Alternate Scenario Site Indices for Post-Harvest Regenerated Stands in TFL 38

Prepared for

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1. INTRODUCTION

1.1 Background

Recommendations were made to the Ministry of Forests (MOF) to include new estimates of site index in the Base Case timber supply analysis for Management Plan 8. The objective was to include the best available information in the Base Case for predicting the growth and yield of post-harvest regenerated (PHR) stands in TFL 38.[1] These recommended interim estimates[2] were developed from data outside the TFL, but from areas with the same ecological conditions. These estimates were deliberately conservative to help address the MOFs concern for changing inventory-based site index estimates in Base Case scenarios without concrete data. These site indices would have provided a better reflection of actual productivity of PHR stands, however, the MOF decided that these estimates should not be included in the Base Case scenario.

This report presents site indices recommended for use in an alternate scenario for the upcoming timber supply analysis. This alternate scenario provides estimates of site index that more closely reflect the actual productivity, but are still somewhat conservative where information is weak such as for minor species and high elevation areas. These new estimates are developed from the best available information from MOF data and MOF prediction methods.

1.2 Issue

The issue addressed in this report is that the TFL 38 inventory site indices will dramatically under-estimate the actual growth of PHR stands. This is not because site productivity has changed or the inventory data are not good, but is the result of using estimated heights and ages from old-growth stands to estimate site index for yield estimation in PHR stands.

When old-growth site indices are used with TIPSY, actual stand growth and yield will be dramatically under-estimated. This alternate scenario will provide the Chief Forester more realistic site productivity and yield information for PHR stands to assist in determination of the annual allowable cut. This is consistent with the philosophy of providing the Chief Forester with the best available information to consider for the management of British Columbia's forests.

[1] These estimates were presented at a meeting with MOF staff in Victoria on March 18, 1997. Attending were Bud Koch, Albert Nussbaum, and Gordon Nigh (MOF), Gerry Sommers (Interfor), Eric Wang (Timberline), and Jim Thrower (J.S. Thrower & Assoc.)

[2] J.S. Thrower and Assoc. Ltd. 1997. Interim site index estimates for post-harvest regenerated stands in TFL 38. Contract Report to Gerry Sommers, International Forest Products Ltd.,Vancouver, B.C. 19 pp. March 18, 1997.

1.3 Objectives

The objective of this paper is to:

> *Present reasonable estimates of average site index for Fd, Hw, Ba, and Cw for the major ecosystems in TFL 38 for use in an alternate scenario to the Base Case in the timber supply analysis for Management Plan 8.*

This alternate scenario will be based on site indices that better reflect expected growth of PHR stands in the TFL. These estimates are based on the best available information from MOF sources and are conservative where information is not strong.

1.4 The Old-Growth Inventory

1.4.1 Age and Site Index

A brief review of the TFL 38 inventory and the methods used to estimate site index provides some background to identify some of the problems in using old-growth site indices stands to predict the growth of PHR stands. The major issue relates to the stand age estimated in former inventories, and the resulting estimates of site index and yield from these estimated ages. Currently, over 75% of the TFL contains stands too old and large to age with increment borers in traditional inventory sampling. Thus, as is common practice on the coast, these old stands were assigned to age class 9 (> 250 yrs).

As demands of the inventory data increased over time, the estimated heights and ages were used to estimate site index to represent the productive potential to grow PHR stands. This was done using an arbitrarily assigned age of 320 years and estimates of height that were most often from air photo interpretation.[3] This assignment of these arbitrary ages was adequate for the intent of the inventories that focused on standing yield, but is not adequate for estimating site index that relies on accurate estimates of ages from carefully selected trees.

The site index of these old-growth stands was then estimated from curves developed for much younger second-growth stands (Bruce for Fd, Wiley for Hw, and Kurucz for Ba). The range of ages in the data used to develop these curves was up to 80 years for Fd, 130 years for Hw, and 160 years for Ba. Thus, estimating site index required extrapolating the estimated heights and ages back to the range of the data. This is an extrapolation back from the arbitrary age of 320 years for 240 years for Fd, 190 years for Hw, and 160 years for Ba. An additional extrapolation is then required for 30, 80, and 110 years back to index age of 50 years to estimate site index. The result of this process is that the appropriate site index to portray the height growth of PHR stands is

[3] Current SIBEC and OGSI standards requires aging trees to within 1% for old-growth and no error in second growth – this is in wide contrast to the differences of hundreds of years in the estimated ages and the actual ages of stands in the inventory that are currently accepted for estimating site index.

under-estimated. The use of these old-growth site indices to estimate the productivity for PHR stands in the Base Case scenario inherently suggests that this accurately reflects the expected growth of these stands. All information and research to date suggests that this is not true.

1.4.2 Yield Prediction

The key issue is not site index alone but how it is used to estimate yield. The appropriate site index for yield prediction is the one used in development of the prediction system. Site index is only a predictor variable that is closely related to yield. Any type or definition of site index, or any other variable can be related to yield in a prediction model. Some predictors are better than others, and thus provide more accurate estimates. Site index is a very good predictor of yield because it is based on the height growth of the largest trees in the stand, it is very closely related to stand volume, and it is very predictable. However, use of a predictor variable that is different from the one used in development of the system will bias the resulting estimates. This is the underlying problem that arises from using site indices estimated in old-growth stands to predict the yield of PHR stands using TIPSY.

2. METHODS

2.1 Overview

The site indices recommended for the alternate scenario are based on the strength of information available for Fd. The average site index for Fd in PHR stands was estimated from over 200 plots with reliable data from the MOF provincial SIBEC and PSP programs. These plots are located in the same ecological conditions as the TFL. The average site index for Hw was estimated using the conversion equation developed by the MOF Research Branch and Gordon Nigh.[4] The average site index for Ba and Cw was then estimated to be slightly lower than for Hw, based on our field experience in observing the relationship between the site indices of these species. No data were available to estimate the site indices for Hw and Ba for the higher elevation areas, thus estimates were derived from the opinions and experience of three expert ecologists with knowledge of the ecological conditions of the area.

2.2 Data Sources

The best information to describe potential productivity is measurements of site index from the PHR stands on the TFL. However, currently there are no survey data available for this area. The next best alternate source of information is the MOF SIBEC and PSP databases that contain estimates of average site index for the same ecological conditions as the TFL. Data from these programs provide the basis for the following recommendations.

[4] Nigh, G.D. 1995. Site index conversion equations for mixed species stands. Min. For. Res. Br., Res. Rep. No. 01. 20 pp.

2.3 CWH Biogeoclimatic Zone

2.3.1 Douglas-fir

The most reliable site index data for the CWHms1 and CWHds1 subzones in the TFL are for Fd. For the CWHms1, the MOF SIBEC database estimates the site index of Fd as 22.5 m (ranked as high reliability), and the PSP database estimates the average for Fd as 23.2 m from 94 plots. These estimates are very consistent and should be highly reliable considering the large number of plots used to compute these averages. The arithmetic average of these two estimates is 22.85 m for Fd in the CWHms1 (rounded to 23 m).

For the CWHds1, the estimates are similar but slightly higher. The MOF SIBEC database estimates the average site index for Fd as 23.9 m (ranked as medium reliability), and the PSP database estimates the average as 25.4 m from 118 sample plots. The arithmetic average of these two estimates is 24.65 m for Fd in the CWHds1 (rounded to 25 m).[5]

2.3.2 Hemlock

There are fewer data available for Hw than for Fd, therefore, we recommend estimating the average site index for Hw in the CWHms1 and CWHds1 using the site index conversion equations developed by the MOF Research Branch and Gordon Nigh.[6]

The basis for the Hw prediction is the strength of the Fd data and confidence in the MOF prediction equation. The site index of Hw is closely related to the site index of Fd on average, and thus having a good estimate for one species provides the information to predict the site index of the other. On average, our experience is that the site index of Hw is lower than Fd growing on the same site by about 2 – 5 m, depending on ecological conditions. This trend is reflected in the MOF conversion equation:

$$SI(Hw) = -0.432 + 0.899\ SI(Fd)$$

For the two main subzones in the TFL, this equation predicts the average site index for Hw as:

CWHds1: SI (Hw) = -0.432 + 0.899 (25) = 22 m
CWHms1: SI (Hw) = -0.432 + 0.899 (23) = 20 m

In both subzones, the estimated average site index for Hw is 3 m lower than for Fd.

[5] A useful benchmark to consider in evaluation of these averages for Fdc is that the overall average site index for Fdi in Weldwood's TFL 5 near Quesnel, B.C. was estimated as 22.1 m. (J.S. Thrower and Assoc. Ltd. 1994. Potential site index of Douglas-fir, lodgepole pine, and spruce on Weldwood's TFL 5. Contract Rep. to Weldwood of Canada Ltd., Quesnel, B.C. 35 pp.)

2.3.3 *Cedar and Balsam*

We recommend that the site index for Cw and Ba is 2.0 m lower than for Hw. This is based on our field observations that the site index of Ba and Cw is usually slightly lower than Hw. For many areas the site index for Ba is the same and sometimes higher than Hw. However, using a site index that is 2 m lower will provide conservatism to reflect this uncertainty. The site index of Cw also varies in relation to Hw and depends on ecological conditions. These are realistic estimates but are probably conservative.

2.4 MH Biogeoclimatic Zone

There are very few data on the productivity of managed stands in the MH zone. Thus, estimates for the average site index for Hw and Ba in this area were derived through consultation from three expert ecologists, including Karl Klinka, Bob Green, and Allan Banner (see previous report). These experts suggest that a reasonable average is 12 m for Ba and 11 m for Ba in these higher elevation areas.

2.5 Other Zones and Species

The proportion of area in the TFL for other BEC subzones and species is very small. Therefore, assumptions for these areas will have very little impact on analyses. The site index for the Fd, Hw, and Cw in these areas can be assigned an average of the values for the CWHms1 and CWHds1. Alternatively, these site indices could be assigned the currently inventory values.

3. RESULTS

3.1 PHR Site Indices

The following summarizes our recommendations for site indices to use in an alternate scenario to the Base Case in the timber supply analyses for Management Plan 8. Site indices for Fd were based on reliable estimates for averages in the CWHms1 and CWHds1 from MOF data in the same BGC subzone from the SIBEC and PSP databases. The average site index for Hw was estimated using site index conversion equations developed by the MOF Research Branch and Gordon Nigh. Estimates for Cw and Ba were related to the Hw estimates based on our field experience and observations of these relationships. Estimates for Hw and Ba in the MH were developed through consultation with three expert ecologists.

3.2 Comparison to Inventory Estimates

These alternate scenario site indices are higher than indicated in the inventory for all species-subzones, except Cw in the CWHds1. Differences for Hw are generally the largest and Cw is the

[6] This was acknowledged as a reasonable approach in the March 18 meeting with the MOF (Gordon Nigh, Albert Nussbaum, and Bud Koch).

lowest. These site indices are still probably conservative, and are lower than averages observed for some interior areas of the Province. The recommended site indices for the MH are only marginally different from the inventory. This is largely to reflect the uncertainty of the productivity in these high elevation areas. These alternate scenario estimates are much lower than suggested by the MOF.[7] This is because the MOF interim estimates are intended to reflect coastal averages, and not transitional areas that are generally somewhat lower in productivity.

Table 1. Site indices recommended for the alternate scenario.

BGC Subzone	Species	Recommended Average Site Index (m)	Information Source
CWHms1	Fd	23	MOF PSP and SIBEC data base
	Hw	20	MOF Conversion Equations
	Ba	18	Field experience
	Cw	18	Field experience
CWHds1	Fd	25	MOF PSP and SIBEC data base
	Hw	22	MOF Conversion Equations
	Ba	20	Field experience
	Cw	20	Field experience
MHmm2	Hw	11	Expert Opinion
	Ba	12	Expert Opinion

Table 2. Comparison of recommended site indices with inventory and MOF recommendations.

BEC Subzone	Leading Species	Inventory Site Index (m)	Alternate Scenario Average Site Index (m)	Alternate Scenario Diff. From Inventory (m)	MOF Interim Estimates Average Site Index (m)	MOF Interim Estimates Diff. From Inventory (m)	Productive Forest Area of TFL (%)
CWHds1	Fdc	21.4	23	+ 1.6	27	+ 5.6	5.8 %
	Hw	15.2	20	+ 4.8	22	+ 6.8	12.7 %
	Ba	NA	18	NA	NA	NA	
	Cw	19.4	18	- 1.4	23	+ 3.6	2.1 %
CWHms1	Fdc	20.5	25	+ 4.5	27	+ 6.5	17.3 %
	Hw	12.7	22	+ 9.3	22	+ 9.3	3.5 %
	Ba	14.2	20	+ 5.8	NA	NA	10.3 %
	Cw	18.3	20	+ 1.7	23	+ 4.7	17.7 %
MHmm2	Hw	9.3	11	+ 1.7	22	+ 12.7	11.5 %
	Ba	10.6	12	+ 1.4	23	+ 12.4	8.5 %

[7] Ministry of Forests. 1995. Memo to all district managers from Janna Kumi regarding 'Procedures for obtaining Site Index for Silviculture Polygons in ISIS and MLSIS.' Attached memo by Pat Martin 'Recommendations to Silvicluturalists on Obtaining Site Index.'