples fell in recent cutover.
- After sample location was complete for a population, UTM coordinates were calculated then the sample shapefile was joined to the population VRI shapefile so that all veg information would be included in the sample file.

## 4) Air Call Samples

Sample Polygons were selected as described in **Sample Polygon Selection** above (except there was no stratification). The sample numbers are 101-200.