
TFL 33
Change Monitoring Inventory
Sample Plan

Prepared for

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Project: FCC-005

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1. INTRODUCTION

1.1 BACKGROUND

Federated Cooperatives Ltd., Canoe BC (FCL) is implementing a Change Monitoring Program (CMI) in a continued effort to improve management of the forest resources of TFL 33. Following the Chief Forester's AAC determination in 2000, FCL has improved the growth and yield (G&Y) information for its current management plan (MP). Included were new managed stand yield tables (MSYT) that incorporated a site index adjustment project¹, new ecological mapping, and revised estimates for root rot losses.

The volume in most post-harvest-regenerated (PHR) stands is projected to be higher than natural stands on the same sites. Increased projected yields exert upward pressure on forecasted timber supply, thus it is important that the G&Y of these stands is closely monitored to ensure this growth is achieved on the landbase. The CMI program complements previous G&Y programs as it provides a broad-level check of G&Y attributes used in the latest MP, identifies potential problems with model predictions, and helps develop more accurate MSYTs for use in timber supply review.

1.2 PROGRAM GOALS & OBJECTIVES

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

The objectives to achieve that goal are to:

1. Design a CMI sampling program that meets FCL goals and that is sufficiently flexible to address potential future changes in conditions, funding, and program objectives.
2. Install CMI ground plots over the 2005/06 and 2006-07 field season.
3. Install new CMI ground plots and re-measure existing plots in the future as determined by this sample, available funding, and information needs at the time.
4. Analyze the data periodically to support future timber supply analyses on the TFL.

1.3 SAMPLE PLAN OBJECTIVES

The objective of this sample plan report is to describe the plan in sufficient detail to guide FCL in the initial installation of CMI plots on the TFL and in future installation and remeasurements. This report will also provide information needed in the future statistical analyses of the CMI data.

1.4 TERMS OF REFERENCE

J.S. Thrower & Associates Ltd (JST) completed this CMI sample plan for FCL on TFL 33. Jeff Lipsett, *RPF* is the project leader for FCL. René de Jong, *RPF* (JST) is the project manager, and Jim Thrower, *RPF*, PhD is the project advisor.

¹ J.S. Thrower & Associates Ltd. 2003. Improved Site Index for PHR Stands on TFL 33. Report prepared for Jeff Lipsett, FCL, October 7, 2003. Project # FCC-003.

2. SAMPLE DESIGN

2.1 OVERVIEW

The key features of the sample design described in this section are:

1. Sample points are located on a 600 m grid based on NAD 83 UTM coordinates.
2. Plots are established at these sample grid points and located in PHR stands older than 15 years of age since harvest
3. Plots are 11.28 m radius (400 m²) circular plots as per the Ministry of Forests and Range (MOFR) CMI standards.²
4. The intent is to install approximately 50% of the plots in the first year and the remaining 50% in the second year.
5. Plot re-measurement and installation of new plots will be done on a 5-year interval.

2.2 TARGET POPULATION

The target population for the CMI program is all PHR stands in the TFL. Harvest history shows that the oldest PHR stands are approximately 39 years of age, whereas a minimum age of about 15 years is required to ensure that establishment plots have measurable merchantable volumes. Therefore, for the purposes of CMI plot establishment, the target population is represented by stands between 15 and 39 years of age. These stands are approximately 30% of the PFLB (Appendix II and Appendix III).³

2.3 PLOT LOCATION

The CMI plots will be located in the target population on a 600 m grid based on NAD 83 UTM coordinates (evenly divisible by 600).⁴ The advantage of locating plots on a grid instead of randomly is the convenience of locating sample points in the future. Statistical properties of the systematic samples and difference from random samples are known and can be addressed in future data analyses and reporting.

2.4 ESTABLISHMENT SAMPLE SIZE

The 600 m grid results in a maximum of 44 grid points within the target population (Appendix IV). Approximately 4 grid points will be excluded at the office stage as they are located directly on main line roads. Additional grid points will only be excluded if a permanent road⁵ has subsequently been established over a grid point. No exclusion will be made for grid points that fall within riparian management areas.⁶

² Ministry of Agriculture and Land (previously Sustainable Resource Management (MSRM)) - National Forest Inventory BC Change Monitoring Procedures for Provincial and National Reporting ver. 1.4 March 2005.

http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nficmp05/nfi_cmp_2k5.pdf

³ The spatial coverage for TFL 33 was based on the dataset for the project 'Natural and Managed Stand Yield Tables for TFL 33 MP 9, March 31 2005' (JST project FCC-004). Stand ages from this file were projected to 2004.

⁴ Possible grid sizes ranged from 500 m to 1,000 m in increments of 100 m. The 600m grid was chosen following review of sample size and future recruitment rates of the different grid size options.

⁵ Permanent roads include mainlines and mainline right-of-ways, and in-block permanent access structures. These exclusions ensure consistency with THLB netdown assumptions.

⁶ While these areas represent the current state of these older PHR stands, the need for their inclusion may change in the future, as current management practice is to exclude the RRZ, and portions of the RMZ from the net area to be reforested.

The 38 CMI plots will be established over two consecutive years subject to funding. Approximately 15 plots will be established during the 2005 field season, with the remaining plots established in 2006.

The current sample size of CMI plots will not likely permit post stratification of the data for analysis at the establishment phase. Post stratification could be considered once the sample size is increased through periodic recruitment of new CMI plots.

2.5 PLOT DESIGN

The plot design is based on MOFR-approved CMI standards (Figure 1). Trees greater than 9 cm diameter at breast-height (DBH) are measured and tagged in the main plot (400 m², 11.28 m radius), trees between 4 and 9 cm are measured and tagged in the small-tree plot (100 m², 5.64 m radius), and all trees taller than 30 cm but less than 4 cm DBH are measured and tallied by species in the regeneration plot (19.6 m², 2.50 m radius).

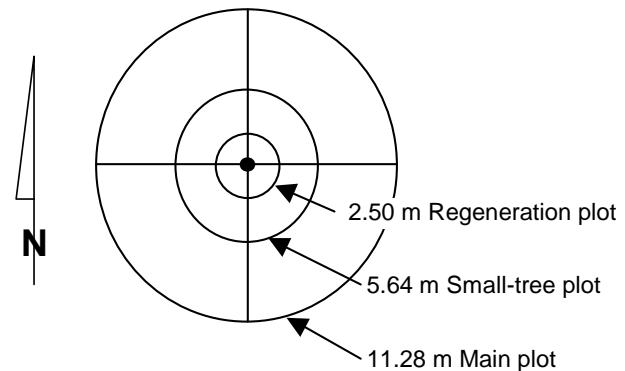


Figure 1. CMI sample plot.

2.6 PLOT MEASUREMENTS

The majority of CMI field procedures will be followed for this project, with the exception of modifications discussed below. These are also summarized in Appendix I.

2.6.1 Range Data

No information is collected on range data.

2.6.2 Ecology Data

Only limited ecological data will be collected during establishment phase. Site features to be recorded on the Ecology card (EP) include site uniformity, BGC subzone / variant, SMR, SNR, site series proportions, percent land cover, slope, aspect, elevation, surface shape, meso-slope, micro topography, substrate, slope failure, gullies, flood hazard, open water, and humus form.⁷

2.6.3 Top Height / Site Trees

There will be no change from standards in the way top height trees ('T' trees) are measured. For leading and secondary species ('L' and 'S' trees), the age and height of the largest diameter, dominant or co-dominant tree of every species present in each plot quadrant will be measured. This ensures the data for both the leading and second species are collected, plus it provides additional valuable data to examine site index relationships between species.⁸

⁷ Additional data that would enable the CMI plot's inclusion into the provincial SIBEC database may be added at a future re-measurement date.

⁸ Collection of this information supports the need to localize site index conversion equations, an issue previously raised by government in other related projects.

2.6.4 Other Height Trees

Other potential site trees will also be identified where the largest diameter tree is deemed unsuitable as a site tree. This includes provision for stepping-down the DBH list until a suitable site tree is identified. Such trees will be recorded as 'O' trees. While these trees will not be used in the CMI compilation program, their collection will ensure a site index estimation is taken for every plot, which would not otherwise be collected under CMI standards.

2.6.5 Tree Tagging

Dark blue or black tree tags are affixed at breast height rather than at stump. This simplifies installation and re-measurement without making the plot unduly visible.

2.6.6 Portion of Plots Outside Target Population

If a portion of a plot overlaps with an adjacent stand outside the target population (eg., mature / old growth) then site trees will be sampled from each stand type.⁹ A drawing of the plot will be used to estimate the target population boundary line, and will be based on the 1:5,000 sample package maps.

2.7 QUALITY CONTROL

Internal quality control will be completed on approximately 10% of the plot samples. Third-party quality assurance will follow current Ministry standards¹⁰.

2.8 DATA ENTRY

Data will be recorded on field cards and checked each night during the field sampling phase. Once field sampling is completed, data entry will use the most recent version of VIDE.¹¹ Alternatively, the option of using electronic field recorders with the CMI version of TIMVEG will also be explored.

2.9 DATA COMPILATION

Data will be compiled using the MOFR CMI data compiler.¹²

2.10 ANALYSIS AND INTERPRETATION

Data analysis is not a part of this project, however, an establishment report will be completed that describes the sample design, plot installation methods, and some basic summaries of the compiled measurements.

2.11 RE-MEASUREMENT SCHEDULE

A five-year re-measurement cycle is recommended, to ensure consistency with FCL's MP. The recruitment rate of new CMI plots entering the minimum 15 year threshold age will be approximately 5 – 8 CMI plots over each five year period, based on the 600 m grid size.

⁹ Although we are interested primarily with PHR stands, suitable site trees originating from adjacent older stands outside the target population should also be measured (email from V. Sundstrom, MSRM, October 2, 2003).

¹⁰ MSRM Change Monitoring Inventory – Ground Sampling Quality Assurance Standards ver. 1.1 March 29, 2002.

¹¹ The software program VIDE was developed by MSRM for VRI and CMI data entry.

¹² This publicly available software was originally written by MSRM to compile both VRI and CMI data, and has been updated to June 27, 2002.

2.12 FUTURE MODIFICATIONS

Future modifications to the CMI program may include:

1) Changes to sample intensity

Sampling intensity can be decreased or increased in the future as more plots are located in PHR stands. The number of plots in the CMI program will increase as more natural stands are harvested, regenerated, and reach 15 years of age. At some point in the future, the cost of the program may become too high and FCL may want to reduce costs. This can be done by randomly dropping some plots in older PHR stands where the comfort on predicting stand yield is higher.

2) Increasing measurement period

The 5-year measurement period is convenient because it corresponds to the MP schedule. However, this period could change if the MP cycle changes, if a higher level of comfort is developed in PHR yield estimates, or if FCL 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, and linking previous measurements may be more complicated.

3) Re-defining the Target Population

Post-stratification of the CMI plots in the future may identify a need to concentrate on just a subset of the data (eg., specific species), and thereby reduce or remove CMI plots occurring in other strata types.

Existing stands were harvested under varying historical standards, and some may be considered for future exclusion (eg, CMI plots located within riparian management zones may be excluded if the THLB netdown process also excluded these areas).

4) Establishing linkages with other programs

Extend the CMI program to mature stands and possibly have links to Vegetation Resources Inventory (VRI) Phase II ground sampling.

Provide a link with silviculture surveys designed to monitor the first 15 years of post-harvest.

5) Combine with other CMI data

Utilize other previously collected CMI data from similar sites to increase statistical confidence of analyses.

6) Adding other information

New tree 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 change estimates could not be computed until two or more measurements of the same attribute were taken. Future additions could also include more detailed ecological descriptions.

3. ROLES AND RESPONSIBILITIES

3.1 FCL

FCL will:

- Coordinate the project.
- Monitor project budget and progress, and communicate with the MSRM.
- Approve the CMI sample plan.
- Ensure quality control is complete.
- Assist in coordinating technical expertise where required.
- Coordinate an independent third party contractor to conduct quality assurance of the fieldwork.

3.2 J.S. THROWER & ASSOCIATES LTD.

JST will:

- Prepare the sample plan.
- Select the plot locations.
- Transfer plot locations from GIS to air photos.
- Prepare sample packages and ensure the sample packages are assembled and complete.
- Mentor field crews at the beginning of the fieldwork.
- Complete fieldwork.
- Complete internal quality control of fieldwork.
- Enter data.
- Complete quality control on data entry.
- Compile data.
- Check data after initial compilation.
- Analyze data.
- Complete establishment report.

APPENDIX I – SAMPLING METHODS VARIANCE FROM CMI STANDARDS

Attribute	MOF CMI Standard	TFL 33 CMI
Plot Establishment		
Tree tags	Affixed at stump height	Tags will be nailed at breast height. Tagging sector (1-8) will be recorded in column S1 of Card 8.
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 (I=in, O=out). If a tree outside target population is identified as the site tree, then also sample an equivalent PHR site tree from within the target population (see tree msmts below). Map 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.
Plot Measurements		
Range data	Collected	Not collected
Ecology data	Collected	Visual estimation of site series from the 11.28 m radius plot, plus site features. No other eco data collected.
Tree Measurements		
Leading / second species	Determined as those species with largest and second largest basal area from 5.64 m radius plot. L and S trees sampled from within each 11.28 m radius plot.	Not pre-determined. Instead, potential site trees are measured from each species in each 11.28 m radius quadrant. Record as 'S' tree. Where plot boundary overlaps with adjacent stand outside target population and the 'S' tree is determined outside the target population, then two '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	Additional 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 as 'O' tree. Note, these trees are not used as part of the CMI compilation procedures. Where plot boundary overlaps with adjacent mature / old growth stand, do not sample 'O' tree from the adjacent older stand.

APPENDIX II – TFL 33 LANDBASE

TFL 33 covers 8,377 ha, of which 7,831 ha (93%) are in the productive forest land base (PFLB) (Table 1).

Douglas-fir (Fd), red-cedar (Cw), interior spruce (Sx), hemlock (Hw) and subalpine fir (Bl) together account for 89% of all leading species in the PFLB (Table 2).

Approximately 30% (2,344 ha) of the PFLB is under 40 years of age, while 52% is 121 years or older.

Table 1. TFL 33 area distribution.

Landbase	Area	
	(ha)	(%)
Entire Landbase	8,377	100
Non-productive forest	546	7
Productive forest	7,831	93

Table 2. TFL 33 Area distribution by leading species and age class.¹³

Spp	Age Class										Total	
	0	1	2	3	4	5	6	7	8	9	(ha)	(%)
(blank)	130						1		6		137	2%
DEC		90	13			59					162	2%
BL		8	87	142	81	7	10	56	485		876	11%
CW		37	58	19	37		28	102	975	4	1,262	16%
FD	17	344	288	6	236	19	236	377	1,274	22	2,819	36%
HW			80	47	189	9	16	32	389	91	854	11%
PL		301	19		137		33	8	11		510	7%
SX	12	691	189	59	116			32	113		1,211	15%
Total	159	1,471	736	274	797	93	324	607	3,253	117	7,831	100%
	2%	19%	9%	3%	10%	1%	4%	8%	42%	2%	100%	

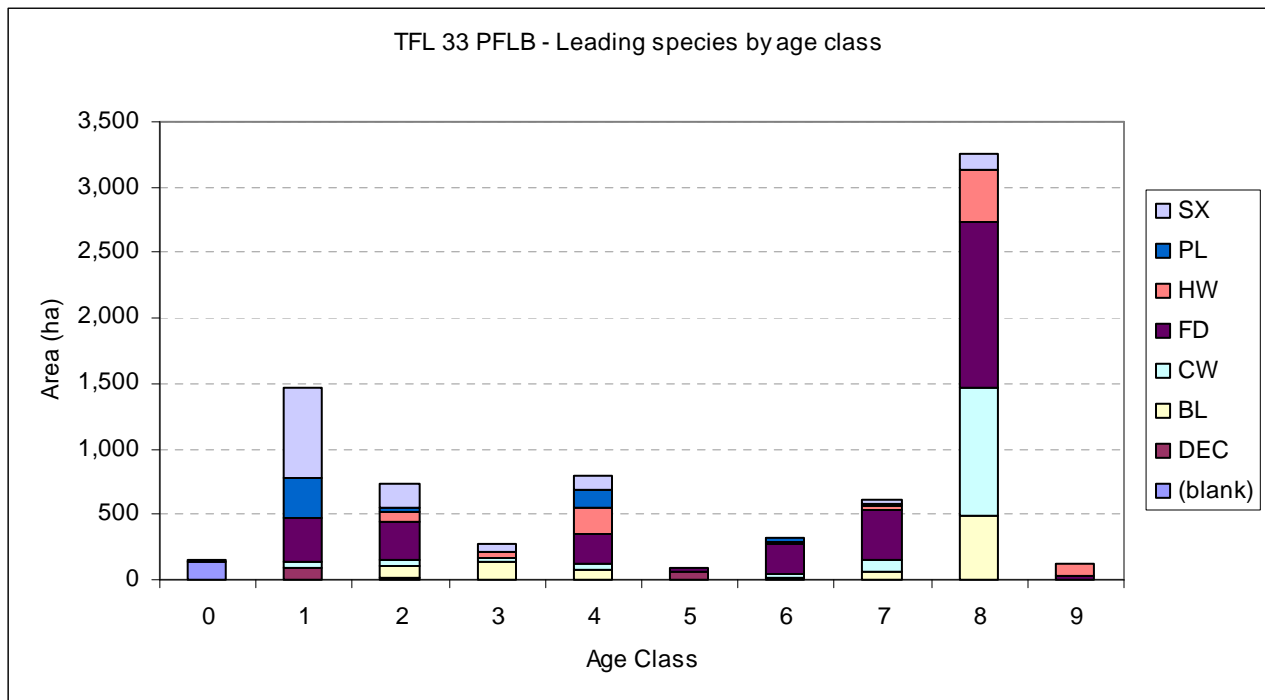


Figure 2. TFL 33 PFLB area distribution by leading species and age class.

APPENDIX III – AREA DISTRIBUTION OF PHR STANDS

Table 3. TFL 33 PFLB area distribution by leading inventory species and age (ha).

Age range (yrs)	Leading Inventory Species								Total	%
	(blank)	BL	DEC	CW	FD	HW	PL	SX		
0 – 4	130				35			34	199	8%
5 – 9				20	88		93	51	253	11%
10 – 14			69	13	26		62	199	369	16%
15 - 19			22	4	212		146	342	725	31%
20 – 24		40	5	28	36	57	18	158	343	15%
25 – 29		10	8	7	135	12	1	57	231	10%
30 – 34				24	110	5			139	6%
35 - 39		24			7	5		50	86	4%
Total	130	74	103	96	649	80	320	892	2,344	100%
%	6%	3%	4%	4%	28%	3%	14%	38%		100%

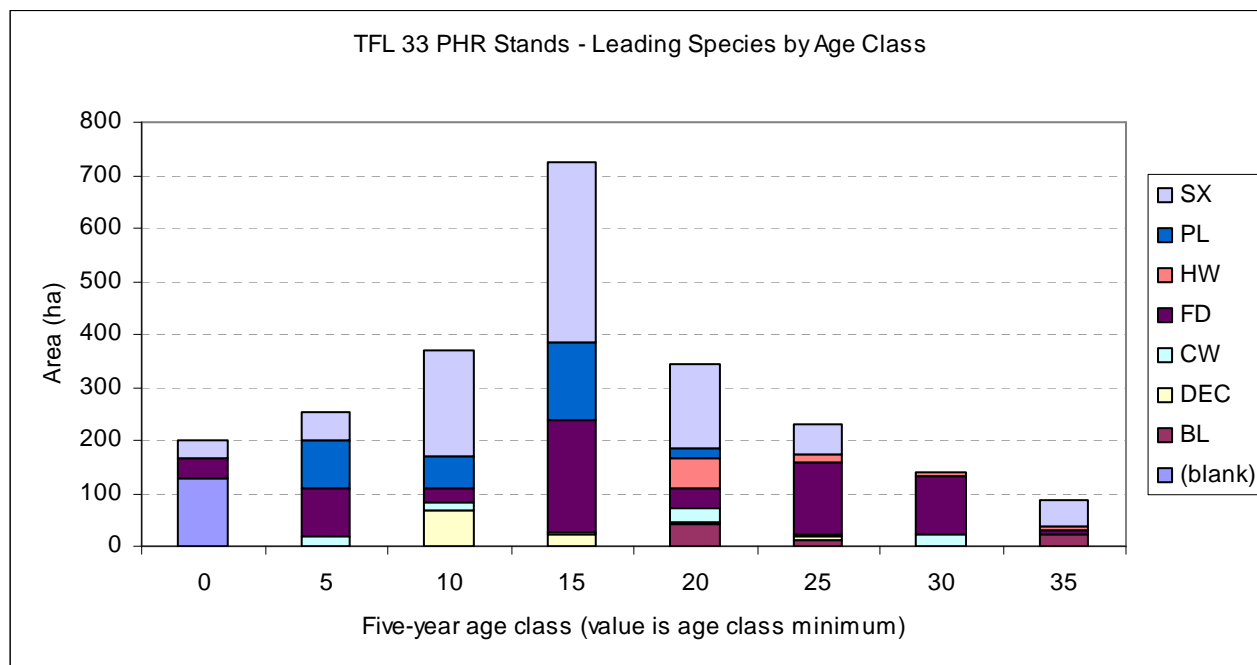


Figure 3. TFL 33 PFLB area distribution by species and age for stands 0 – 49 years old.

¹³ Age class attributes are projected in the inventory file to the year 2004.

APPENDIX IV – TFL 33 CMI ESTABLISHMENT SAMPLE LIST

The following sample list is based on a 600 m grid size for all possible sample points located on conifer leading stands between 15 and 39 years of age (relative to 2004). A pre-field office review has identified the rejection of four plots that are located directly on permanent roads based on the ortho image (shaded cells). Field assessment may identify other reasons for exclusion (eg., new permanent roads established, safety reasons).

Grid	Random plot number	mapsheet + polygon	BGC subzone	UTM easting	UTM northing	Species 1	Species 1 %	Projected age to 2004	Projected Height to 2004	Inventory SI
600	1	082L096 2735	ICHwk1	364200	5649400	HW	33	21	5.6	18
600	2	082L096 2859	ICHwk1	364800	5650600	SX	70	15	1.3	16
600	3	082L096 1469	ICHwk1	361200	5642200	FD	29	15	3.0	17
600	4	082L096 1294	ICHmw2	362400	5647000	FD	40	33	11.4	20
600	5	082L096 2002	ESSFwc2	365400	5650000	SX	68	16	1.3	15
600	6	082L096 2000	ICHwk1	363600	5646400	FD	60	21	4.8	16
600	7	082L086 1023	ICHwk1	359400	5639800	SX	80	38	6.8	15
600	8	082M006 2014	ICHmw2	363000	5653600	FD	60	18	2.6	12
600	9	082L096 1174	ESSFwc2	366000	5648800	SX	60	26	3.6	16
600	10	082L096 1176	ESSFwc2	365400	5648200	SX	97	16	1.3	15
600	11	082L086 1027	ICHwk1	360000	5639800	SX	80	38	6.8	15
600	12	082L096 2821	ICHmw2	363600	5650600	FD	60	30	4.9	11
600	13	082L096 2772	ICHwk1	361800	5642800	SX	37	20	1.9	15
600	14	082L096 1147	ESSFwc2	364800	5648800	SX	40	22	2.3	15
600	15	082L096 1331	ICHwk1	363000	5646400	FD	72	29	9.8	20
600	16	082L096 1366	ICHmw2	362400	5646400	FD	59	28	9.4	20
600	17	082L096 1097	ICHmw2	361800	5650000	FD	32	16	3.4	17
600	18	082L096 1047	ICHmw2	361800	5650600	PL	51	16	3.7	16
600	19	082L085 1122	ICHmw2	357600	5636800	FD	50	15	3.0	17
600	20	082L096 1393	ICHwk1	363000	5644600	CW	32	23	6.0	17
600	21	082L096 1275	ESSFwc2	364200	5647000	SX	70	24	4.0	19
600	22	082L096 2760	ICHmw2	362400	5645200	FD	59	28	9.4	20
600	23	082L096 1023	ICHwk1	364800	5651200	SX	80	18	1.8	17
600	24	082M006 2099	ICHwk1	365400	5651800	SX	80	18	1.8	17
600	25	082L086 2703	ESSFwc2	360600	5640400	PL	78	18	4.4	16
600	26	082L096 2749	ICHmw2	362400	5648200	FD	54	16	3.4	17
600	27	082L096 1054	ICHmw2	363000	5650600	HW	60	35	8.8	16
600	28	082L096 2772	ICHwk1	362400	5644000	SX	37	20	1.9	15
600	29	082L096 1484	ESSFwc2	360600	5641000	PL	35	18	4.4	16
600	30	082L096 1344	ICHwk1	363000	5645800	FD	65	31	10.6	20
600	31	082L096 2704	ESSFwc2	366000	5651200	SX	68	19	1.7	15
600	32	082L096 1028	ICHmw2	363600	5651200	FD	40	30	4.4	10
600	33	082L096 1341	ICHwk1	363600	5645800	SX	50	27	5.1	19

Grid	Random plot number	mapsheet + polygon	BGC subzone	UTM easting	UTM northing	Species 1	Species 1 %	Projected age to 2004	Projected Height to 2004	Inventory SI
600	34	082L096 1366	ICHmw2	362400	5645800	FD	59	28	9.4	20
600	35	082L096 1176	ESSFwc2	365400	5648800	SX	97	16	1.3	15
600	36	082L096 1147	ESSFwc2	364800	5649400	SX	40	22	2.3	15
600	37	082L096 1401	ICHwk1	363600	5644000	SX	40	24	2.5	14
600	38	082L096 1058	ESSFwc2	364800	5650000	SX	70	17	1.5	16
600	39	082L096 2826	ICHmw2	363600	5650000	FD	40	31	12.5	23
600	40	082L096 2735	ESSFwc2	364200	5648200	HW	33	21	5.6	18
600	41	082L096 2749	ICHmw2	362400	5647600	FD	54	16	3.4	17
600	42	082M006 2014	ICHmw2	363600	5653600	FD	60	18	2.6	12
600	43	082L096 2738	ICHmw2	362400	5649400	PL	56	17	5.8	21
600	44	082L096 1480	ICHwk1	360600	5641600	SX	40	18	1.5	15

APPENDIX V – TFL 33 CMI 5-YEAR RECRUITMENT SAMPLE LIST

The following sample list is based on a 600 m grid size for all possible recruitment sample points in five year's time, located on stands between 10 and 14 years of age (relative to 2004). No assessment has yet been made whether any grid point should be excluded (eg., located on mainline roads or mainline right of ways, safety).

Grid	Random plot number	mapsheet + polygon	BGC subzone	UTM easting	UTM northing	Species 1	Species 1 %	Projected age to 2004	Projected Height to 2004	Inventory SI
600	1	082L085 2704	ICHmw2	358200	5639800	DEC	51	12	4.8	20
600	2	082M006 2707	ESSFwc2	366600	5652400	SX	100	12	1.0	15
600	3	082L096 2777	ICHmw2	360000	5642200	SX	100	10	0.9	17
600	4	082L096 2737	ICHmw2	363000	5649400	PL	100	10	1.8	17
600	5	082L096 2706	ESSFwc2	366600	5650600	SX	92	11	0.9	15
600	6	082M006 2707	ESSFwc2	367200	5651800	SX	100	12	1.0	15
600	7	082L085 2703	ICHwk1	358800	5639800	PL	50	11	2.0	16
600	8	082L096 2717	ICHmw2	363000	5650000	CW	33	10	1.4	24
600	9	082L096 2706	ESSFwc2	366600	5650000	SX	92	11	0.9	15
600	10	082L085 2706	ICHmw2	357600	5638600	DEC	59	10	4.8	24
600	11	082M006 2707	ESSFwc2	367200	5652400	SX	100	12	1.0	15

APPENDIX VI – ESTABLISHMENT SAMPLE LIST SPECIES DISTRIBUTION

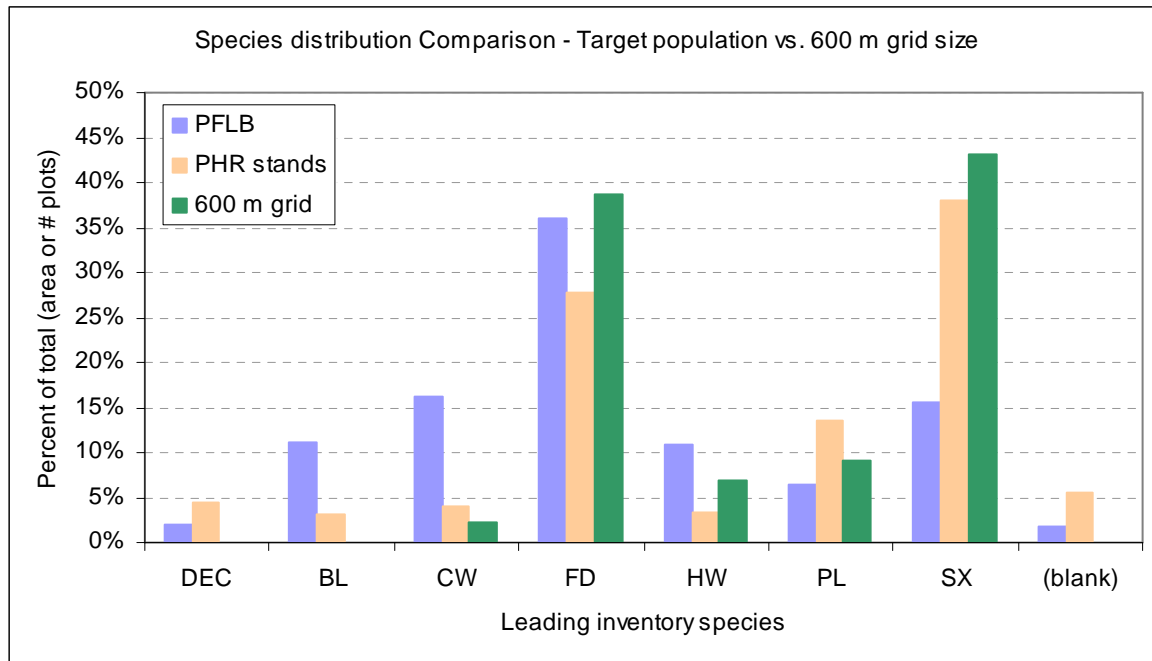


Figure 4. TFL 33 Comparison of species distribution between entire PFLB, PHR stands, and sample points based on a 600 m grid.

APPENDIX VII – 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 \$2,500 / plot (sample plan + establishment) and \$1,250 / plot (re-measurement). Shaded cells include the chosen grid size for TFL 33.

Sample Size						Year 0 cost		Year 5 cost			Year 10 cost				
Grid (m)	Sample population age range	Grid area representation (ha / plot)	Establishment sample size (# plots)	Recruitment size (10-14 yr old stands)	Recruitment size (5-9 yr old stands)	Total # plots	Total cost	Total # plots	Establishment cost	Re-measurement cost	Total cost	Total # plots	Establishment cost	Re-measurement cost	Total cost
500	15-39	25	63	15	10	63	158,000	78	37,000	79,000	116,000	88	25,000	97,000	122,000
600	15-39	36	44	10	7	44	110,000	54	26,000	55,000	81,000	61	18,000	68,000	86,000
700	15-39	49	24	8	5	24	60,000	32	19,000	30,000	49,000	37	13,000	39,000	52,000
800	15-39	64	23	6	4	23	58,000	29	14,000	29,000	43,000	33	10,000	36,000	46,000
900	15-39	81	21	5	3	21	53,000	26	11,000	26,000	37,000	29	8,000	32,000	40,000
1000	15-39	100	14	4	3	14	35,000	18	9,000	18,000	27,000	20	6,000	22,000	28,000

APPENDIX VIII – MOFR FEEDBACK ON SAMPLE PLAN

The following feedback from the MOFR's review of the sample plan (dated August 2, 2005) have been incorporated into the current sample plan (dated August 15, 2005). JST's responses are listed in italics.

-----Original Message-----

From: Macdonald, Bob G FOR:EX [mailto:Bob.MacDonald@gov.bc.ca]
Sent: Friday, August 12, 2005 12:52 PM
To: JST.dejong@jstthrower.com
Cc: Bowdige, Laurence A FOR:EX; Otukol, Sam FOR:EX; Macdonald, Bob G FOR:EX
Subject: TFL 33 CMI Draft Sample Plan Review
Importance: High

Review of TFL 33 CMI Draft Sample Plan dated August 2, 2005 (FCC-005). Review points are annotated with the reviewer's initials (SO - Sam Otukol, LB - Laurence Bowdige and BM - Bob Macdonald)

- 1) The plan makes numerous references to the Ministry of Agriculture and Lands (MAL) and MSRM. The standards now reside with the Ministry of Forests and Range (MOFR).

JST: all references have been changed to MOFR.

- 2) SO - Section 1.1: I am a bit uncomfortable with the definition of post-harvest-regenerated (PHR) stands. In paragraph 2 it is stated: "The volume in most post-harvest-regenerated (PHR) stands is projected to be higher than natural stands on the same site." Has this theory been proved or is this an assumption based on anecdotal information? What is the difference between PHR stands and what is called "natural" stands?

JST: The above generalized statement was based on observations from similar previously completed projects. PHR stands are considered 'managed' stands regenerating after harvest, as opposed to natural stands regenerating following natural disturbance (eg., fire). No changes made to sample plan.

- 3) SO - Section 1.2: It might be useful to include the Goals & Objectives the purpose for which the data is being collected, i.e., what questions is the data collection hoping to answer. Is the data trying to prove that second growth stands are producing more volume than what is indicated by yield models? Is a specific model being targeted, e.g. TASS?

JST: this section does state this is a monitoring program to check the growth and yield assumptions that were made in the last MP and TSR, and identify if changes in GY need to be made.

- 4) BM - Section 2.11 should define the age when samples may become eligible for deletion. Re-defining the target population based upon the current TFLB may support sample exclusion but this would be at the risk of any reversion back to the THLB would not be represented. The linkage to the SIBEC program might be quite valuable in assessing suitability of SIBEC estimates. The combination of other CMI data might be a challenge and we would need to better understand and review how this data would be incorporated into the analysis. In adding other data you might want to consider the frequency and period for these measurements as some may only require 10 year or longer assessment or may be tied to particular stages in stand development.

JST: These are important comments, and will need to be addressed when recruitment CMI plots are included at a future date.

- 5) SO - Section 2.2: Does the definition of target population coincide with what was targeted by SIS or OGSi? When OGSi (or SIA) was implemented, was the SI adjustment limited to "PHR" type stands or was it applied to second growth conditions, regardless of stand management type or stand origin? To my recollection the applications of SI adjustments was to all stands younger than 30, which had a SI transferred from old growth stands. If this monitoring is aimed at confirming the optimistic SI adjustment, it might be a good idea to ensure that the sampling covers the same population as what was adjusted.

JST: The target population is a standard definition used in the majority of JST's CMI programs. This is directly related to the assignment of these stands to 'managed stand yield curves' in the timber supply analysis. The managed stand GY assumptions are directly compared against ground measurements. As an aside, for site index assignment, a separate project was recently completed on TFL 33 that generated potential site index estimates across the landbase, regardless of stand age.

- 6) BM - The stands 15-39 years of age only represent 19.5% of the PFLB in Appendix 3. Stands 0-39 years of age represent ~30% of the PFLB.

JST: no changes.

- 7) LB/BM - Footnote #4 - a 700m grid is indicated in the footnote but a 600m grid is indicated in Section 2.1 and 2.3 and appendices 4-6.

JST: this correction was made in the footnote.

- 8) BM - Section 2.4 notes that 6 grid points were excluded but the listing in Appendix 4 highlights only 4 exclusions.

JST: Section 2.4 was corrected to be consistent with appendix 4. At this time only 4 grid points have been excluded during the office check.

- 9) LB - Section 2.5 Plot Design - The main plot is actually where all trees greater than 9 cm diameter at breast-height are measured.

JST: Section 2.5 has been corrected.

- 10) LB - Section 2.6.2 Ecology Data - I'm happy to see that at least some of the ecology data is being captured. My issue is that without digging a soil pit, it becomes much more difficult (and in the case of the humus form, impossible) to collect the SMR, SNR and humus form information. I would like to see more details on how they intend to capture this information. For the site series proportions, I would also like to see details on how they intend to do this without completing the vegetation assessment.

JST: The sample plan stated that only limited eco data would be collected at this time. It did involve assessment of humus layer, general topography, and indicator plants. But no soil pits were dug, and the vegetation card was not filled out.

- 11) LB - Section 2.6.2 Ecology Data - This data must be collected by a Certified Ecology Sampler.

JST: Field crews completing the work were eco-certified.

- 12) BM - With the amount of information identified and the small number of samples it could be cost effective to collect the additional information to support SIBEC requirements to augment the Provincial database and provide localized assessment of SIBEC estimates.

JST: This was a decision by our client not to complete full eco collection.

- 13) SO - Section 2.6.3: The proposal to collect top height, and all species site data is a major expansion on the collection of site data. This is a good thing, but the inclusion of all species at each plot location and the measurement of age at two locations (at dbh and at stump Ht) might result in the work requiring more than one day at each sample location.

JST: Field crews were able to complete each plot in one day. Only one core was taken per tree at breast height. Non-standard stump age data were not taken in order to maintain field sampling efficiencies.

- 14) BM - Section 2.6.5 Will the tree tag number be unique to the sample or unique to the project?

JST: Tree tags are unique to each sample only.

- 14) LB - Section 2.6.4 Other Height Trees - if they intend to use the step-down process, the non-largest DBH trees must still be dominant or co-dominant and meet the other suitability criteria.

JST: Yes, that is the process used. Such 'O' trees will be separately identified and not included in the standard CMI compilation results.

- 15) LB - Section 2.6.6 Tree Ages - how do they intend to record this information as there are currently no locations on the field card to collect multiple ages for a single tree? BM - The age data collected in this study might refine estimates but it would not eliminate errors. There would still be total age correction for ages taken above germination point (e.g. 30 cm).

JST: In the end, only one core was taken from each tree at breast height. We did not sample for age at stump height.

- 16) SO - Section 2.6.7: The proposal site data collection where plots fall outside the target population might distort the site tree data collection definition. If the boundary between the PHR stand and the older stand cut the 0.01ha quadrant in half, does the site information collected on the PHR side of the quadrant still meet the site tree data collection definition?

JST: There is probably no 'best' way of evaluating these overlap areas. We just wanted to track both, so that in the analysis, we could identify where anomalies occurred.

- 17) LB - Section 2.7 Data Entry - NOTE that VIDE is no longer supported by the MoFR and any problems or data integrity issues that arise are the responsibility of the Contractor to correct. BM - Data may be entered with TIMVEG on either a field recorder or PC. This would provide the current data format. Completed digital data is to be submitted to MoFR.

JST: we will be using TIMVEG for data entry.

- 18) LB - Section 2.9 Analysis and Interpretation - any reports are to be delivered to MOFR.

JST: we will deliver completed reports to MOFR.

- 19) LB - Section 3.1 - an indication that third-party quality assurance will be completed must be included in Section 2.6 of the Plan. SO - Section 3.1: Will the collected data be provided to BC government (MOF perhaps)? No role is listed here for any government agency.

JST: External audit of 2 out of the 15 plots was completed by Verne Sundstrom.

- 20) LB - Section 3.2 - an indication that internal quality control will be completed should also be included in Section 2.6 of the Plan.

JST: This is SOP.

- 21) BM - use digital ortho photo images if available (you mentioned Ortho's in Appendix 1) to support digital archive and spatial representation. Enter data into digital format using TIMVEG. Analyse data as per section 2.9.

JST: Ortho images were used for sample package preparation.

- 22) SO - Appendix 1 In my view, this plan is modifying NFI standards to mitigate the lack of management unit monitoring standards. This should perhaps be indicated. It might make it easier to address the major modification of the site tree data collection standards.
- 23) LB - Appendix I, Plot Measurements, Ecology data - "...11.28m radius plot, plus site features and humus form."
- 24) LB - Appendix I, Tree Measurements, Leading / second species - "Determined as the leading and second species by basal area within the 11.28 m radius plot."
- 25) BM - Tree meas - MoF - L and S trees sampled from within each 11.28 m radius quadrant.
- 26) LB - Appendix IV - "...the rejection of four plots that are located..." In Section 2.4 of the Plan, six plots are identified as being located on permanent roads and are therefore being rejected.
- 27) BM - Appendix V for clarity I would title this "... 5 year recruitment sample list"

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