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# TFL 45 Vegetation Resources Inventory Year-End Summary Report

*Prepared for*

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## 1. INTRODUCTION

### 1.1 BACKGROUND

International Forest Products Ltd. (Interfor) is implementing a Vegetation Resources Inventory (VRI) on Tree Farm Licence (TFL) 45 in response to the Chief Foresters request that a more accurate forest inventory be used for Management Plan 4. The VRI is the provincial standard for forest inventories and is a three-phase process that uses the results of ground samples to adjust photo-estimated polygon level attributes. Timberline Forest Inventory Consultants Ltd. completed the Photo Estimation (Phase I) in December 2000. The Ground Sampling phase (Phase II) is a 2-year program that began in 2001 and will be completed in 2002. Statistical adjustment of the Photo Estimation phase will follow completion of the ground sampling phase.

### 1.2 REPORT OBJECTIVES

The purpose of this report is to provide a year-end summary of the activities and results of the 2001 field sampling and recommend a sample size for the 2002 field season

### 1.3 TERMS OF REFERENCE

Gerry Sommers, *RPF* of Interfor is the project leader. J.S. Thrower & Associates Ltd. (JST) is implementing the Phase II sampling and will complete the statistical adjustment at the conclusion of the sampling. Hamish Robertson, *RPF* is the JST project manager and Guillaume Thérien, *PhD* and Dave Affleck, *MSc* are the analysts. Norm Shaw, *ATE* of BCIT is the field mentor and Olympic Resources Management Ltd. (ORM) completed the first year of field work.

## 2. METHODS

### 2.1 STUDY AREA

TFL 45 is located in the Campbell River District of the Vancouver Forest Region and covers approximately 232,000 ha, of which 65,000 ha (or 28%) are productive. Most of the TFL is situated along the major drainage systems feeding into the northern part of Knight Inlet. The remaining area is located around Phillips Arm, on the mainland coast east of the town of Sayward on Vancouver Island.

### 2.2 FIELD SAMPLING

#### 2.2.1 Timber Emphasis Sampling

ORM was selected to do the field sampling in 2001. Forty (40) VRI Timber-Emphasis Plots (TEPs) were selected for sampling and installed in two crew shifts in the 2001 field season. Thirty-six (36) plots were installed in the Vegetation Treed portion of the timber harvest land base (VT-THLB) (as defined in the project implementation plan)<sup>1</sup> and three were installed outside the VT-THLB in the productive forest land

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<sup>1</sup> J.S. Thrower & Associates Ltd. 2001. International Forest Products Ltd. Tree Farm Licence 45 Vegetation Resources Inventory Project Implementation Plan. July 27, 2001. 10 pp.

base.<sup>2</sup> Field sampling followed the Ministry of Sustainable Resource Management (MSRM) ground sampling procedures.<sup>3</sup>

### 2.2.2 Net Volume Adjustment Factor Sampling

Fourteen (14) of the 40 clusters installed in 2001 had net volume adjustment factor (NVAF) data collected on two randomly selected satellites per plot. This procedure is a departure from normal NVAF sampling procedures and was approved by Will Smith, *RPF* of the MSRM prior to sampling. This data will be given to Will Smith to generate a tree list for destructive sampling. Additional NVAF plot data will be collected during the TEP installation in the 2002 field season so that 40% of all TEPs have NVAF data. Destructive NVAF sampling will occur following completion of the TEP sampling.

### 2.2.3 Quality Assurance

Roman Bilek, *DoT* of the MSRM, Vancouver Forest Region and Norm Shaw audited five of the 2001 clusters. At least one cluster was selected and audited for each crew leader. All plots exceeded VRI minimum sampling standards.

## 2.3 INTERIM ANALYSIS

The overall goal of the interim analysis was to determine the sample size required for the 2002 field season to meet MSRM precision requirements. To compute the required sample size, a preliminary statistical adjustment of the database was completed (Figure 1). The statistical adjustment procedure followed MSRM standard procedures.<sup>4</sup>

In the first step, height and age in the unadjusted VRI database were adjusted using the height and age adjustment ratios developed from the ground sample data and the unadjusted estimates. In the second

step, a volume<sup>5</sup> was generated using *VDYP version 6.6d* and the adjusted heights and ages. This produced the attribute-adjusted volume. A volume adjustment ratio was computed between the attribute-adjusted volume and the ground sample volume. In the usual adjustment process, the next step is to apply the volume adjustment ratio to the attribute-adjusted database to obtain the adjusted VRI database. However, for this preliminary analysis, this last step is not necessary. Instead, the coefficient of variation

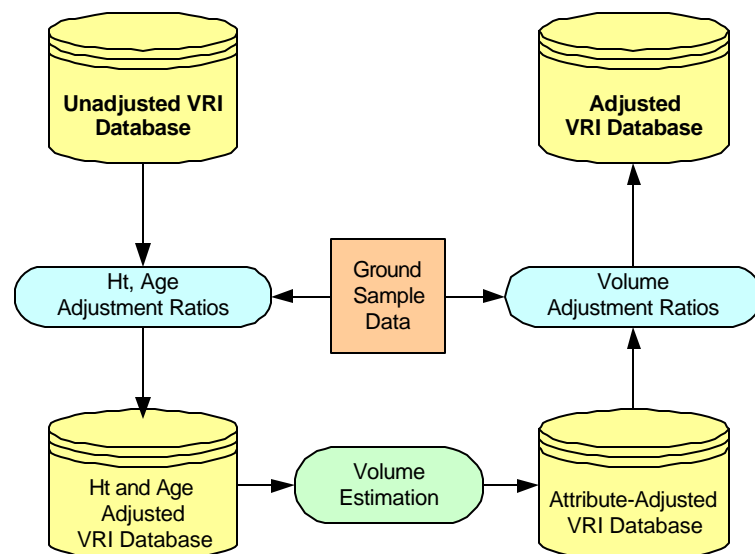


Figure 1. VRI statistical adjustment process.

<sup>2</sup> Plot 1 was not installed due to safety concerns. This plot is outside the VT-THLB and will be replaced in 2002.

<sup>3</sup> <http://www.for.gov.bc.ca/RIC/Pubs/teVeg/gsp/index.htm>.

<sup>4</sup> Ministry of Sustainable Resource Management. 2001. Vegetation Resources Inventory Attribute Adjustment Procedures Draft. Draft Version 4.2, September 2001. 37 pp.

(CV) of the volume adjustment ratio is estimated, and this CV is used to estimate the required sample size using the following formula:

$$n = \frac{3 \times CV^2}{E^2}$$

where  $n$  is the sample size and  $E$  is the relative precision required by the MSRM (10% at a 90% precision level).

### 3. RESULTS

#### 3.1 PRE-ADJUSTMENT VOLUME

Using photo-estimated height and age, the average Photo Estimated volume for the VT-THLB is 416 m<sup>3</sup>/ha. The average mature volume (stands greater than 60 years) for the VT-THLB is 585 m<sup>3</sup>/ha.

#### 3.2 HEIGHT AND AGE ADJUSTMENT

Height was slightly under-estimated in the Photo-Estimation Phase (Table 1). The ratio of means (ROM) was 1.034. Age, however, tended to be over-estimated by almost 16%. The relationship between inventory and ground height and age was relatively good.

Table 1. Height and age adjustment statistics for the VT-THLB on TFL 45.

Attribute	Population		Sample			R <sup>2</sup>	Population Adj. Inv. Avg.
	Inv. Avg.	Size	Ground Avg.	Inv. Avg.	ROM		
Height (m)	20.0	34	27.3	26.4	1.034	43.2%	20.7
Age (yrs)	154.3	34	163.4	193.6	0.844	65.0%	130.2

#### 3.3 VOLUME ADJUSTMENT

The attribute-adjusted volume under-estimated the ground volume by about 4% (Table 2). The final adjusted volume for the entire TFL was 453 m<sup>3</sup>/ha. The adjusted volume in mature stands (60 years and greater) was 642 m<sup>3</sup>/ha. The adjusted mature average is identical to the preliminary MSRM audit average volume for a similar land base (642 m<sup>3</sup>/ha).<sup>6</sup> In March 2001, JST analyzed ground plots from a special inventory and found an average volume of 660 m<sup>3</sup>/ha for a subset of the mature land base.<sup>7</sup> Therefore, three independent sources of ground information showed similar volumes for the mature land base.

Table 2. Volume adjustment statistics for the VT-THLB on TFL 45.

Attribute	Population		Size	Sample		ROM	R <sup>2</sup>	Population Adj. Map Avg. (m <sup>3</sup> /ha)
	Area (ha)	Inv. Avg. (m <sup>3</sup> /ha)		Ground Avg. (m <sup>3</sup> /ha)	Inv Avg. (m <sup>3</sup> /ha)			
Volume	24,994	436.5	36	436.4	420.5	1.038	54.4%	453.0

<sup>5</sup> For the purpose of this project, volumes were whole-stem volume minus decay, waste (estimated from the MSRM loss-factor equations), and breakage at a utilization level of 17.5 cm+.

<sup>6</sup> Keith Tudor, MSRM, personal communication.

<sup>7</sup> J.S. Thrower & Associates Ltd. 2001. TFL 45 Inventory Audit and Statistical Adjustment. Unpubl. Rep. Contract No. IFV-031-012. 13 pp.

### 3.4 SAMPLE SIZE DETERMINATION

The MOF precision target standard is  $\pm 10\%$  at a 95% confidence level, when using VDYP6 as the basis for calculating the ratio. The CV of the volume adjustment ratio for the TFL 45 VRI sample was 49%. Based on this CV, the required sample size can be computed as:

$$n = \frac{3 \times CV^2}{10^2} = \frac{3 \times 49^2}{10^2} = 72$$

or 72 plots. Since 36 samples plots have already been established, this means that another 36 plots should be installed in the 2002 field season. Interfor should consider adding a few additional ground plots in case the CV obtained in the next field season is higher than the one obtained in 2001.

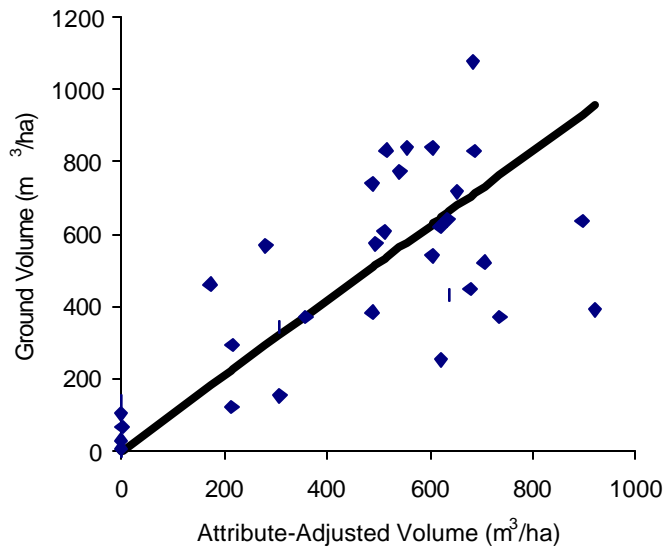


Figure 2. Ground volume versus attribute-adjusted volume for the VT-THLB on TFL 45.



### APPENDIX I – INVENTORY AND GROUND DATA

Plot No	Mapsheet	Polygon	Leading Spp	Height		Age		Volume	
				Inventory	Ground	Inventory	Ground	Attribute-Adjusted	Ground
2	092N022	1301	FD	7.2	13.1	4	14.8	0	0
3	092N013	68	FD	20.5	22.2	254	91.4	686.4	828.9
4	092N032	1116	HW	31.1	40	39	45.5	306.5	343.2
5	092K043	8	HW	30.5	36.7	83	76	541.7	772.6
6	092N032	730	HW	36.1	23	134	233.8	487.9	739.5
7	092N013	1800	HW	34.1	29.3	22	27.5	0	139.1
8	092N023	535	FD	4.6	8.8	19	20.2	0	103.3
9	092K043	178	HW	40.2	45.2			635.1	639.4
10	092N002	1082	HW	40.2	22.5	74	116.3	281	568.4
11	092N032	578	HW	37.1	41.6	87	96.2	682.9	1077.1
12	092K043	65	HW	31.7	31.4	67	94.7	173.1	460
13	092K044	50	HW	30.5	31.5	65	106.5	516	831
14	092K054	230	HW	33.5	37.8	404	340.4	920.8	390.1
15	092K054	212	HW	15.8	30.7	204	382.8	705.2	521.2
16	092K054	285	FD	53.1	31.8	254	248.4	653.6	717.1
17	092K083	32	HW	3.5	8.5	14	22.7	1.8	65.5
18	092N022	803	HW	29.1	35.1	8	13.8	678.6	447.2
19	092K053	49						0	0
20	092K054	176	HW	20.9	26	305	230.6	307.3	152.9
21	092K072	474	BA	6.1	9.5	65	28.9	214	121.2
22	092K093	70				303	209.4	637.3	432
23	092N002	458	HW	19.2	17.9	39	41.3	216	293.6
24	092K053	284	FD	7.7	15.8	350	383.3	619.9	620.2
25	092N022	83	BA	45.1	54.4	24	27	0	29
26	092N022	361	FD	5.9	14.4	203	246.9	358.5	370.4
27	092N022	210	HW	23.2	22.5	21	22.8	0	4.9
29	092N022	82	CW	38.9	50.6	353	215.8	735.2	370.6
31	092N042	500	CW	36	47.6	353	244.1	555.1	837.6
32	092K033	47	HW	0.9	4.4	503	357	605.2	539.1
34	092K054	205	HW	35	0	353	321.7	896	635.2
35	092N032	755	BA	28.8	33.6	18	26.7	0.3	7.9
36	092N014	160	HW	36	35.3	352	268.7	511.9	605.8
37	092K054	346	HW	35.3	0	352	321.7	604.3	838.5
38	092N022	773	HW	40.1	46.1	352	233.8	622.1	251.5
39	092K054	45	HW	36.2	44.9	302	271	494.4	572
40	092K053	240	HW	4.7	17	602	174.1	488.7	383.1