Second-Growth Site Index Estimates for Douglas-fir, Western Hemlock, Pacific Silver Fir, and Western Redcedar on TFL 46

Version 2.0

Prepared for

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Executive Summary

Second-growth site index (SGSI) estimates were developed for coastal Douglas-fir (Fdc), western hemlock (Hw), Pacific silver fir (Ba), and western redcedar (Cw) for the forested ecosystems on Tree Farm Licence 46. These SGSI estimates will be used to generate managed stand yield tables for the next timber supply analysis for Management Plan 4.

SGSI estimates were developed using four different methods:

1. statistical adjustment of ecologically-based preliminary site index estimates (CWHxm2, CWHmm1, CWHmm2, and CWHvm1),
2. elevation model (CWHvm2),
3. unadjusted preliminary SGSI (MHmm1), and
4. localized site index conversion equations (for Ba and Cw throughout the TFL).

The final average SGSI estimates vary for the four main species. Average SGSI for Fdc and Hw are approximately 24% and 10% higher, respectively, than the current forest cover inventory site index estimates. SGSI for Ba decreased 10% and Cw SGSI remained unchanged. The new SGSI estimates should better reflect growth in second-growth stands on TFL 46. These estimates should be monitored and updated as new information becomes available.

Adjustment Formula	Ba	Cw	Fdc	Hw
Inventory Avg Site Index (m)	24.8	25.2	26.3	25.6
Avg PSI (m)	22.4	25.4	32.7	28.2
Difference (m)	-2.4	0.2	6.4	2.6
Difference (%)	-9.5	1.0	24.2	10.3

The major contribution of this project is that new SGSI estimates are available at the eco-polygon level. This provides a spatial distribution of site index estimates across the TFL and will improve the timber supply analysis and contribute to better planning and forest management.

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1. INTRODUCTION

1.1 BACKGROUND

Site index[1] is a function of height and age and is the single most important variable used in models to develop yield tables. Traditionally, site index has been determined using photo-interpretation of the current forest cover. However, site index for future second-growth stands is generally under-estimated for stands currently older than 140 years because tree damage and suppression are difficult to detect from the photo. Additionally, accurate height estimates are difficult to obtain for young second-growth stands (less than 40 years old). On TimberWest Forest Ltd. (TimberWest) Tree Farm Licence (TFL) 46, over one third of the operable forest landbase (OFLB) is older than 140 years and an additional 20% is too young to provide accurate site index estimates (Appendix 1).

In 1995, a site index project was completed on TFL 46 to provide reliable site index estimates for second-growth stands. Accurate site index estimates are important to provide a realistic forecast of predicted yield for the upcoming timber supply analysis.

1.2 OBJECTIVES

The objectives of this project were to:

1. *Develop reliable second-growth site index (SGSI) estimates for second-growth stands for the major commercial tree species and ecosystems on TFL 46.*
2. *Quantify the difference between the ecologically-based second-growth site index and the current site index in the inventory.*
3. *Study the impact of applying a site series based second-growth site index to ecologically complex eco-polygons.*[2]

The main commercial species on TFL 46 are coastal Douglas-fir (Fdc), western hemlock (Hw), Pacific silver fir (Ba), and western redcedar (Cw). Site index estimates will be applied at the eco-polygon level to develop reliable yield tables for the timber supply analysis for Management Plan 4.

1.3 TERMS OF REFERENCE

This project was completed for Jim McPhalen, *RPF* of TimberWest. This report was prepared by Guillaume Thérien, *PhD*, Christie Staudhammer, *MSc,* and Céline Boisvenue, *MSc, RPF* of J.S. Thrower and Associates Ltd (JST). Funding for the project was provided through Forest Renewal BC.

[1] In BC, site index is defined as the top height of a stand at 50 years, breast-height age.
[2] Eco-polygons are polygons from the Terrestrial Ecosystem Map.

2. METHODS

2.1 OVERVIEW

The SGSI estimates were developed in three phases:

Phase 1: **Preliminary SGSI estimates** were developed for the major commercial tree species and ecosystems on TFL 46 using the knowledge and experience of experts in coastal forest productivity and ecosystem classification.

Phase 2: **Field sampling** was completed to estimate site index in random plots throughout the TFL.

Phase 3: **Final SGSI estimates** for the different species were developed using four different methods (Table 1).

i) Statistical adjustment of preliminary SGSI estimates (AdjSGSI) from field sampling.
ii) Elevation model.
iii) Unadjusted preliminary SGSI (PSGSI).
iv) Ministry of Forests (MOF) site index conversion equations (ConvEqn).

Table 1. Final SGSI estimation method.

Variants	Site Series	Species			
		Ba	Cw	Fdc	Hw
CWHxm2, CWHmm1, CWHmm2 & CWHvm1	All	AdjSGSI	ConvEqn	AdjSGSI	AdjSGSI
CWHvm2	All	AdjSGSI	ConvEqn	AdjSGSI	AdjSGSI
MHmm1	All	PSGSI			PSGSI

2.2 PHASE 1 – PRELIMINARY SGSI ESTIMATES

Preliminary second-growth site index estimates were developed by Bob Green, *MSc*, *RPF* and Tara McCormick, *BSc* for Fdc, Hw, and Ba in 1999 (Appendix I). These experts used their collective knowledge of the ecosystems and forest productivity of the TFL as well as SGSI estimates developed for TFL 37 and the SIBEC database to produce these estimates. The average preliminary SGSI estimates for the entire TFL were 31.9 m, 26.8 m, and 27.7 m for Fdc, Hw, and Ba respectively (Table 2).

Table 2. Preliminary SGSI estimates (m) statistics.

Spp	Area (ha)	Avg Si	Min	Max
Ba	95,432	27.7	8.0	40.0
Fdc	95,466	31.9	18.0	40.0
Hw	97,755	26.8	8.0	32.0

2.3 PHASE 2 – FIELD SAMPLING

2.3.1 Objectives

The objective was to measure height and age of site trees to determine site index from a representative sample of second-growth stands and ecological conditions in the TFL. The field site index estimates were then compared to the preliminary SGSI estimates to develop a ratio to adjust preliminary SGSI estimates across the TFL.

2.3.2 Target and Sample Populations

The target population was the OFLB (97,755 ha), which is where SGSI estimates will be applied. The sample population includes all Fdc, Hw, and Ba leading stands greater than 3 ha between 21 and 120 years old in the CWH zone (as of May 1st, 1995). The CWHvm2 variant was removed from the sample population since productivity is negatively correlated with elevation in this variant. The sample population, without the CWHvm2 component, was 35,002 ha (36% of the OFLB). The sample population has not sufficiently changed between 1995 and 1999 to warrant additional sampling on the TFL.

The sample population is all areas where a reliable estimate of actual site index could be obtained. While the sample was somewhat different from the sample population, it corresponded adequately to the target population across subzones (Figure 1).

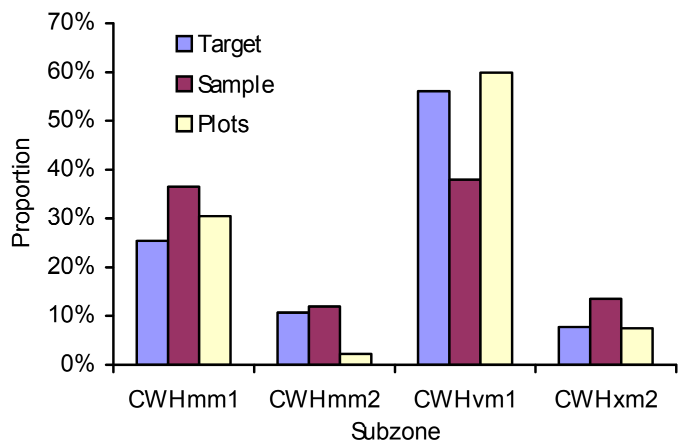

Figure 1. Area proportion (%) by BEC subzone in the target and sample populations, and the sample.

2.3.3 Sample Size and Allocation

Field data was collected from 86 400-m^2 (11.28-m radius) plots located throughout the sample population between May and July 1995. Sample polygons were selected with probability proportional to area and a sample point was then randomly selected within each polygon using a 10-m grid. Universal Transverse Mercator (UTM) coordinates for the random point were estimated from field maps.

Fertilized stands had not been mapped in 1995, so field crews relied on information from TFL 46 foresters to avoid establishing plots in fertilized stands. However, a recent map showed that 17 plots were established in fertilized stands; these were dropped from the analysis.

Mapping of biogeoclimatic units on the TFL has changed since 1995. Two sample plots are now located in the MHmm1 subzone and were dropped from the analysis. Five plots, reclassified to the CWHvm2 variant, were also dropped since an elevation model will be used to develop SGSI estimates in this subzone. Sixty-two plots were used in the adjustment procedure.

2.3.4 *Site Index*

Site index was estimated using *SiteTools* (version 3.0) from height and age measurements for the three target species in each plot. Two plots contained all three species and 12 plots contained two species, which resulted in 78 site index observations (31 Fdc, 30 Hw, and 17 Ba). The average field site index estimates were 33.2 m, 28.9 m, and 24.4 m for Fdc, Hw, and Ba respectively (Table 3).

Table 3. Field site index (m) statistics.

Spp	N	Avg	Min	Max	Std Dev
Fdc	31	33.2	16.3	45.4	6.65
Hw	30	28.9	16.8	36.8	5.96
Ba	17	24.4	17.0	36.1	4.96

2.4 PHASE 3 – FINAL SGSI ESTIMATES

2.4.1 Statistical Adjustment

Adjusted SGSI estimates were developed for Fdc, Hw, and Ba in all site series in the CWHmm1, CWHmm2, CWHvm1, and CWHxm2. The preliminary SGSI estimates for each eco-polygon were adjusted using a ratio reflecting the relationship between preliminary SGSI and field site index estimates for each species. The coefficients of the model were estimated using the least-squares method where each observation was weighted by the portion of the sample cluster area inside the eco-polygon.[3]

2.4.2 Elevation Model

Experts in ecological classification recognize that site productivity in the CWHvm2 generally decreases with elevation. For most site series in this variant, site indices were assumed to decrease linearly as elevations increased from 450 m (the limit between CWHvm1 and CWHvm2) to 1,000 m (the limit between CWHvm2 and MHmm1).

A maximum and minimum site index was required for each site series to develop the rate of decrease. Equivalent site series were defined between the three variants (Table 4). For a given site series in the CWHvm2, the rate of decrease was calculated between:

- the adjusted SGSI estimate from the corresponding CWHvm1 site series (max SGSI), and
- the unadjusted SGSI estimate from the corresponding MHmm1 site series (min SGSI).

Table 4. Equivalent site series used in elevation model.

CWHvm1	CWHvm2	MHmm1
01	01	01
03	03	02
05	05	03
14	11	09

Note: Other CWHvm2 site series have not been mapped on TFL 46.

The rates of decrease were developed from Hw and Ba only. No preliminary SGSI estimates were available for Fdc in the MHmm1 variant. Instead, the Hw rate of decrease was used for Fdc.

[3] Weights were required because some clusters crossed eco-polygon boundaries.

2.4.3 Unadjusted Preliminary SGSI Estimates

Very few sampling opportunities existed in second-growth stands in the MHmm1 variant (2,177 ha, 2% of the OFLB). Forest productivity in the MHmm1 was assumed not to correlate with elevation because the range of productivity is small and climatic factors strongly influence productivity. For this variant, it was considered reasonable to use the unadjusted preliminary SGSI estimates.

2.4.4 Site Index Conversion Equation

A site index conversion equation was used to predict Cw site index from Hw site index. The equation has not been officially released by the MOF, but we received the permission to use it for this project.[4]

[4] Gord Nigh, *PhD, RPF,* MOF-Research Branch, personal communication, 1st March 2000

3. RESULTS

3.1 STATISTICAL ADJUSTMENT

3.1.1 Fdc

The average adjusted Fdc SGSI estimate for the CWHxm2, CWHmm1, CWHmm2, and CWHvm1 was 34.4 m with a sampling error of ±2.2 m (Table 5). This represents a 6.7% increase between the preliminary SGSI estimates and the field site index (Figure 2). The distribution of the final Fdc SGSI estimates has shifted slightly upward compared to the preliminary estimates (Figure 3).

Adjusted Fdc SI = 1.067 * prelim Fdc SI

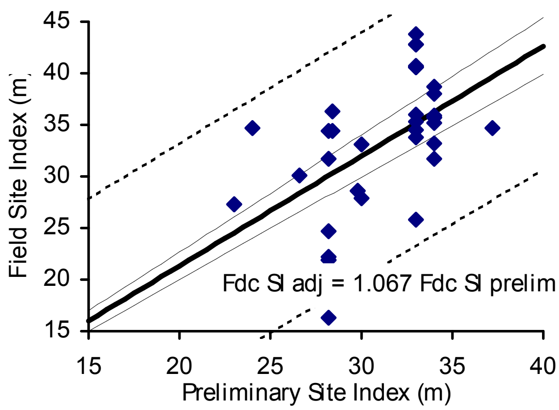

Figure 2. Field and preliminary site indices for Fdc (small dashed line is 95% confidence interval of observations; thin solid line is 95% confidence interval of the mean).

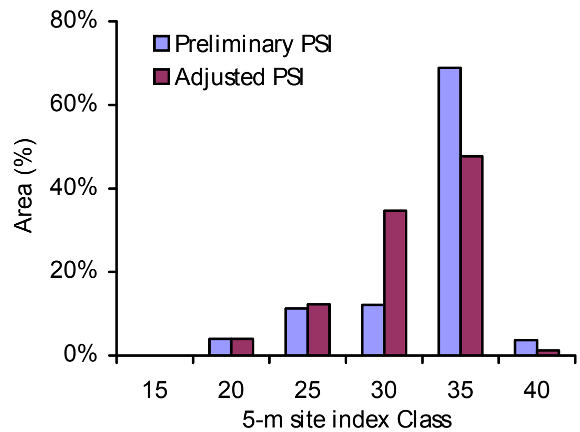

Figure 3. Fdc SGSI distribution, before and after statistical adjustment.

Table 5. Statistical adjustment statistics.

Spp	N	Ratio	SE of ratio	CI of Ratio (95%)	Avg Prelim SGSI	Avg Adj SGSI	SE of Adj SGSI	CI of Adj SGSI (95%)
Fdc	39	1.067	0.033	[1.000, 1.134]	32.2	34.3	1.1	[32.1, 36.5]
Hw	37	1.077	0.031	[1.013, 1.141]	27.2	29.1	0.9	[27.3, 30.9]
Ba	16	0.837	0.040	[0.751, 0.923]	28.4	23.8	1.1	[21.3, 26.2]

Note: N is greater than the number of sample plots because some plots crossed more than one eco-polygon.

3.1.2 Hw

The average adjusted Hw SGSI estimate for the CWHxm2, CWHmm1, CWHmm2, and CWHvm1 was 29.1 m with a sampling error of ±1.7 m (Table 5). This represents a 7.7% increase from the preliminary SGSI estimates (Figure 4). The distribution of the final Hw SGSI estimates has shifted slightly upward compared to the preliminary estimates (Figure 5).

Adjusted Hw SI = 1.077 * prelim Hw SI

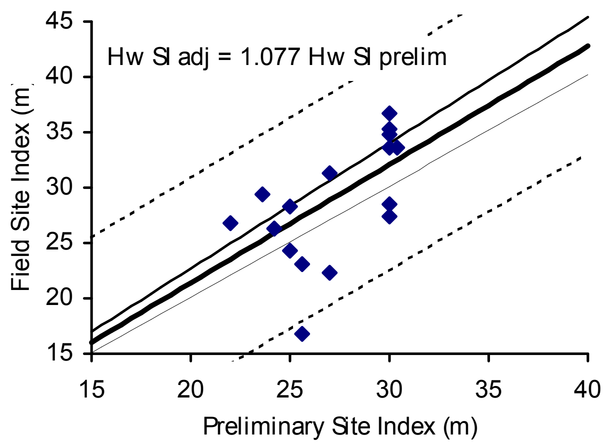

Figure 4. Field and preliminary site indices for Hw (small dashed line is 95% confidence interval of observations; thin solid line is 95% confidence interval of the ratio; weight is not represented).

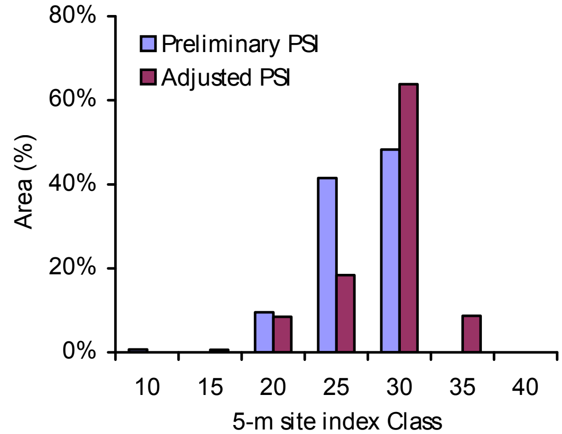

Figure 5. Hw SGSI distribution, before and after statistical adjustment.

3.1.3 Ba

The average adjusted Ba SGSI estimate for the CWHxm2, CWHmm1, CWHmm2, and CWHvm1 was 23.8 m with a sampling error of ±2.5 m (Table 5). This represents a 16.3% decrease from the preliminary SGSI estimates (Figure 6). The final Ba SGSI estimates have shifted downward compared to the preliminary estimates, mainly from the 30-m class to the 25-m class (Figure 7).

Adjusted Ba SI = 0.837 * prelim Ba SI

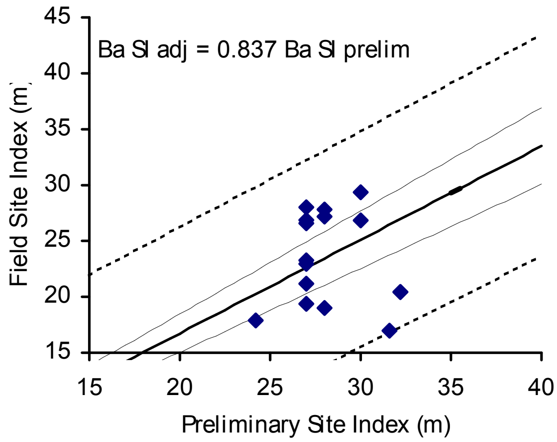

Figure 6. Field and preliminary site indices for Ba (small dashed line is 95% confidence interval of observations; thin solid line is 95% confidence interval of the mean).

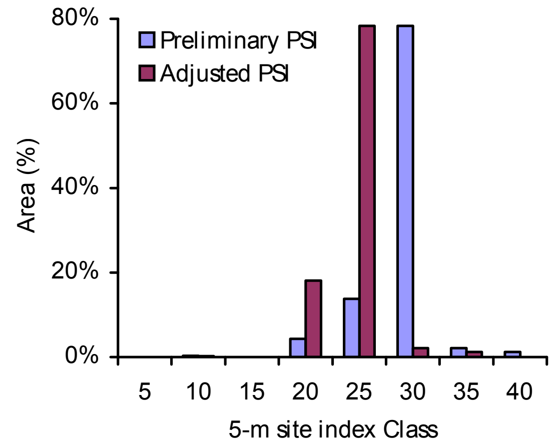

Figure 7. Ba SGSI distribution, before and after statistical adjustment.

3.2 Elevation Model

The rate of forest productivity decrease ranged from 2.7 to 2.8 m per 100 m gain in elevation for Fdc and Hw, and 1.2 to 1.9 m per 100 m gain in elevation for Ba (Table 6). The average site index for the site series where the elevation model was used was 24.4 m, 23.3 m and 19.4 m for Fdc, Hw, and Ba, respectively.

Table 6. Rate of decrease in productivity (m/100 m elevation gain).

Site Series	Ba	Fdc and Hw
01	-1.4	-2.8
03	-1.6	-2.7
05	-1.2	-2.8
11	-1.9	-2.7

3.3 Unadjusted Preliminary SGSI Estimates

The unadjusted preliminary SGSI estimates were used in the MHmm1. The average site index for this variant was 13.6 m and 14.4 m for Hw and Ba respectively.

3.4 Site Index Conversion Equation

The following site index conversion equation was used to estimate Cw from the final Hw SGSI:

$$\text{Cw SGSI} = -1.199 + 0.9545 \text{ Final Hw SGSI}$$

The average Cw SGSI in the CWHmm1, CWHmm2, CWHvm1, CWHvm2, and CWHxm2 was 25.7 m. Cw does not grow in the MHmm1.

4. DISCUSSION

4.1 Target and Sample Populations

In a sampling design, the sample population is usually identical to the target population. However, in cases where the variable of interest (site index) cannot be measured throughout the target population, sampling is limited to a subset of the target population. Therefore the relationship between preliminary and field site index must be assumed to be identical on a given ecological unit in the target and sample populations to infer results from the sample population. This is considered a safe assumption as site series is independent of age and leading species, which were the criteria used to define the sample population.

4.2 Adjustment Ratios

There are many unbiased estimators of the relationship between preliminary and field site index estimates that can be used. The weighted least-squares method without intercept was considered the most appropriate estimator because the variation in field site index appeared constant across the range of preliminary SGSI estimates. The average final SGSI for Fdc and Hw were similar to the site indices observed on TFL 37. This indicates that the adjusted SGSI estimates are reasonable, despite the variation in the adjustment ratios.

4.3 Variation Between Preliminary and Field Estimates

The variability in the adjustment ratios resulted in precision ranging from ± 1.7 m to ± 2.5 m for the average final SGSI estimates (Table 6). This range was not unexpected as there are many sources of variation that cannot be controlled by the sampling design. The four main sources of variation are:

1. within-site series variation,
2. within-polygon variation,
3. mapping error, and
4. different bias trends in the relationship between preliminary and field estimates.

4.3.1 Within-Site Series Variation

Forest productivity variation within a site series is the major source of variation in the relationship between SGSI and field site index estimates. Site index on any individual site series can deviate by 2 to 3 m from the average site index due to local variation in environmental and climatic factors.

4.3.2 Within-Polygon Variation

There are approximately 34,430 ha (34% of the OFLB) of complex site series in the OFLB database. The preliminary SGSI estimate for these eco-polygons is a weighted average of the preliminary SGSI estimates for all the site series within the eco-polygon. If a cluster is established in an ecologically complex eco-polygon, sampling may occur on site series not identified on the eco-polygon map. This difference introduces variation in the relationship between preliminary SGSI and field site index estimates.

On TFL 46, within-polygon variation appeared to have a minor impact on the overall variation. The standard error of the ratios was marginally better when sample plots from homogeneous eco-polygons were considered separately (Table 7). The gain in precision due to ecological homogeneity of the polygons was offset by the reduced sample size.

Table 7. Ratio statistics for ecologically homogeneous polygons.

Spp	N	Ratio	SE of ratio	CI of ratio (95%)
Ba	5	0.885	0.063	[0.710, 1.060]
Fdc	23	1.112	0.032	[1.054, 1.186]
Hw	25	1.106	0.030	[1.045, 1.168]

4.3.3 Mapping Error

There were three sources of mapping error on TFL 46:

1. It was difficult to confirm whether a polygon had been fertilized or not from the historical records. Plots retained for analysis may have been located in fertilized stands or plots from unfertilized stands may have been dropped from the analysis.
2. Mapping from an aerial photograph can be imprecise and some polygon lines or labels may not reflect the actual site series on the ground.
3. There is often a difference of a few meters between polygon boundaries on the map and the boundaries on the ground. For plots located close to eco-polygon boundaries, the map polygon may be different from the ground polygon. This error increases as mapping resolution increases and smaller polygons are delineated.

The standard error of the Fdc adjustment ratio decreases substantially for ecologically homogeneous polygons where the site series on the ground was the same as on the map (Table 8). A more careful reconciliation between the map and the ground information may have improved the precision of the Fdc adjustment ratio, but not the Hw ratio.

Table 8. Ratio statistics for polygons with same site series on the map and the ground.

Spp	N	Ratio	SE of ratio	CI of ratio (95%)
Fdc	6	1.015	0.026	[0.950, 1.082]
Hw	9	1.104	0.043	[1.006, 1.204]

4.3.4 Different Bias Trends in the Relationship Between Preliminary and Field Estimates

Ideally, each species and site series combination should have a unique adjustment ratio. However, this would make sampling too costly as each combination would require an independent sample. To reduce sampling costs, it is safe to assume that the same adjustment ratio applies to a group of site series. This assumption introduces a source of variation, but it is a reasonable compromise between sampling costs and precision.

4.4 APPLICATION IN TIMBER SUPPLY ANALYSIS

The final SGSI estimates should be slightly higher than the site index estimates in the current inventory database. For polygons where the inventory site index estimates are reliable (Fdc or Hw leading, age 41 to 120 years), SGSI estimates are the same as inventory site index for Fdc polygons and about 15% higher for Hw polygons (Table 9). There is not enough area in other leading species to be meaningful.

Table 9. Comparing current inventory to adjusted SGSI estimates (age between 41 and 120 years).

	Area	Site Index		Difference	
Spp	(ha)	Current	Adjusted SGSI	(m)	(%)
Fdc	9,535	27.0	26.6	-0.4	-1.6%
Hw	4,670	25.1	29.1	4.0	15.9%

When the entire OFLB is considered, the change in site index for Fdc is important with a 24% gain (Table 10). Hw site index increases by 10%, Cw remains unchanged and Ba site index decreases 10% in future second-growth stands.

Table 10. Comparing current inventory to SGSI estimates (entire OFLB).

	Site Index		Difference	
Spp	Current	Adjusted SGSI	(m)	(%)
Fdc	26.3	32.7	6.4	24.2
Hw	25.6	28.2	2.6	10.3
Cw	25.2	25.4	0.2	1.0
Ba	24.8	22.4	-2.4	-9.5

The main contribution of this project is the spatial resolution of site index estimates for second-growth stands for use in timber supply analysis. Previously, site index was assigned to an entire forest cover polygon. The new SGSI estimates, developed at the eco-polygon level, create a more realistic estimate of the spatial timber supply and should contribute to better planning and forest management.

5. RECOMMENDATIONS

1. **Use the new SGSI estimates in the MP 4 timber supply analysis.**
   The final SGSI estimates represent the best forest productivity estimates for TFL 46. They should provide a more accurate estimate of the long-run sustained yield in future timber supply analysis. We recommend that these be used to generated the yield tables for second-growth stands on the TFL for the timber supply analyses for MP 4.

2. **Update these SGSI estimates frequently.**
   The SGSI estimates reflect the best information currently available on TFL 46. However, these estimates should be updated as old-growth stands are harvested and replaced with second-growth stands. Silviculture surveys, monitoring plots, and special surveys and projects are potential sources of information.

3. **Improve estimates of site index for the higher elevations.**
   SGSI estimates at higher elevations were not based on field data because there are few areas to measure SGSI accurately. The elevation model and unadjusted SGSI estimate will provide better information than is currently available in the inventory. However, we recommend that special studies be conducted to quantify forest productivity at higher elevations. Productivity of mountain Hemlock (Hm) in the MHmm1 should also be studied.

4. **Monitor the growth of PHR stands**
   There is some uncertainty in the new SGSI estimates resulting from the sampling design and site index prediction methods. We recommend that the growth of PHR stands be periodically monitored to ensure the SGSI estimates and the associated growth and yield continue to adequately represent the actual conditions of the TFL.

APPENDIX I – TFL 46 LANDBASE

Location

TimberWest's TFL 46 is located on the west coast of southern Vancouver Island between Lake Cowichan and Port Renfrew (Figure 8). It covers 108,389 ha, of which 97,755 ha (90%) is the OFLB (Table 11). The TFL is composed of seven different blocks that are managed as one unit. The current allowable annual cut is 535,000 m^3.

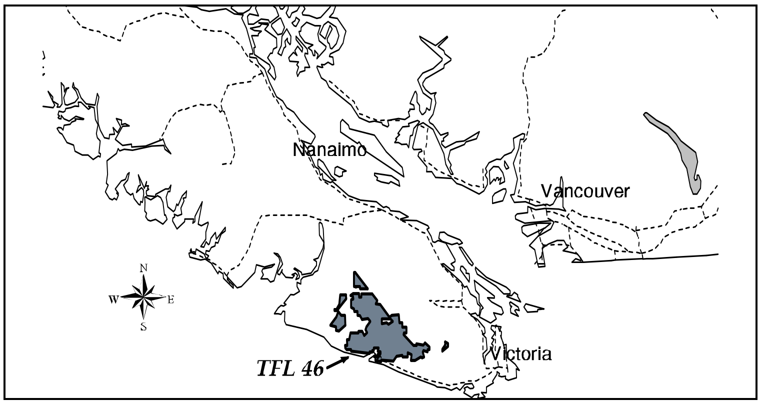

Figure 8. Location of TFL 46 on Vancouver Island.

Table 11. Area breakdown for TFL 46.

Description	Area (ha)
Entire TFL	108,389
Non-Forested	5,399
Forested	102,990
Non-Productive	780
Productive	102,210
Non-Operable	4,455
Operable	97,755

Forest Cover

Fdc and H (both Hm and Hw) are the most common species on the TFL, accounting for more than 75% of the OFLB (Table 12). Cw and Ba are the two other important species (18% of the OFLB). Other species on the TFL include red alder (Dr), yellow cedar (Yc), Sitka spruce (Ss), bigleaf maple (Mb), white pine (Pw), and cottonwood (Ac). Approximately one third of the TFL is older than 140 years. Harvesting has been relatively constant in the last 60 years, with 1% of the TFL being regenerated annually.

Table 12. Area distribution of species by age class in TFL 46.

Leading	Age Class (yrs)								Total	
Spp	0-20	21-40	41-60	61-80	81-100	101-120	121-140	141+	ha	%
Fdc	6,599	18,646	10,645	1,765	263	25	19	2,032	39,994	40.9
H	10,605	4,088	4,858	2,363	827	122	18	12,955	35,836	36.7
Cw	1,446	62	21	26	4	1		9,505	11,065	11.3
Ba	1,450	484	205	79	8	6	2	4,444	6,678	6.8
Dr	15	177	834	929	3				1,959	2.0
Yc	224					35		1,663	1,922	2.0
Ss	18	17	4	110	19	3	0	25	197	0.2
Mb			38	39				3	80	0.1
Pw		16	1		2			0	19	0.0
Ac			2	3					6	0.0
Area (ha)	20,358	23,490	16,609	5,315	1,125	192	39	30,626	97,755	
(%)	*20.8*	*24.0*	*17.0*	*5.4*	*1.2*	*0.2*	*0.0*	*31.3*		*100*

Ecological Classification

Approximately 98% of the TFL is in the CWH biogeoclimatic zone (the rest is in the MH zone). The CWHvm1 variant occupies nearly 50% of the CWH zone and the remainder is split between the CWHmm1, vm2, mm2, and xm2 variants (Figure 9).

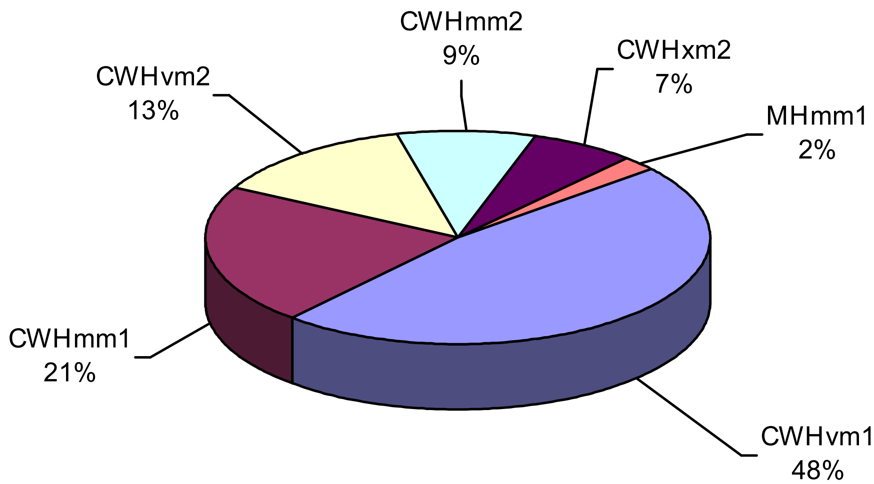

Figure 9. Distribution of variants on TFL 46.

APPENDIX II – PRELIMINARY SECOND-GROWTH SITE INDEX ESTIMATES

Table 13. Preliminary site index estimates.

	CWHmm1			CWHmm2			CWHvm1			CWHxm2			MHmm1	
Site Series	Fdc	Hw	Ba	Fdc	Hw	Ba	Fdc	Hw	Ba	Fdc	Ba	Hw	Hw	Ba
01	33	27	30	30	25	28	34	30	29	33	27	30	15	16
01s							26	25	25	26	24	25		
02	20	12	12	18	10	10	20	12	12	20	12		8	8
03	25	20	23	22	18	23	29	23	21	25	20		16	17
04	28	22	26	25	20	24	29	25	24	28	22	26	15	16
05	37	28	36	35	26	34	37	31	29	37	28	36	18	19
06	34	28	30	31	27	28	34	31	30	34	28	30	10	10
06s							26	23	23	26	23	25		
07	40	28	40	31	27	28	38	32	31	40	28	40	11	11
08	43	28	40	38	26	38				43	28	40	8	8
09				8	8	8	38	32	31				8	8
10					21		24	24	26					
11		8					20	20	21		8			
12	24	23						23	23	24	23			
13								8	8					
14							24	23	23					