

TFL 55
CHANGE MONITORING INVENTORY
SAMPLE PLAN

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1.0 INTRODUCTION

1.1 Background

Louisiana-Pacific Canada Ltd., Malakwa BC (LP) is implementing a Change Monitoring Inventory (CMI) program in a continued effort to improve management of the forest resources of TFL 55. Following the Chief Forester's allowable annual cut (AAC) determination in 2001¹, LP improved the growth and yield (G&Y) information for its current management plan². Included were new managed stand yield tables that incorporated the results from a site index adjustment project, new ecological mapping, and a new Vegetation Resources Inventory (VRI). This updated management plan was submitted to the Deputy Chief Forester in June 2006 and resulted in the release of the rationale for determination for the TFL in March 2007.³ In the rationale, the Deputy Chief Forester requested that LP:

“monitor growth in natural and managed stands to assess its site productivity estimates and ensure the yield projections used in future analyses appropriately reflect volumes per hectare realized in harvesting operations”

To address this request, LP is implementing a CMI program to monitor growth in managed stands. Natural stands are not included in this project because the risk and uncertainty to future timber supply is much greater in managed versus natural stand yield projections.⁴

1.2 Program Goal

As a result, LP's goal for the CMI program is to monitor and track changes in key G&Y attributes over time in managed stands on the TFL. The key attributes include volume, site index, top height, and species composition. The intent is that the data from this program will be used to compare the predicted and actual G&Y of managed stands to support future timber supply analyses.

¹ Ministry of Forests. 2001. Tree Farm Licence 55. Rationale for allowable annual cut (AAC) determination. British Columbia Ministry of Forests. Victoria, BC. Effective April 18, 2001. 56 pp.

² LP Building Products Ltd. 2006. Timber Supply Analysis Information Package: Selkirk Tree Farm Licence 55 (TFL 55) Management Plan No. 4. Accepted by the Ministry of Forests and Range June 16, 2006.

³ Ministry of Forests. 2007. Tree Farm Licence 55. Rationale for allowable annual cut (AAC) determination. British Columbia Ministry of Forests. Victoria, BC. Effective March 8, 2007. 50 pp.

⁴ Perr Com. This issue was discussed with Gordon Nienaber (Timber Supply Forester – MoFR Forest Analysis and Inventory Branch – Analysis Section) and Bud Koch (Senior TFL Analyst – MoFR Forest Analysis and Inventory Branch – Analysis Section) on February 19, 2008. The MoFR representatives, Mike Copperthwaite (LP), Dan Turner (Timberline), and Jim Thrower (Timberline) all discussed the issue and agreed that a growth monitoring program in natural stands would be of little benefit.

1.3 Program Objectives

The CMI program objectives to achieve this goal are to:

1. Design a cost effective CMI program that is sufficiently flexible to address potential future changes in conditions and funding.
2. Install CMI sample plots over the 2008 and 2009 field seasons.
3. Install new CMI sample plots and re-measure existing plots in the future as determined by this sample plan, available funding, and information needs at the time.
4. Analyze the data periodically to support future timber supply analyses on the TFL

1.4 Terms of Reference

This project was completed, following standards outlined in the Ministry of Sustainable Resource Management change monitoring procedures,⁵ by Timberline Natural Resource Group (Timberline) for Mike Copperthwaite, *RPF* and Fernando Cocciolo, *RPF* of LP. The Timberline team was Dan Turner, *RPF* (project manager), Craig Mistal, *RPF* (data analysis) Darryl Klassen, *BNRSc* (GIS analysis and mapping), Eleanor McWilliams, *MSc, RPF* (technical advisor), and Jim Thrower, *PhD, RPF* (technical advisor). This report will be submitted to the MoFR Forest Analysis and Inventory Branch for review and approval prior to plot establishment.

⁵ Ministry of Sustainable Resource Management – Resource Information Branch. 2005. National Forest Inventory - Change Monitoring Procedures for Provincial and National Reporting ver. 1.4 March 2005. Victoria, BC. March 31, 2005. 208 pp. http://srmwww.gov.bc.ca/risc/pubs/teveg/cmi2k3/cmi_ground_2k3.pdf

2.0 SAMPLE DESIGN

2.1 Target Population

The target population is all managed stands 20 to 39 years of age.⁶ This roughly corresponds to when clearcut logging began on the TFL and includes 3,446 hectares (13%) of the productive operable TFL area (Appendix I). The intent is to include all harvested stands with some measurable volume (ie., at least 20 years of age). Two key points are that:

- 1) the target population will expand over time to include more stands as they meet the minimum target population age of 20 years, and
- 2) stands currently in the target population (20 to 39 years of age) will not be dropped as they pass 40 years of age (discussed more in Section 2.3).

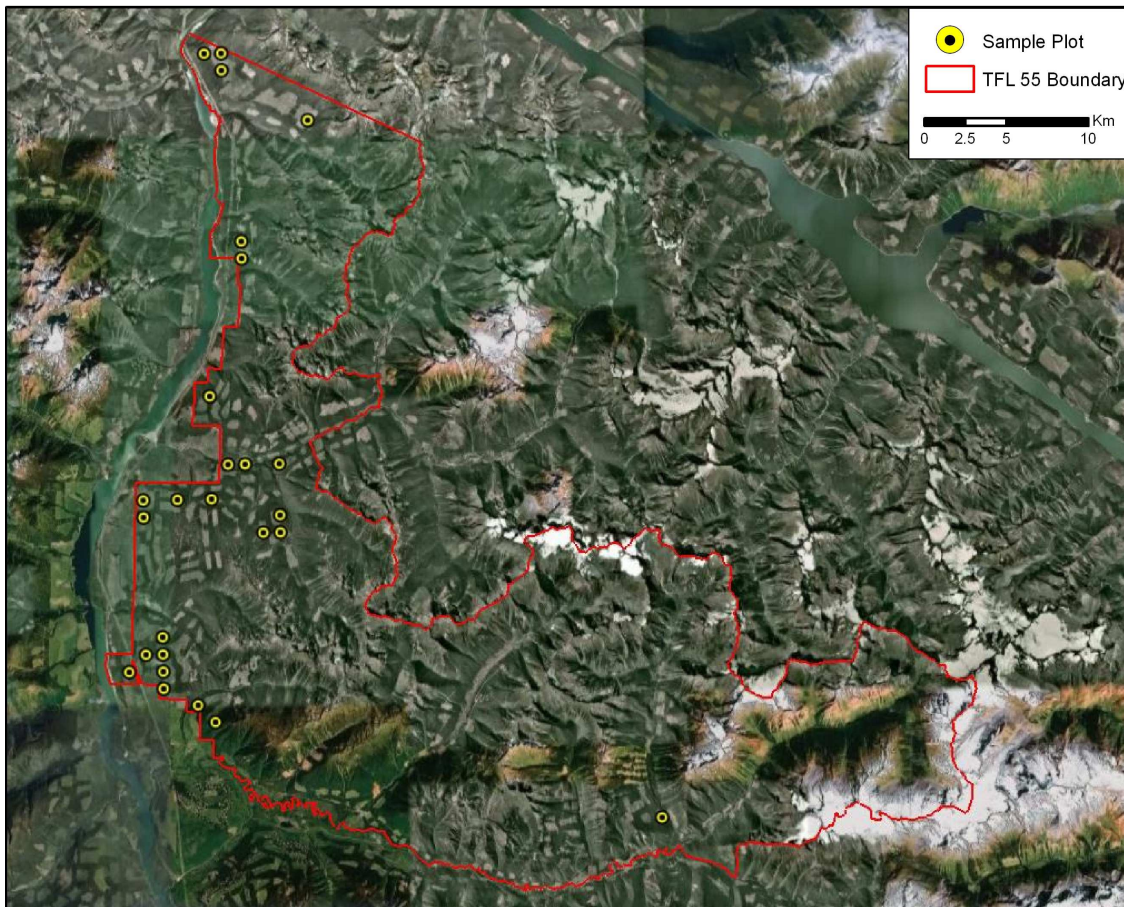


Figure 1. TFL 55 CMI sample plot locations.

⁶ Ages were all projected to the end of the 2008 growing season and managed stands were defined using the “logged” attribute in the Vegetation Resources Inventory (VRI) file. The accuracy of the VRI “age” and “logged” attributes were visually confirmed in our GIS using the most recent TFL ortho photos.

2.2 Sample Grid & Sample Size

The sample plots are located on a 1.0 km square grid using NAD 83 UTM coordinates evenly divisible by 1,000 meters.⁷ The 1.0 km grid gives an approximate sample intensity of one plot for each 100 hectares of the target population. Twenty-six (26) grid points are identified in the VRI as being in the target population and located on the sample grid (Figure 1 & Appendix III).

2.3 Remeasurement Period & Recruitment

We recommend a 5-year remeasurement period to coincide with the 5-year management plan cycle. This remeasurement period will provide new information to compare the predicted and actual productivity of managed stands in each future management plan timber supply analyses. The rate of harvest has historically been around 200 hectares per year on the TFL; therefore, this remeasurement period will result in approximately 2 recruitment plots every year.⁸

2.4 Plot Design

The plot design follows the standard CMI protocol for tree attributes (Figure 2). The main plot is 400 m² (11.28 m radius) where all trees greater than or equal to 9.0 cm are measured and tagged. The small tree plot is (100 m², 5.64 m radius) where all trees greater than or equal to 4.0 are measured and tagged. The regeneration plot is (19.6 m², 2.5 m radius) where all trees greater than or equal to 30 cm in height and less than 4 cm diameter at breast height are tallied by species.

2.5 Plot Measurements

While the majority of the MoFR CMI standard field procedures⁵ will be used, a few modifications were made to better address the goals and objectives of this CMI program. All modifications made to the current standards are outlined in Appendix IV.

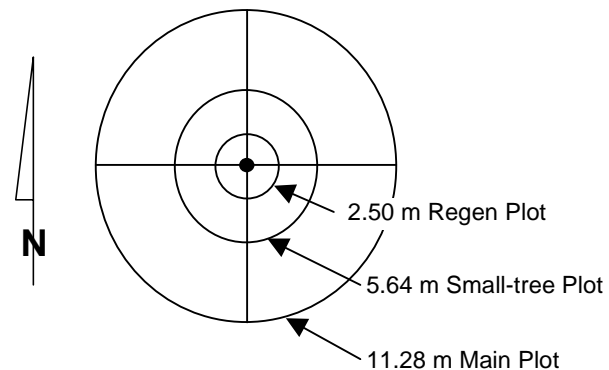


Figure 2. CMI sample plot.

⁷ The alternate sampling options outlined in Appendix II were discussed with LP staff on January 11, 2008. The 1.0 km grid option was selected because it best addressed the project goals and objectives.

⁸ The TFL VRI files are continually updated as newer information is gathered from surveys and harvesting operations. These VRI updates often change the age of a stand which could potentially change the target population. Therefore, we recommend that the target population be overlaid with the sample grid prior to each remeasurement period to ensure that all the samples are measured. All changes to the target population must be identified and accounted for in each analysis to ensure that the results of the analysis are being applied to the correct population.

2.6 Data Management & Analysis

Data collected in the field will be entered into the MoFR data entry software TimVeg and sent to the CMI data custodian for QA and incorporation into the MoFR database. All data used in future analyses will be requested back from the data custodian.

Data analysis will occur periodically to support future timber supply analyses on the TFL. We recommend that analysis occur after the establishment of the first 26 samples and again after the first remeasurement period.

2.7 Future Modifications

Future modifications to the CMI program may include:

1) Decreasing sample intensity

The number of plots in the CMI program will increase as more natural stands are harvested, regenerated, and reach 20 years of age. At some point in the future, the cost of the program may become too high and LP may want to reduce costs. This can be done by randomly dropping some plots in older managed stands where the comfort in predicting stand yield is higher.

2) Increasing remeasurement period

The 5-year measurement period is convenient because it corresponds with the management plan schedule. However, this period could change if the management plan cycle changes, if a higher level of comfort is developed in managed stand yield estimates, or if LP wants to decrease the cost of the program. The advantage of an increased measurement period is lower costs, however, the disadvantage is that less information can be obtained from the data.

3) Additional plot measurements

New tree, ecological, or range measurements can be added to the CMI program at any time in the future. For example, measurements of branch size, tree taper, or wood quality could be included in the next measurement cycle. This would provide the same representative sample, but measurements of change over time could not be calculated until two or more measurements of the same attribute were taken.

Future additions could also include more detailed ecological descriptions or estimates of coarse wood debris. The same issue applies as for tree attributes, i.e., more than one measurement is needed to estimate change over time.

4) Additional plots in natural stands

Extend the target population of the CMI program to include one or more strata of samples in mature stands. The data collected in mature plots could provide a mechanism to monitor the growth of natural stands and possibly stand attributes associated with habitat issues found outside of the current managed stand target population.

3.0 IMPLEMENTATION SCHEDULE

The initial establishment of the 26 CMI plots will be split into two field seasons to keep the cost of the project below the available Forest Investment Account funding. Due to the short period of time between the snow melt and the start of the growing season, it is recommended that the plots be established in the fall. A brief establishment report will be written after each season of fieldwork summarizing the work completed. Analysis of the establishment data can occur anytime after the data from the 26 plots has been reviewed and approved by the MoFR Forest Analysis and Inventory Branch.

Table 1. CMI program schedule.

Activities	2008				2009				2010				2011			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
1. Approved sample plan	■															
2. Establishment Year 1			■													
3. Establishment Year 2							■									
4. Establishment Analysis & Reporting									■	■						
5. Information Package Due														■		

APPENDIX I – TFL 55 LANDBASE SUMMARIES

TFL 55 covers 92,864 ha, of which 26,447 hectares (28%) are in the productive operable forest (Table 2).⁹ Interior spruce (Sx), hemlock (Hw), and cedar (Cw) together account for 83% of all leading species in the productive operable forest (Table 3). Twenty-six (26) percent (7,017 ha) of the productive operable forest is under 40 years of age, while 14% (3,617 ha) is 20 to 39 years of age (highlighted grey in Table 4). The target population of the CMI program is a subset of these 3,617 hectares where there is a record of harvesting.

Table 2. TFL 55 area distribution (ha).

Landbase	Area	
	(ha)	(%)
Entire Landbase	92,864	
Inoperable	65,795	71%
Operable	27,069	29%
Non Productive	622	
Productive	26,447	

Table 3. TFL 55 area distribution (ha) by leading species and age class.

Ldg. Spp	Age Class									Total		
	0	1	2	3	4	5	6	7	8	9	(ha)	(%)
SX		2,719	2,345	129	227	543	127	384	5,929	249	12,654	48
HW		41	236	27	15	30	164	210	650	3,367	4,739	18
CW		292	122	0	16	12	36	13	703	3,294	4,489	17
BL		72	19	27	63	95	82	437	1,069		1,864	7
FD		144	378	32	1	6	107	33	977	184	1,862	7
DEC		11	134	8	55	14	22	18	49		311	1
PL		8					24				32	0
(blank)	471		26								497	2
Total	471	3,757	3,260	223	377	699	563	1,095	9,378	7,094	26,447	100
Percent	1	13	12	1	1	3	2	4	35	27		

Table 4. TFL 55 productive operable forest area (ha) by leading inventory species and age.

Ldg. Spp	Age									Total	
	0-4	5-9	10-14	15-17	18-19	20-24	25-29	30-34	35-39	(ha)	(%)
SX		449	804	709	415	1,427	824	382	55	5,064	72
FD		12	106	17	10	280	8	91		522	7
CW		162	94	17	15	67	46	12		414	6
HW			11	20	11	166	2	59	9	277	4
DEC						99	45			144	2
BL		21	22	29		0		0	19	91	1
PL		8								8	0
(blank)	471						26			497	7
Total	471	651	1,037	791	450	2,039	951	544	83	7,017	100
Percent	7	9	15	11	6	29	14	8	1		

⁹ The September 2005 MP 4 information package identified 24,859 ha of productive operable forest. The difference in these areas are because the MP 4 definition removed 802 ha of roads and defined productive as all stands with over 10% crown closure. The CMI sample plan used the more recent definition of “vegetated upland” using the BCLCS levels in the VRI (BCLCS_LVL_1=V & BCLCS_LVL_3=U).

APPENDIX II – CMI ALTERNATE SAMPLING OPTIONS

A range of grid sizes were assessed to evaluate the species distribution, current establishment sample sizes, and recruitment rates. Note that sample sizes are based on spatial grid overlays, and costs are estimated at \$1,750 / plot (establishment) and \$1,200 / plot (re-measurement). Shaded cells include the grid size selected for the TFL 55 CMI program.

Grid Size & Age Range			Establishment		5-year Recruitment			10-year Recruitment				
Grid Size (m)	Age range	Grid representation (ha / plot)	Total # plots	Total cost	Total # plots	Establishment cost	Remeasurement cost	Total cost	Total # plots	Establishment cost	Remeasurement cost	Total cost
800	15-39	64	66	115,500	14	24,500	79,200	103,700	8	14,000	96,000	110,000
900	15-39	81	64	112,000	11	19,250	76,800	96,050	6	10,500	90,000	100,500
1,000	15-39	100	40	70,000	12	21,000	48,000	69,000	8	14,000	62,400	76,400
1,100	15-39	121	42	73,500	11	19,250	50,400	69,650	7	12,250	63,600	75,850
1,200	15-39	144	32	56,000	7	12,250	38,400	50,650	6	10,500	46,800	57,300
800	18-39	64	55	96,250	23	40,250	66,000	106,250	16	28,000	93,600	121,600
900	18-39	81	55	96,250	20	35,000	66,000	101,000	11	19,250	90,000	109,250
1,000	18-39	100	33	57,750	14	24,500	39,600	64,100	15	26,250	56,400	82,650
1,100	18-39	121	35	61,250	13	22,750	42,000	64,750	13	22,750	57,600	80,350
1,200	18-39	144	25	43,750	16	28,000	30,000	58,000	9	15,750	49,200	64,950
800	20-39	64	44	77,000	22	38,500	52,800	91,300	20	35,000	79,200	114,200
900	20-39	81	47	82,250	17	29,750	56,400	86,150	16	28,000	76,800	104,800
1,000	20-39	100	26	45,500	14	24,500	31,200	55,700	14	24,500	48,000	72,500
1,100	20-39	121	31	54,250	11	19,250	37,200	56,450	12	21,000	50,400	71,400
1,200	20-39	144	20	35,000	12	21,000	24,000	45,000	12	21,000	38,400	59,400

APPENDIX III – SAMPLE LIST

Plot	Mapstand	Subzone	UTM Easting	UTM Northing	Leading Species	Leading Species %	Age (years)	Inv SI (m)
1	082M077_2434	ICHvk1	387000	5731000	SX	100	30	25
2	082M077_2436	ICHvk1	388000	5732000	SX	80	27	20
3	082M077_2406	ICHvk1	388000	5740000	SX	100	20	21
4	082M087_2011	ICHvk1	388000	5741000	SX	90	23	19
5	082M077_2451	ICHvk1	389000	5730000	SX	70	27	24
6	082M077_2442	ICHvk1	389000	5731000	SX	70	29	21
7	082M077_2445	ICHvk1	389000	5732000	SX	70	30	21
8	082M077_2423	ICHvk1	389000	5733000	SX	60	31	24
9	082M088_1438	ESSFvc	390000	5741000	SX	80	25	21
10	082M078_2532	ICHvk1	391000	5729000	CW	50	27	21
11	082M068_2402	ESSFvc	392000	5728000	HM	40	22	22
12	082M088_1454	ESSFvc	392000	5741000	SX	70	26	17
13	082M088_1168	ICHvk1	392000	5747000	SX	80	21	21
14	083D008_2400	ICHvk1	392000	5767000	SX	100	21	22
15	082M088_1431	ICHvk1	393000	5743000	CW	60	25	20
16	083D008_2400	ICHvk1	393000	5766000	SX	100	21	22
17	083D008_2401	ICHvk1	393000	5767000	SX	90	22	22
18	082M088_1503	ICHvk1	394000	5743000	SX	80	24	23
19	082M098_2118	ICHvk1	394000	5755000	CW	80	21	24
20	082M098_2120	ICHvk1	394000	5756000	SX	80	23	15
21	082M078_2506	ESSFvc	395000	5739000	SX	80	21	20
22	082M078_2507	ICHvk1	396000	5739000	SX	90	21	21
23	082M088_1580	ICHvk1	396000	5740000	SX	80	21	20
24	082M088_1398	ICHvk1	396000	5743000	FD	80	24	17
25	083D008_2431	ICHvk1	398000	5763000	SX	100	20	21
26	082M070_2615	ICHvk1	418000	5722000	SX	80	21	23

APPENDIX IV - SAMPLING METHODS VARIANCE FROM CMI STANDARDS

Attribute	MoFR CMI Standard ⁵	TFL 5 CMI
<i>Plot Establishment</i>		
Tree tags	Affixed at stump height	Tags will be nailed at breast height.
Plot boundary overlaps with adjacent polygon outside target population (eg., mature / old growth stand, permanent road)	No provision other than to sample all trees as per CMI standards, regardless if managed or old growth.	Trees outside the target population will be identified in column S2 of card 8 ('=in, R=out). If a tree outside target population is identified as the site tree, then also sample an equivalent site tree from within the target population (see tree measurements below). Map the portion of plot outside target population using map drawing on CL card. Reference boundary line using 1:5,000 ortho image with forest cover polygons overlaid.
<i>Plot Measurements</i>		
Range data	Collected	Not collected
Ecology data	Collected	Only visual estimation of site series from the 11.28 m radius plot and the site features. No other eco data collected.
<i>Tree Measurements</i>		
Top height tree	Collected	Record as 'T' tree.
Leading species / Second species	Leading (L) and second (S) species are those determined with largest and second largest basal in the plot.	Where plot boundary overlaps with adjacent stand outside target population and the 'L' or 'S' tree is determined outside the target population, then two 'L' and/or 'S' trees are measured (one from the stand outside target population and one from PHR stand inside target population).
Non-largest DBH trees (leading and second species)	Not measured	Potential site trees are measured from the next largest DBH tree of each conifer species in each 11.28 m quad if the largest DBH tree is unsuitable for site index. Record the non-largest DBH tree as an 'O' tree. Where plot boundary overlaps with adjacent mature / old growth stand, do not sample 'O' tree from the adjacent older stand.
<i>Stump / CWD Measurements</i>		
CWD	Collected	Not collected