Timber Supply Review

Analysis Report – Pacific TSA

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Prepared for:

BC Timber Sales
Strait of Georgia, Seaward-Tlasta, and Skeena Business Areas

BRITISH COLUMBIA

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Executive Summary

This report describes the timber supply analysis for the Pacific Timber Supply Area (TSA). The analysis involves testing and reporting on a variety of assumptions and management strategies. The purpose of this report is to provide the Chief Forester with sufficient information to make an informed Allowable Annual Cut (AAC) determination.

The following are described in this report:

- Base Case harvest forecast - models current management and tree growth in the Pacific TSA;
- Sensitivity analyses - used to assess the risk associated with Base Case assumptions;
- Alternate harvest flows investigating the impacts of alternate initial harvest levels;
- Investigations of harvest forecasts from specific geographic areas.

A portion of the Pacific TSA (56,605 ha) falls under the South-Central Coast Order (SCC), the Central North Coast Order (CNC) and the Great Bear Rain Forest Order (GBR) establishing Ecosystem Based Management (EBM). Under the *Great Bear Rainforest (Forest Management) Act*, the AAC for the portions of the Pacific TSA that fall within the GBR will be established by the Lieutenant Governor in Council by regulation. Following this, the Chief Forester would have authority to determine the AAC, and specify AAC partitions, for the areas of the Pacific TSA that fall outside the GBR. For this reason the GBR is excluded from the Pacific TSA Base Case.

The Base Case harvest forecast is illustrated in Figure 1. The initial harvest level of 688,245 m^3 per year is maintained for 10 years, before the harvest is reduced by 8.5% to 630,080 m^3 per year for another 10 years. The long-term harvest level of 612,520 m^3 per year (2.8% decline) is reached at year 21.

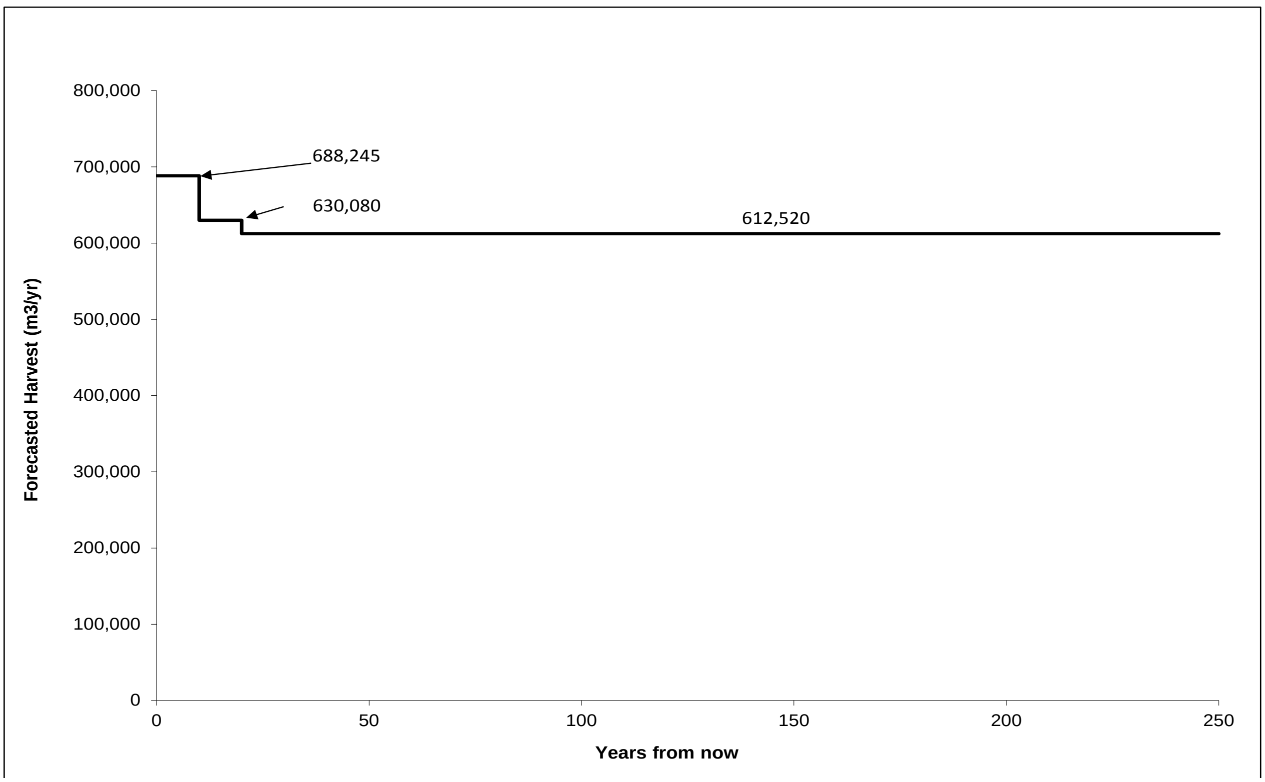

Figure 1: Base Case harvest forecast

The Base Case for this analysis is robust; downward pressures in the short term can be deferred to the medium and long term. The sensitivity analyses and alternate harvest flows demonstrate that timber supply crashes associated with changes to initial harvest level and/or analysis assumptions do not generally occur until late in the planning horizon, if at all. In most cases unsustainable harvest levels are apparent only in the long-term decline of the growing stock. This delayed response reduces the risk associated with a given short-term harvest level, as it allows future AAC determinations to respond to new information and management regimes.

The sensitivity analyses revealed that changes in analysis assumptions had generally small or negligible impacts with a few exceptions:

- As expected, increasing or decreasing managed stand yields had an impact on the long-term harvest level (LTHL) similar to the magnitude of change in stand yields. A 10% yield increase produced an approximately 10 % higher LTHL, while a similar decrease in stand yields reduced the LTHL by approximately 10%.
- Several sensitivity analyses were completed investigating the impact of changes to the size of the economically operable land base. These sensitivity analyses demonstrated that the impact of increasing the economically operable land base on timber supply is significant. This impact is mostly related to the economic operability of the helicopter land base and less to that of the conventional land base.
- The sensitivity analyses demonstrated that harvesting second growth stands at very young ages in lieu of the older stands would impact the long-term harvest level significantly and negatively. Ensuring that the entire harvest profile is harvested in the Pacific TSA is important for the sustainability of timber supply.

Two alternated harvest flows were completed for the Base Case land base: one with the initial harvest level at the current AAC of 1,279,731 m^3 per year (without the GBR contribution) and another where the initial harvest level was set at 950,000 m3 per year.

Maintaining the current AAC for the first 10 years resulted in significant timber supply deficits in the mid-term between years 66 and 135. It was also necessary to lower the LTHL from that of the Base Case somewhat to stabilize the growing stock. The long-term growing stock in this scenario remained significantly lower than that of the Base Case.

With the initial harvest level at 950,000 m^3 per year for the first 10 years, the late mid-term harvest level had to be decreased by 6.1% annually between years 61 and 105 to compensate for the increased harvest in the short-term. The LTHL settled at the same level as in the Base Case; however, the long-term growing stock stabilized at a lower level compared to the Base Case.

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. It is assumed that harvest in these areas is economic only during the market cycles with high log prices, while conventional harvest areas are assumed to be economic in average market conditions. The size of the THLB that falls within the helicopter harvest area in the Base Case is 9,367 ha.

The contribution of the helicopter harvest areas was investigated in this timber supply analysis. In the Base Case, the harvest from these areas fluctuates significantly with the average harvest over the planning horizon from the helicopter land base at 56,285 m3 per year.

When the helicopter land base was analysed independently, it produced a long-term harvest forecast of 56,765 m3 per year with a short-term harvest (10 years only) of 58,450 m3 per year.

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1 Introduction

1.1 Context

British Columbia Timber Sales (BCTS) is preparing a timber supply review (TSR) analyzing the strategic timber supply for the land base in the Pacific TSA. This analysis report is the second of three documents making up the TSR process summarizing the timber supply analysis results. The first document – the Information Package - documents the procedures, assumptions, data and model used in the analysis. The final document - the Rationale for AAC Determination - documents the Chief Forester's AAC determination and the rationale behind it. Section 8 of the *Forest Act* provides the legislative authority for AAC determinations and outlines the factors that must be considered by the Chief Forester during the process.

1.2 Timber Supply Analysis

This report describes the timber supply analysis for the Pacific TSA. Timber supply analysis examines the availability of timber volume for harvesting over time. It involves testing and reporting on a variety of assumptions and management strategies. The timber supply analysis provides the Chief Forester with information about the relationship between current management and timber supply. The purpose of this report is to provide the Chief Forester with sufficient information to make an informed Allowable Annual Cut (AAC) determination.

Timber supply analysis is intended to ensure that current harvest levels do not threaten the availability of future timber volume. Sustainability is therefore the key concept in this report and in timber supply analysis in general. However, the main indicator of sustainability in timber supply analysis is the long-term stability of growing stock, and therefore the continuous availability of timber for harvest. This analysis does not attempt to evaluate sustainability in terms of the wider range of biological, social, or economic values that are affected by timber harvesting. Because of its limited definition of sustainability, timber supply analysis is only one aspect of a larger decision-making process used to set the AAC.

1.3 Timber Supply Forecasts

A single harvest forecast is not sufficient to depict the timber supply dynamics of the Pacific TSA due to the complexity of factors affecting timber supply. There are uncertainties about how well the analysis assumptions reflect the realities of timber supply in the TSA and there are many options for setting harvest levels in response to the timber supply dynamics. Several forecasts are developed in this analysis to account for these uncertainties and options. The purpose of presenting different forecasts is to construct a complete understanding of the timber supply dynamics of the Pacific TSA. The following forecasts are presented in this report:

Base Case: The Base Case is the standard against which other forecasts are compared when assessing the effects of uncertainty on timber supply. In most timber supply analyses, the Base Case reflects the best available knowledge about current management activities and forest development in a management unit.

Sensitivity Analyses: Sensitivity analyses are used to determine the risk associated with uncertainties in the assumptions of the analysis. These forecasts isolate an area of uncertainty and test the implications of using a variety of assumptions.

Alternative Harvest Forecasts: Alternative harvest forecasts explore different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvests. Alternative forecasts enable the Chief Forester to assess short-, medium-, and long-term trade-offs.

2 Description of the Land Base

The Pacific TSA consists of 30 Blocks on Vancouver Island, the Sunshine Coast, the Mainland Coast, and Douglas Channel. Figure 2 shows the location of the Pacific TSA Blocks. The TSA overlaps parts of five natural resource districts: Coast Mountains (DKM), North Island-Central Coast (DNI), Campbell River (DCR), Sunshine Coast (DSC), and South Island (DSI). The Blocks range in size from 76 ha (Block 4) to over 400,000 ha (Block 28). An area summary of the TSA Blocks is shown in Table 1.

The Pacific Timber Supply Area (TSA) was established In July 2009 from an amalgamation of various tree farm license (TFL) areas taken back by the Province through the Forestry Revitalization Act (Bill 28, 2003). BCTS is the major operator in the Pacific TSA, holding approximately 93% of the AAC, with First Nations tenures making up the remaining cut.

At the time the TSR was initiated, the TSA was spread over three BCTS Business Areas (BA): Strait of Georgia (TSG), Seaward-Tlasta (TST), and Skeena (TSK). BCTS has since initiated a transition of TSA Blocks in the Sunshine Coast (Blocks 21, 22, and 23) from the TSG BA to the Chinook BA (TCH). This transition was completed March 31, 2016, however for the purposes of this analysis; all documentation associated with these Blocks will remain with a reference to TSG.

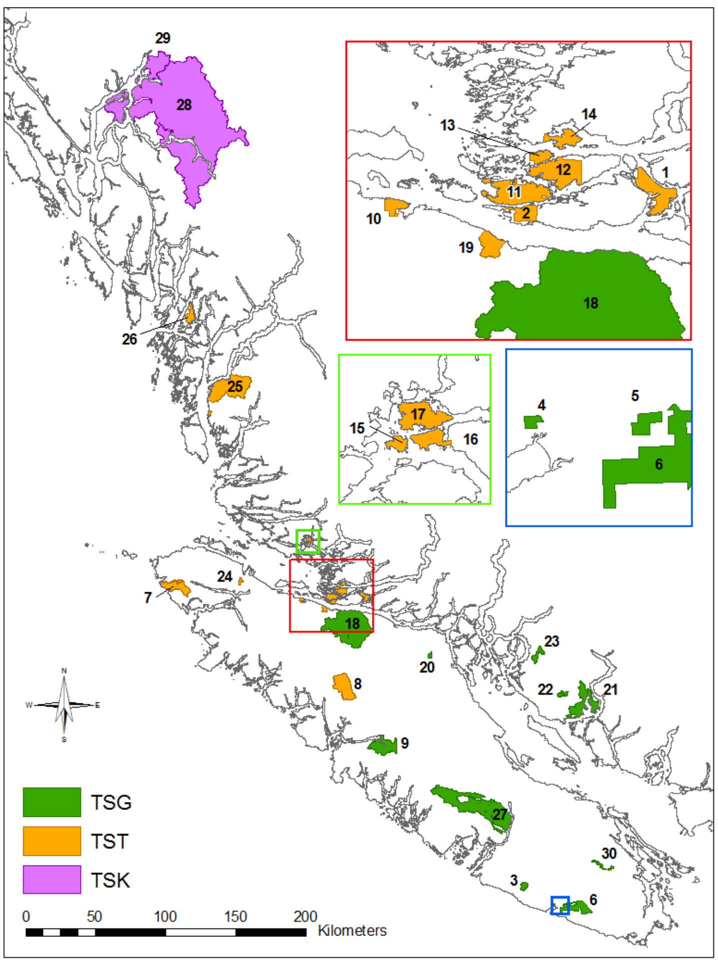

Figure 2: Pacific TSA Blocks, coloured by Business Area

Table 1: Pacific TSA Blocks, Natural Resource Districts, and Business Areas

Block	Block Name	District	Business Area	Total Area (ha)
1	East Cracroft Island	DNI	TST	2,336
2	West Cracroft Island	DNI	TST	1,017
3	Roseander	DSI	TSG	2,294
4	San Juan	DSI	TSG	76
5	San Juan	DSI	TSG	198
6	San Juan	DSI	TSG	10,233
7	Holberg	DNI	TST	11,400
8	Vernon Lake	DNI	TST	18,351
9	Burman/Jacklah	DCR	TSG	16,623
10	Beaver Cove	DNI	TST	798
11	Harbledown Island	DNI	TST	3,459
12	Turnour Island	DNI	TST	3,085
13	Village Island	DNI	TST	645
14	Gilford Island	DNI	TST	1,128
15	Kinnaird Island	DNI	TST	259
16	Burley Bay	DNI	TST	521
17	Watson Island	DNI	TST	1,114
18	Eve/Naka/Tsitika	DCR	TSG	59,145
19	South Kaikash	DCR	TSG	1,350
20	Farewell Lake	DCR	TSG	834
21	Granville/Lois (Hotham Sound)	DSC	TSG	20,604
22	Dodd	DSC	TSG	1,700
23	Theodosia	DSC	TSG	3,719
24	Quatse	DNI	TST	1,015
25	Doc Creek	DNI	TST	37,565
26	Yeo Island	DNI	TST	5,476
27	Sproat Lake	DSI	TSG	64,293
28	Douglas Channel	DKM	TSK	405,279
29	Wathl/Wathlsto	DKM	TSK	21,454
30	Hill 60	DSI	TSG	2,070
Total				**698,041**

2.1 Forest Inventory

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. Each inventory was converted to VRI format by the Forest Analysis and Inventory Branch (FAIB), projected to 2014, and then provided to Forest Ecosystem Solutions Ltd. (FESL). FESL combined all these separate inventories into one consolidated VRI for the entire Pacific TSA. See the Information Package for a more detailed description of the inventory.

2.2 Land Base Classification

2.2.1 Timber Harvesting Land Base

Land base assumptions define the land base classification in the Pacific TSA. The different classes are a result of a land base netdown. The netdown is an exclusionary process. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of netdown factors (e.g. inoperable) is often greater than the net area removed; a result of overlapping resource issues.

The TSA is classified in the following classes:

Excluded Land Base (EXLB) — private lands, non-forested areas and roads are excluded from the land base. These areas are excluded because they do not contain forest or are not managed by the Crown.

Crown Forested Land Base (CFLB) – the CFLB is identified as the broader land base that contains forest and can contribute towards meeting both timber and non-timber objectives (i.e. biodiversity).

Timber Harvesting Land Base (THLB) - the THLB is the portion of the CFLB considered to be physically, environmentally, economically and socially available for timber harvesting. It is productive forest land that is harvestable according to current forest practices and legislation.

Non-Harvestable Land Base (NHLB) – this is the portion of the CFLB where harvesting is not expected to occur according to current forest practices and legislation. The NHLB includes some areas that are currently not harvestable due to economic considerations. There is a possibility that some or all of these areas could become harvestable under different economic conditions.

The land base netdown is shown in Table 2. The netdown reductions are described in the Information Package.

Table 2: Pacific TSA netdown summary

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area		**698,041**
Not Managed by Crown	9,931	9,931
Non-Forest	259,515	264,157
Non-Commercial Brush	30,839	31,199
Roads	4,198	4,598
Crown Forested Land Base Area	**393,559**	
Parks and Protected Areas	9,604	11,050
Ungulate Winter Range	18,777	25,395
Wildlfe Habitat Areas	13,052	30,667
Marbled Murrelet Reserves	2,380	5,253
Class 1 Grizzly Bear Habitat (EBM)	592	725
Clayoquot reserves	3,112	5,526
Old Growth Management Areas	30,832	43,881
Preservation VQO areas	296	728
Terrain and ESA	45,440	70,093
Inaccessible Areas	28,806	244,132
Deciduous-leading Stands	2,932	5,083
Non-merchantable (low volume) Stands	43,740	386,422
Uneconomic Areas	74,708	137,773
Archeological Sites	661	840
Recreation Areas	513	2,840
Riparian Management Areas	5,616	28,313
High Value Fish Habitat (EBM)	64	81
Non-high Value Fish Habitat (EBM)	122	559
Active Fluvial Areas (EBM)	485	813
Red/Blue listed ecosystems (EBM)	475	1,470
Wildlife Tree Retention Areas	9,003	13,126
Karst	14	558
First Nations considerations (EBM)	152	208
Non-Harvesting Land Base Area	**291,372**	
Timber Harvesting Land Base Area	**102,187**	

2.3 Current Forest Conditions

2.3.1 Biogeoclimatic Zones

The climate in the TSA is coastal, with the dominant biogeoclimatic zone being the coastal-western hemlock (CWH), with some mountain hemlock (MH), some Englemann spruce-subalpine fir (ESSF), and alpine areas (BAFA, CMA). Table 3 shows the areas of biogeoclimatic variants in the Pacific TSA.

Table 3: Biogeoclimatic variants in the Pacific TSA

Subzone	CFLB (ha)	% of Total
Alpine	150	0.04%
CWHdm	14,619	3.68%
CWHmm1	15,059	3.79%
CWHmm2	3,786	0.95%
CWHvh1	7,230	1.82%
CWHvh2	43,915	11.04%
CWHvm1	105,865	26.62%
CWHvm2	48,450	12.18%
CWHws1	10	0.00%
CWHws2	84,424	21.23%
CWHxm	794	0.20%
CWHxm1	786	0.20%
CWHxm2	7,376	1.85%
ESSFmk	8,940	2.25%
ESSFmkp	50	0.01%
MHmm1	46,751	11.76%
MHmm2	55	0.01%
MHmmp	697	0.18%
MHwh	55	0.01%
MHwh1	8,652	2.18%
MHwhp	10	0.00%

2.3.2 Species Profile

The CFLB in the Pacific TSA is dominated by western hemlock (Hw) mixed with balsam (Ba), western redcedar (Cw) and Douglas fir (Fd). The hemlock/balsam (HemBal) leading stands constitute approximately 71% of the CFLB. The share of Cw-leading stands is 11% while Fd is the dominant species on 9% of the land base (Figure 3).

HemBal leading stands also dominate the THLB (63% of the area); however the share of Fd leading stands is substantially higher on the THLB at 22% of the area (Figure 4).

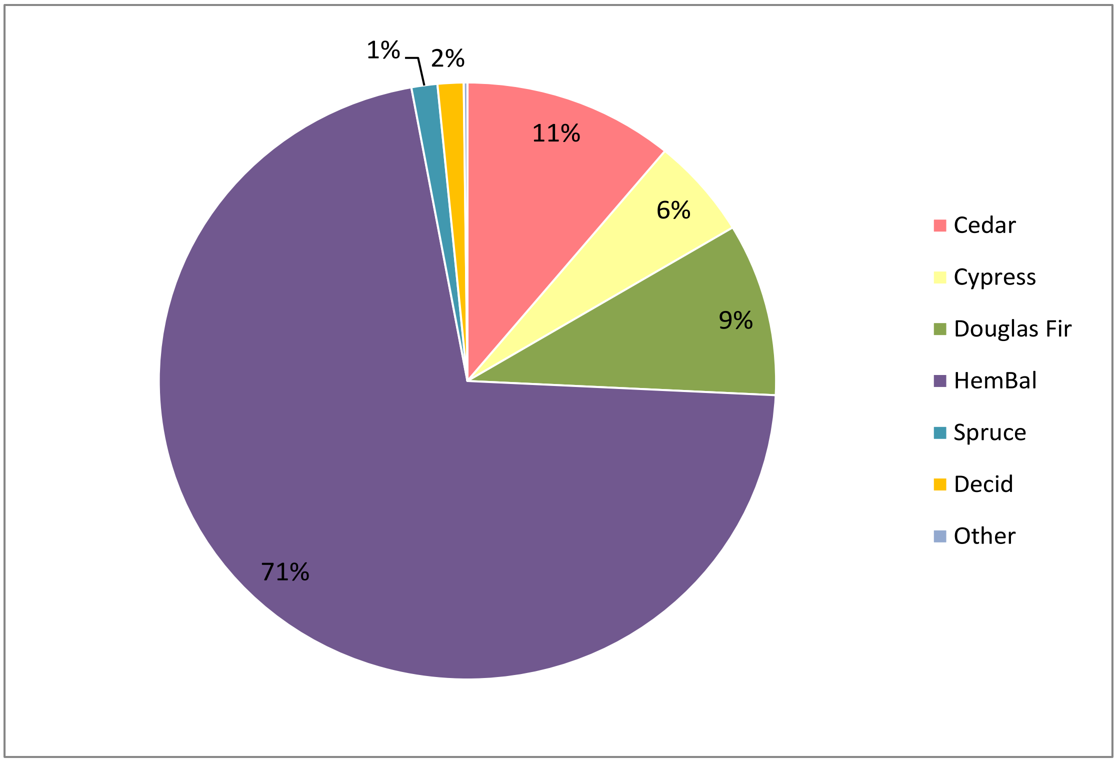

Figure 3: Leading species in the CFLB, Pacific TSA

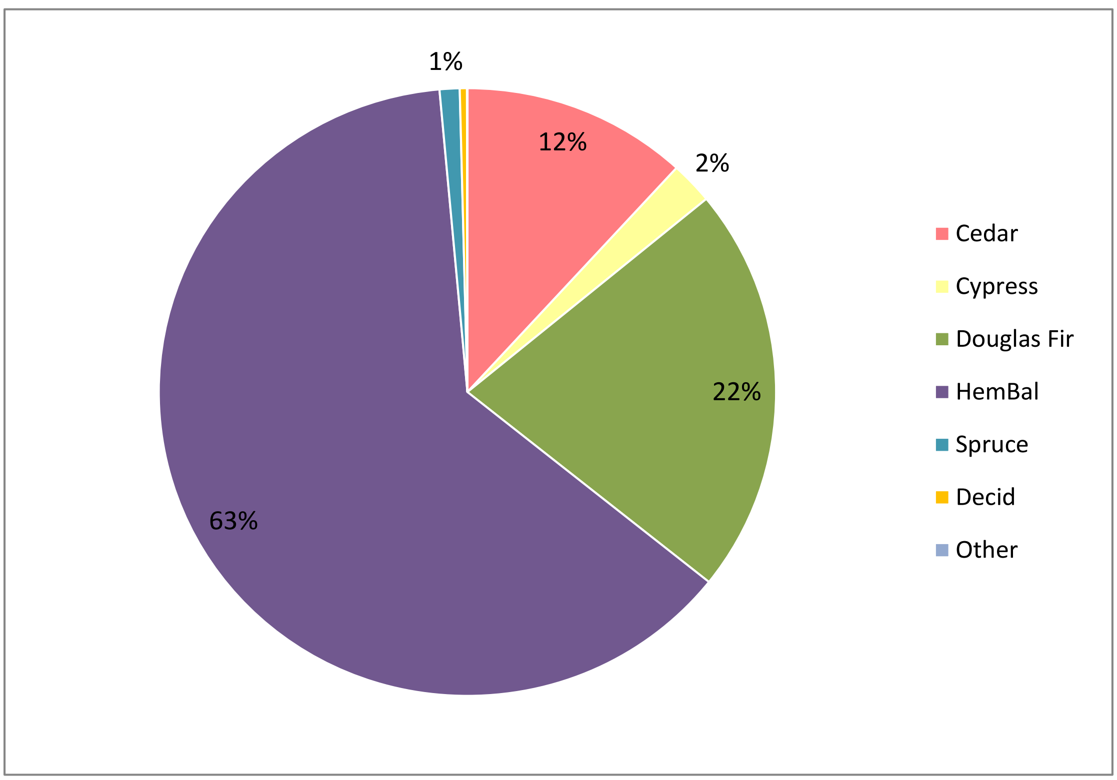

Figure 4: Leading species in the THLB, Pacific TSA

2.3.3 Age Class Distribution

While older age classes dominate the productive forest in the TSA, younger age classes are more prevalent in the THLB. Approximately 64% of the productive forest is older than 140 years; however only 23% of the THLB is older than 140 years. Approximately 50% of the stands in the THLB are younger than 40 years. Figure 5 depicts the distribution of NHLB and THLB by Vegetation Resource Inventory (VRI) twenty-year age classes. Age classes 6 and 7 are not well represented; harvesting in the short and medium term in the TSA will depend on the timber currently in age classes 2, 3, 4 and 5, and available timber in age classes 8 and 9.

The TSA age class distribution in the southern and mid-coast portions of the TSA (Figure 6) mirror that of the entire TSA, while almost all the land base in the TSK BA (83%) consists of age classes 8 and 9 with the majority of the THLB is in age classes 1 and 9 (Figure 7).

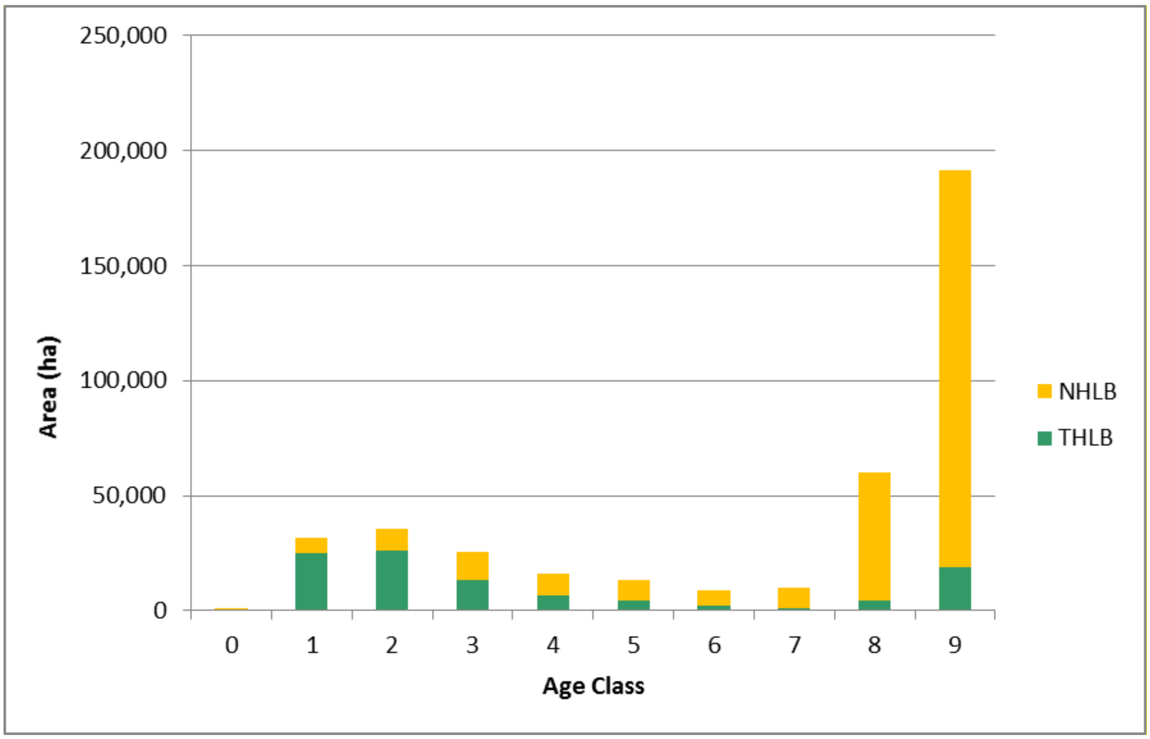

Figure 5: Age class distribution in the Pacific TSA

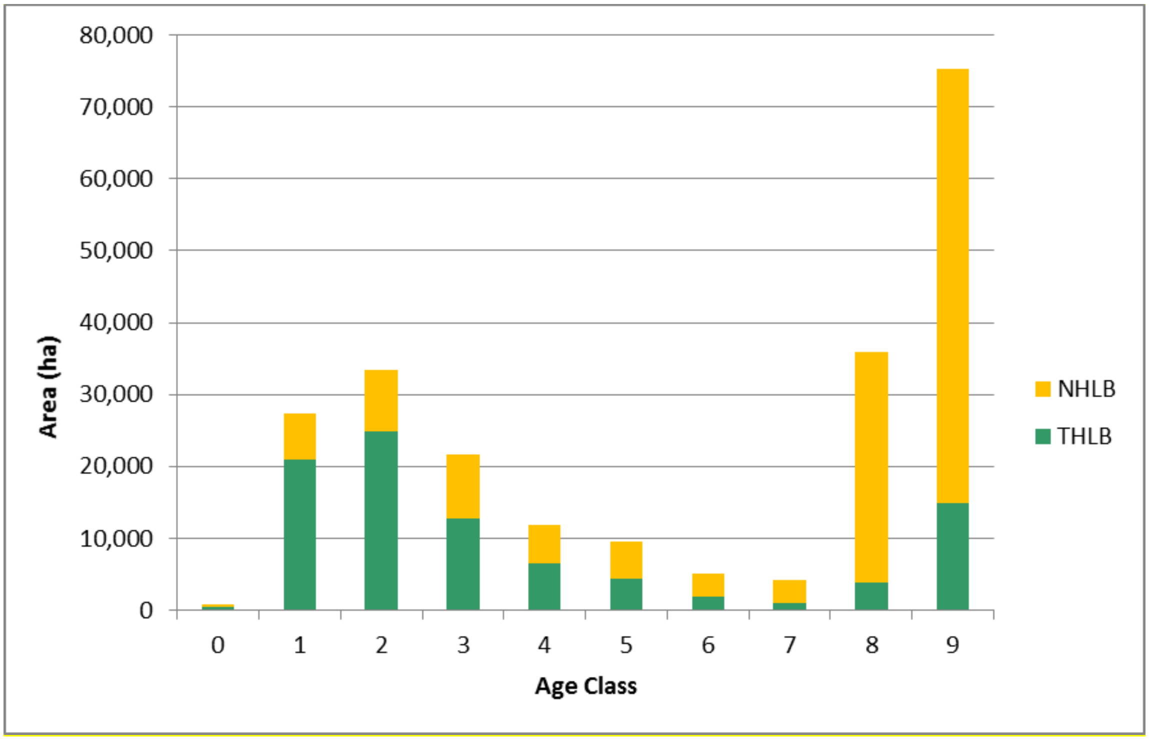

Figure 6: Age class distribution, TSG and TST business areas

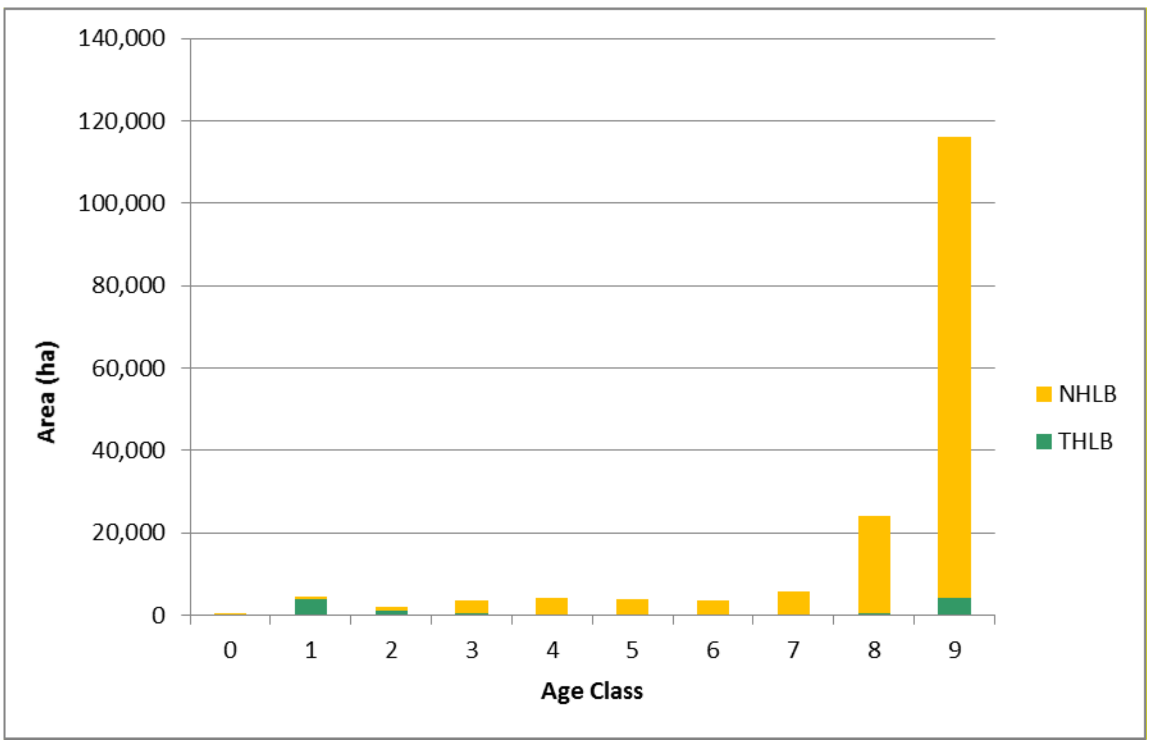

Figure 7: Age class distribution, TSK business area

2.3.4 Growing Stock

The total growing stock in the Pacific TSA is estimated at 27.8 million m^3. Approximately 84% or 23.4 million m^3 of this is currently estimated to be merchantable. HemBal volume forms the majority of the merchantable growing stock at around 13 million m^3 (57%). The shares of Cw/Yc and Fd volume are significant at 4.9 million m^3 (21%) and 4.4 million m^3 (19%) correspondingly (Figure 8).

The majority of the merchantable growing stock is older than 250 years (age class 9, 53%) consisting mostly of HemBal and Cw/Yc volume (Figure 9 and Table 4). Douglas fir is well represented in age classes 2, 3 and 4.

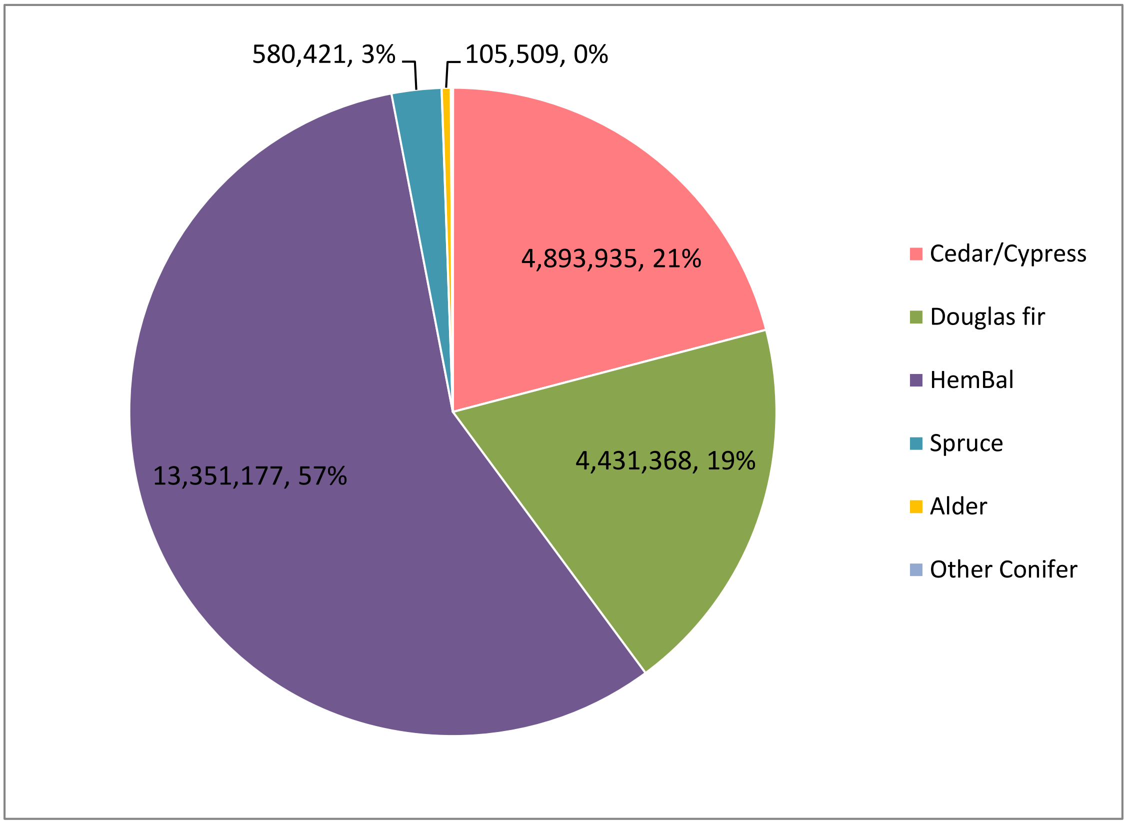

Figure 8: Merchantable growing stock by species in the Pacific TSA

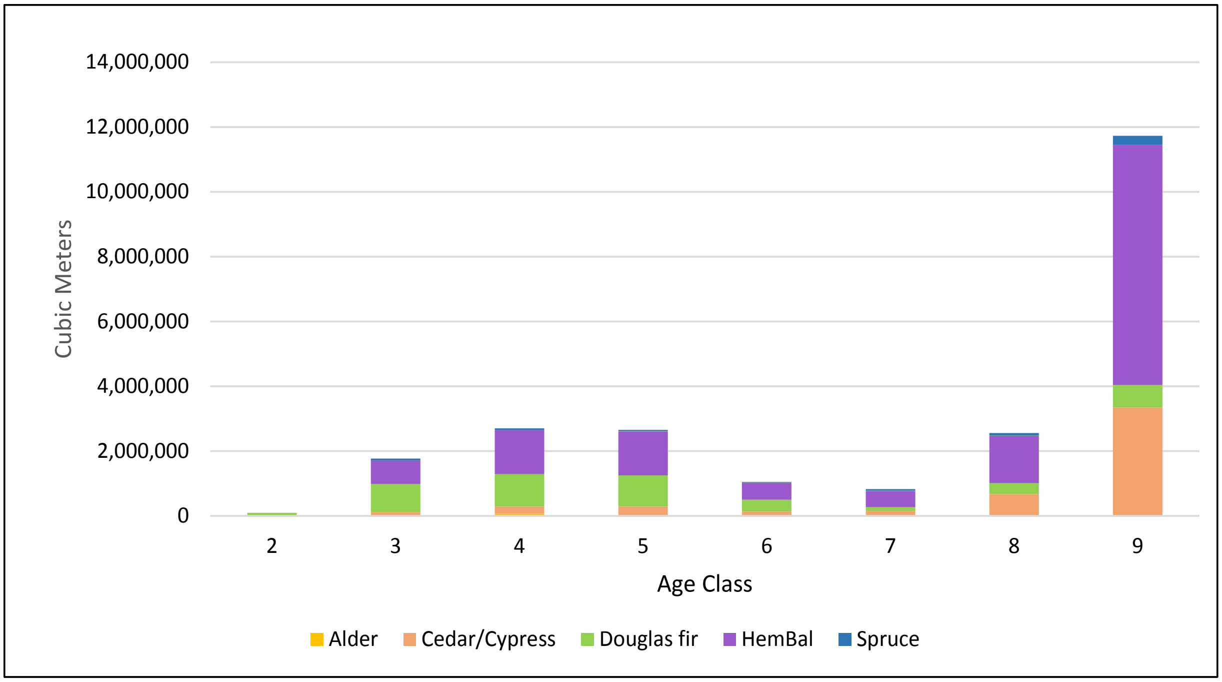

Figure 9: Merchantable growing stock by species and age class in the Pacific TSA

Table 4: Merchantable growing stock by species and age class in the Pacific TSA

Age Class	Alder	Cedar/ Cypress	Douglas Fir	HemBal	Other Conifer	Spruce	Total
2	0	32	95,685	0	0	0	**95,718**
3	10,814	103,930	863,562	736,714	859	55,662	**1,771,541**
4	64,745	221,814	1,002,856	1,360,971	3,172	48,014	**2,701,571**
5	20,264	268,603	962,076	1,354,799	4,330	43,922	**2,653,993**
6	7,724	129,067	368,065	518,874	2,362	23,234	**1,049,325**
7	1,319	145,157	124,172	502,870	885	50,037	**824,441**
8	371	676,875	330,801	1,466,085	4,078	80,387	**2,558,597**
9	272	3,348,456	684,150	7,410,865	8,149	279,165	**11,731,057**
Total	**105,509**	**4,893,935**	**4,431,368**	**13,351,177**	**23,834**	**580,421**	**23,386,243**

3 Assumptions and Methods

This section briefly describes the inputs and assumptions to the timber supply analysis. A full description of these issues is provided in the Pacific TSA Timber Supply Review Information Package.

3.1 Timber Supply Model

All analysis presented in this report was conducted using Forest Simulation and Optimization System (FSOS), a proprietary forest estate model developed by FESL. FSOS has both simulation and heuristic (pseudo-optimization) capabilities. The time-step simulation mode was primarily used in this analysis. Time-step simulation grows the forest based on growth and yield inputs and harvests units of land area based on user-specified harvest rules and constraints that cannot be exceeded.

3.2 Growth and Yield

3.2.1 Site Index

On the recommendation of the Forest Analysis and Inventory Branch (FAIB), the provincial site productivity data layer was used in the analysis to model the growth and yield of managed stands. Where there is no data in the provincial layer, the SIBEC site index for the leading TEM/PEM site series was used. If TEM or PEM data did not exist, or if SIBEC contained no site index, the VRI site index was used.

The growth and yield of natural stands were modeled using the inventory site index. Table 5 compares the average site index values from VRI to those from the provincial site index layer.

Table 5: Average site productivity in the Pacific TSA, (leading species in VRI)

Business Area	Site Index Type	Cedar	Hemlock	Balsam	Douglas Fir	Spruce
TSG, TST	VRI Site Index Average (THLB):	17.5	21.3	16.9	28.5	28.1
	Provincial SI average (THLB):	21.1	25.5	23.4	31.2	28.9
TSK	VRI Site Index Average (THLB):	14.0	14.7	16.6	n/a	19.7
	Provincial SI average (THLB):	22.6	23.1	25.7	n/a	27.4

3.3 Analysis Units

An analysis unit is a grouping of similar forest area with the objective of simplifying the analysis and the interpretation of analysis results.

3.3.1 Natural Stands

Stands established prior to 1966 (>= 50 years old in 2014) are considered natural stands in this analysis. Their growth and yield was modeled using the Variable Density Yield Prediction (VDYP7) yield model. Inventory site index estimates are considered to be the most appropriate in modelling these stands. A more detailed description of the growth and yield modelling of these stands is presented in the Information Package.

The large number of natural stand yield curves (30,883 VRI stands in the FMLB) were aggregated into 1379 analysis unit yield curves. The grouping was completed based on TSA business area, species composition, inventory site index and the volume per ha at ages 75 and 150.

3.3.2 Managed Stands

Stands established after 1965 are considered managed stands in this analysis. Their growth and yield was modeled using Tree and Stand Simulator (TASS). TASS is a three dimensional growth simulator that generates growth and yield information for even aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia. Provincial site productivity layer estimates of site index are considered to be the best estimates of site productivity for modelling managed stands.

Analysis units for managed stands are based on BEC groupings and site index. The aggregation of the data within each analysis unit was completed separately for the TSK business area.

Regeneration assumptions and detailed inputs to TASS are presented in the Information Package.

3.3.2.1 Management Eras (Managed Stands)

3.3.2.1.1 Era 1; Stands established between 1966 and 1978

Stands established between 1966 and 1978 are considered existing managed stands. While some of these stands were planted, their current species composition is often reflective of naturally regenerated stands. These stands were considered naturally regenerated in growth and yield modelling.

3.3.2.1.2 Era 2; Stands established between 1979 and 2003

Stands established between 1979 and 2003 are also considered existing managed stands. These stands were generally regenerated through planting with seedlings of no genetic worth. These stands were modeled as planted with ingress in growth and yield modelling.

In the TSK business area this era extends from 1979 to 2009.

3.3.2.1.3 Era 3; Stands established between 2004 and 2009

Stands established between 2004 and 2009 were generally regenerated through planting with seedlings of modest genetic worth (in TSG and TST). These stands were modeled as planted with ingress in growth and yield modelling.

3.3.2.1.4 Era 4; Stands established after 2009

Stands established after 2009 and those that will be planted in the future are considered future managed stands. These stands are regenerated through planting with seedlings of significant genetic worth (in TSG and TST). These stands were modeled as planted with ingress in growth and yield modelling.

3.4 Integrated Resource Management

3.4.1 Land Use Direction

The Pacific TSA contains several land use plans. The Vancouver Island Land Use Plan (VILUP) covers all of Vancouver Island except Clayoquot Sound. VILUP sets legal objectives for resource management zones (enhanced and general) and special management zones. Resource management in Clayoquot Sound is governed by the Clayoquot Sound Land Use Decision and implemented in the Pacific TSA through the Upper Kennedy Watershed Plan.

The TSG business area Blocks are managed under VILUP with the exception of Blocks 21, 22 and 23, which are managed through local land use plans. Several local sustainable resource management plans (SRMP) also exist in the TSG VILUP areas.

Some of the TST Blocks are managed under VILUP (7, 8, 10, and 24), while the Coast Land Use Decision (South-Central Coast Order (SCC), Central and North Coast Order (CNC), and Great Bear Rainforest Order (GBRO)) provide management direction for the south central and central coast. As with TSG, in the VILUP areas, SRMPs provide additional guidance.

Kalum LRMP, Kalum South SRMP and Kowesas SRMP govern the management of natural resources in the TSK business area.

3.4.2 Management Zones and Multi-Level Objectives

Management zones are geographically specific areas that require unique management considerations. Areas requiring the same management regime or the same forest cover requirements are grouped into management zones. Table 6 lists the management zones for the Pacific TSA and the rationale used to define these zones. Further information on management zones is presented in the Information Package. Multiple resource issues may be present in the same forest area. For example, a management zone that requires a minimum area of mature and old seral forest may also have areas that are visually sensitive and require specific visual objectives. Forest estate models can accommodate multiple overlapping resource layers by establishing target levels for each layer. The models then schedule harvest units which best meet the target levels for all resource layers together.

Table 6: Management Zones –Base Case

Management Zone	Total Area (ha)	CFLB Area (ha)	Criteria Used to Delineate	Notes
VILUP HLPO RMZ: Enhanced Forestry Zones (EFZ) General Management Zones (GMZ) Special Management Zones (SMZ)	 74,759 67,430 33,526	 63,253 52,788 29,513	Legally established in the VILUP HLPO Section 1.	Green-up is applied by RMZ. Green-up and maximum block size are modified in EFZ. SMZ have non-spatial mature and old seral stage targets.
Visual Quality Objectives: Retention (R) Partial Retention (PR) Modification (M) Maximum Modification (MM)	 4,426 97,084 28,058 79	 2,609 69,192 24,575 70	Scenic areas as per VILUP, FRPA, GAR.	Targets are applied to each VQO polygon separately. Visual green-up heights are based on slope.
Clayoquot Sound Scenic Areas: Small-scale alteration Minimal alteration Natural appearing	 931 2,170 143	 866 1,858 125	Clayoquot Sound Scientific Panel Report and Watershed Plans	Mapped and modeled to equivalent VQO class i.e. PR, PR,R.
Clayoquot Sound Sub-Basins Rate of Cut	11,348	9,058	Upper Kennedy Watershed Plan.	Defines a maximum rate of cut.
Clayoquot Sound Biodiversity	11,348	9,058	Clayoquot Sound Scientific Panel Report and Watershed Plans	Target of 40% old forest (>250 years old) by watershed sub-basin.
EBM Important Fisheries Watersheds.	20,841	17,568	SCC and CNC	ECA targets.
EBM Upland Streams	42,978	35,432	CNC	ECA targets for EBM upland stream areas.
EBM Biodiversity	56,006	48,458	GBRO	Current and long-term targets for old forest (>250 years old) by landscape unit and site series grouping.
Kalum Watersheds: Brim Hugh Owyacumish Wahoo Wathlsto	 15,764 5,381 8,322 21,334 5,539	 2,501 3,675 2,191 4,500 3,952	Kalum South SRMP	Targets for old forest (>250 years old) based on PEM site series within undeveloped watersheds.
Sayward Potential Spring Forage	1.3	1.3	Sayward Land Use Plan	Sets cover constraints
Sayward Elk Visual Cover	17	9	Sayward Land Use Plan	Sets cover constraints
Landscape Units: 33 Landscape units in the Pacific TSA			Legally established under FRPA	Landscape units (33) are used to define specific land use objectives outside of VILUP, Clayoquot Sound or the Great Bear Rain Forest. Examples are non-visual green-up and non-spatial old growth objectives (if not achieved through OGMAs)
Fisheries Sensitive (FSW) and Assessed Watersheds: FSW f-1-008 FSW f-1-010	 2,700 9,320	 2,652 7,689	Fisheries sensitive watersheds have been established through GAR order.	Management of FSW is required by law. Current practice is to follow ECA recommendations for other assessed watersheds.
Community Watersheds: 910.012 930.021	 10,988 21,766	 7,475 18,155	Designated community watersheds.	Limit harvest to designated percent of area annually.

3.5 Unsalvaged Losses

Non-recoverable losses provide an estimate of the average annual volume of timber damaged or killed within the THLB and not salvaged or accounted for by other factors. These losses result from natural events such as insects, diseases, wind, wildfires, etc.

Data from on-going and recently completed TSRs that cover the Pacific TSA area were combined and prorated to develop an estimate for non-recoverable losses (NRL). The values shown in Table 7 indicate the estimated annual volume that will not be salvaged. The estimate is for all sources summed up. Non-recoverable losses are removed from the harvest volume for each timber supply forecast.

Table 7: Annual non-recoverable losses

Neighbouring TSA	NRL within THLB (m^3/yr)	THLB area (ha)	Pacific TSA THLB (ha)	THLB Ratio	Pacific TSA NRL (m^3/yr)
Arrowsmith	9,105	58,613	28,342	48%	4,403
Kalum	5,000	80,820	10,618	13%	657
Kingcome	16,666	75,066	20,043	27%	4,450
Mid-Coast	20,102	124,605	3,835	3%	619
Strathcona	43,150	162,873	27,360	17%	7,249
Sunshine Coast	12,650	222,894	11,979	5%	680
Total					**18,057**

3.6 Minimum Harvest Criteria

Minimum harvest criteria is the earliest age, volume per ha or other criterion such as DBH at which stands become eligible for harvest within the timber supply model. Minimum harvest criteria can have a profound effect on modeled harvest levels by creating acute timber supply shortages, or "pinch points", that constrain the rest of the planning horizon.

For this analysis, the minimum harvestable criteria for stands in each analysis unit is the age at which the stand is predicted to reach a volume of 300 m^3/ha. In practice, most forest stands are harvested beyond the minimum harvest age due to economic considerations and constraints on harvesting, which arise from managing for other forest values. The potential impact of different minimum harvest criteria is explored through sensitivity analyses.

3.7 Minimum Periodic Volume

Minimum volume requirements can be set for an area, when it is known that the financial viability of the harvest from that area requires a minimum harvestable volume. Due to the scattered and isolated nature of the Pacific TSA Blocks, many of them require a minimum harvest volume to reflect the operational reality associated with mobilization and demobilization. The following table shows all the TSA Blocks, or the combinations of Blocks that are subject to minimum volume requirements in the base case. The requirements are applied to a period of 5 years.

Table 8: Minimum 5-year harvest volume requirements

Pacific TSA Block	Area Name	Area (ha)	THLB Area (ha)	Minimum Harvest Volume m^3 over 5 years
1	East Cracroft Island	2,336	1,275	35,000
2	West Cracroft Island	1,017	776	35,000
3	Roseander	2,294	1,168	10,000
4, 5, 6	San Juan	10,507	4,831	10,000
7	Holberg	11,401	6,741	15,000
8	Vernon Lake	18,351	4,178	35,000
9	Burman	10,644	2,502	40,000
	Jacklah	5,979	1,566	40,000
10	Beaver Cove	798	615	20,000
11	Harbledown Island	3,459	1,779	30,000
12	Turnour Island	3,085	2,026	25,000
13	Village Island	645	314	35,000
14	Gilford Island	1,128	553	35,000
15	Kinnaird Island	259	111	35,000
16	Burley Bay	521	244	35,000
17	Watson Island	1,114	632	35,000
19	South Kaikash	1,350	29	35,000
20	Farewell Lake	834	424	10,000
21	Granville	5,855	2,837	20,000
	Lois	5,710	3,642	10,000
	Khartoum	9,038	2,973	30,000
23	Theodosia	3,719	1,325	30,000
24	Quatse	1,016	801	30,000
25	Doc Creek	37,566	2,795	Defer entire Block for 40 years. Minimum volume of 70,000m^3.
26	Yeo Island	5,476	1,040	40,000
30	Hill 60	2,070	1,603	10,000

3.8 Harvest Scheduling Rule

Simulation models are rule-driven, and require harvest scheduling rules to control the order in which stands are harvested. It is important that these rules are able to organize the harvest in a way that realizes the productive potential of the land base in a reasonable manner to understand the impacts of the timber supply assumptions and constraints.

The relative oldest first rule is a commonly used harvest rule that will be used in the base case. In this rule, the age of a stand is related to its minimum harvestable age. Stands that have the greatest proportional difference between their actual age and their minimum harvest age are given priority for harvest, subject to forest cover requirements.

4 Base Case Harvest Forecast

The Base Case is the foundation for comparison between timber supply forecasts. Base Case assumptions are described in the Information Package. The Base Case assumptions determine how the TSA land base is expected to respond to the current management regime over time. The purpose of the Base Case is to understand the implications of current management to future timber supply, including short, medium and long terms. This section describes the Base Case, first by defining the area that the Base Case forecast applies to, then explaining how sustainable harvest levels are determined, and finally by describing the predicted development of selected attributes of the Pacific TSA associated with the chosen sustainable harvest level.

4.1 Base Case Land Base

A portion of the Pacific TSA (56,605 ha) falls under the South-Central Coast Order (SCC), the Central North Coast Order (CNC) and the Great Bear Rain Forest Order (GBR) establishing Ecosystem Based Management (EBM). Blocks within the EBM area are 1, 2, 11-17, 25, and 26. All are located in the Seaward-Tlasta Business Area and the North Island/Central Coast Natural Resource District

Under the *Great Bear Rainforest (Forest Management) Act*, the AAC for the portions of the Pacific TSA that fall within the GBR will be established by the Lieutenant Governor in Council by regulation. Following this, the Chief Forester would have authority to determine the AAC, and specify AAC partitions, for the areas of the Pacific TSA that fall outside the GBR. For this reason the GBR is excluded from the Pacific TSA Base Case. The THLB netdown for the land base outside of the GBR is presented Table 9.

Table 9: THLB netdown for the area outside of the GBR

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area		**641,436**
Not Managed by Crown	9,929	9,929
Non-Forest	251,741	256,375
Non-Commercial Brush	30,839	30,969
Roads	3,831	4,227
Crown Forested Land Base Area	**345,095**	
Parks and Protected Areas	100	101
Ungulate Winter Range	18,777	25,395
Wildlfe Habitat Areas	13,051	30,667
Marbled Murrelet Reserves	2,380	5,253
Clayoquot reserves	3,112	5,526
Old Growth Management Areas	30,832	43,881
Preservation VQO areas	296	728
Terrain and ESA	37,126	58,083
Inaccessible Areas	28,383	240,413
Deciduous-leading Stands	2,860	4,975
Non-merchantable (low volume) Stands	36,211	360,734
Uneconomic Areas	67,745	122,094
Archeological Sites	583	748
Recreation Areas	513	2,840
Riparian Management Areas	4,991	26,153
Wildlife Tree Retention Areas	7,499	10,767
Karst	14	473
Non-Harvesting Land Base Area	**254,473**	
Timber Harvesting Land Base Area	**90,622**	

4.2 Sustainable Harvest Level

A reliable and objective indicator of sustainability is required to differentiate sustainable harvest levels from unsustainable harvest levels in timber supply analysis. Crashes in timber supply occur at pinch points when there is insufficient merchantable volume to satisfy the target harvest level. Timber supply analysts commonly use these crashes as an indicator of non-sustainable harvest levels. However, pinch points are directly related to how minimum harvest criteria are defined and may not reflect true constraints on timber supply.

Pinch points are only useful as indicators of sustainability if minimum harvest ages are equal or close to the culmination ages of mean annual increment (MAI). When minimum harvest ages are set close to culmination age, pinch points indicate that the model is attempting to harvest stands below culmination age. Pinch points are less effective indicators of sustainability when minimum harvest ages are set using other criteria, such as volume per ha as in this analysis. The stable long-term growing stock is the sole indicator of sustainability in this timber supply analysis. Short- and medium-term harvest levels are considered sustainable if they do not compromise growing stock in the long term.

4.3 Determining the Base Case Harvest Level

Growing stock becomes stable when the rate of harvest equals the rate of growth of the forest. At low harvest levels stands are harvested after their MAI culmination age - provided that they have achieved their minimum harvestable volume - and the growing stock accumulates until an equilibrium is reached, often way into the future. If the harvest level is too high, the stands are harvested below their culmination age. This often causes a rapid decline of the growing stock until it can no longer support the desired harvest level.

Maximum sustainable even flow is the highest harvest level that can sustain a stable growing stock. In the absence of constraints, this harvest rate would equal the average MAI culmination of the land base. However, the presence of forest cover constraints such as VQOs can limit the ability of the model to harvest stands at culmination age. As a result, long-term harvest levels are typically somewhat lower than the maximum possible growth rate of the forest.

In this analysis the maximum sustainable even flow was established first. After this, the short-term harvest was elevated as high as possible without compromising the long-term sustainability of the harvest forecast. The transitions to lower harvest levels were not allowed to exceed 10%.

4.4 Description of the Base Case

The Base Case is the point of comparison for all sensitivity analyses. The purpose of this section is to describe and interpret the attributes of the Base Case in detail.

4.4.1 Harvest Forecast

The Base Case harvest forecast is illustrated in Figure 10. The initial harvest level of 688,245 m^3 per year is maintained for 10 years, before the harvest is reduced by 8.5% to 630,080 m^3 per year for another 10 years. The long-term harvest level of 612,520 m^3 per year (2.8% decline) is reached at year 21. Note that the planning horizon starts at year 2016.

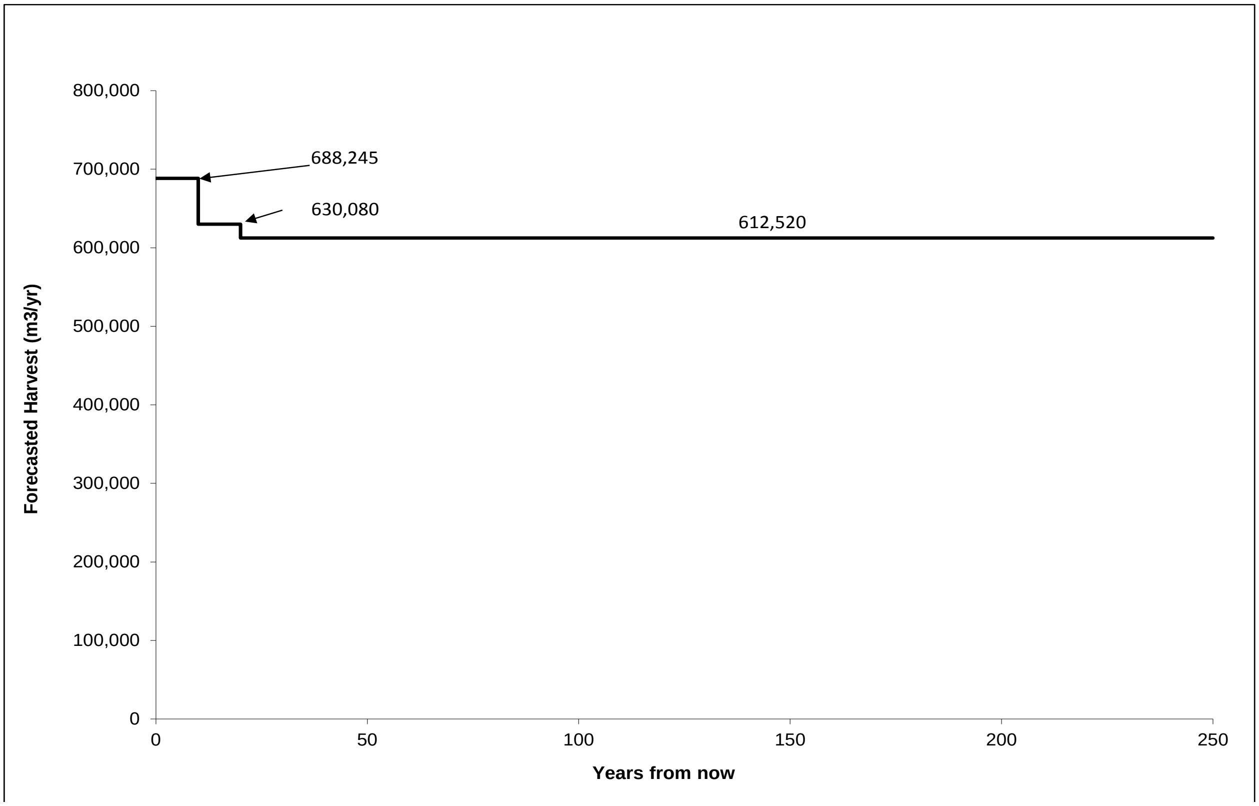

Figure 10: Base Case harvest forecast

4.4.2 Growing Stock

Figure 11 depicts the predicted development of the growing stock. The stable long-term growing stock indicates a sustainable long-term harvest level. Note that the Base Case initial growing stock is based on the entire projected growing stock at the beginning of 2016. No consideration is given to committed unused volumes in Block 18, and Blocks 28 and 29.

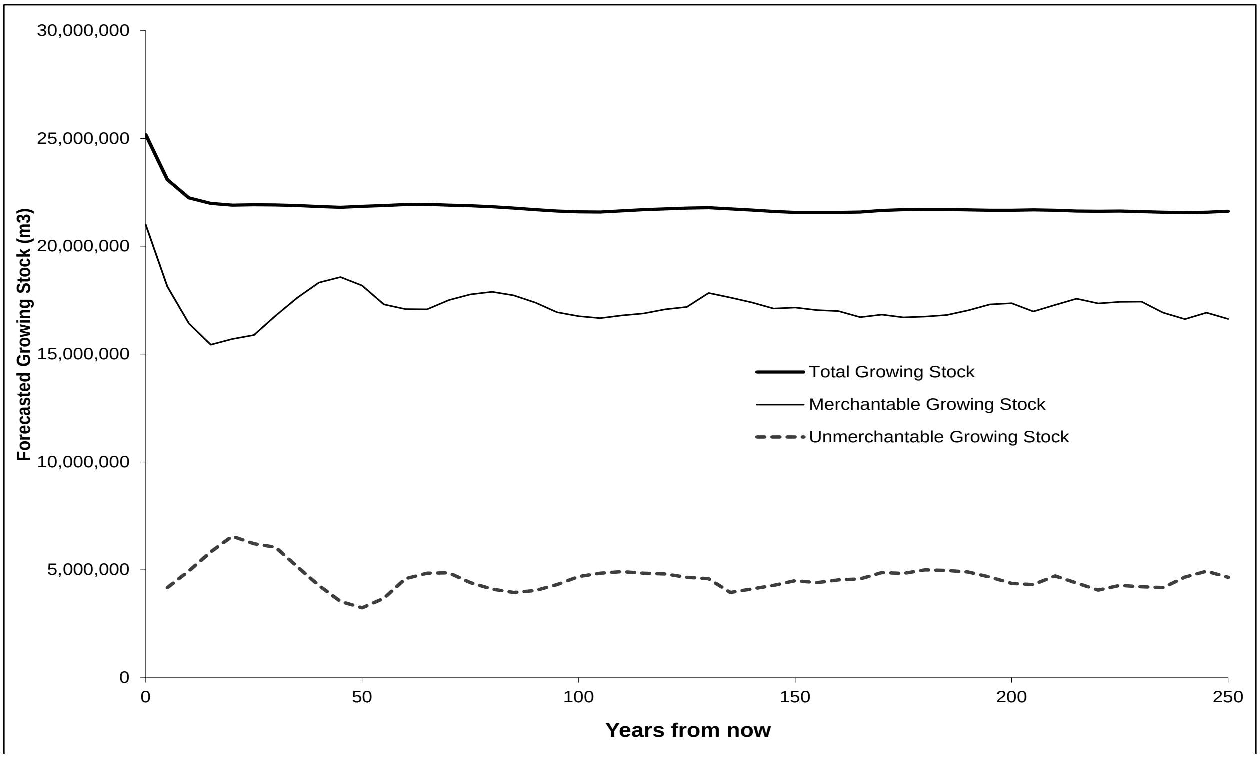

Figure 11: Predicted development of the growing stock; Base Case

4.4.3 Harvest Age, Harvest Volume and Harvest Area

The predicted age class of stands at harvest is shown in Figure 12. Throughout the planning horizon, the majority of the harvest volume comes from stands greater than 60 years old while some harvest in younger stands occurs. The long-term average harvest age is around 80 years (Figure 13).

In the short-term the Base Case harvest forecast consist mainly of age class 9 stands (>250 years). The harvest of older stands continues for approximately 40 years until the transition to younger stands occurs. This trend is the result of the relative oldest harvest rule used in the Base Case; oldest stands in the land base are harvested first.

The harvest of older stands at the beginning of the planning horizon is reflected in Figure 14 illustrating the Base Case harvest forecast by volume per ha class. Older stands usually contain higher volumes and their harvest results in high average harvest volumes also shown in Figure 15; the overall average harvest volume is around 900 m^3 per ha during the first 10 years of the planning horizon, then levelling out to around 600 m^3 per ha in the long run.

The high per ha harvest volumes require less area to be harvested to meet the harvest request. This can be seen in Figure 16 depicting the predicted annual harvest area for the Base Case.

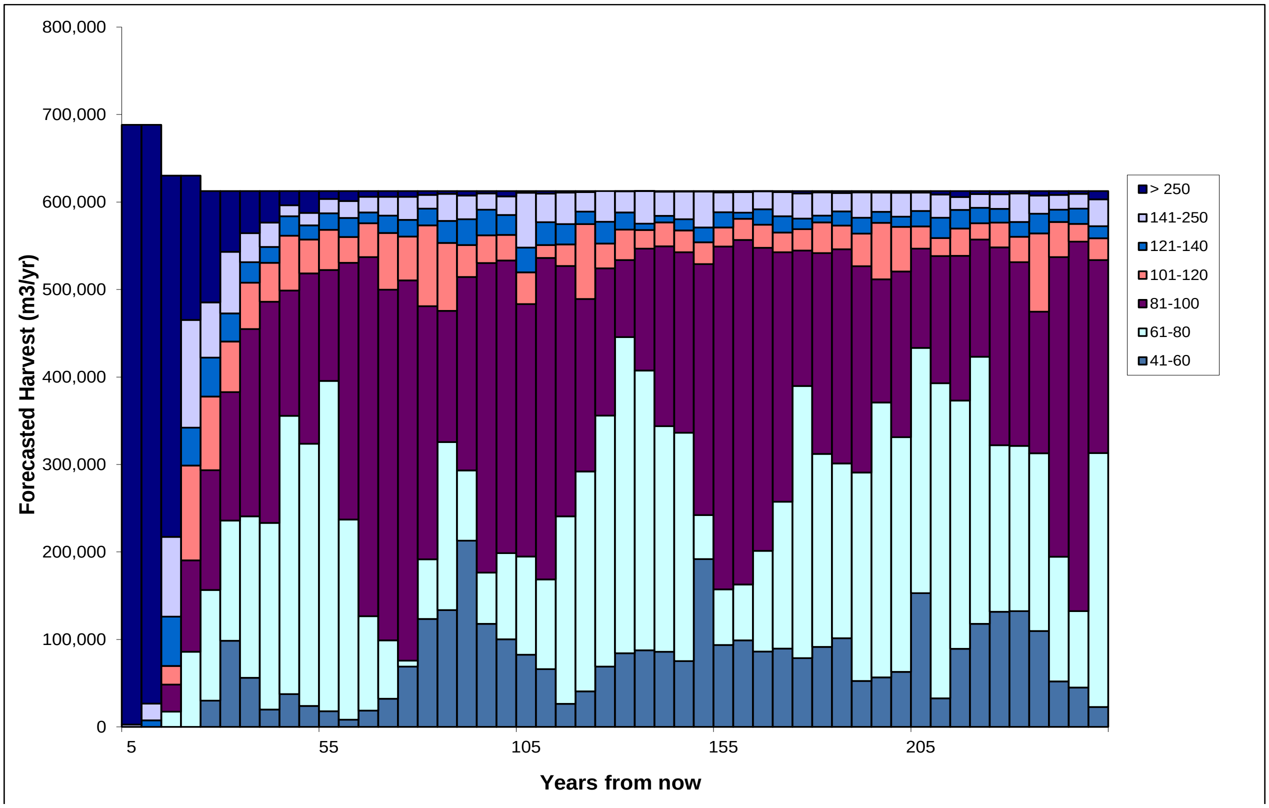

Figure 12: Base Case harvest forecast by age class

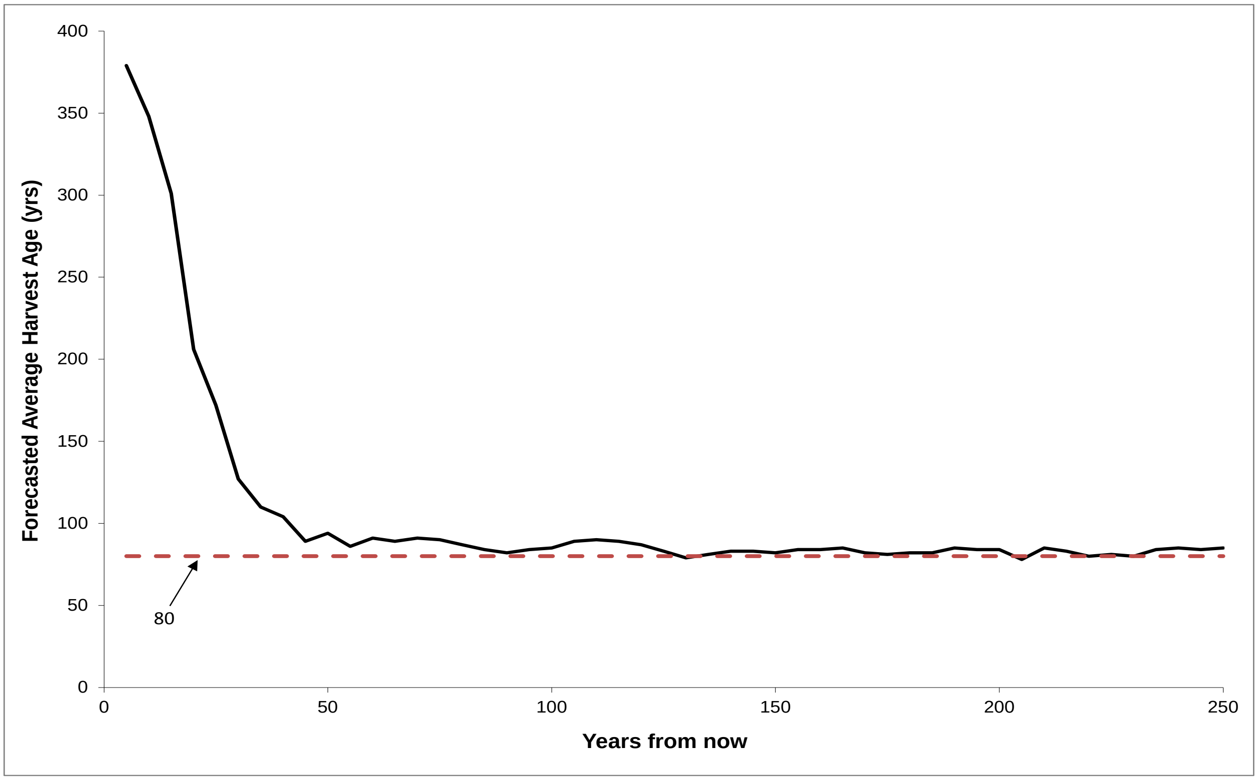

Figure 13: Average harvest age: Base Case

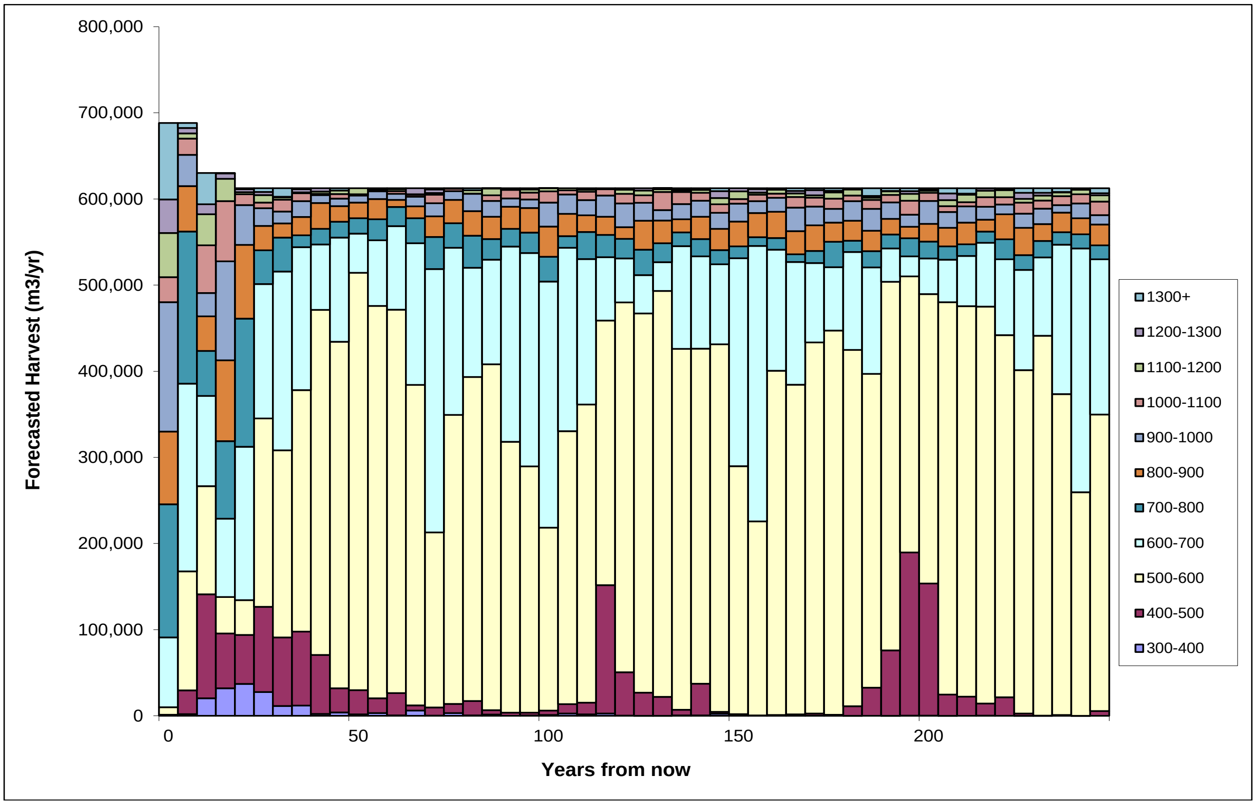

Figure 14: Base Case harvest forecast by volume per ha class

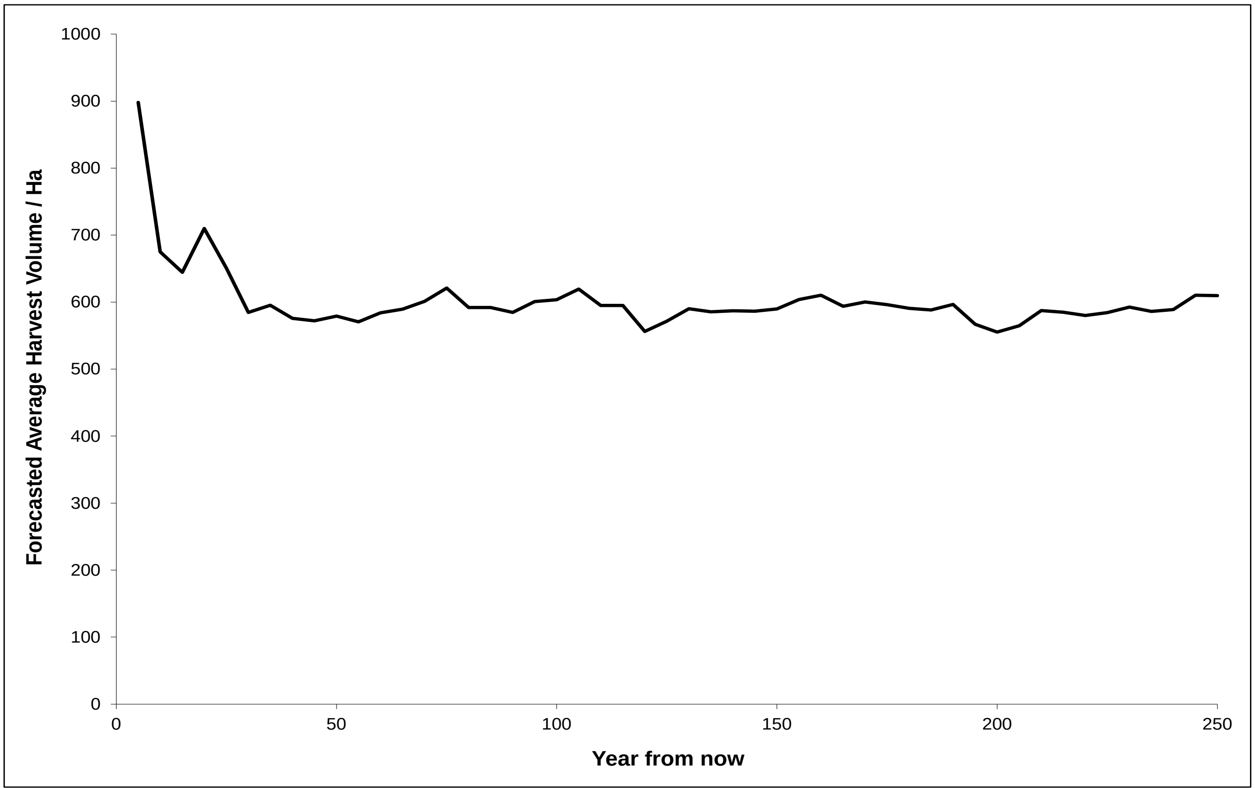

Figure 15: Average harvest volume per ha; Base Case

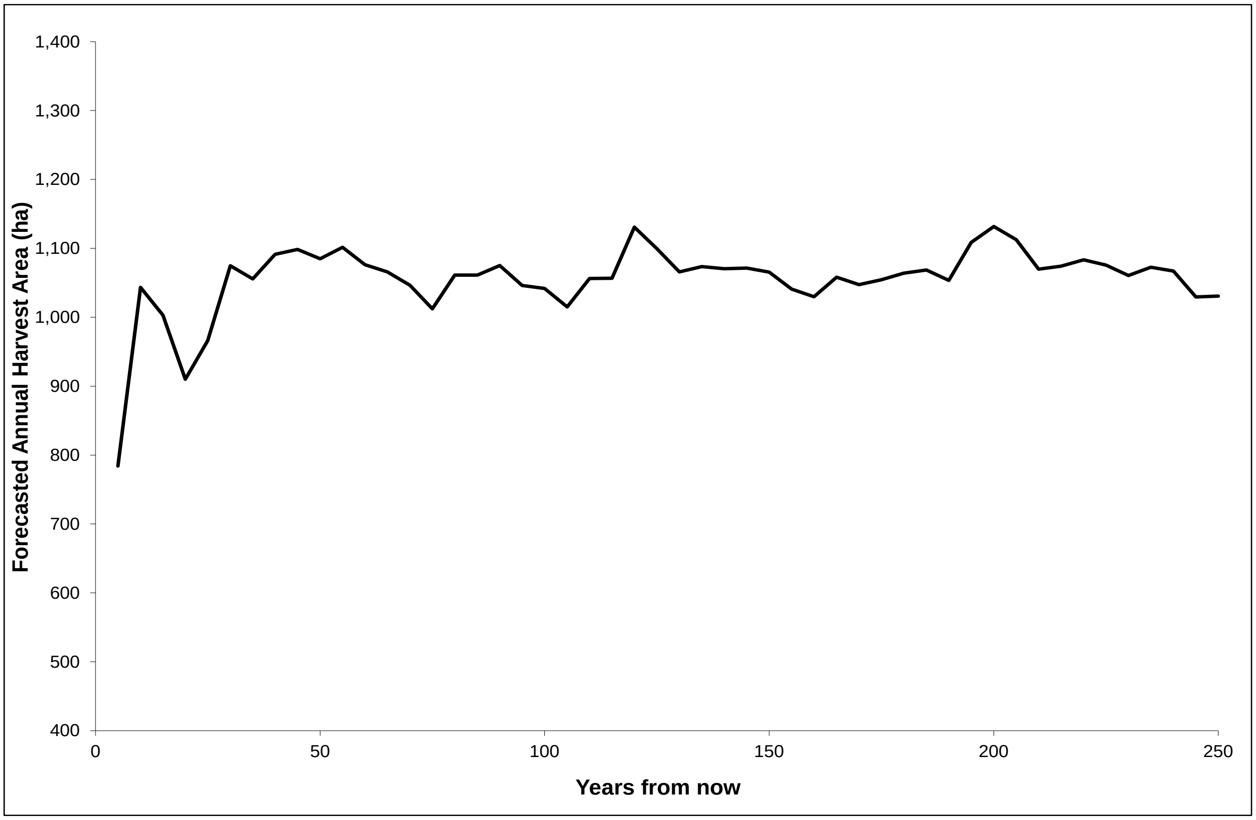

Figure 16: Average annual harvest area (ha); Base Case

4.4.4 Composition of Harvest by Yield Type

The yield tables for this analysis were developed by classifying the stands of the Pacific TSA into yield types. Harvest from these yield types is shown in Figure 17. Old natural stands, which are currently >50 years old, dominate the harvest in the first 30 years. This reflects the current age class distribution on the TSA and is also a result of the relative oldest first harvest scheduling rule prioritizing stands that are old relative to their minimum harvest age.

Existing Managed stands (second growth stands 50 or younger) become a significant source of volume in 25 years and by year 50 contribute approximately 80% of the harvest. They remain a dominant source of volume until year 80 and continue to contribute to harvest into the long-term. By definition, the long-term begins when future managed stands become the dominant source of harvest which occurs at around year 80.

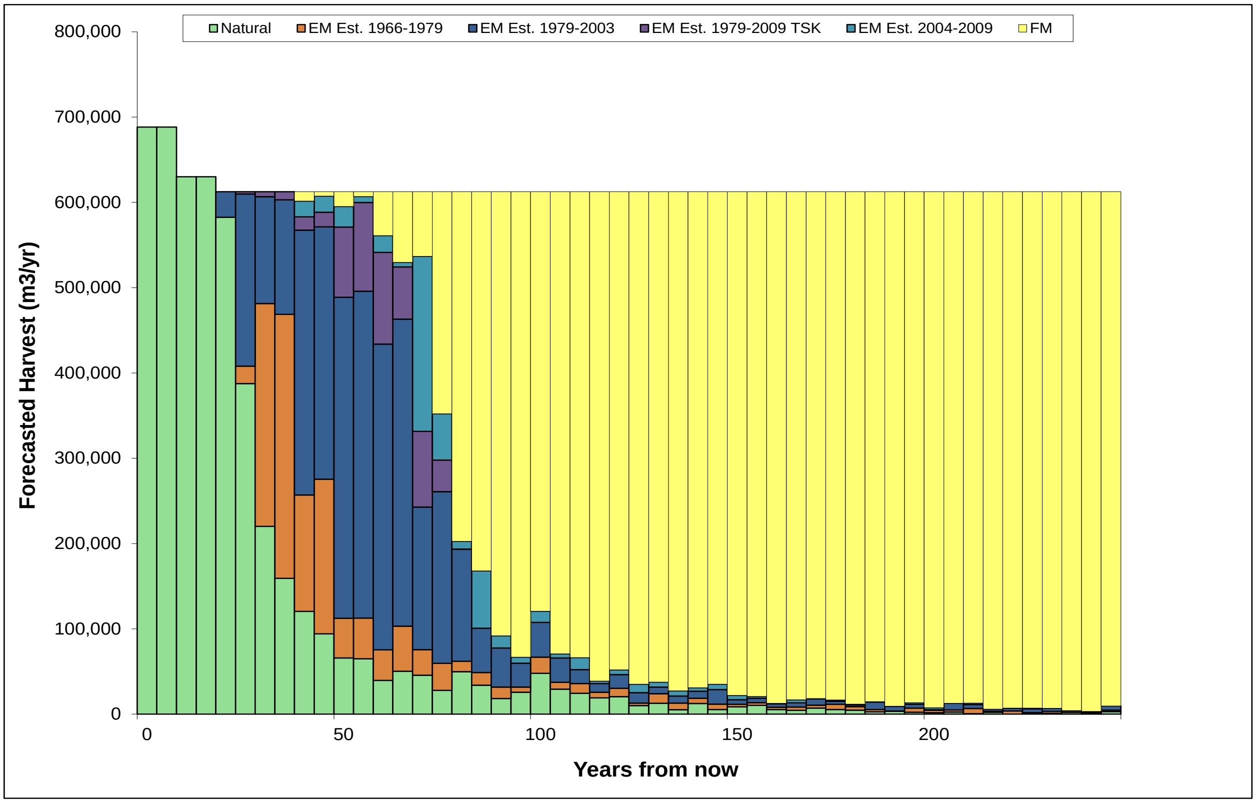

Figure 17: Harvest by yield type; Base Case

4.4.5 Species Composition of Harvest

Figure 18 shows the contribution of major tree species to volume harvested over the planning horizon. The species composition of harvest during the first 15 years more or less reflects the species composition of old stands. The species profile starts to change at year 20 as second-growth Douglas-fir stands (natural age class 4, 5 and 6 stands) become a significant contributor to the total harvest volume.

Eventually, Douglas-fir and western red cedar become the dominant harvest species while the harvest of other species is reduced. Note that while the species composition of the predicted harvest from natural and existing managed stands is based on the forest cover inventory, the future species profile reflects general assumptions about current regeneration and planting practices within the Pacific TSA. The predicted species profile for the first 75 to 80 years of the planning horizon is therefore more reliable than that of the long-term.

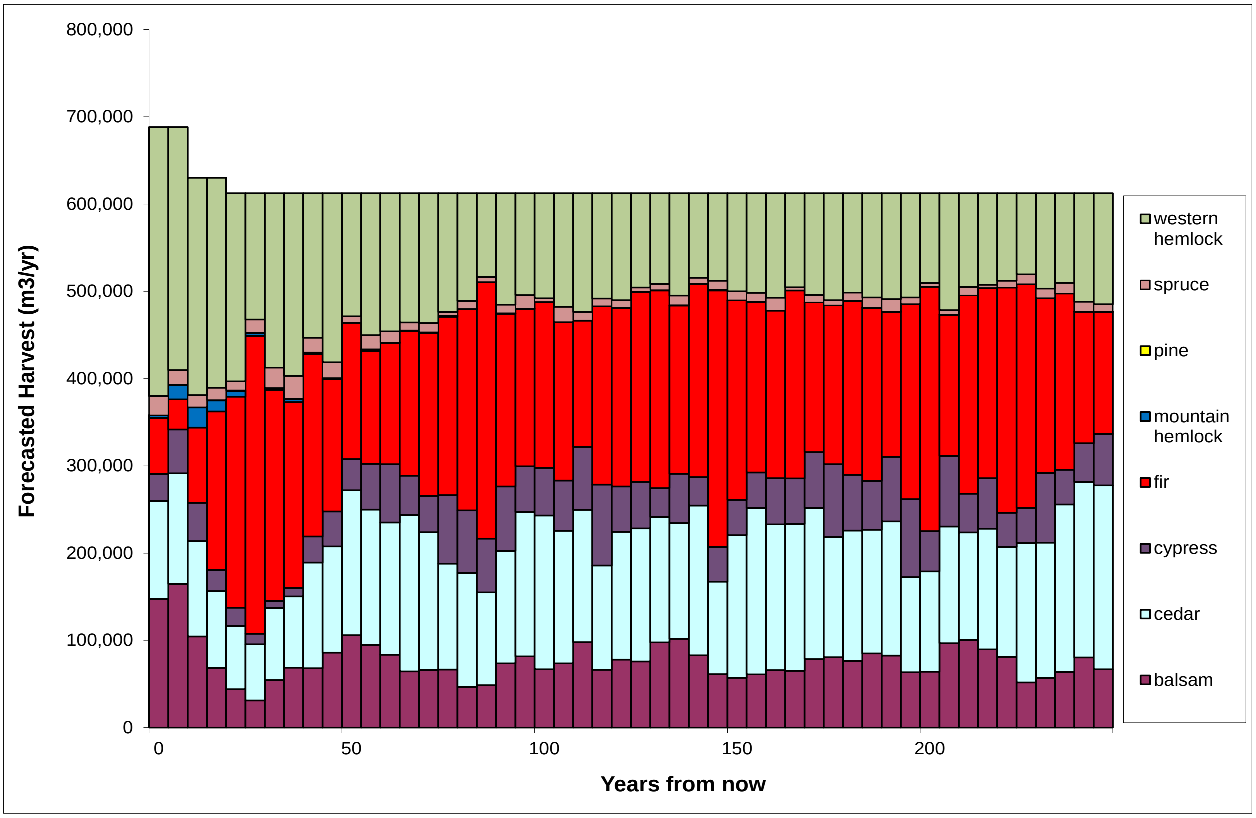

Figure 18: Predicted harvest by species; Base Case

4.4.6 Age Structure

Figure 19, Figure 20, Figure 21, Figure 22, Figure 23 and Figure 24 illustrate the projected age class structure of the forest, should the Base Case harvest schedule be followed. In the course of time, most of the NHLB will become late seral (over 250 years of age). The harvest would occur in the THLB, which would not generally age much beyond 100 years. The majority of the harvest is expected to come from age class 3 and 4 stands in the long run.

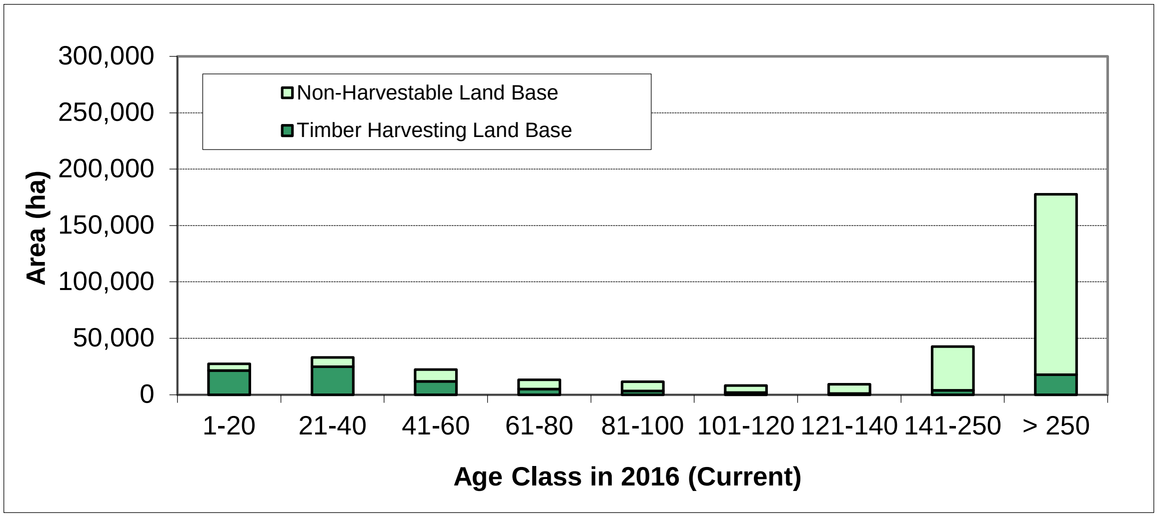

Figure 19: Current age class distribution

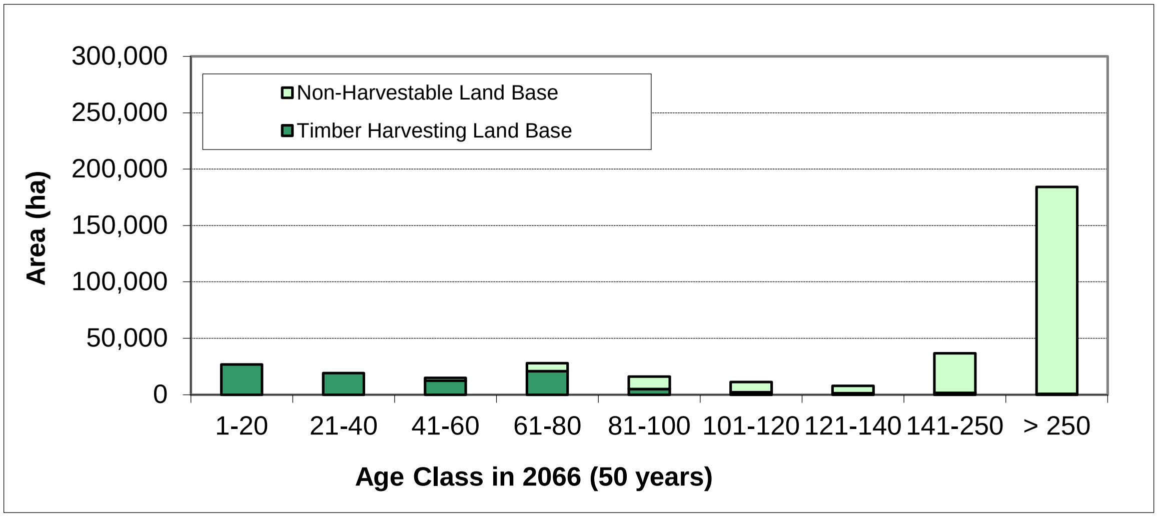

Figure 20: Projected age class distribution in 20 years

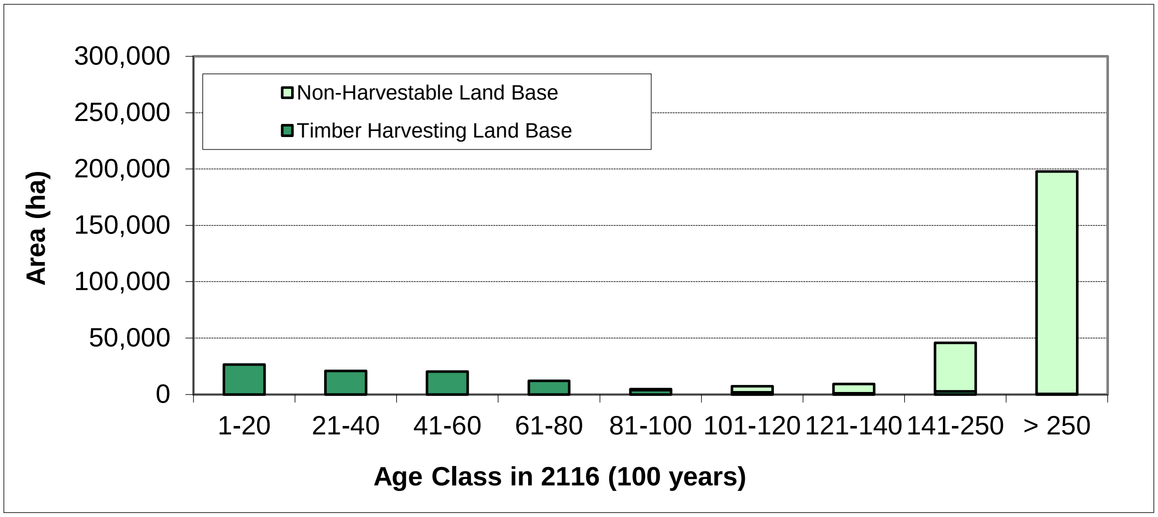

Figure 21: Projected age class distribution in 100 years

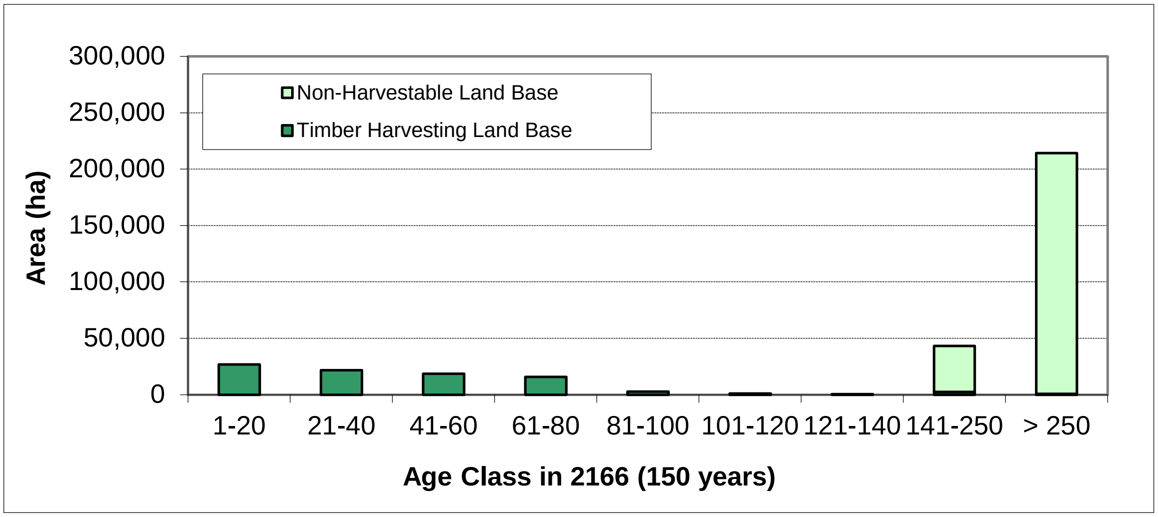

Figure 22: Projected age class distribution in 150 years

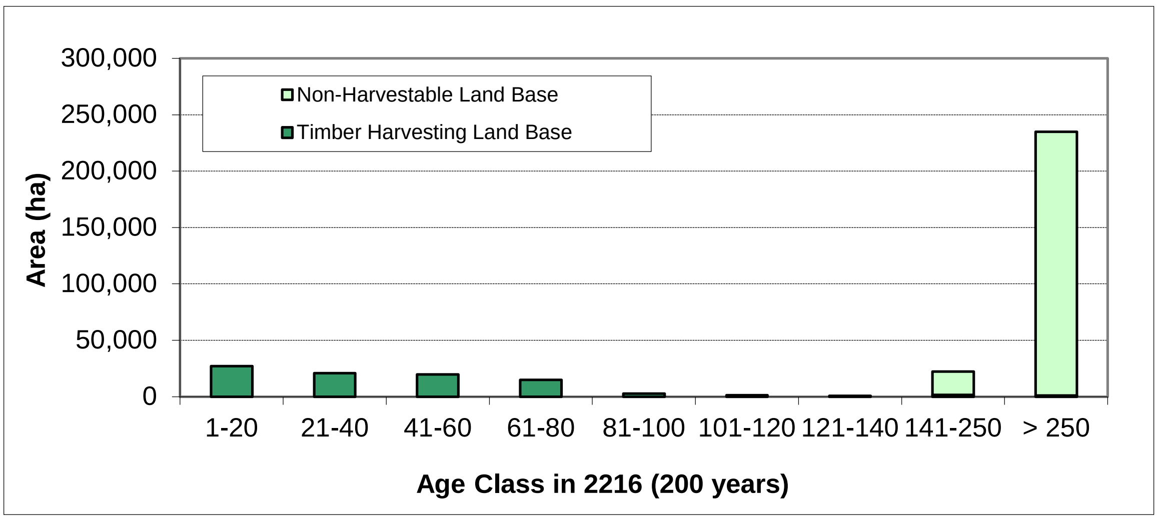

Figure 23: Projected age class distribution in 200 years

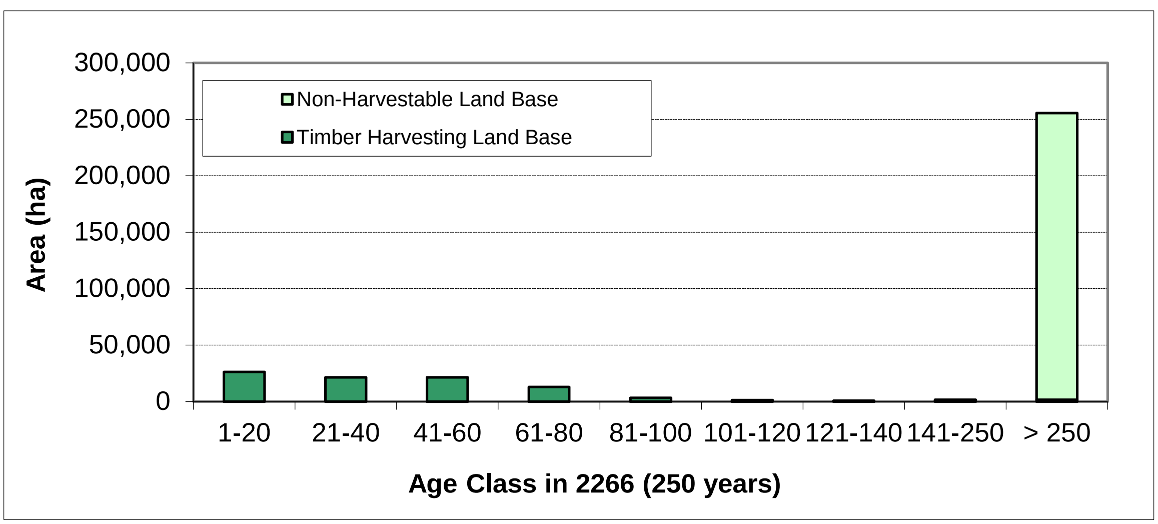

Figure 24: Projected age class distribution in 250 years

5 Sensitivity Analyses

Sensitivity analyses provide an understanding of the contribution of specific data and assumptions to the timber supply dynamics of the Base Case. They also verify that the model is applying the harvest constraints correctly. Table 10 presents a summary of the sensitivity analyses that were carried out to test the various uncertainties that exist in the Base Case data and assumptions.

Table 10: Summary of sensitivity analyses

Issue	Sensitivity Analysis	Result	
Land Base Revisions	Entire TSA land base including GBR. Add 11,544 ha of THLB.	Year 1 to 10 Year 11 to 20 LTHL	+8.6% +11.1% +9.3 %
	Remove draft WHA, goshawk nests, non-legal recreation areas and research installations from the THLB.	LTHL	-1.0%
	Remove areas from the THLB that are currently deferred from harvesting.	LTHL	-1.0%
Management Assumptions	Remove harvest scheduling controls in woodsheds.	No impact	
	Impact of spatial adjacency. Buffer blocks harvested within last 10 years by 250 m and test impact on short-term harvest.	No impact.	
	Apply ECA limits to all watersheds where ECA limits have been recommended by a professional.	No impact.	
	Block 18; 800,000 m^3 committed unused volume licence over the next 5 years. Volume assumed harvested and not available.	LTHL	-0.3%
	Blocks 28 and 29; 252,870 m^3 committed unused First Nations volume. Volume assumed harvested and not available.	No impact.	
	Established non-declining even flow for Block 30. Even flow of 10,000 m^3/yr can be achieved.	No impact.	
Combined Scenario	Combine non-legal netdowns, deferrals, ECA limits, committed unused volumes (Blocks 18, 28 and 29) and even flow for Block 30 in one scenario.	LTHL	-2.9%
Minimum Harvest Criteria	Increase minimum harvest volume to 400 m^3 per ha.	LTHL	-3.0%
	Minimum harvest age 80 for Cw/Yc, 60 for Fd, Hw and Ba	LTHL	-1.0%
Economically Operable Land Base	Increase economically operable land base by using high historical prices for both conventional and helicopter land base.	Year 1 to 10 Year 11 to 20 LTHL	+7.9% +8.3% +4.9%
	Increase economically operable land base by considering all conventional areas economic.	Year 1 to 10 Year 11 to 20 LTHL	+10.7% +11.5% +7.3%
	Increase the economically operable land base by considering all physically accessible timber economic.	Year 1 to 10 Year 11 to 20 LTHL	+70.3% +70.1% +64.6%
Growth and Yield	Adjust yields of existing natural stands (VDYP), increase by 10%	Year 1 to 10 Year 11 to 20 Year 21 to 30 LTHL	+13.8% +13.2% +5.0% No change

	Adjust yields of existing natural stands (VDYP), decrease by 10%, allow LTHL decrease	LTHL	-1.8%
	Decrease managed stand yields by 10%	Year 21 to 30 LTHL	-6.4% -9.8%
	Increase managed stand yields by 10%	Year 11 to 20 LTHL	+6.4% +9.5%
	Adjust future yields for effects of shading in high retention areas (retention > 7%) by -10%	LTHL	-2.0%
Harvest Scheduling	Test the impact of concentrating harvest on young stands. Prioritize harvest of young age class 3 and 4 stands.	LTHL	-1.0%
	Test the impact of concentrating harvest on young stands. Prioritize harvest of stands currently less than 81 years old.	Year 66 to 110 LTHL	-11.0% -9.0%

5.1 Land Base Revisions

5.1.1 Run the Analysis Including GBR in the Land Base

This sensitivity analysis explored the timber supply for the entire TSA and included the GBR in the analysis. The GBR adds 11,544 ha of THLB to the land base and increases the harvest forecast by 8.6% from year 1 to 10, 11.1% from year 11 to 20 and 9.3% in the long term (Figure 25).

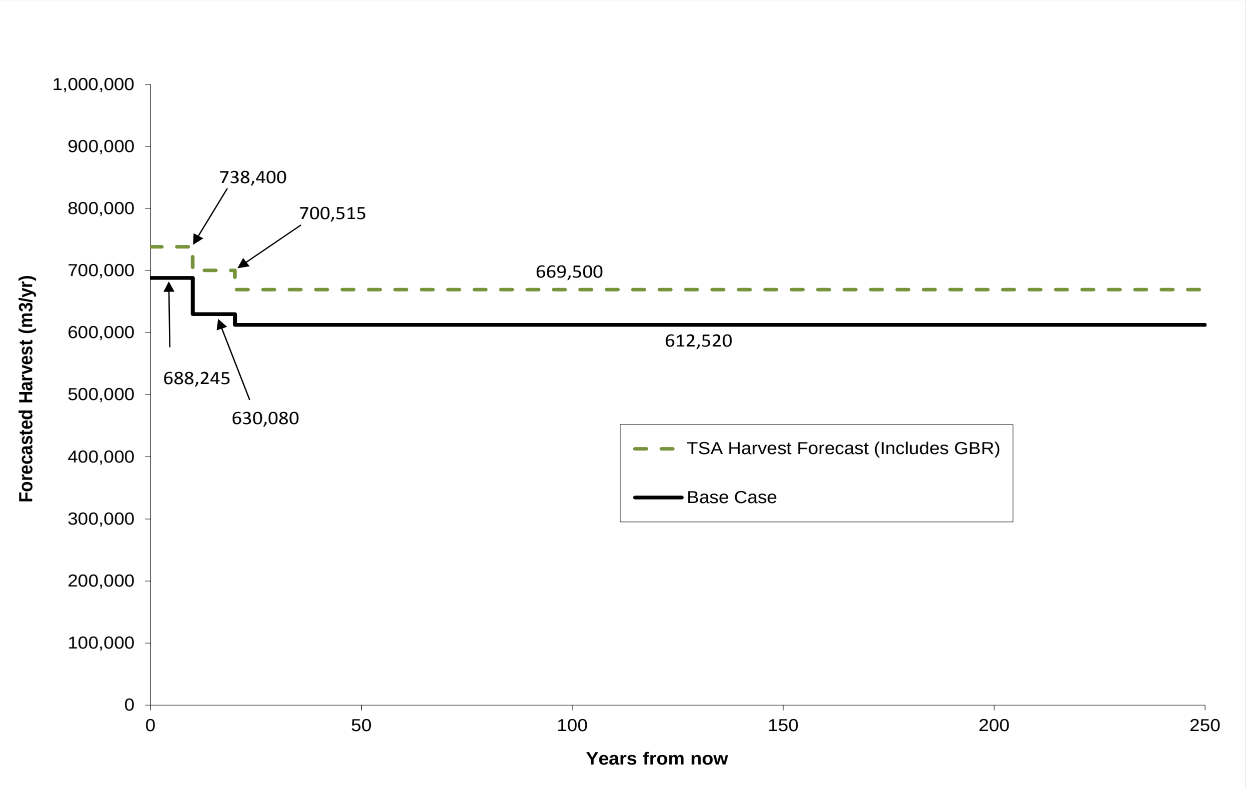

Figure 25: Harvest forecast for the entire TSA, including the GBR

5.1.2 Remove Non-Legal Netdowns and Deferred areas from the THLB

The THLB netdown removes only those areas from the THLB that are directed for removal by legislation or policy. In practise, there are additional areas that are not currently harvestable due to pending legal orders or policy. These areas were removed from the THLB and the impact was tested in this sensitivity analysis.

This removal reduced the timber harvesting land base by 1,160 ha and resulted in a small 1% decrease in the LTHL (Figure 26).

In addition to the non-legal netdowns, there are 969 ha of THLB that is currently deferred from harvest for various reasons. These areas were removed from the THLB and the impact of this removal was tested.

This removal resulted in a small 1% decrease in the LTHL (Figure 27).

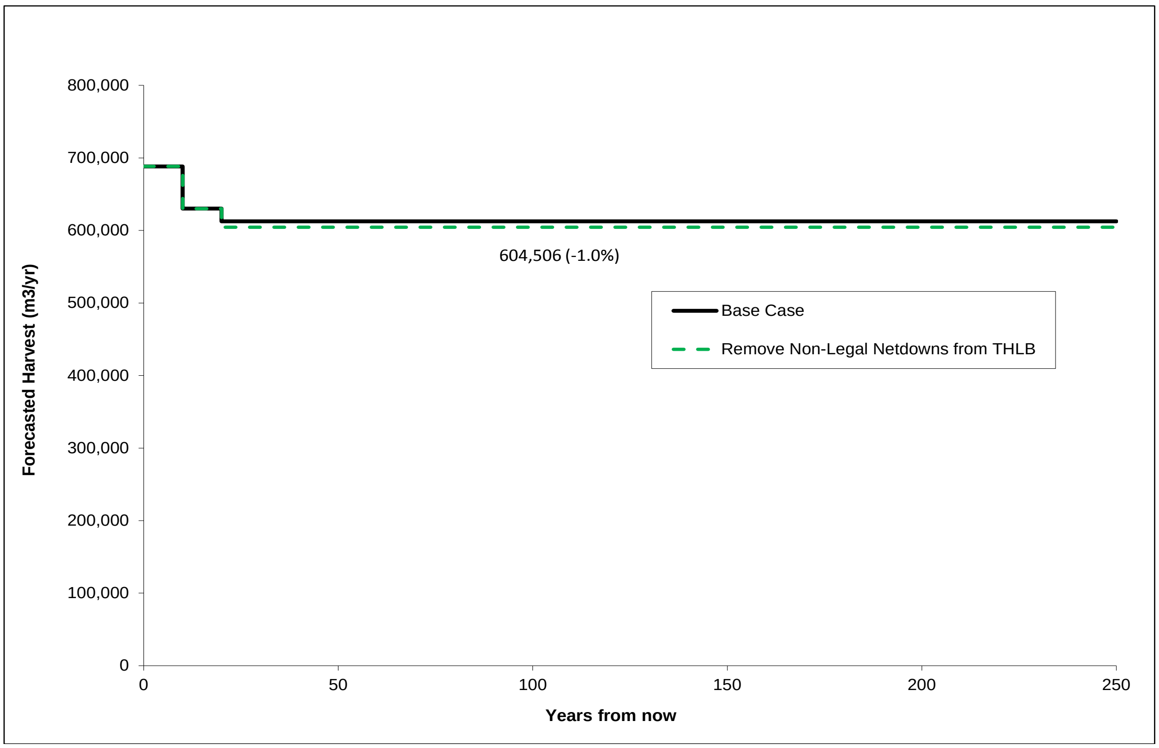

Figure 26: Remove non-legal netdowns from the THLB

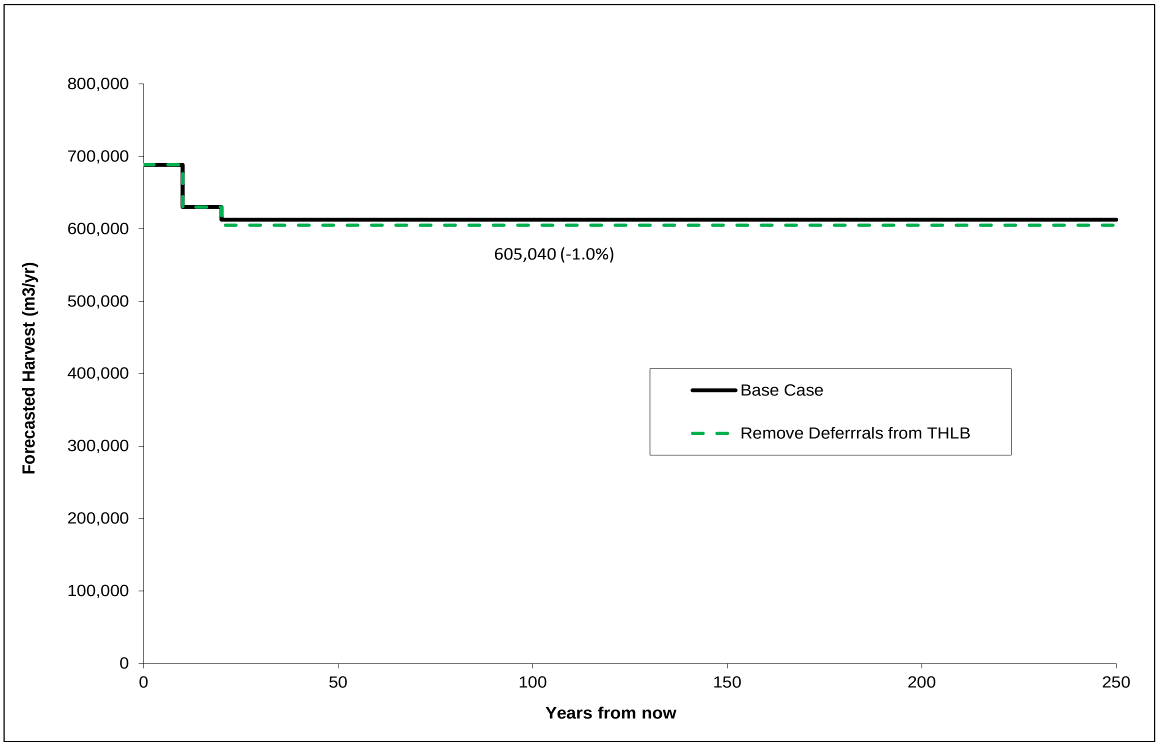

Figure 27: Remove deferred areas from the THLB

5.2 Management Assumptions

5.2.1 Harvest Scheduling Controls in Selected Woodsheds

Minimum volume requirements can be set for an area, when it is known that the financial viability of the harvest from that area requires a minimum harvestable volume. Due to the scattered and isolated nature of the Pacific TSA Blocks, many of them require a minimum harvest volume to reflect the operational reality associated with mobilization and demobilization. Several TSA Blocks, or the combinations of Blocks were subject to minimum volume requirements in the Base Case. These Blocks or combination of Blocks are referred to as woodsheds in this analysis.

This sensitivity analysis tested the impact removing the minimum volume requirements from the analysis. The harvest forecast was not impacted.

5.2.2 Spatial Adjacency

In operations the harvest of timber is constrained by previously harvested areas nearby. Adjacent harvest areas must be greened up before new harvesting can occur in their vicinity. In the Pacific TSA the new harvest areas must meet the *Forest Planning and Practices Regulation* (FPPR) section 65. The section defines “adjacent” as an area that is sufficiently close to a cutblock that, due to its location, could directly impact on, or be impacted by, a forest practice carried out within the cutblock. For the purposes of this analysis we used a minimum distance of 250 m from previously harvested non-greened up blocks to define spatial adjacency.

This timber supply analysis used surrogates to model adjacency constraints. In non-scenic areas a landscape green-up constraint was applied in the Base Case, specifying that no more than 25% of the THLB area in each landscape unit outside of VILUP may be below the green-up height of 3 m at any given time. The same constraint applies to the VILUP SMZ and GMZ; in the EFZ a shorter green-up height of 1.3 m was required. In scenic areas the same approach was used with the required green-up tree heights varying by slope classes and the maximum denudation of the CFLB (not THLB) changing by visual absorption capability.

At times BCTS staff have difficulties locating new harvest areas due to constraints posed by non-greened up adjacent blocks. For this reason they wanted to test the sensitivity of the short-term timber supply to explicit spatial adjacency. This was accomplished by buffering all the blocks harvested within the past 10 years by a 250 m buffer. No harvest was allowed within the buffer for 10 years (until after 2026).

Excluding the harvest within these buffers had no impact on the short-term timber supply.

5.2.3 ECA Limits

There are 67 watersheds in TSG business area where watershed assessments have been carried out. ECA limits ranging from 20% to 40% have been established for these watersheds. Apart from the Fisheries Sensitive Watersheds (FSW) and the Sproat Community Watershed (930.021) - where management observes ECAs through forest stewardship plans - there is no legal requirement to follow these limits.

Eight of the 67 assessed watersheds are within FSWs and were modeled in the Base Case. The Sproat Community Watershed (930.021) sub-basins was also considered in the Base Case

Because operational planning accounts for the ECA limits in the remaining watersheds, their impact on timber supply was tested through a sensitivity analysis.

Applying the ECA limits to watersheds where they have been recommended by a professional had no impact on timber supply.

5.2.4 Committed Unused Volume

Two sensitivity analyses were completed testing the impact of harvesting committed unused volumes in Block 18, and Blocks 28 and 29. In Block 18, the timber supply model was directed to harvest 800,000 m^3 of timber in five years using the relative oldest harvest rule. The harvested blocks were tagged, their ages set to zero and they were placed on future managed stand yield curves. The timber supply model was run again for the Base Case THLB with the harvested blocks considered in the analysis.

The results were compared to the Base Case and the impact of harvesting this volume over the first five years was found to be negligible. The harvest forecast had to be lowered by 0.3% starting at year 21.

The same procedure was repeated for Blocks 28 and 29 for the total 5-year harvest volume of 252,870 m^3. This projected harvest had no impact on the Base Case timber supply.

5.2.5 Non-Declining Even Flow for Block 30

This sensitivity analysis first tested whether a non-declining even flow of 10,000 m^3 could be maintained for Block 30. After this the Base Case harvest forecast was run without Block 30. The results demonstrated that a non-declining even flow of 10,000 m^3 per year could be maintained for Block 30, and the overall Base Case harvest forecast was not impacted.

5.3 Combined Scenario

This sensitivity analysis combined land base revisions and management assumptions into one scenario. BCTS considers this scenario as the most representative of their current practise. The scenario incorporated the following changes from the Base Case:

- Non-legal netdowns were removed from the THLB;
- Deferred areas were removed from the THLB;
- ECA limits were modeled in all watersheds where watershed assessments exist;
- Committed unused volumes were accounted for (Blocks 18, 28 and 29);
- Non-declining harvest flow of 10,000 m^3 per year was imposed on Block 30.

The projected timber supply for the combined scenario is illustrated in Figure 27. Incorporating the above land base revisions and the changes in management assumptions decreased the harvest by 2.9% in the long term. The short term was not impacted.

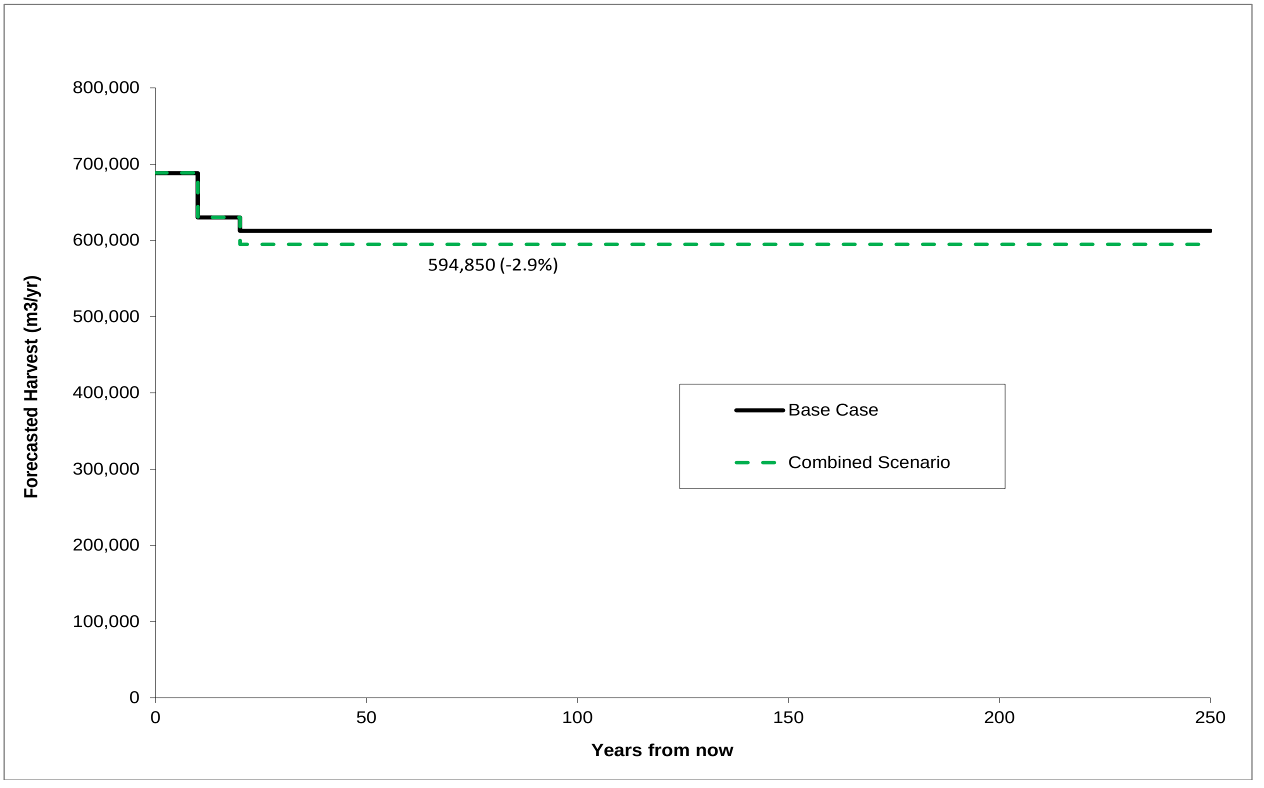

Figure 28: Combined scenario (land base revisions and management assumptions)

5.4 Minimum Harvest Criteria

In the Base Case, the stands can be harvested once they reach a volume of 300 m^3 per ha. This minimum harvestable volume may be low in poor market conditions and at times higher volumes may be required for the harvest to be economic. In this sensitivity analysis the minimum harvest volume was increased to 400 m^3 per ha.

The increased minimum harvest criteria reduced the LTHL by 3%. There was no short or medium-term impact (Figure 28).

In their operations the BCTS would like to ensure that managed stands are not harvested at young ages. If possible they would like to make sure that Cw/Yc leading stands are not harvested before they reach the age of 80, on average. Their desired minimum harvest age for Fd, Hw and Ba leading stands is 60.

A sensitivity analysis testing the impact of setting the minimum harvest ages at 80 for Cw/Yc and 60 for Fd, Hw and Ba shows that there is only a small negative impact (-1%) on the LTHL. The short-term and the mid-term were not impacted (Figure 29).

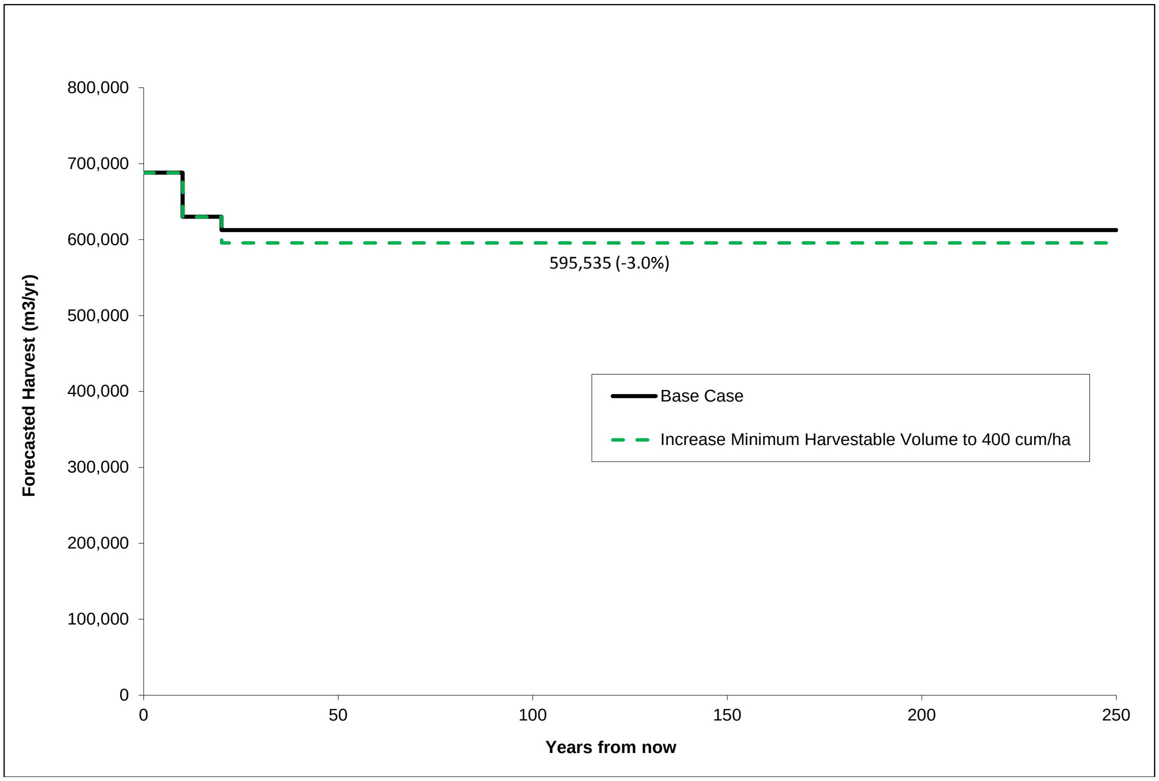

Figure 29: Increase minimum harvest volume to 400 m^3 per ha

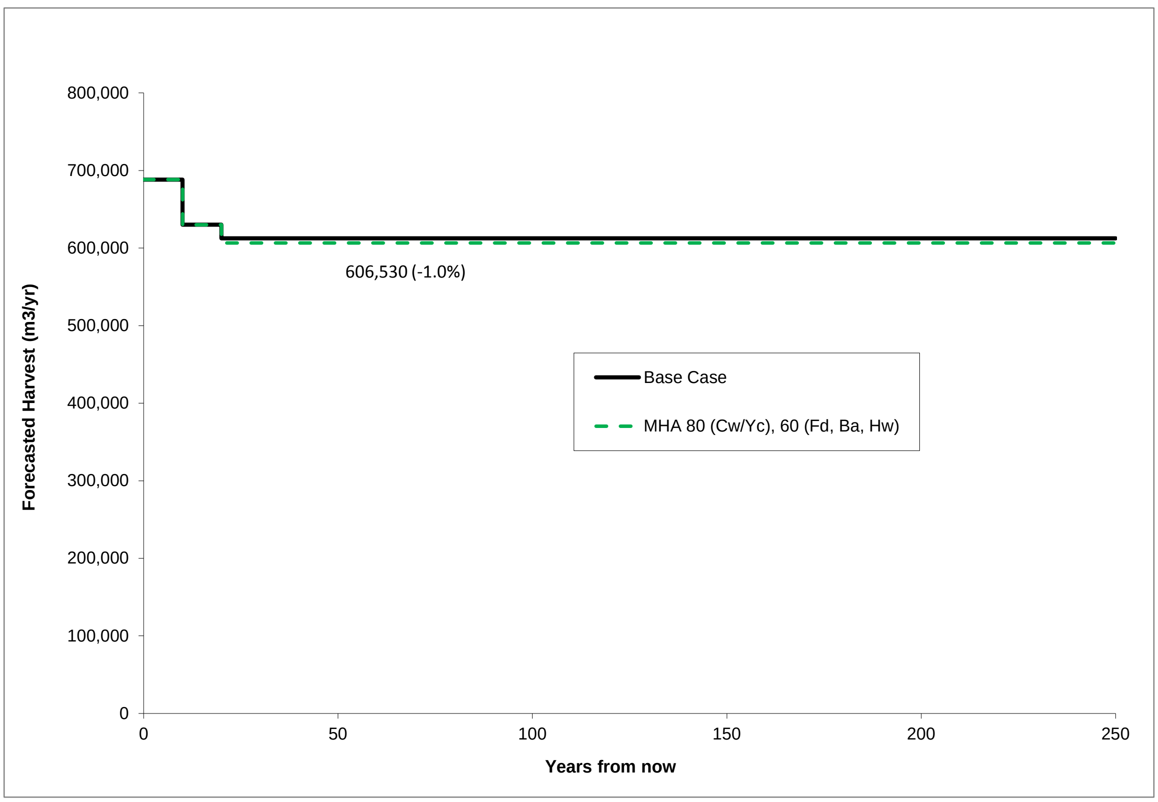

Figure 30: MHA 80 (Cw/Yc), 60 (Fd, Hw, Ba)

5.5 Economically Operable Land Base

An economic operability assessment was completed as part of the Pacific TSA TSR. The economically operable area forms one of the netdown items used to classify the THLB. Areas that are classified as un-economic for harvest operations were removed from the THLB.

The economic operability analysis is a strategic, landscape level analysis of the economically operable land base. The objective of the analysis was to determine the land base where – on average – operations are expected to be economic in average market conditions.

The methodology employed to complete the economic operability analysis relied on value and cost assumptions that are subject to uncertainty. The economically operable land base is sensitive to changes in these assumptions as described in the Economic Operability Assessment, Analysis Report – Pacific TSA. Several sensitivity analyses were constructed to investigate the sensitivity of the timber supply to changes in the economically operable land base.

5.5.1 Increase Economically Operable Land Base by Using High Historic Prices

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. In the Base Case it is assumed that harvest in these areas is economic only during the market cycles with high historic log prices, while conventional harvest areas are assumed to be economic in average market conditions. This sensitivity analysis explored the impact of using high historic log prices for the entire THLB.

Using high historic prices increases the THLB by 5.1% from 90,634 ha to 95,238 ha. The increase in the size of the THLB comes entirely from the conventional land base: 80.4% of the increase is from the TSK (Blocks 28 and 29) business area, while 13.6 % is from the TSG business area (Block 18).

The larger THLB increases the Base Case harvest forecast by 7.9% in the first 10 years, 8.3% between years 11 and 20 and 4.9% in the long term (Figure 30).

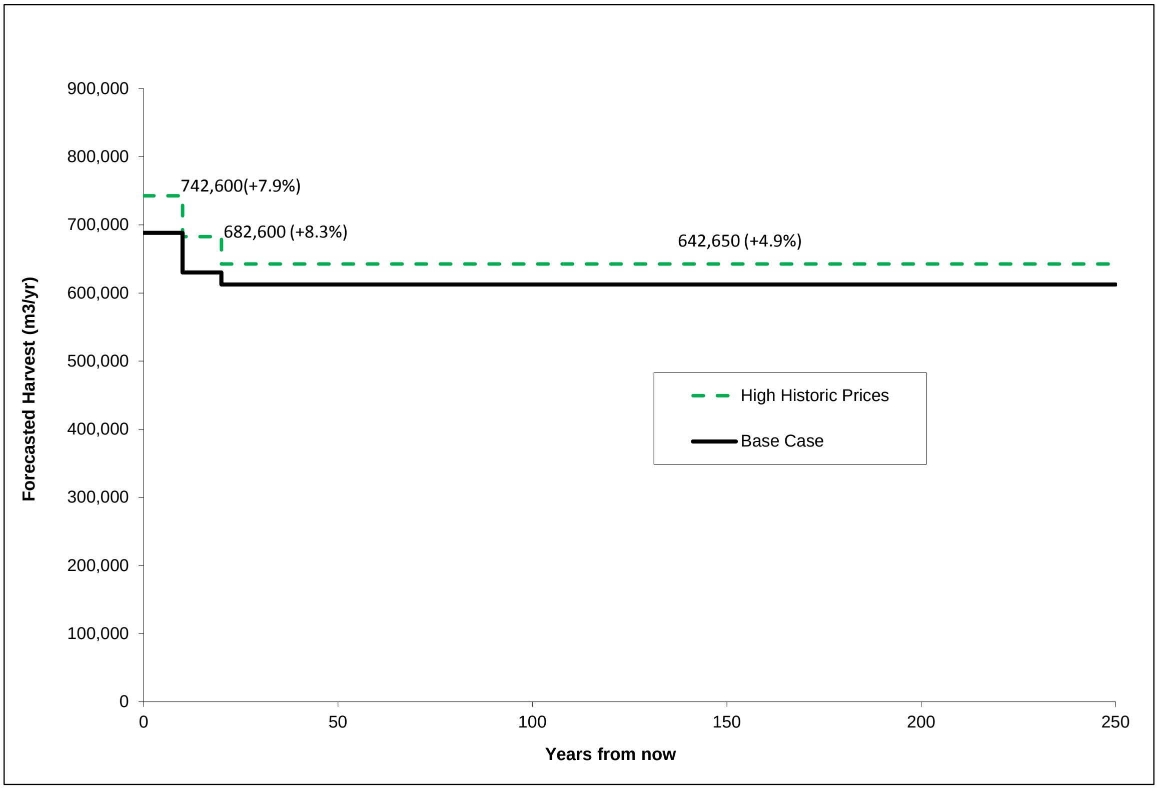

Figure 31: Use high historic prices for the entire land base

5.5.2 Increase Economically Operable Land Base by Considering All Conventional Areas Economic

This sensitivity analysis considered all conventional harvest areas economic. This assumption increases the THLB by 7.5% from 90,634 ha to 97,394 ha. The increase in the size of the THLB comes entirely from the conventional land base: 80.5% of the increase is from the TSK (Blocks 28 and 29) business area, while 12.7 % is from the TSG business area (Block 18).

In this sensitivity analysis the Base Case harvest forecast is increased by 10.7% in the first 10 years, 11.5% between years 11 and 20 and 7.3% in the long term (Figure 31).

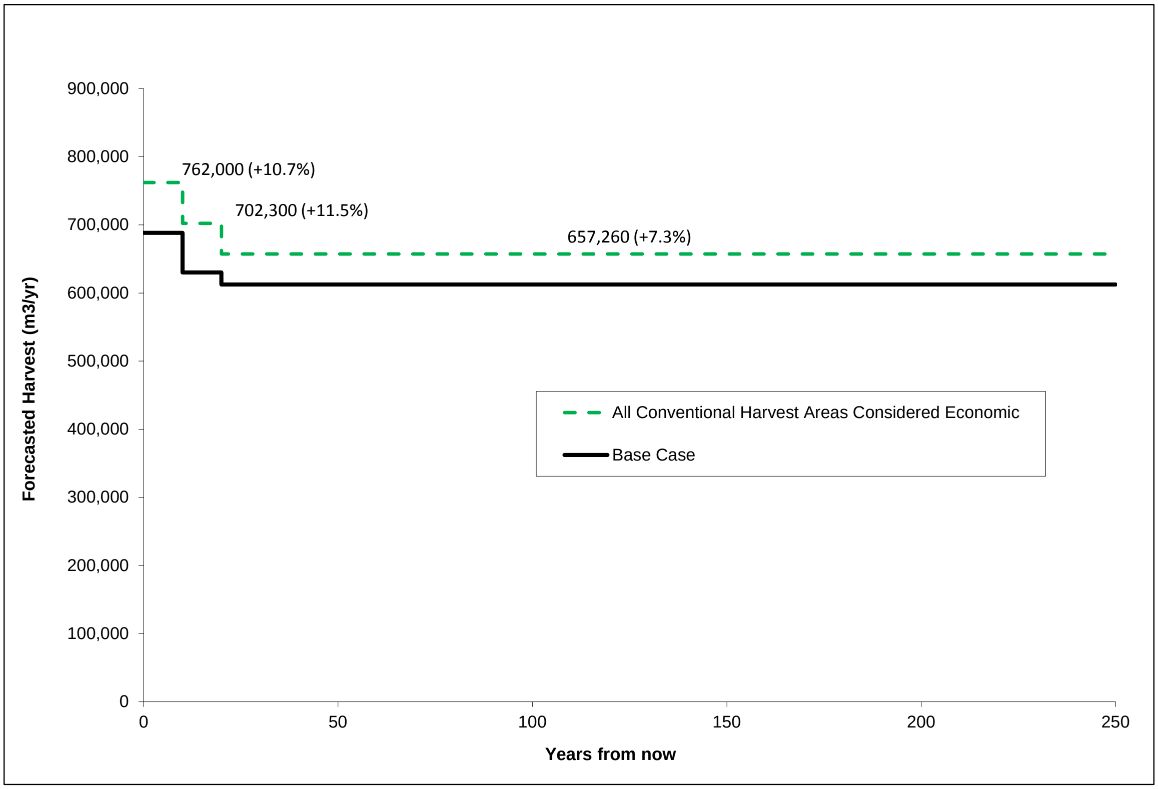

Figure 32: Consider all conventional harvest areas economic

5.5.3 Increase Economically Operable Land Base by Considering All Accessible Areas Economic

This sensitivity analysis considered all physically accessible harvest areas economic. This assumption increases the THLB by 64.7% from 90,634 ha to 153,599 ha. This increase comes mostly from the helicopter land base (89.3%), while 73% of the increased THLB is located in the TSK business area (Blocks 28 and 29).

The larger THLB increases the Base Case harvest forecast by 70.3% in the first 10 years, 70.1% between years 11 and 20 and 64.6% in the long term (Figure 31).

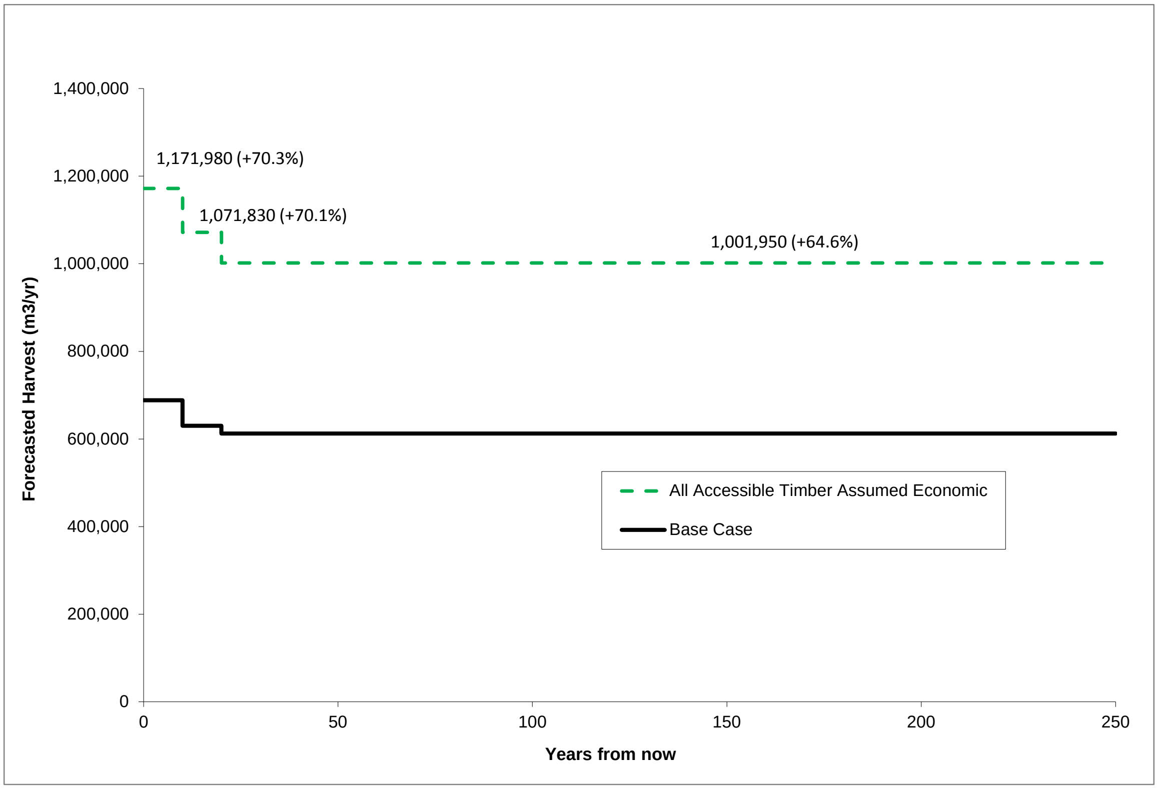

Figure 33: Consider all accessible areas economic

5.6 Inventory Volume, Growth and Yield

5.6.1 Uncertainty of Predicted Inventory Volumes

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. Each inventory was converted to VRI format and projected to 2014. These separate inventories were consolidated to one VRI for the entire Pacific TSA.

The purpose of this sensitivity analysis is to test the risk associated with an overestimation in volumes predicted by the VRI. While underestimation of the inventory volumes poses no risk to timber supply, its impact was tested as well.

Reducing the natural stand yields by 10% decreased the mid and long-term harvest forecast by 1.8%, while the short-term harvest level was not affected (Figure 33).

Figure 34 illustrates the impact increasing the natural stand volumes by 10%. The harvest forecast is increased over the first 30 years of the planning horizon: 13.8% for the first 10 years, 13.3% between years 11 and 20 and 5.0% between years 21 and 30.

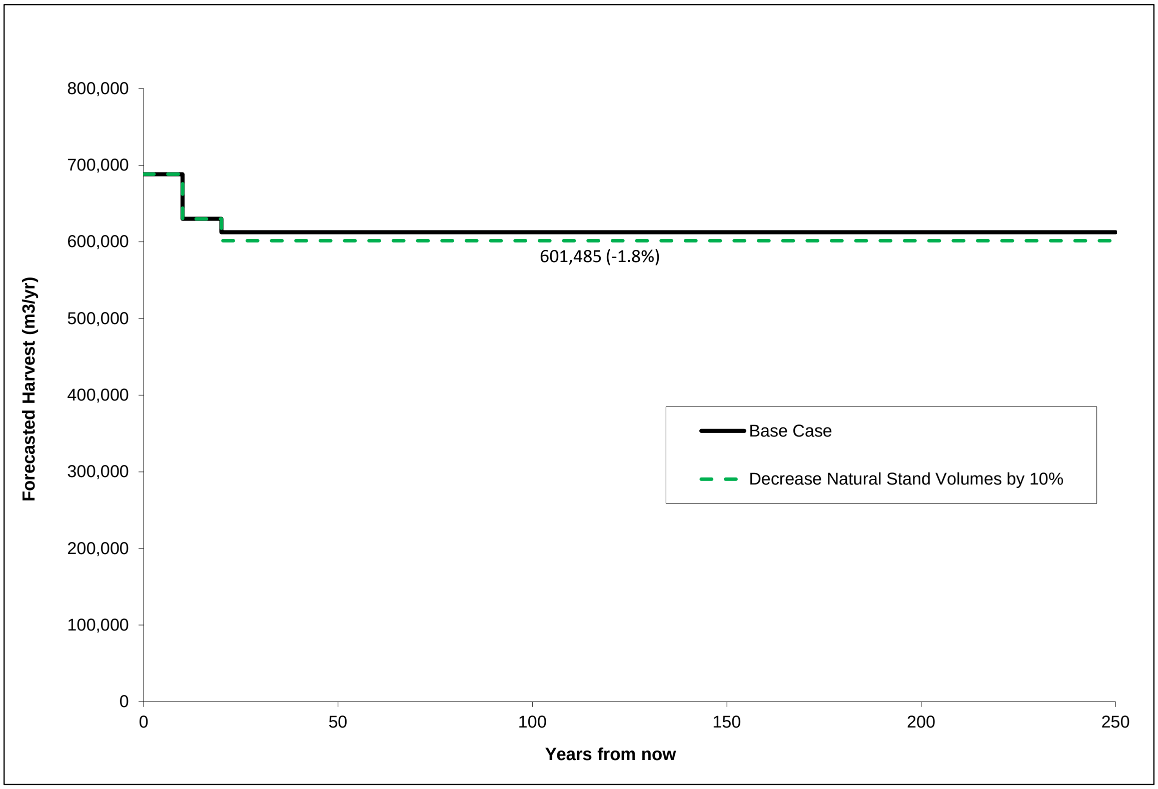

Figure 34: Reduce natural stand volumes by 10%, maintain the short-term harvest level

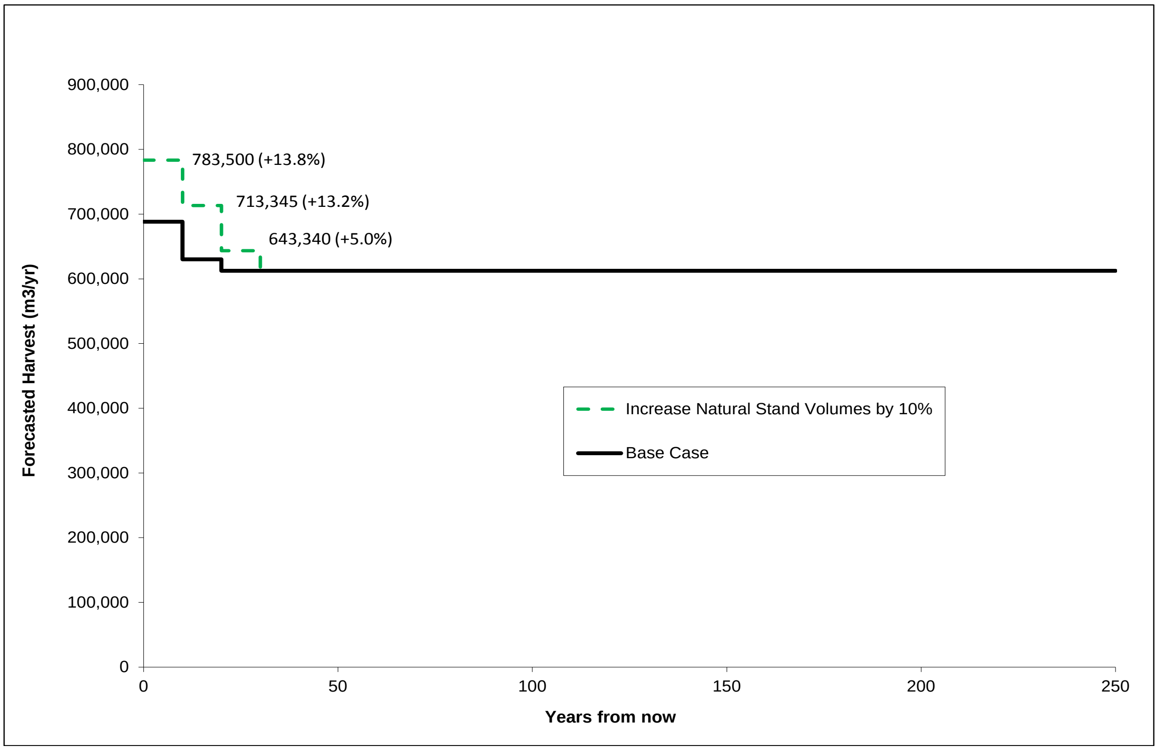

Figure 35: Increase natural stand volumes by 10%

5.6.2 Uncertainty of Predicted Growth and Yield of Managed Stand

Existing and future managed stands are the dominant source of volume in the medium and long terms. The purpose of this sensitivity analysis is to assess the impact associated with an over or underestimation in the growth of existing and future managed stands. The potential impact of high levels of retention on future supply was also explored.

A 10% reduction in the yield of managed stands reduces the medium and long-term harvest level by 9.8% (Figure 35). There is also a 6.4% reduction between years 21 and 30 when the transitioning from natural stands to managed stands begins.

Increasing the managed stand yields by 10 % increased the harvest forecast between years 11 and 20 by 6.4%, while the medium and long-term harvest forecast was 9.5% higher than that of the Base Case (Figure 36).

In the Pacific TSA, the retention levels for wildlife trees and wildlife tree patches are high in some landscape units and management zones. Approximately 39,075 ha of the THLB (43%) is expected to have retention levels higher than 7%. The growth and yield of future stands might be negatively impacted by the shading effects in these areas. Figure 37 shows the result of a sensitivity analysis testing the potential impact of shading on future timber supply. The sensitivity analysis assumed that the growth and yield of future stands would be reduced by 10% in all areas where higher than 7% retention is applied.

The 10% reduction in the growth and yield of future stands in high retention areas resulted in a 3.8% decrease in the long-term harvest forecast. The short term was not impacted.

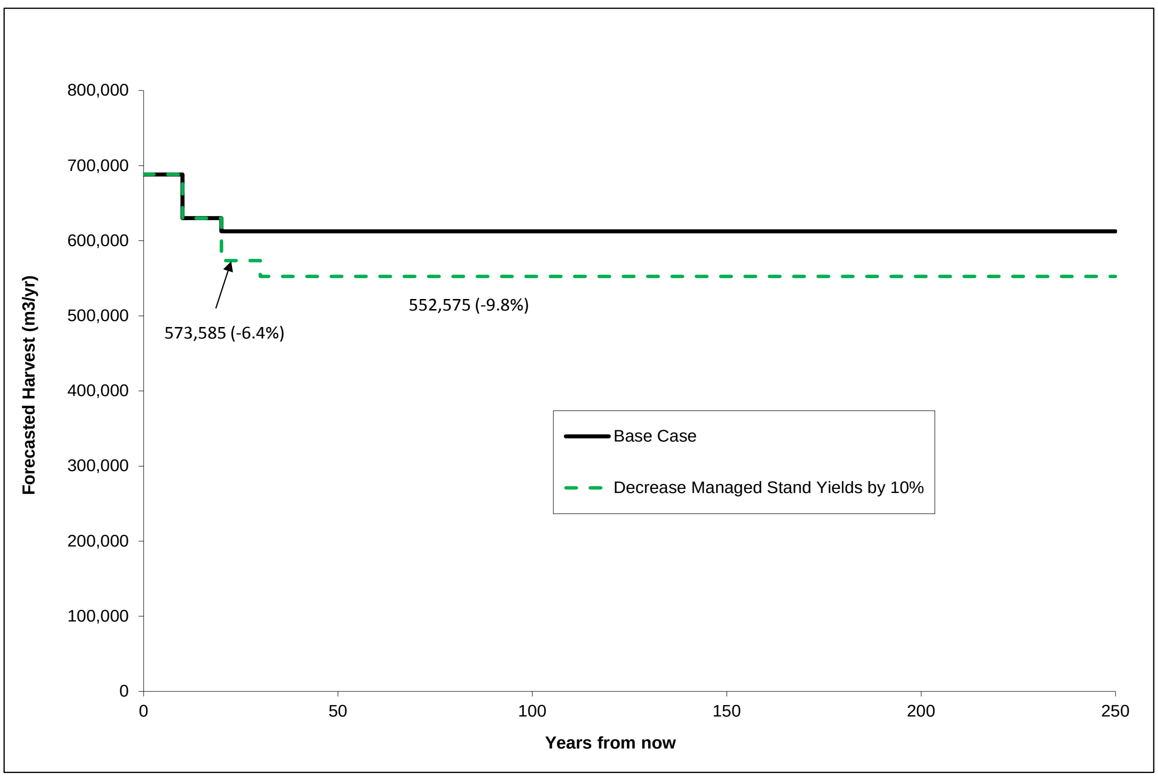

Figure 36: Decrease managed stand yields by 10%

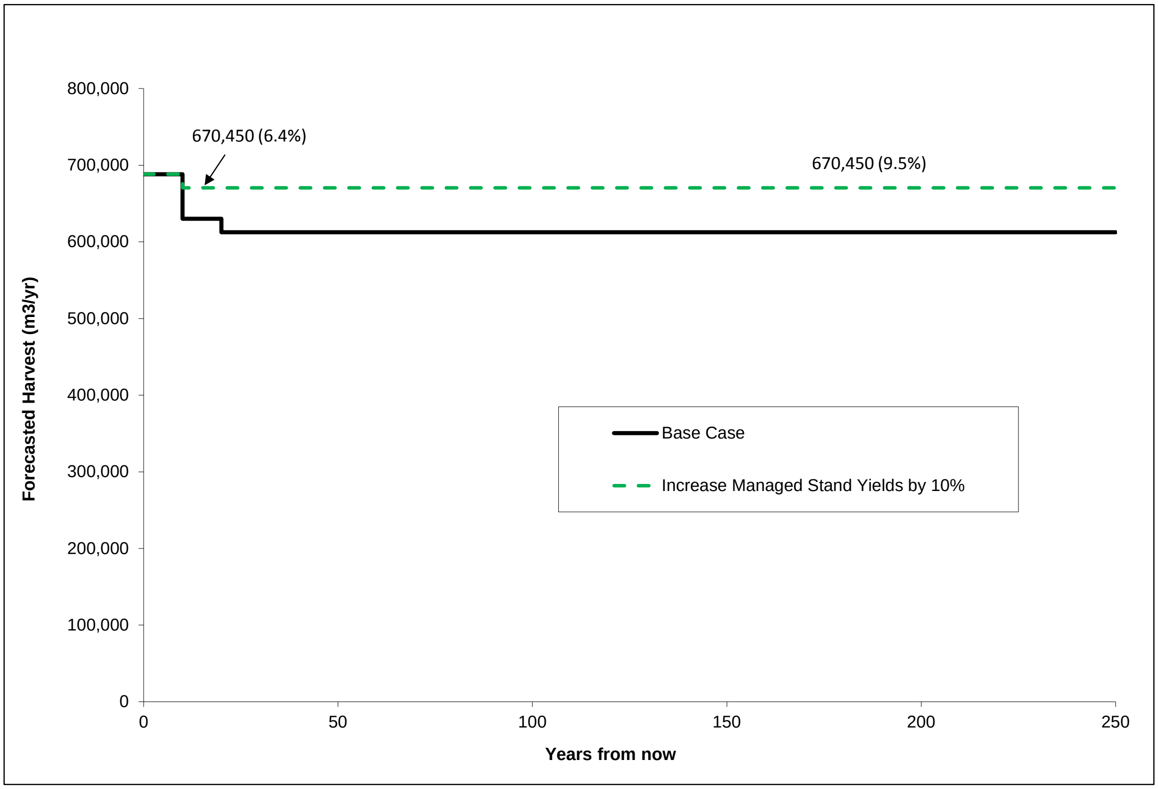

Figure 37: Increase managed stand yields by 10%

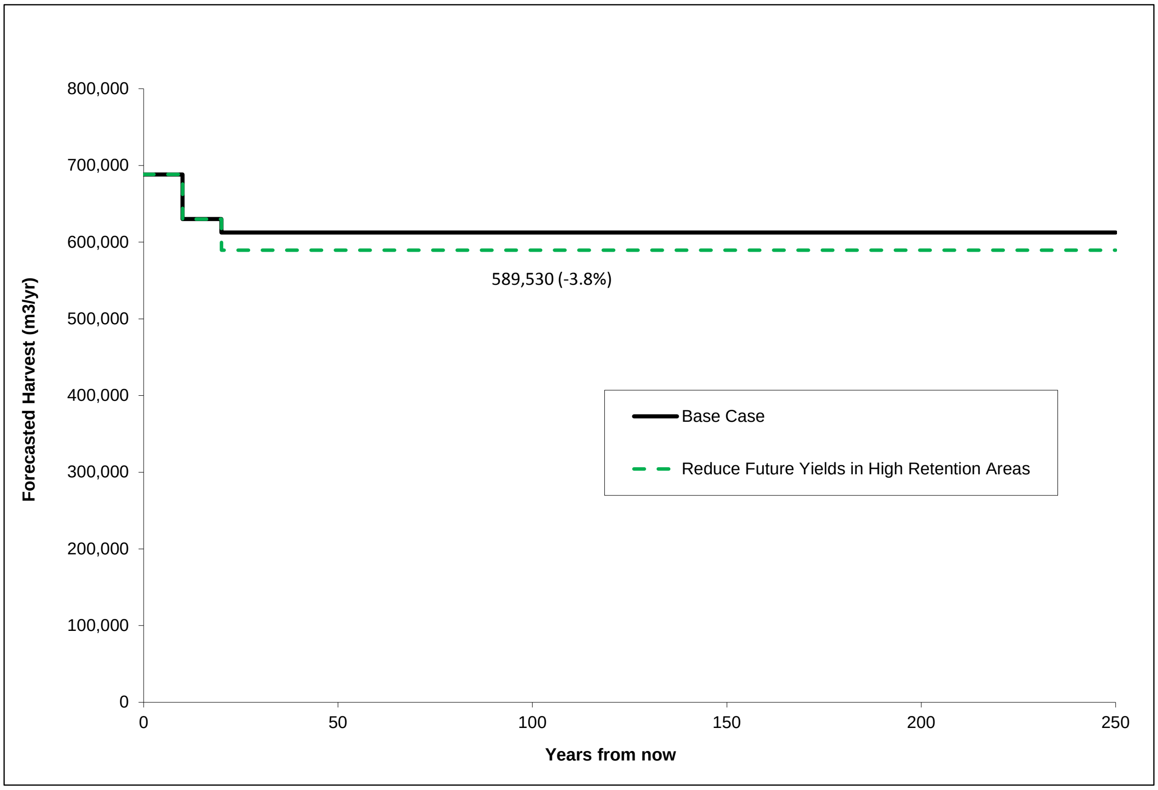

Figure 38: Reduce the future yield of stands in high retention areas by 10%

5.7 Harvest Scheduling

It is likely that the relative oldest harvest rule employed in the Base Case does not fully reflect current management in the Pacific TSA. Due to market conditions and access, second growth stands are harvested in conjunction with older stands. This trend is expected to continue.

The timber supply impact of harvesting younger stands at the beginning of the planning horizon was explored trough two sensitivity analyses. The first one prioritized the harvest of age class 3 and 4 stands (61 to 100 years old). The second sensitivity analysis placed the harvest priority on a larger population and included all stands currently younger than 81. The very young stands could be harvested in the model, as long as they met the minimum merchantability criteria of 300 m^3 per ha.

5.7.1 Prioritize Harvest of Age Class 3 and 4 Stands

Figure 38 illustrates the timber supply impact of prioritizing the harvest of age class 3 and 4 stands. The medium and long term harvest is impacted slightly, as the harvest forecast is decreased by 1%. The short-term harvest is not impacted.

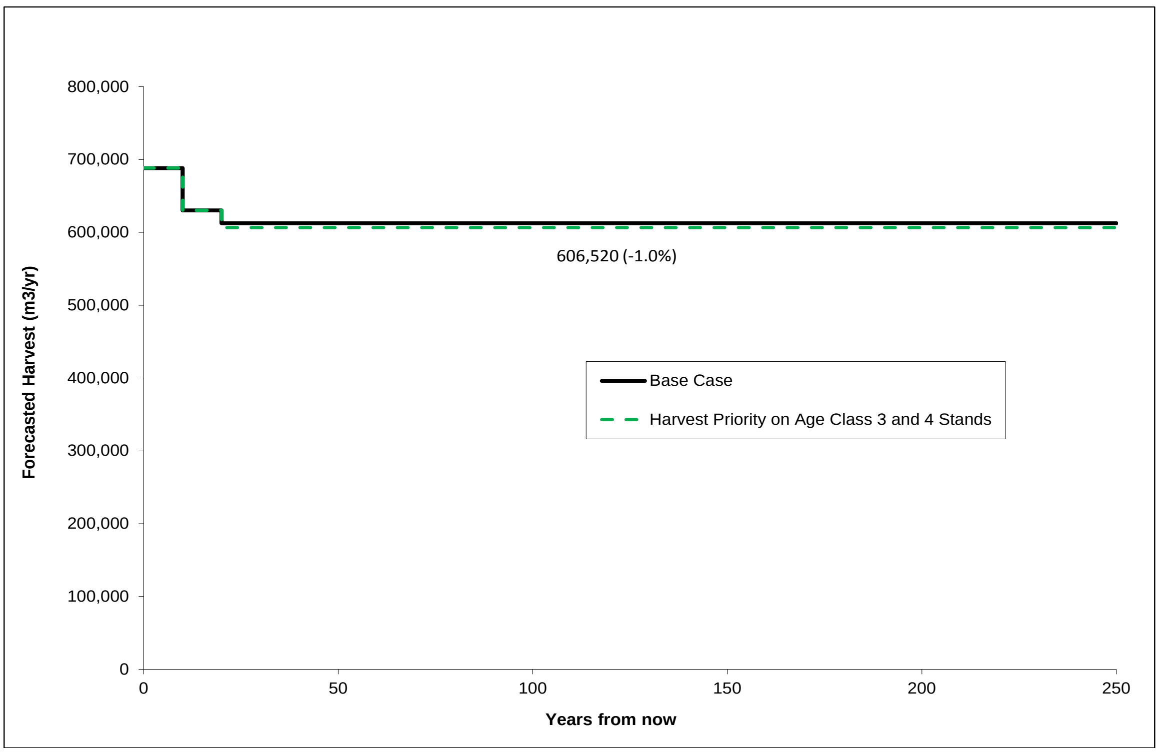

Figure 39: Prioritize the harvest of current age class 3 and 4 stands

5.7.2 Prioritize Harvest of Stands Younger than 81 Years Old

When the harvest priority is set high for all stands currently less than 81 years old, the forest estate model attempts to harvest the high priority stands as soon as they meet the minimum merchantability criteria of 300 m^3 per ha. Many stands are harvested below the culmination of their mean annual increment and the conversion of older, unmanaged stands to managed stands is delayed. This has a significant impact on the medium and long-term timber supply as can be seen in Figure 39. The harvest forecast is reduced by 11% to 545,085 m^3 per year at year 66. The long-term harvest level of 557,500 m^3 per year is 9% lower than that of the Base Case. It is reached at year 111.

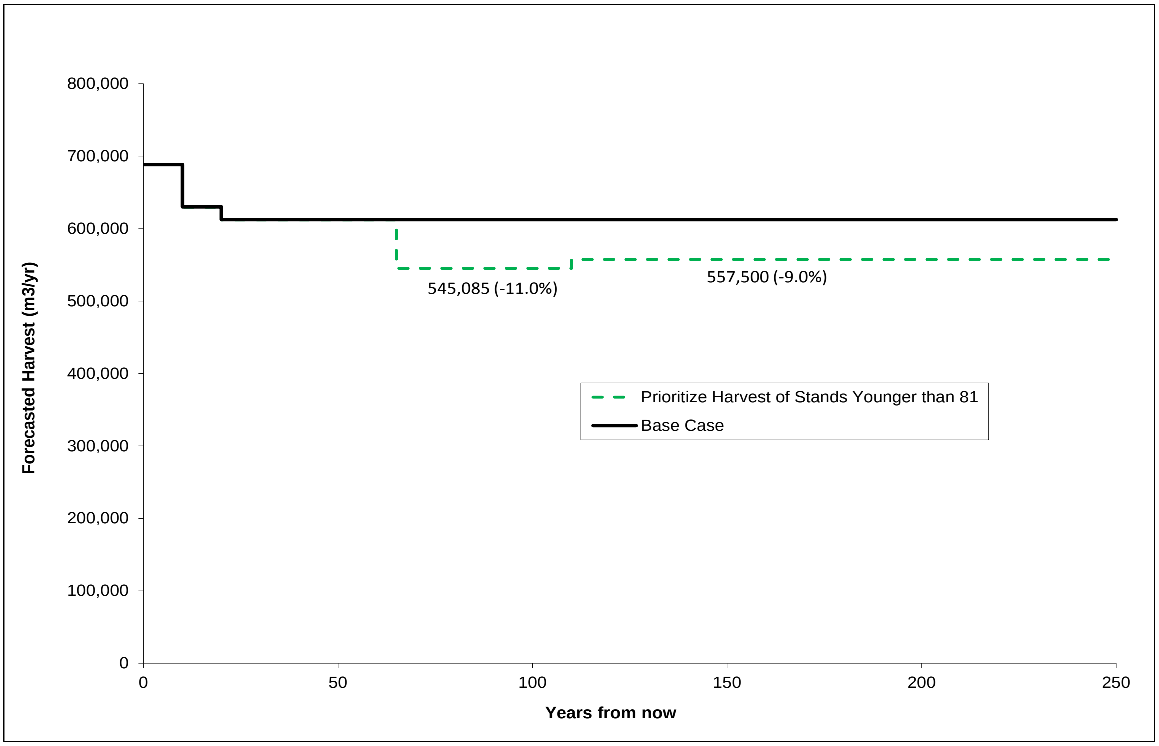

Figure 40: Prioritize the harvest of stands currently younger than 81

6 Partitioned Harvest Flows

6.1 Harvest Contribution from Helicopter Harvest Areas and Clayoquot Sound

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. It is assumed that harvest in these areas is economic only during the market cycles with high log prices, while conventional harvest areas are assumed to be economic in average market conditions. The size of the THLB that falls within the helicopter harvest area in the Base Case is 9,367 ha.

The Clayoquot Sound area is located within Block 27. Resource management in Clayoquot Sound is governed by the Clayoquot Sound Land Use Decision and implemented in the Pacific TSA through the Upper Kennedy Watershed Plan. There has been limited harvesting in Clayoquot Sound in the past. The size of the THLB within the Clayoquot Sound area is 1,769 ha.

The contribution of Clayoquot Sound, the helicopter harvest areas and the conventional harvest areas outside of Clayoquot Sound to timber supply were investigated in this timber supply analysis as illustrated in Figure 40. The harvest from these areas fluctuates significantly with the average harvest over the planning horizon from Clayoquot Sound and the helicopter land base at 14,640 m^3 per year and 56,285 m^3 per year respectively. The average harvest from the conventional area outside of Clayoquot is 545,295 m^3 per year.

When Clayoquot Sound was analysed independently, a long term harvest level of 14,300 m^3 per year was achieved with modestly higher forecasts for the short term: 15,920 m^3 per year for the first 10 years and 14,530m^3 per year for years 11 to 20 (Figure 41).

The helicopter land base alone produced a long-term harvest forecast of 56,765 m^3 per year with a short-term harvest (10 years only) of 58,450 m^3 per year (Figure 42).

Figure 43 illustrates the harvest forecast for the conventional land base outside of Clayoquot Sound. This land base produced a long-term timber supply forecast of 535,410 m^3 per year with the short-term forecast of 560,310 m^3 for the first 10 years.

Figure 44 compares the summed up partition harvest forecasts to the Base Case harvest forecast. The aggregated timber supply forecast (Clayoquot Sound, helicopter land base and the conventional land base outside Clayoquot Sound) is smaller than that of the Base Case. In the first 10 years, 53,565 m^3 (7.8%) less timber is harvested annually and between years 11 and 20 23,605 m^3 (3.7%) less than in the Base Case is harvested. The long term harvest forecast is marginally smaller than that of the Base Case (less than 1% difference).

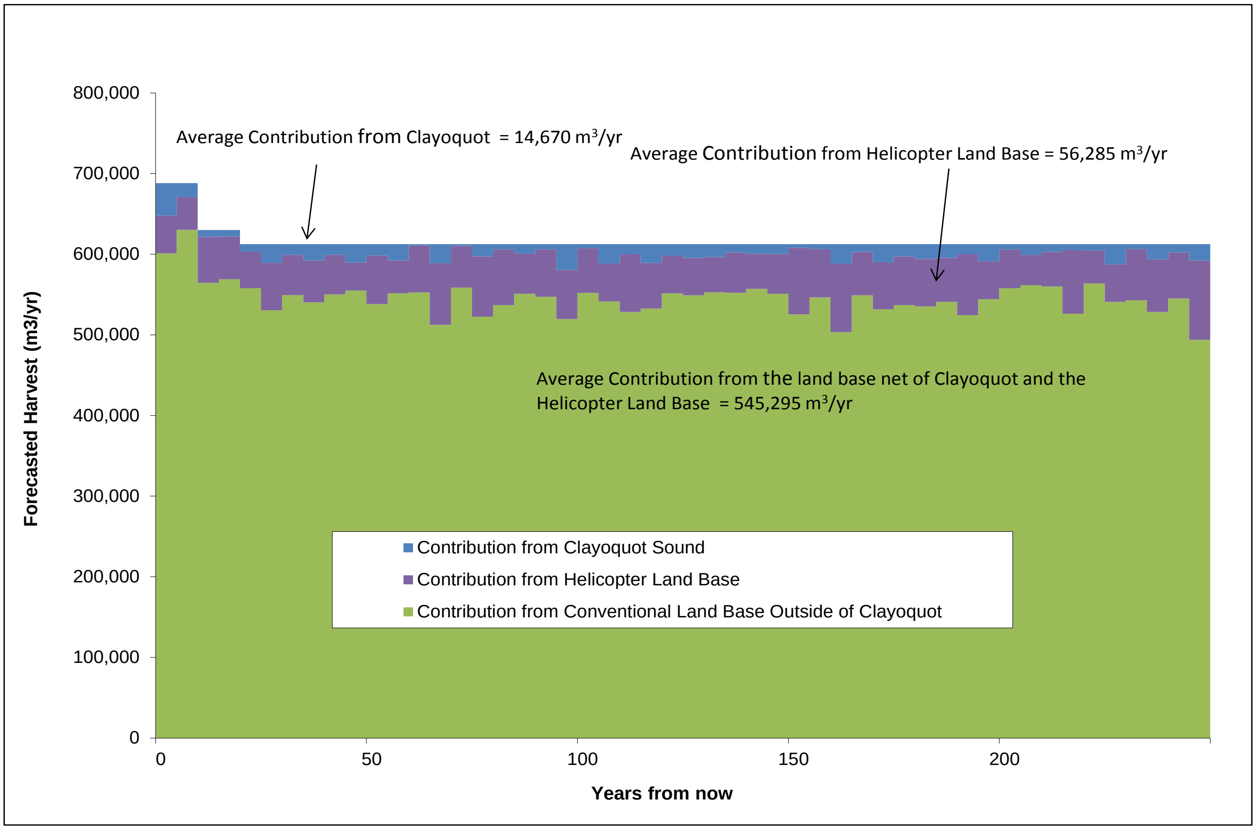

Figure 41: Contribution of Clayoquot Sound and the helicopter harvesting areas to timber supply

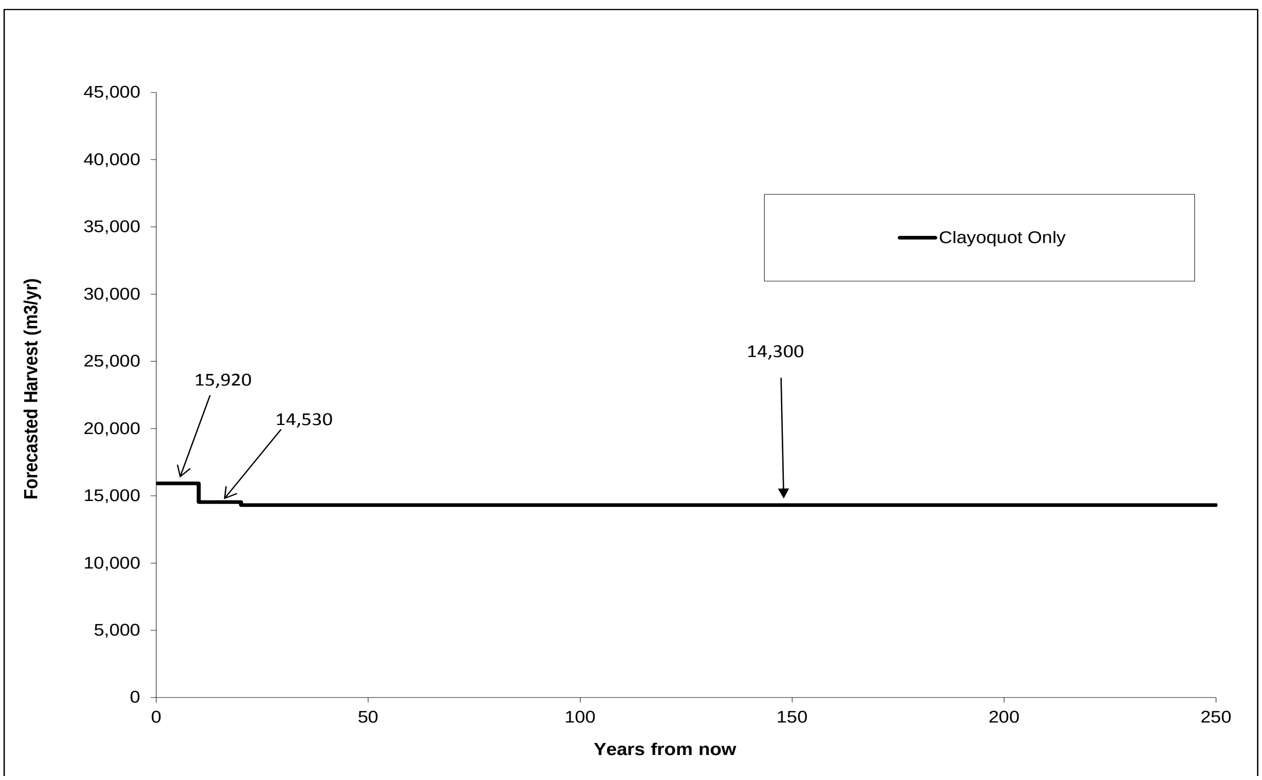

Figure 42: Harvest forecast for Clayoquot Sound

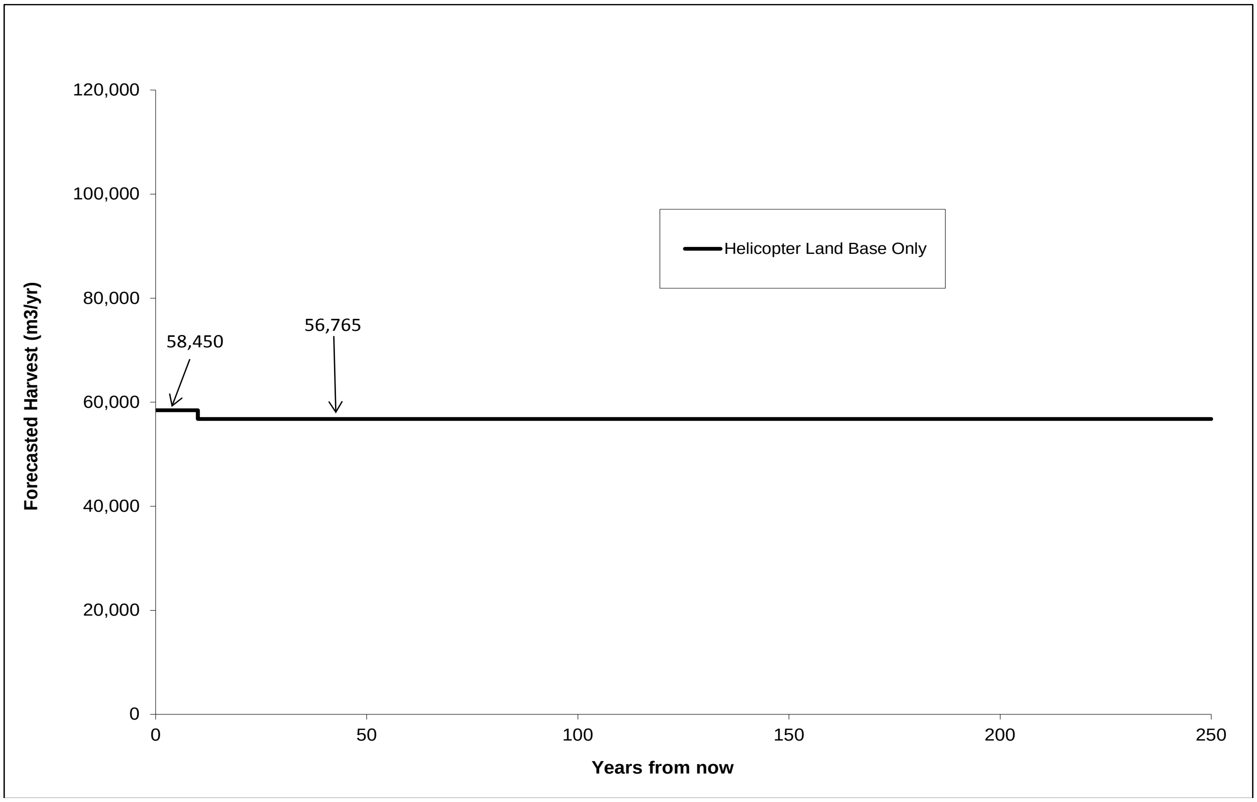

Figure 43: Harvest forecast for the helicopter land base

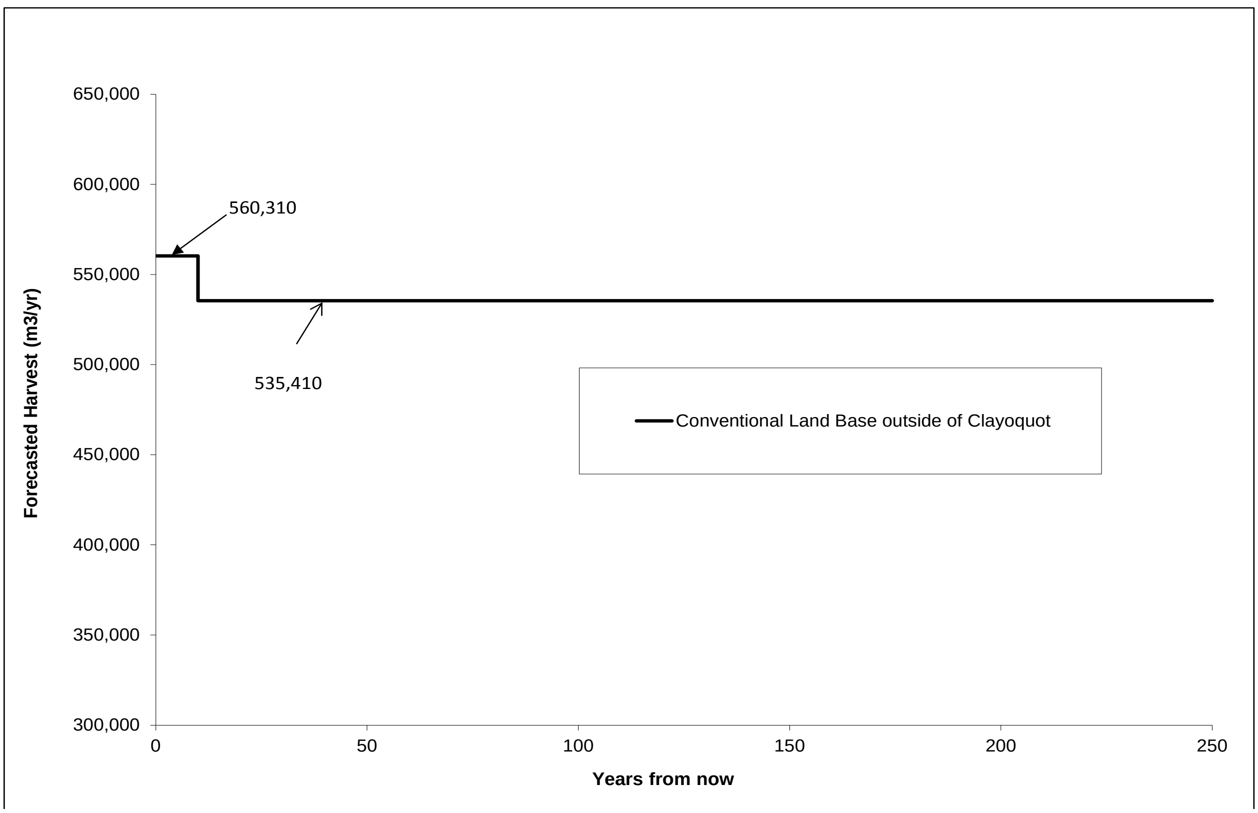

Figure 44: Harvest forecast for the conventional land base outside of Clayoquot Sound

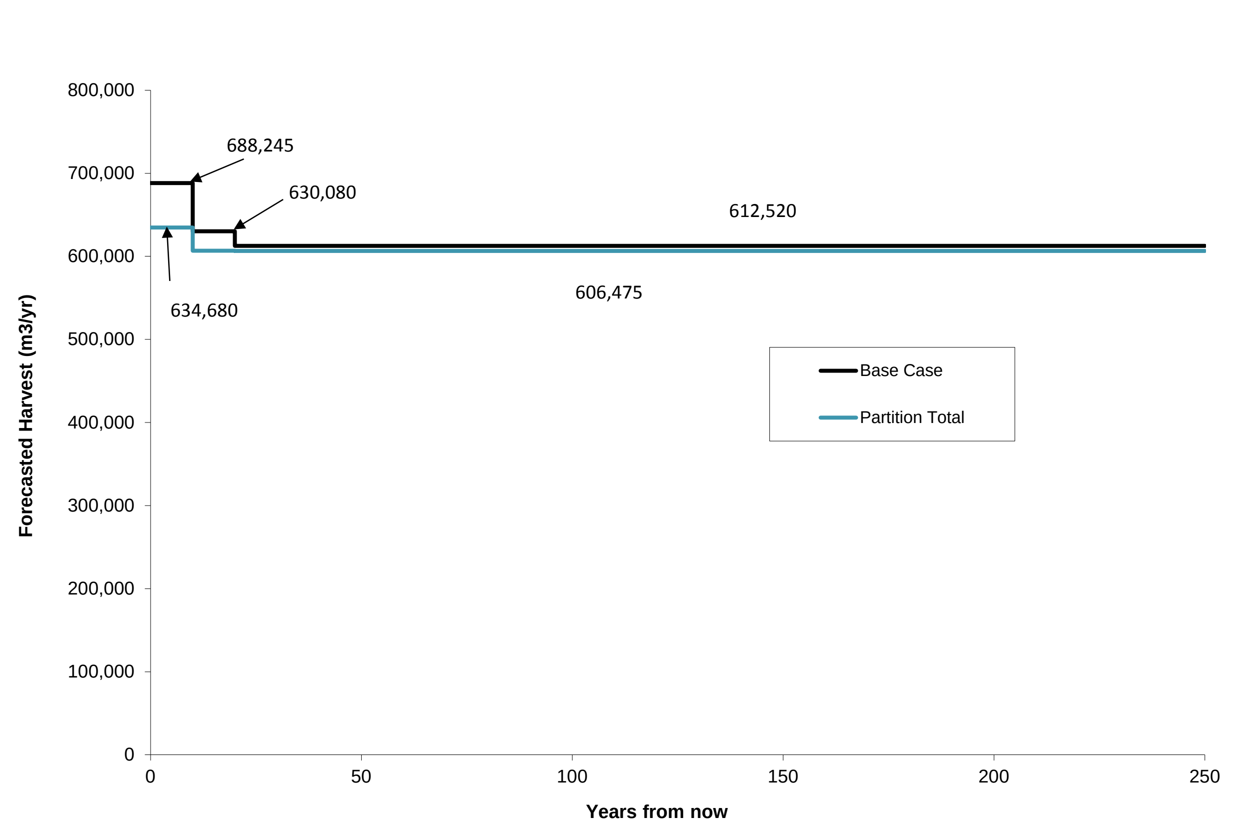

Figure 45: Base Case compared to the partition total

6.2 Business Area Harvest

The contribution of the three business areas to the Base Case harvest forecast is illustrated in Figure 45. The TSG business area is the largest contributor to the harvest with approximately 74% of the total harvest (455,750 m^3 per year average) over the planning horizon. TST contributes approximately 14% (86,700 m^3 per year average) with TSK at 12% (73,350 m^3 per year average).

When TSG was analysed independently, a long term harvest level of 455,750 m^3 per year was achieved with a higher forecast of 502,375 m^3 per year for the first 10 years (Figure 46).

TST alone produced a long-term harvest forecast of 83,350 m^3 per year with a significantly higher short-term harvest level: 112,745 m3 per year for the first 10 years, 101,300 m^3 per year for years 11 to 20 and 91,100 m^3 per year for years 21 to 30 (Figure 47).

Figure 48 illustrates the harvest forecast for the TSK business area. This land base produced a flat-line timber supply forecast of 73,200 m^3 per year.

Figure 49 compares the summed up harvest forecasts of all business areas to the Base Case harvest forecast. The aggregated short-term business area timber supply forecast is marginally greater than that of the Base Case. In the first 20 years the difference is negligible; however between years 21 and 30 7,480 m^3 (1.2%) more timber is harvested. The long term harvest forecast is marginally smaller than that of the Base Case (less than 1% difference).

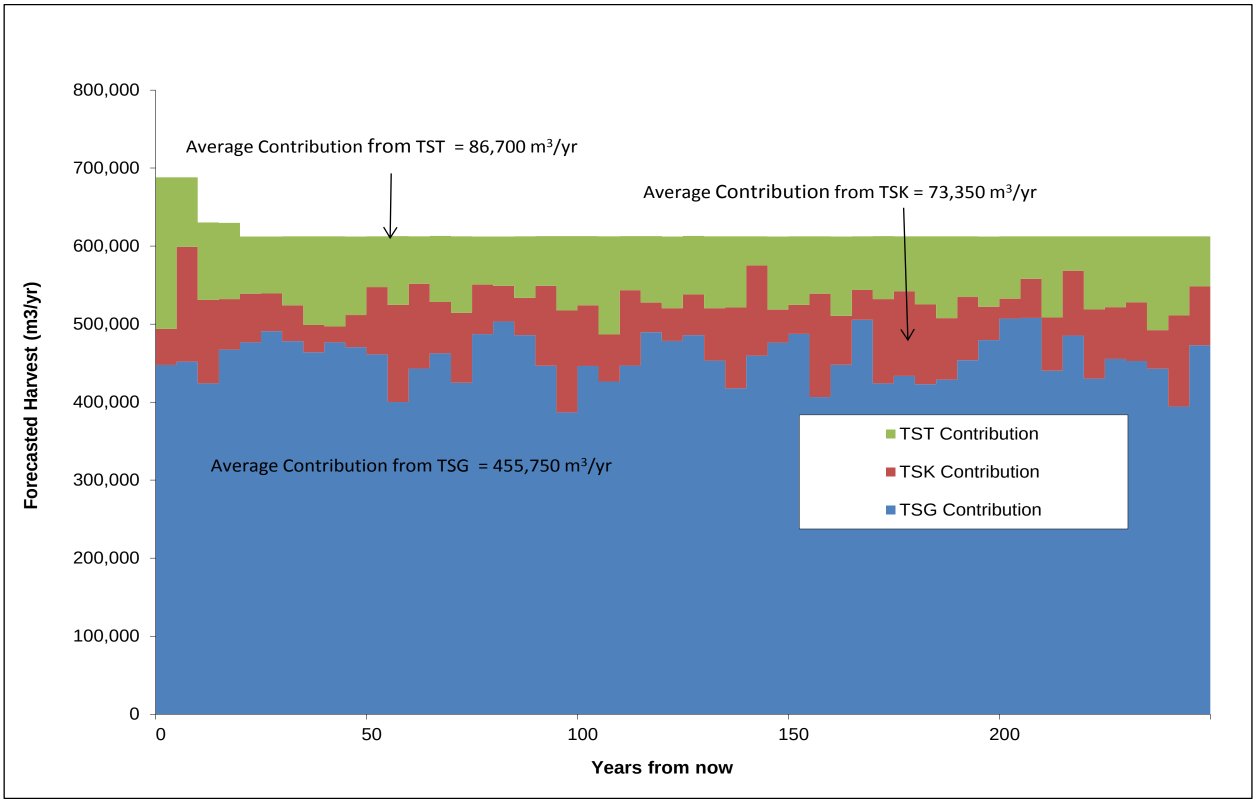

Figure 46: Contribution of business areas to the Base Case harvest forecast

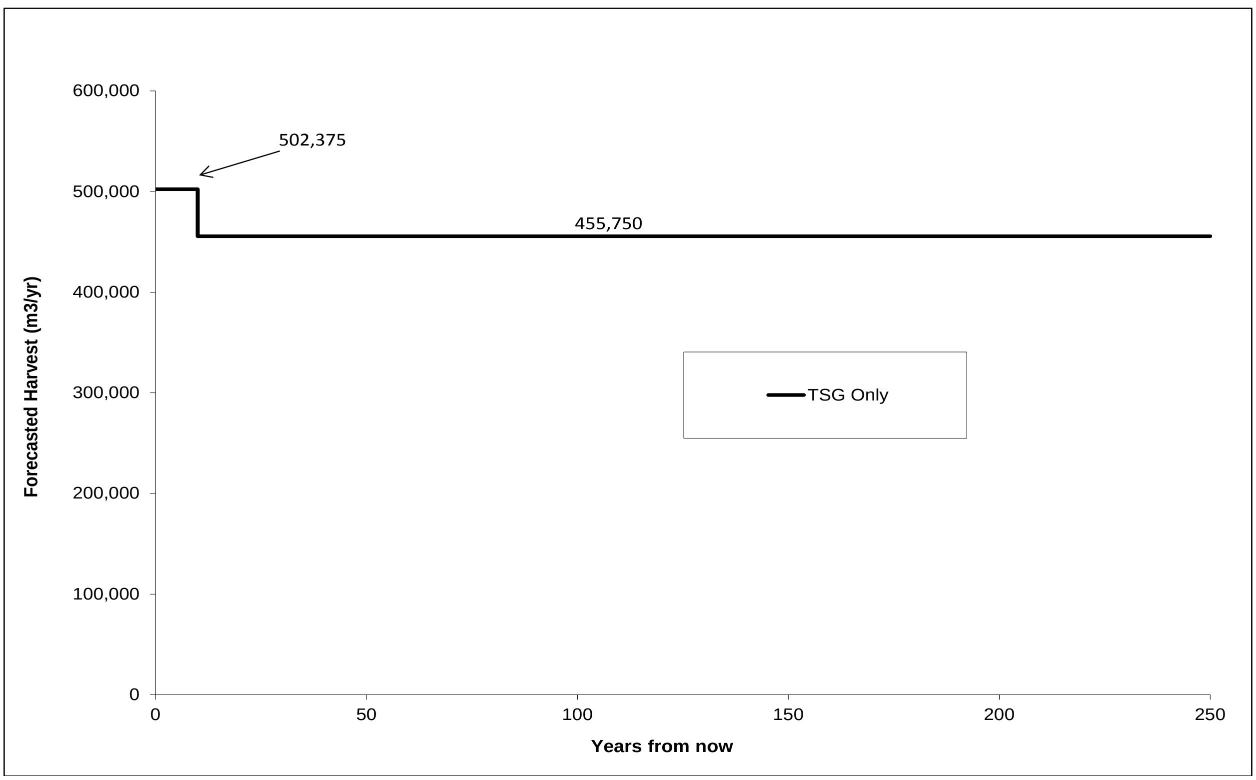

Figure 47: Harvest forecast for the TSG business area

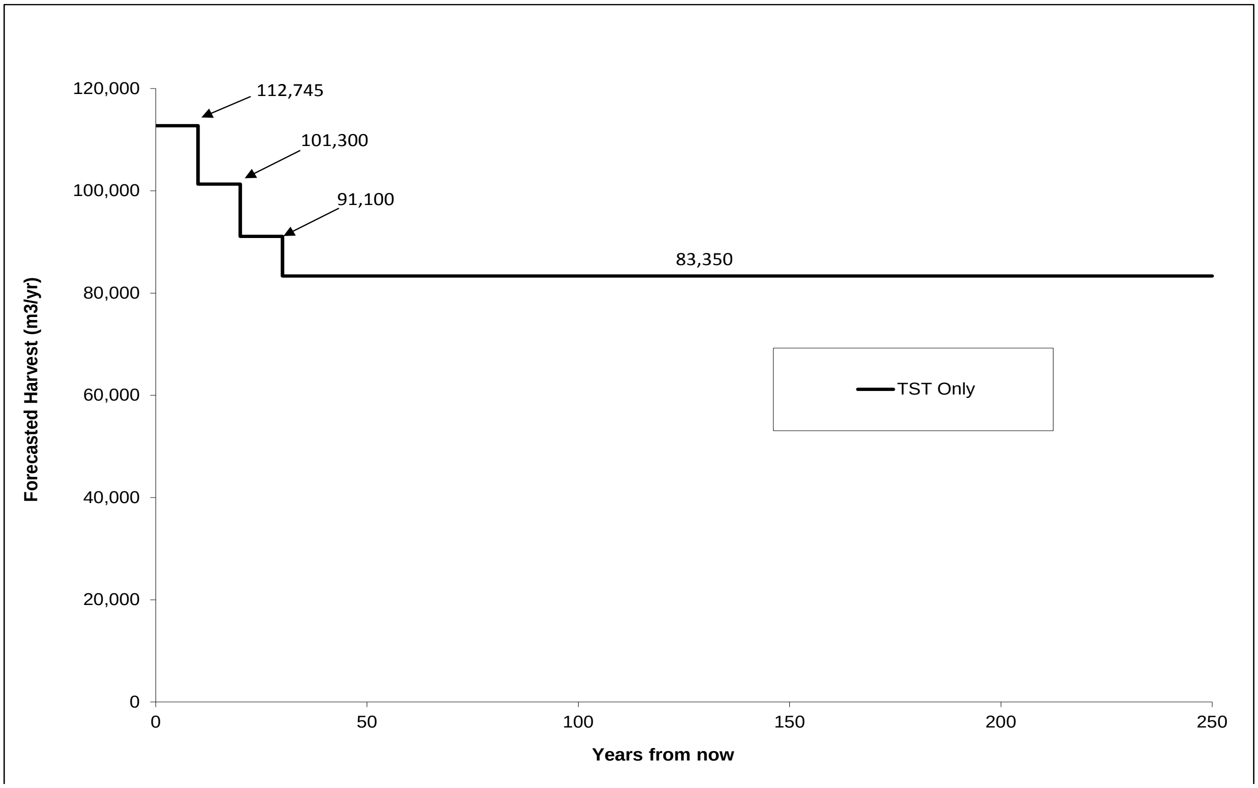

Figure 48: Harvest forecast for the TST business area

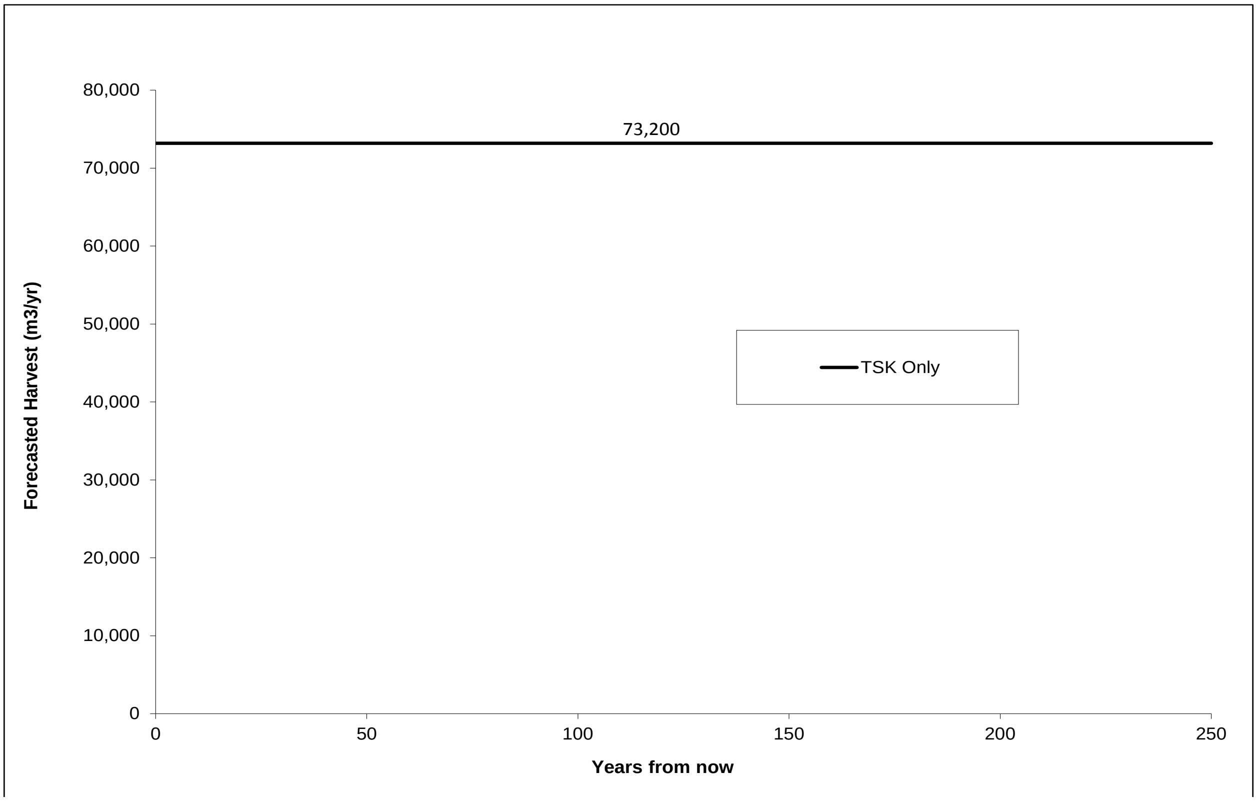

Figure 49: Harvest forecast for the TSK business area

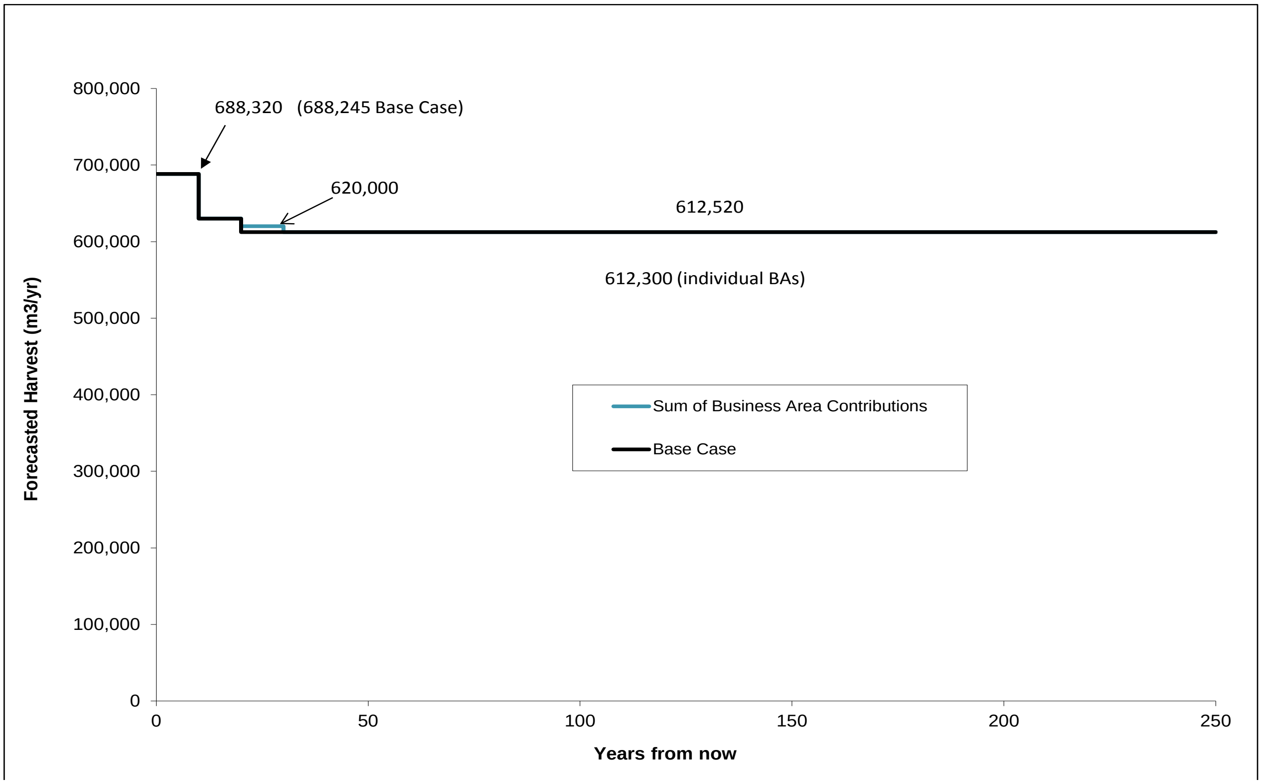

Figure 50: Summed up harvest contribution of business areas compared to the Base Case

7 Alternative Harvest Flows

Many possible harvest flows can exist on any given land base. These flows may have different initial harvest levels and decline rates and include various trade-offs between short- and long-term harvest levels. Two alternated harvest flows were completed for the Base Case land base: one with the initial harvest level at the current AAC and another where the initial harvest level was set at 950,000 m^3 per year.

7.1 Initial Harvest Level at Current AAC

The current AAC for the Pacific TSA without the GBR contribution is 1,279,731 m^3 per year. Maintaining the current AAC for the first 10 years resulted in significant timber supply deficits in the mid-term between years 66 and 135 as depicted in Figure 50. It was also necessary to lower the LTHL from that of the Base Case somewhat (612,120 m^3 per year vs. 597,300 m^3 per year) to stabilize the growing stock. The long-term growing stock remains significantly lower than that of the Base Case as shown in Figure 51.

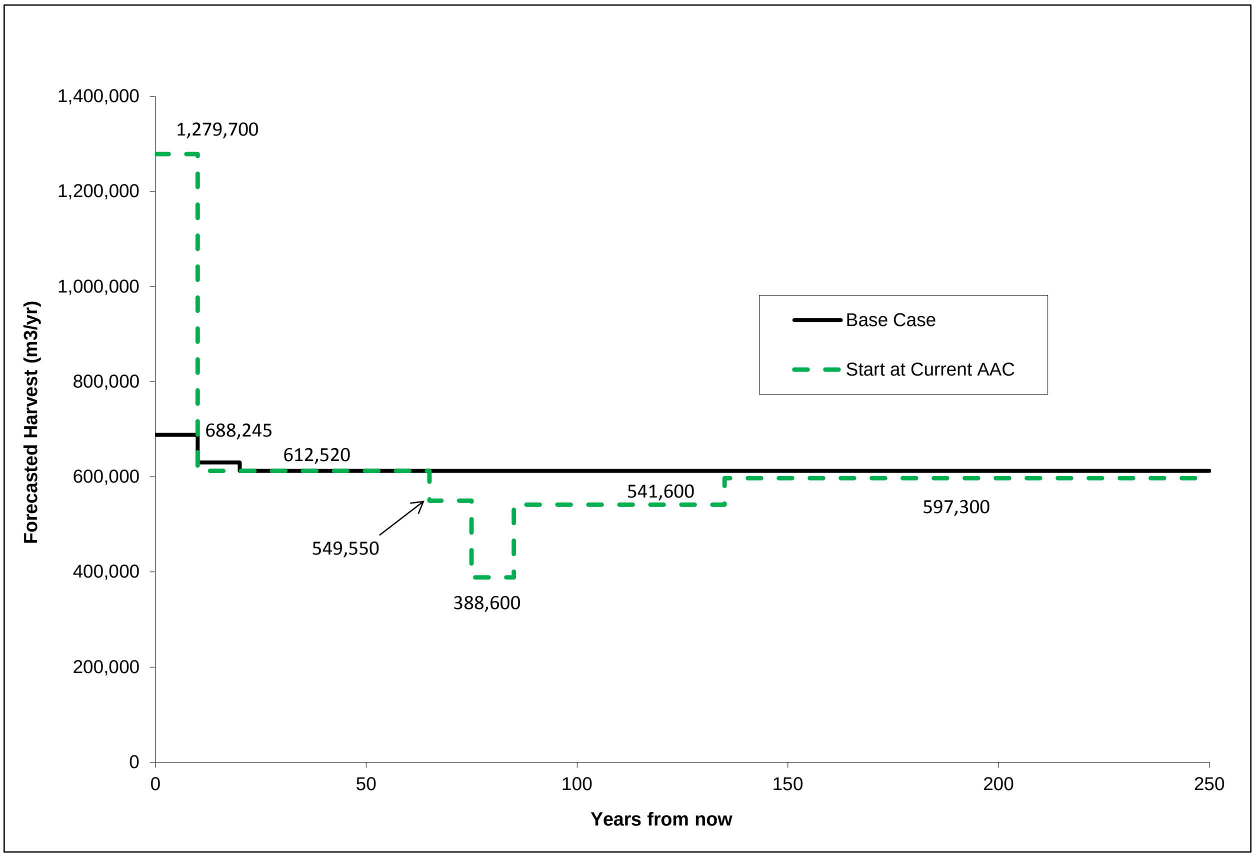

Figure 51: Alternate harvest flow: Initial harvest level at current AAC compared to the Base Case

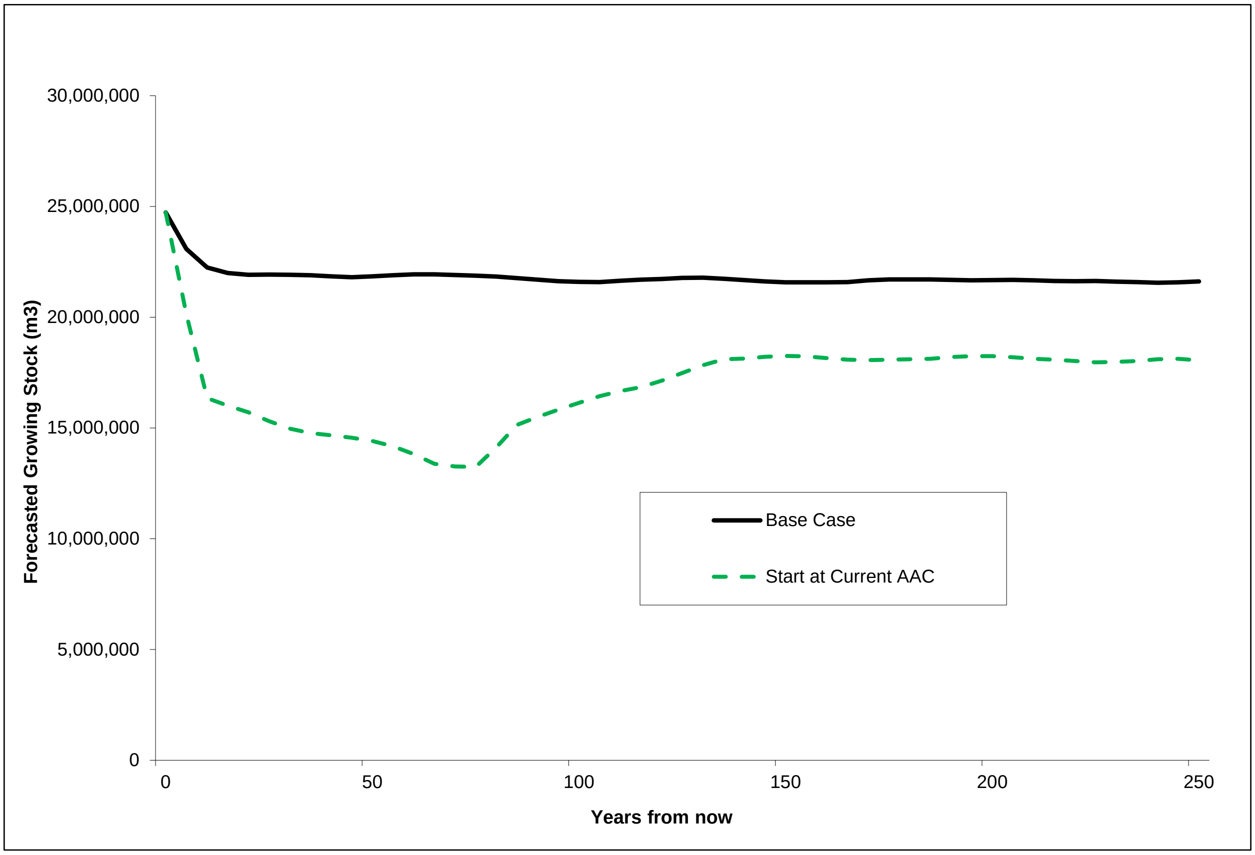

Figure 52: Total growing stock comparison: Initial harvest level at current AAC compared to the Base Case

7.2 Initial Harvest Level at 950,000 m^3 per Year

Figure 52 shows a harvest forecast with the initial harvest level at 950,000 m^3 per year for the first 10 years. The late mid-term harvest level needs to be decreased by 6.1% annually between years 61 and 105 to compensate for the increased harvest in the short-term. The LTHL settles at the same level as in the Base Case. However, the long-term growing stock stabilizes at a lower level compared to the base case as seen in Figure 53.

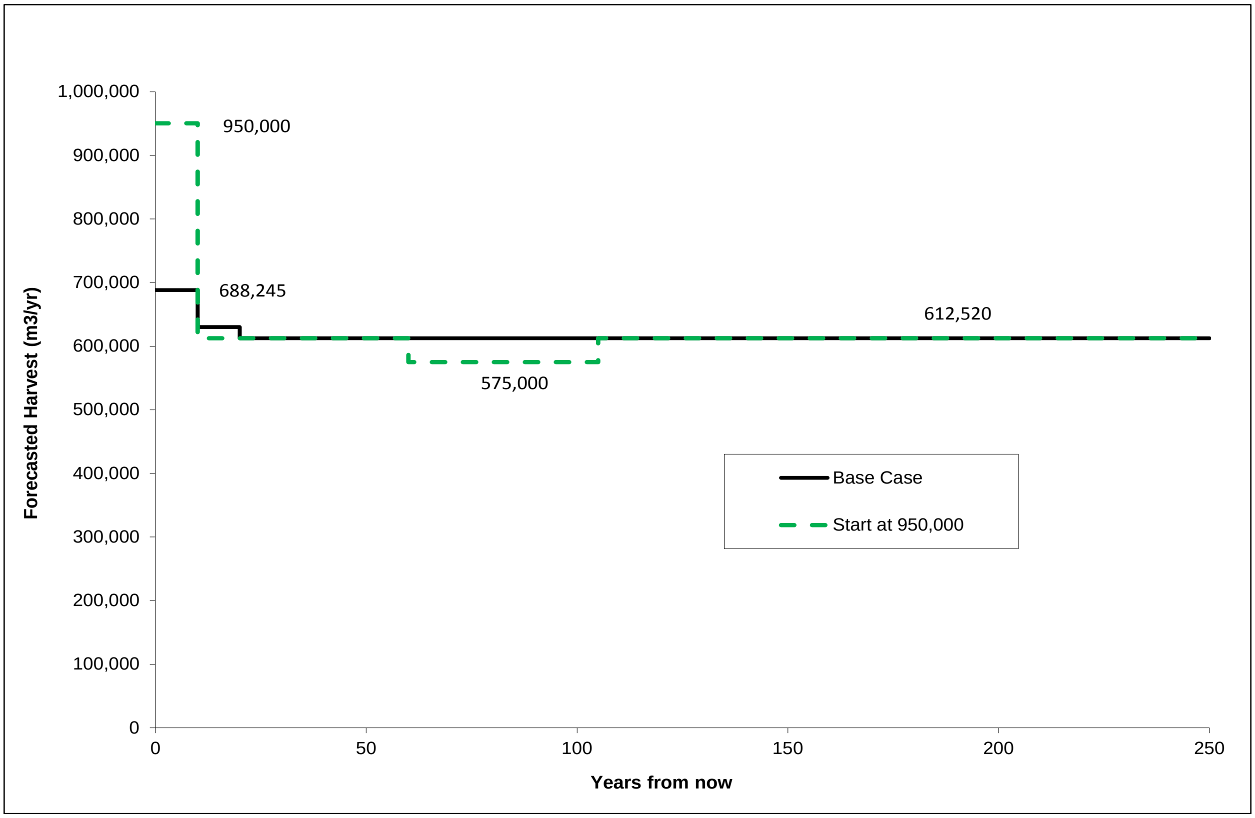

Figure 53: Alternate harvest flow: Initial harvest level at 950,000 m^3 per year compared to the Base Case

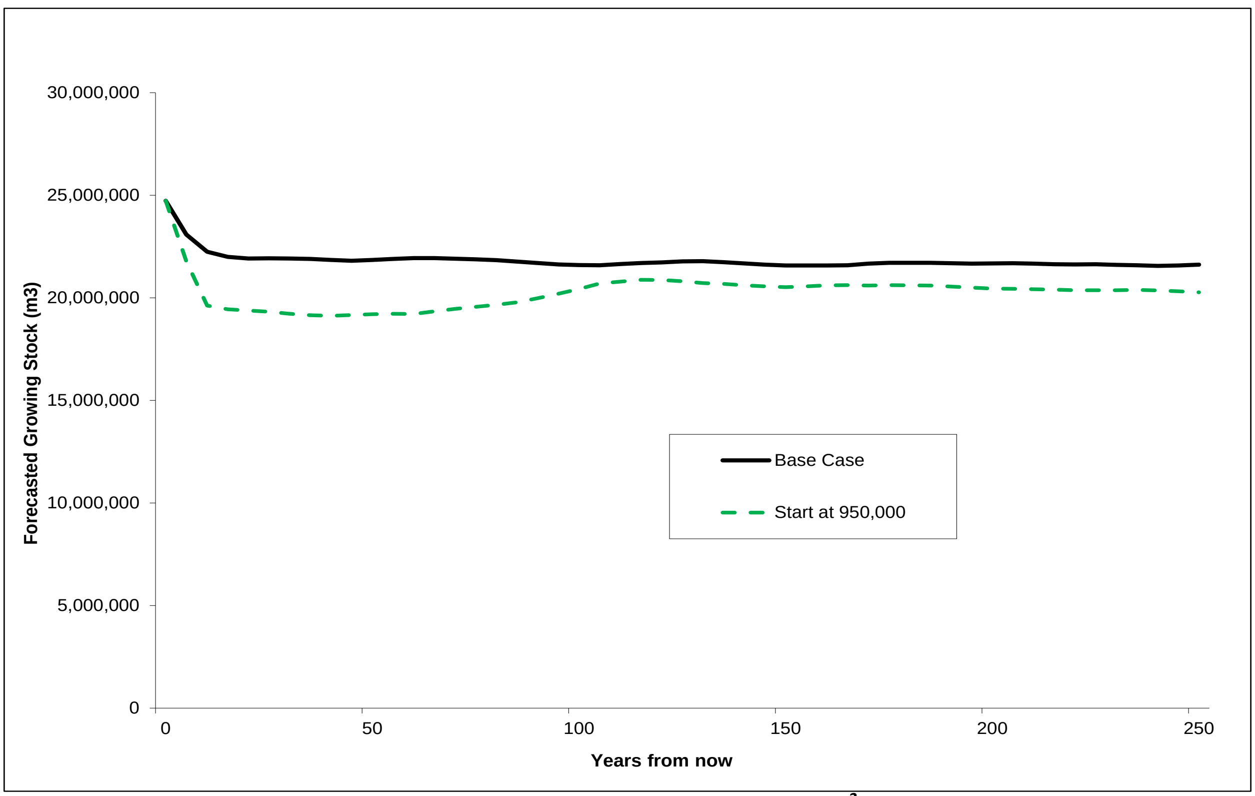

Figure 54: Total growing stock comparison: Initial harvest level at 950,000 m^3 per year compared to the Base Case

8 Conclusions

The Base Case harvest forecast starts at 688,245 m^3 per year. In 10 years the forecast is reduced to 630,520 m^3 per year and the long-term harvest level of 612,520 m^3 per year is reached at year 21. This type of harvest flow, where harvest levels are initially higher than the long-term harvest level, is typical of coastal forest management units that are still harvesting higher volume old growth stands.

The Base Case for this analysis is robust, because downward pressures in the short term can be deferred to the medium and long term. The alternate harvest flows and sensitivity analyses demonstrate that timber supply crashes associated with changes to initial harvest level and/or analysis assumptions do not generally occur until late in the planning horizon, if at all. In most cases unsustainable harvest levels were apparent only in the long-term decline of the growing stock. This delayed response reduces the risk associated with a given short-term harvest level, as it allows future AAC determinations to respond to new information and management regimes.

8.1 Economic Operability

The feedback and comments received from the public regarding the data and analysis assumptions centered on the economic operability assessment that was completed as part of this timber supply review. The consistent theme in these comments was the notion that the economically operable land base might have been underestimated.

Several sensitivity analyses were completed investigating the impact of changes to the size of the economically operable land base. The sensitivity analyses demonstrated that the impact of increasing the economically operable land base on timber supply is significant. However, this impact is mostly related to the economic operability of the helicopter land base and less to that of the conventional land base.

If all physically accessible harvest areas that were classified as uneconomic to harvest were to be classified as economic, the THLB would increase by 62,965 ha or 69.5%. This is turn increases the harvest forecast by 64.6% in the long term. The short term harvest forecast increases by approximately 70%.

Approximately 56,205 ha or 89.3 % of this increased THLB comes from the helicopter harvesting land base and 41,030 ha or 73% from the helicopter harvesting land base in the TSK business area (Blocks 28 and 29).

If physically accessible conventional harvest areas that were classified as uneconomic to harvest were to be classified as economic, the size of the THLB would increase by 10.7% or 6,760 ha. This is turn increases the harvest forecast by 7.3% in the long term. The short term harvest forecast increases by 10.7% to 11.5%.

Harvest performance and how it relates to the economic operability classification needs to be monitored before the next timber supply review. In particular, the harvest performance in helicopter harvest areas in the TSK business area is of interest due to its potential impact on timber supply.

8.2 Harvest Scheduling

The harvest profile in many coastal management units is not desirable. The remaining harvestable old growth often consists of hemlock and balsam stands, many of them in high elevations. This has led to the increased harvest of young, second growth stands, especially during difficult economic times. The sensitivity analyses demonstrated that harvesting second growth stands at very young ages in lieu of the older stands would impact the long-term harvest level negatively. Ensuring that the entire harvest profile is harvested in the Pacific TSA is important and the harvest performance should be monitored.

8.3 Forest Inventory

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. While no formal audit has been completed on the inventory, we believe that the old converted TFL inventories are likely unreliable. This poses only a small risk to timber supply; a sensitivity analysis showed that a significant reduction in the current growing stock had no impact on the short-term harvest and the impact on the mid and long-term harvest level was small.

Some of the uncertainty regarding the forest inventory will be reduced in the future, when the FLNRO completes the new VRI for all the coastal TSAs.

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10 List of Acronyms

Acronym	Description
AAC	Annual Allowable Cut
BCGW	BC Geographic Warehouse
BCLCS	BC Land Classification System
BCTS	BC Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
BMTA	Biodiversity, Mining, and Tourism Area
CDC	Conservation Data Centre
CFLB	Crown Forested Land Base
CNCO	Central and North Coast Order (EBM)
DBH	Diameter at Breast Height
DCR	Campbell River Natural Resource District
DIB	Diameter inside bark
DKM	Coast Mountains Natural Resource District
DNI	North Island Central Coast Natural Resource District
DRS	Draft Recovery Strategy for Northern Goshawk
DSC	Sunshine Coast Natural Resource District
DSI	South Island Natural Resource District
EBM	Ecosystem Based Management
ECA	Equivalent Clearcut Area
ESA	Environmentally Sensitive Area
EXLB	Excluded Land Base
FAIB	Forest Analysis and Inventory Branch, Ministry of Forests, Lands, and Natural Resource Operations
FC1	Former Forest Cover Inventory Standard
FESL	Forest Ecosystem Solutions Ltd.
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
FMLB	Forest Management Land Base
FPPR	Forest Planning and Practices Regulation
FRPA	Forests and Range Practices Act
FSOS	Forest Simulation and Optimization System (model used for analysis)
FSW	Fisheries Sensitive Watershed
GAR	Government Action Regulation
GBRO	Great Bear Rainforest Order (EBM)
GIS	Geographic Information Systems
HVFH	High Value Fish Habitat
IRM	Integrated Resource Management
LRMP	Land and Resource Management Plan
LU	Landscape Unit
LUOCS	Landscape Unit Order Clayoquot Sound
MAI	Mean Annual Increment
MOE	Ministry of Environment

Acronym	Description
MSYT	Managed Stand Yield Table
NCBR	Non-Commercial Brush
NHLB	Non-Harvesting Land Base
NHVFH	Non-High Value Fish Habitat
NRL	Non-recoverable Losses
NSR	Not Sufficiently Restocked
NTA	No Typing Available
NSYT	Natural Stand Yield Table
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
PEM	Predictive Ecosystem Mapping
PSP	Permanent Sample Plot
RMA	Riparian Management Area
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
SCCO	South Central Coast Order (EBM)
SIBEC	Site Index by BEC Site Series
SMZ	Special Management Zone
SRMP	Sustainable Resource Management Plan
SSG	Site Series Grouping
TASS	Tree and Stand Simulator
TEM	Terrestrial Ecosystem Mapping
TFL	Tree Farm License
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation for Stand Yields
TSA	Timber Supply Area or Timber Supply Analysis
TSG	BCTS Strait of Georgia Business Area
TSK	BCTS Skeena Business Area
TSR	Timber Supply Review
TST	BCTS Seaward/Tlasta Business Area
UWR	Ungulate Winter Range
VAC	Visual Absorption Capability
VDYP	Variable Density Yield Projection
VEG	Visually Effective Green-up
VILUP	Vancouver Island Land Use Plan
VRI	Vegetation Resource Inventory
VQO	Visual Quality Objective
WHA	Wildlife Habitat Area
WTRA	Wildlife Tree Retention Area

Appendix 1 – Information Package

Timber Supply Review

Information Package – Pacific TSA

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Prepared for:

BC Timber Sales
Strait of Georgia, Seaward-Tlasta, and Skeena Business Areas

BRITISH COLUMBIA

BRITISH COLUMBIA
Ministry of
Forests, Lands and
Natural Resource Operations

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1 Introduction

1.1 Context

British Columbia Timber Sales (BCTS) is preparing a timber supply review (TSR) analyzing the strategic timber supply for the land base in the Pacific TSA. This information package documents the procedures, assumptions, data and model to be used in the analysis. The information package is the first of three documents making up the TSR process. A separate document - the Analysis Report - summarizes the timber supply analysis results. The final document - the Rationale for AAC Determination - documents the Chief Forester's AAC determination and the rationale behind it.

In July 2009 the Pacific Timber Supply Area (TSA) was established from an amalgamation of various tree farm license (TFL) areas taken back by the Province through the Forestry Revitalization Act (Bill 28, 2003). The Pacific TSA consists of 30 Blocks located on Vancouver Island, the Sunshine Coast, the Mainland Coast, and Douglas Channel. The Blocks range in size from 76 ha to 405,000 ha.

BCTS is the major operator in the Pacific TSA, holding approximately 93% of the AAC, with First Nations Tenures making up the remaining cut.

At the time the TSR was initiated, the TSA was spread over three BCTS Business Areas (BA): Strait of Georgia (TSG), Seaward-Tlasta (TST), and Skeena (TSK). Since the analysis data set was prepared, BCTS has initiated a transition of TSA Blocks in the Sunshine Coast (Blocks 21, 22, and 23) from the TSG BA to the Chinook BA (TCH). This transition was completed by March 31, 2016. For the purposes of this analysis, all documentation associated with these Blocks will remain with a reference to TSG.

BCTS has engaged Forest Ecosystem Solutions Ltd. (FESL) to prepare the information package and complete the timber supply review on their behalf. Upon approval by the Forest Analysis and Inventory Branch, the assumptions detailed in this information package will be used to guide the development of the timber supply analysis.

The purpose of this information package is to:

- Provide a detailed account of the factors related to timber supply that the Chief Forester must consider under the Forest Act when determining an AAC and how these factors will be applied in the timber supply analysis;
- Provide a means for communication between staff from BCTS, Ministry of Forests, Lands, and Natural Resource Operations (FLNRO), other government agencies, First Nations and stakeholders.
- Provide staff of the different ministries, First Nations and stakeholders with the opportunity to review data and information that will be used in the timber supply analysis before it is initiated;
- Ensure that all relevant information is accounted for in the analysis to an acceptable standard;
- Reduce the risk of having the analysis rejected because input assumptions and analysis methods were not agreed upon in advance.

This timber supply review will focus on current management practices in the TSA with some exceptions; in those cases where new rules or legislation are imminent, the analysis assumptions are consistent with the anticipated changes.

The current management scenario is called the base case. During the analysis, various sensitivity analyses, harvest flow alternatives, and management options will be tested to determine the influence of various factors on harvest levels. The combination of the base case and sensitivity analyses will provide the basis for discussions, public feedback and ultimately the Chief Forester's AAC determination.

1.2 First Nations Considerations

During past consultation processes with First Nations, BCTS has identified First Nation values and interests within the Pacific TSA. The applicable sections covering these values and interests are outlined below in Table 1.

Table 1: Sections in this document covering First Nations interests

Aboriginal Interest	Information Package Section
Fish Habitat	4.3 Riparian Classification
	5.1.22 Timber Harvesting Land Base, EBM High Value Fish Habitat
	5.1.23 Timber Harvesting Land Base, EBM Not High Value Fish Habitat
	5.1.24 Timber Harvesting Land Base, EBM Active Fluvial Units
	6.3.5 Forest Cover Requirements, Watersheds
Wildlife and Biodiversity	5.1.6 Timber Harvesting Land Base, Ungulate Winter Range
	5.1.7 Timber Harvesting Land Base, Wildlife Habitat Areas
	5.1.8 Timber Harvesting Land Base, Northern Goshawk Reserves
	5.1.9 Timber Harvesting Land Base, Marbled Murrelet Reserves
	5.1.10 Timber Harvesting Land Base, Peregrine Falcon Reserves
	5.1.11 Timber Harvesting Land Base, Grizzly Bear Habitat (EBM)
	5.1.12 Timber Harvesting Land Base, Clayoquot Sound Reserves
	5.1.14 Timber Harvesting Land Base, Old Growth Management Areas (OGMA)
	5.1.25 Timber Harvesting Land Base, EBM Red and Blue Listed Ecosystems
	5.1.28 Timber Harvesting Land Base, Wildlife Tree Retention
	6.3.4 Forest Cover Requirements, Rate of Cut Restrictions
	6.3.6, 6.3.7, 6.3.8 Forest Cover Requirements, Biodiversity
	6.3.9 Forest Cover Requirements, Special Management Zones (Clayoquot)
	6.3.10 Forest Cover Requirements, Wildlife
Cultural Heritage	5.1.27 Timber Harvesting Land Base, Archeological Sites
	5.2.2, 5.2.3 Age Class Distribution and Species Profile
Other First Nations Considerations	5.1.26 Timber Harvesting Land Base, EBM First Nation Considerations

1.2.1 Cultural Cedar

First Nations access cultural cedar on both the timber harvesting land base (THLB) and non-harvestable land base (NHLB). There is a continued demand for cultural cedar and an expectation that a sustainable supply is maintained into the future. This analysis will provide statistics on the volume of cedar by age class that remains in the land base over time.

For definitions of the THLB and NHLB see section 5.1.

1.3 Study Area

The Pacific TSA consists of 30 Blocks on Vancouver Island, the Sunshine Coast, the Mainland Coast, and Douglas Channel. Figure 1 shows the location of the Pacific TSA Blocks. The TSA overlaps parts of five natural resource districts: Coast Mountains (DKM), North Island/Central Coast (DNI), Campbell River (DCR), Sunshine Coast (DSC), and South Island (DSI). The Blocks range in size from 76 ha (Block 4) to over 400,000 ha (Block 28). A summary of Blocks within in each district and business area is shown in Table 2.

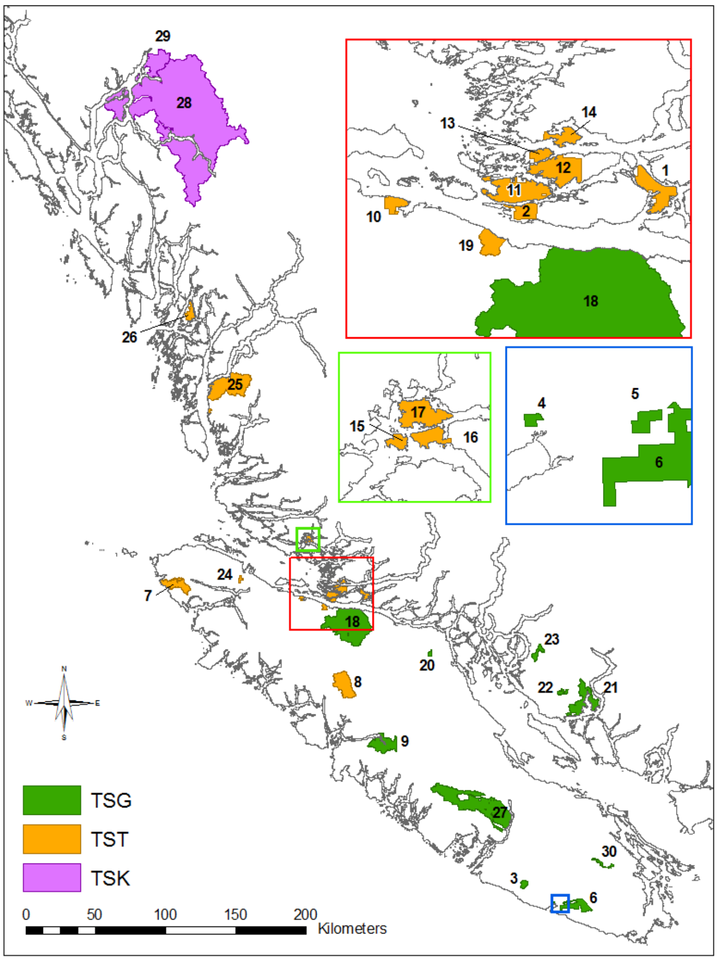

Figure 1: Pacific TSA Blocks, coloured by Business Area

Table 2: Pacific TSA Blocks, Natural Resource Districts, and Business Areas

Block	Block Name	District	Business Area	Area (ha)
1	East Cracroft Island	DNI	TST	2,336
2	West Cracroft Island	DNI	TST	1,017
3	Roseander	DSI	TSG	2,294
4	San Juan	DSI	TSG	76
5	San Juan	DSI	TSG	198
6	San Juan	DSI	TSG	10,233
7	Holberg	DNI	TST	11,400
8	Vernon Lake	DNI	TST	18,351
9	Burman/Jacklah	DCR	TSG	16,623
10	Beaver Cove	DNI	TST	798
11	Harbledown Island	DNI	TST	3,459
12	Turnour Island	DNI	TST	3,085
13	Village Island	DNI	TST	645
14	Gilford Island	DNI	TST	1,128
15	Kinnaird Island	DNI	TST	259
16	Burley Bay	DNI	TST	521
17	Watson Island	DNI	TST	1,114
18	Eve/Naka/Tsitika	DCR	TSG	59,145
19	South Kaikash	DCR	TSG	1,350
20	Farewell Lake	DCR	TSG	834
21	Granville/Lois (Hotham Sound)	DSC	TSG	20,604
22	Dodd	DSC	TSG	1,700
23	Theodosia	DSC	TSG	3,719
24	Quatse	DNI	TST	1,015
25	Doc Creek	DNI	TST	37,565
26	Yeo Island	DNI	TST	5,476
27	Sproat Lake	DSI	TSG	64,293
28	Douglas Channel	DKM	TSK	405,279
29	Wathl/Wathlsto	DKM	TSK	21,454
30	Hill 60	DSI	TSG	2,070
Total				**698,041**

1.3.1 Land Use Plans

The Pacific TSA contains several land use plans. The Vancouver Island Land Use Plan (VILUP) covers all of Vancouver Island except Clayoquot Sound. VILUP sets legal objectives for resource management zones (enhanced and general) and special management zones. Resource management in Clayoquot Sound is governed by the Clayoquot Sound Land Use Decision and implemented in the Pacific TSA through the Upper Kennedy Watershed Plan.

The TSG Business Area Blocks are managed under VILUP with the exception of Blocks 21, 22 and 23, which are managed through local land use plans. Several local sustainable resource management plans (SRMP) also exist in the TSG VILUP areas as shown in Table 3.

Some of the TST Blocks are managed under VILUP (7, 8, 10, and 24), while the Coast Land Use Decision (South-Central Coast Order (SCC), Central and North Coast Order (CNC), and Great Bear Rain Forest Order (GBR)) provide management direction for the south central and central coast. As with TSG, in the VILUP areas, SRMPs provide additional guidance.

Kalum LRMP, Kalum South SRMP and Kowesas SRMP govern the management of natural resources in the TSK Business Area.

Table 3: Land Use plans in the Pacific TSA

Block	Business Area	Land Use Plan/Order	Local Plan
1	TST	SCC	
2	TST	SCC	
3	TSG	VILUP	Renfrew SRMP
4	TSG	VILUP	Renfrew SRMP
5	TSG	VILUP	Renfrew SRMP
6	TSG	VILUP	Renfrew SRMP
7	TST	VILUP	North Island-Central Coast SRMP (San Joseph LUO)
8	TST	VILUP	North Island-Central Coast SRMP (Upper Nimpkish LUO)
9	TSG	VILUP	
10	TST	VILUP	North Island-Central Coast SRMP (Lower Nimpkish LUO)
11	TST	SCC	
12	TST	SCC	
13	TST	SCC	
14	TST	SCC	
15	TST	SCC	
16	TST	SCC	
17	TST	SCC	
18	TSG	VILUP	Johnstone Strait SRMP
19	TSG	VILUP	Johnstone Strait SRMP
20	TSG	VILUP	Sayward LUP (Campbell River SRMP)
21	TSG		Brittain LUP, Lois LUP
22	TSG		Lois LUP
23	TSG		Bunster LUP
24	TST	VILUP	North Island-Central Coast SRMP (Tsulquate LUO)
25	TST	CNC	
26	TST	CNC	

Block	Business Area	Land Use Plan/Order	Local Plan
27	TSG	VILUP outside of Clayoquot Sound. Clayoquot Sound Land Use Decision in Clayoquot Sound	Sproat Lake LUP (South Island SRMP). Upper Kennedy Watershed Plan (Clayoquot Sound)
28	TSK	Kalum LRMP	Kalum South SRMP, Kowesas SRMP
29	TSK	Kalum LRMP	Kalum South SRMP
30	TSG	VILUP	

1.3.2 Ecosystem Based Management

A portion of the Pacific TSA (56,605 ha) falls under the South-Central Coast Order (SCC), the Central North Coast Order (CNC) and the Great Bear Rain Forest Order (GBR) establishing Ecosystem Based Management (EBM). Blocks within the EBM area are 1, 2, 11-17, 25, and 26 - all in the Seaward-Tlasta Business Area and the North Island/Central Coast Natural Resource District (Table 4).

Table 4: Blocks in the EBM area

Block	District	Business Area	Area (ha)
1	DNI	TST	2,336
2	DNI	TST	1,017
11	DNI	TST	3,459
12	DNI	TST	3,085
13	DNI	TST	645
14	DNI	TST	1,128
15	DNI	TST	259
16	DNI	TST	521
17	DNI	TST	1,114
25	DNI	TST	37,565
26	DNI	TST	5,476
Total			**56,605**

2 Timber Supply Scenarios and Sensitivity Analyses

This section briefly describes the management scenarios that will be presented in the Timber Supply Analysis Report.

2.1 Base Case

The base case will be a non-spatial analysis using time-step simulation. The base case will reflect current management activities based on the following guidelines:

- Management activity as defined mostly by historical operations with emphasis on the last 5 years;
- EBM old growth targets based on site series groupings, as described in the GBR order, will be modeled in the base case;
- *Forest and Range Practices Act* (FRPA);
- Forest cover inventory projected and updated to 2014;
- Apply inventory adjustments where appropriate;
- VDYP natural stand yields (NSYTs) for stands originating before1966 and younger stands leading in red alder;
- TASS managed stand yield tables (MSYTs) for all stands originating after 1965;
- Current utilization standards;
- Provincial site index layer to construct MSYTs;
- Genetic gains from tree improvement;
- Follow management direction from the Vancouver Island Land Use Plan (VILUP) Higher Level Plan Order (HLPO), Kalum SRMP, the South-Central Coast Order and the Central North Coast Order along with landscape unit plans.

2.2 Sensitivity Analyses

Sensitivity analyses provide an understanding of the contribution of specific data and assumptions to the timber supply dynamics of the base case. They also verify that the model is applying the harvesting constraints correctly. Table 5 presents the sensitivity analyses that are proposed to test the various uncertainties that exist in the base case data and assumptions. Additional sensitivities may be included if new uncertainties are identified while completing the base case.

Table 5: Proposed Sensitivity analyses

Issue	Sensitivity analysis	Notes
BCTS business area harvest	Run the analysis separately for each Business Area, using the base case assumptions.	Tests the impact of consistent harvest in each BA.
Harvest scheduling controls in selected woodsheds	Remove harvest scheduling controls.	
Landbase revisions	Remove draft WHA, goshawk nests, non-legal recreation areas and research installations from the THLB.	While not legally designated, these areas are currently avoided in harvest operations.
	Remove areas from the THLB that are currently deferred from harvesting.	Portion of Block 8. Blocks 10, 13, 15, 16, 17 and portion of block 27.
Economically Operable Land Base	Adjust minimum harvestable age/volume	Increase from 300 m^3/ha to 400m^3/ha
	Increase economically operable land base	Use high price scenario for conventional harvest areas
Growth and yield	Adjust yields of existing natural stands (VDYP)	+/- 10%
	Adjust future yields for effects of shading in high retention areas.	- 10 %
Management assumptions	Impact of spatial adjacency.	Buffer blocks harvested within last 10 years by 250 m and test impact on short-term harvest.
	Apply ECA limits to all watersheds where ECA limits have been recommended by a professional.	While not legally binding, operations use ECA limits.
	Prioritize harvest of young age class 3 and 4 stands.	Test the impact of concentrating harvest on young stands.
	Block 18; 800,000 m^3 committed unused volume licence over the next 5 years.	Test the impact of this commitment on timber supply.
	Established non-declining even flow for Block 30.	Test the impact of specific rate-of-cut in Block 30.
Combined Scenario	Combine all land base revisions and ECA sensitivity in one scenario.	Test the impact of all projected land base and management revisions.

2.3 Previous Timber Supply Reviews

There has been no formal timber supply review for the Pacific TSA in the past. The current AAC for the TSA was established through a proportional allocation of the AACs of those TFLs that formed the Pacific TSA.

3 Model

Model Name: Forest Simulation and Optimization System (FSOS)

Model Developer: Dr. Guoliang Liu

Model Development: UBC, Hugh Hamilton Limited, Forest Ecosystem Solutions Ltd.

Model Type: Landscape Design Model

For this analysis Forest Simulation and Optimization System (FSOS) is used for modelling timber supply. FSOS uses C++ programming language. The model interfaces directly with Microsoft Access for data management. Although FSOS has both simulation and heuristic (pseudo-optimization) capabilities, the time-step simulation mode will primarily be used in this analysis. Time-step simulation grows the forest based on growth and yield inputs and harvests resultant polygons based on user-specified harvest rules and constraints that cannot be exceeded. Using these “hard” constraints and harvest rules instead of targets (as would be applied in the heuristic mode of FSOS) gives results that are repeatable and more easily interpreted.

From GIS overlay, the land base is divided into resultant polygons, each with a unique set of attributes. Constraints and harvest criteria are applied to each polygon based on these attributes. Constraints and harvest criteria can be defined by analysis unit, forest type, forest age, silviculture treatment, user allocation, site index, non-timber resource objectives or any other parameter.

FSOS uses individual stand ages to project the current age structure of stands in the analysis area. As stands age, they move into and out of age classes established as a basis for meeting target objectives. Generally, FSOS runs utilize 5-year periods, as the output is intended to be operationally applicable and reflect 5-year management plan objectives, but 1, 10 or 20 year periods can easily be assigned. The middle of the period (year 3 for 5-year periods) is used for reporting.

The planning horizon length can vary as required. FSOS can produce spatially and temporally explicit plans over 20 years or for multiple rotations. A unique feature of FSOS is its ability to integrate strategic, tactical and operational planning phases into one process. Analysis runs include harvest timing and location for each period, as well as long-term sustainable harvest levels.

The reporting functions of FSOS are extensive. The data for each period is easily accessible for any analysis unit, zone, polygon, LU, etc. and gives an overview of the forest state at any point in time. Species compositions, age structure, patch distribution, harvest scheduling, and many other variables are tracked and reported by period. Reporting functions are highly effective for the direct comparison of differing sensitivity analysis scenarios. FSOS is linked directly to the powerful ArcMap environment for high-quality map production.

4 Forest Inventory and Land Base Data

4.1 Data Sources

The data and assumptions for this project were provided by BCTS. The base case of this analysis is considered to reflect current management in the Pacific TSA. Table 6 lists all the spatial data layers used in the analysis, with their source and vintage.

Table 6: Spatial Data Sources

Layer Name	Description	Source	Vintage
pacific_tsa	Pacific TSA boundary	BCGW	2014
first_nation	First Nations consultative boundaries	BCTS (BCGW)	2014
lrmp	LRMP areas	BCGW	2014
lu	Landscape units	BCGW	2014
rmpa	RMP management areas	BCGW	2014
wshed_eemiss	Clayoquot watersheds and Eehmis areas	GEOBC	2011
ebm_watersheds	Upland Stream watersheds	FESL (BCGW, EBM)	2014
eca_watershed	Assessed watersheds with max ECA	BCTS	2015
ogma	Legal, non-legal, and draft Old growth management areas	BCGW and BCTS	2014
f_own	Generalized ownership	BCGW	2014
wdlt_cf	Managed forests – woodlots, community forests, and First Nations Woodland Licenses	BCGW	2014
timber_lic	current timber licenses	BCGW	2014
timber_lic_elim	eliminated timber licenses	BCGW	2014
tfl	current tree farm licenses	BCGW	2014
tfl_add	additions to tree farm licenses	BCGW	2014
tfl_del	deletions from tree farm licenses	BCGW	2014
clab_ir	Federal Indian Reserves	BCGW	2014
parks	Provincial parks and protected areas	BCGW	2014
conserve	Conservancies	BCGW	2014
survey_pa	Survey parcels	BCGW	2014
tseshaht	Tseshaht First Nations Woodland Licence	BCTS	2014
cws	Community Watersheds	BCGW	2014
clayoquot_reserves	Clayoquot Sound no harvest areas	GEOBC	2011
clayoquot_smz	Clayoquot Sound special management zones	GEOBC	2011
clayoquot_eehmiss	Clayoquot Sound Eehmis areas	GEOBC	2011
clayoquot_wshed	Clayoquot Sound watersheds and sub-basins	GEOBC	2011
karst	known and predicted karst areas	BCGW and BCTS	2014
ssg	Site Series Groupings (EBM area)	FESL (TEM)	2014
terrain	Terrain stability and ESA mapping	BCTS	various
vqo	Visual quality objectives	BCGW and BCTS	2014
UWR	Ungulate winter ranges	BCGW	2014
WHA_legal	Wildlife habitat areas	BCGW	2014
WHA_proposed	Wildlife habitat areas	BCGW	2014
grizzly_wha	proposed grizzly WHA	BCTS	2014
sutton_wha	proposed goshawk WHA	BCTS	2014
ebm_grizzly	grizzly habitat	EBM	2013
caribou	caribou herd locations	BCGW	2014
fsw	fisheries sensitive watersheds	BCGW	2014
ebm_ifw	important fisheries watersheds	EBM	2013

Layer Name	Description	Source	Vintage
mamu	TSG marbled murrelet reserves	BCTS	2014
clay_mamu	Clayoquot marbled murrelet reserves	GEOBC	2011
nogo_nests	Goshawk and falcon nest locations (points)	BCTS, CDC	2014
nogo_200m	200m buffer around goshawk nests	FESL	2014
falcon	200m buffer around peregrine falcon nest	FESL	2014
nogo_forage	2500m buffer around goshawk nest clusters, for DRS scenario	FESL	2014
nogo_DRS	reserve buffers around goshawk nests for DRS scenario	FESL	2014
spring_forage	Sayward LUP potential spring forage	BCTS	2003
elk_cover	Sayward LUP elk visual cover areas	BCTS	2003
bec	Provincial BEC layer	BCGW	2014
red_blue	Red and blue listed ecosystems (EBM)	FESL	2015
water_polys	Lakes, Rivers and Wetlands	FESL (TRIM, VRI, BCTS)	2014
streams	Classified streams	BCTS and FESL	2014
aoa_final	Archeological potential	FLNRO	2014
psp	Permanent sample plots	BCGW	2015
research	Research Installations	BCTS (BCGW)	2014
active_fluvial	Active fans and floodplains plus buffers (EBM)	FESL (TEM)	2015
ebm_aquatic_habitat	High value and not high value fish habitat buffers (EBM)	FESL	2014
recreation	recreation areas (trails, huts, etc)	BCTS and BCGW	2014
site_productivity	Provincial site index layer: Raster SIBEC site indices by species for entire province	FLNRO	2012
arch_sites	Archeological and historic sites	BCTS (FNLR)	2014
vri_final	VRI plus depletions to 2014	FESL (BCGW, BCTS, FLNRO)	2014
tem	Terrestrial Ecosystem mapping	BCGW and BCTS	various 1999-2014
pem	Predictive Ecosystem mapping	MOE	2010
FRPA_rip_buffers	Riparian management areas	FESL	2014
rds_tsr	Roads	BCTS and FESL	2014
woodsheds	Catchment areas where all logs go to the same location	FESL, based on BCTS notes	2015
cws_sub_basins	Watershed sub-basins in Block 29 community watershed	BCGW	2015
new_harv	Harvesting from 2014 and 2015	BCTS	2015

4.2 Forest Inventory and Depletions

The current forest inventory in the Pacific TSA is a combination of new Vegetation Resource Inventory (VRI), rolled over FC1, and non-standard TFL forest inventories. Each inventory was converted to VRI format by the Forest Analysis and Inventory Branch (FAIB), projected to 2014, and then provided to FESL. FESL combined all these separate inventories into one consolidated VRI for the entire Pacific TSA. The following issues were dealt with while processing the VRI.

4.2.1 Missing Species Percentage

In the converted forest inventory from TFL39 (Blocks 11-17, and 24) some of the forest cover data lacked species distribution information (percentage) while actual species information was present. In these areas, the percentages were estimated using the average species composition from other stands containing the same species within the same BEC variant. These estimated species percentages were mapped and forwarded to the field teams at BCTS for review.

4.2.2 Edge Matching

In several Blocks (mostly in Blocks 6 and 30), the VRI data did not extend to the Block boundary. This is most likely due to discrepancies in the Block boundary location between the originating TFL and the TSA. These missing slivers were filled in by extending the adjacent VRI polygons to the boundary. No new polygons were created. Figure 2 shows an example from Block 6 of a no data (NTA) gap in the VRI data. The polygons to the north are from one VRI source, and the small polygons to the south and west of the NTA area are from a different inventory. The red NTA polygon is a gap between the two source inventories, about 60 ha in size. The right hand map shows how the adjacent polygons were adjusted to fill in this hole. Over the Pacific TSA, approximately 250 ha of NTA gaps were filled in using this methodology.

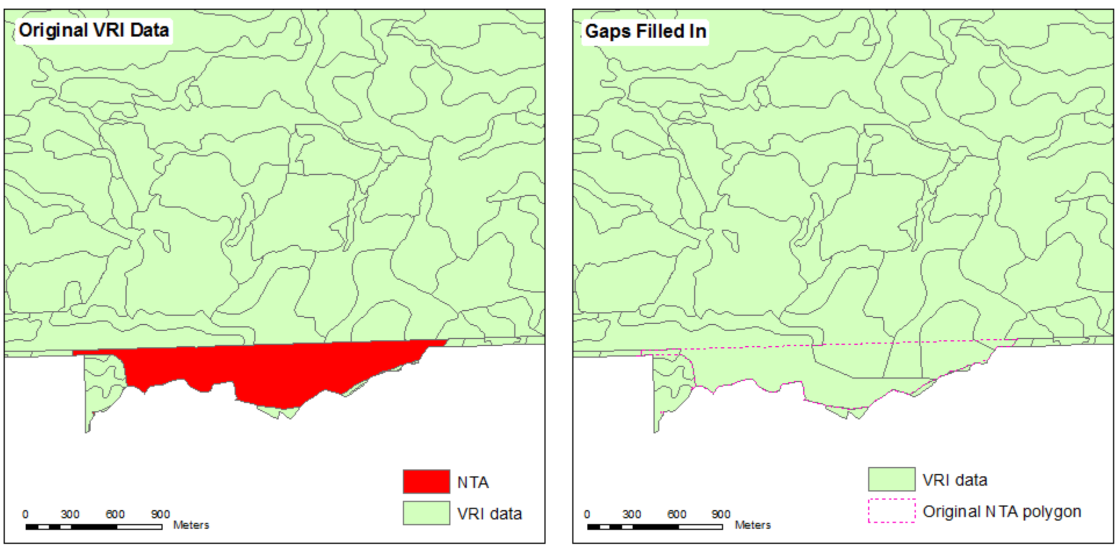

Figure 2: Filling in missing VRI data

4.2.3 BC Land Classification System

When the non-standard inventories were converted to VRI format, the BC Land Classification System was only populated for treed polygons. All non-treed polygons were called unclassified (BCLCS level 1 = U). FESL manually populated these non-forested records based on the non-productive descriptors. For example, a lake would be classified as N-W-W-<null>-LA and a scree slope (talus) would become N-L-U-RO-TA.

4.2.4 Depletions

Depletion data for the Pacific TSA originate from a number of different sources:

- Consolidated Cutblocks 2014;

- Consolidated Cutblocks 2013;
- RESULTS openings;
- VRI opening indicator;
- VRI harvest date;
- VRI opening id;
- Cengea (recent BCTS harvest);
- Weyerhaeuser past blocks;
- Western Forest Products past blocks and salvage blocks;
- Manual additions by BCTS and FESL based on orthophotos;

All these depletions were combined, mapped and spot-checked against orthophotos and Google Earth. BCTS reviewed the data and provided information on missing cutblocks, and corrections, particularly in Block 21, where the 2014 Consolidated Cutblocks layer erroneously indicated that large areas had been harvested.

Once all updates were completed the final depletions dataset was added to the VRI.

4.2.5 Forest Management Land Base

The forest management land base field (FMLB) was not populated for most of the VRI in the TSA. After the depletions were added to the VRI, FESL generated the FMLB using the standard methodology as described below.

- All harvest depletions are FMLB = Y;
- Any records with a non-productive descriptor are FMLB = N;
- If BCLCS level 1 = U or N, or if BCLCS level 3 = A, FMLB = N;
- If site index is null or < 5, FMLB = N;
- If site index is >= 5, FMLB = Y;

Additional criteria for defining FMLB were developed by FESL and BCTS based on orthophotos and knowledge of specific areas. The additional criteria are:

- If age >= 60, there is no depletion, opening id = 0, and site index is null or <5, set FMLB = N;
- if age >= 60, there is no depletion, and BCLCS level 4 is not (TC, TB, or TM), set FMLB = N;
- if age >= 60, there is no depletion, BCLCS level 4 is treed, and crown closure < 15, set FMLB = N;

These additional rules only apply in areas where inventory standard code = V, as there is insufficient data in the old inventories. Approximately 3,300 ha were changed from FMLB = Y to FMLB = N using these additional criteria, mostly in alpine areas and avalanche tracks.

A summary of FMLB is shown in Table 7.

Table 7: FMLB areas by Block

Block	Y	N
1	2,258	78
2	974	43
3	2,278	16
4	70	6
5	192	6
6	10,022	211
7	11,181	220
8	12,168	6,183
9	12,038	4,586

Block	Y	N
10	779	19
11	3,304	155
12	3,053	32
13	612	33
14	1,063	65
15	259	0
16	486	34
17	1,099	15
18	50,170	8,975
19	1,280	70
20	734	100
21	19,395	1,208
22	1,657	43
23	3,123	595
24	989	26
25	30,654	6,912
26	5,205	271
27	56,888	7,404
28	185,938	219,341
29	15,241	6,214
30	2,069	1
Total	**435,181**	**262,861**

4.2.6 VRI Adjustments

4.2.6.1 Blocks 7 and 8

The non-standard inventories for Blocks 7 and 8 (TFL 6 and 37) had a VRI phase II adjustment completed before the Pacific TSA was formed. A phase II inventory adjustment and the adjusted inventory and related yield curves represent the best available growth and yield, and inventory information. For this reason it was important to ensure that the adjusted inventories for these Blocks were used for this TSR. As this analysis will use a different growth and yield model than the one used for the original inventory adjustments – VDYP 7 instead of VDYP 6 – to model natural stand yields, it was not appropriate to utilize the adjustment ratios from the past adjustments. Rather, we acquired the original sample plot data and applied an adjustment to both inventories using procedures designed for VDYP 7. The adjustment reports for Blocks 7 and 8 are attached to this document in Appendix 2 .

4.2.6.2 Blocks 28 and 29

Blocks 28 and 29 are located in the TSK Business Area. These Blocks used to be part of TFL 41. An inventory adjustment was completed for TFL 41 in 1998; however, due to the lack of original plot data it was not possible to adjust the inventory in an unbiased manner using VDYP 7. Instead, 41 inventory audit plots established between 1993 and 1995 in the mature, operable land base were used to adjust the inventory for Blocks 28 and 29 of the Pacific TSA. The adjustment was completed on the current inventory (1996 - 1998) not the original inventory (1972 - 1976).

The adjustment steps are described in Appendix 2.

4.2.7 Projected Attributes

The provided VRI attributes were projected to 2014. As some inconsistencies were noted in the data, FAIB provided FESL with the VDYP 7 input files for each Block inventory. We used VDYP 7 Console (version 7.17g.41) to project the VRI to 2014. Based on the new VDYP projections, the projected age, height, basal area, stems per hectare, site index, and stand volumes were updated in all Block inventories.

4.2.8 Age Update

The depletion data were used to update the VRI age in 2014; the following criteria were used:

- For depletions in 2010 or later, calculate age in 2014 as 2014 minus depletion year;
- For depletions between 1998 and 2009, the VRI may already be updated. An expected age was calculated as (2014 minus depletion year) and compared to the VRI projected age. If the VRI projected age was greater than the expected age plus 2 years, we used expected age, otherwise the VRI age was used;
- For older depletions, if the VRI age was null, we used the depletion year to calculate age, otherwise the VRI age was used;
- If the VRI has been adjusted, we used the adjusted age;
- For all other stands, we used the VRI projected age;
- If a stand belongs to the FMLB with the VRI age null and no depletion date, we assumed that the stand is NSR and set age in 2014 to 0.

4.3 Riparian Classification

Under FRPA guidelines, water features are classified based on their size and whether or not they are fish habitat. This classification is straightforward for polygon features (lakes, wetlands, and large rivers), but not for smaller streams. The stream data was supplied by BCTS. Much of the data was unclassified or it was classified at variable levels of classification. The following sections detail the riparian classification methodology.

4.3.1 Streams – GIS classification

In Blocks 18, 27, 28 and 29 large areas encompassing entire watersheds were unclassified. In these Blocks a GIS methodology was developed using stream order, slope, and fish observation data.

1. Using TRIM, a clean stream network with no gaps was created. A skeletonizer was used to extend lines through polygon features;
2. Stream order was assigned to each segment and braided channels were cleaned up;
3. Segments were divided based on slope greater or less than 20%;
4. Fish observation points were linked to nearest stream;

The following rules were used to assign stream classes:

1. All segments downstream of a fish observation point are fish-bearing;
2. All segments upstream of a fish barrier (slope > 20%) are not fish-bearing;
3. All fourth order or higher streams are assumed to be fish-bearing;
4. First and second order streams are classified as S4 if fish-bearing, and S6 if not;
5. Third order streams are S3 if fish-bearing, S5 if not;

6. Fourth order streams are classified as S2;
7. Fifth order and above are classified as S1;

The classified streams were mapped and forwarded to BCTS for verification. Some changes were made based on field knowledge.

4.3.2 Streams – manual classification

In Blocks where most of the streams were already classified, any remaining unclassified streams were manually classified using the following methodology:

1. If a stream is known to have fish or its slope <=20% and it is not located upstream of a fish barrier, it is considered a fish-bearing stream;
2. Anything downstream of a fish observation point is fish-bearing;
3. Any stream with a slope > 20% or which is upstream of a fish barrier is not fish-bearing;
4. If a stream is not visible on the orthophoto it is S6 or S4;
5. If a stream is visible on the orthophoto, it is S5 or S3;
6. If a stream is clearly visible on the orthophoto, it is S3 or S2, depending on width;
7. Look at similar streams nearby for help in classifying;
8. Verify that classification makes sense, i.e. S3 stream cannot flow into S6 etc.

Streams already classified were not changed unless the current classification was illogical (e.g. S5 downstream of S2). The classification was reviewed by field teams before being finalized.

4.3.3 Large Rivers

River polygons were constructed from TRIM left and right stream bank line features. The width of these polygons was calculated as width = area / (perimeter / 2). Rivers wider than 100 m are S1A, rivers between 20 and 100 m wide are S1B, rivers less than 20 m wide are S2. A manual check of the rivers was also performed and wider reaches were split out to make the widths more accurate.

4.3.4 Lakes and Wetlands

Lake data originates from TRIM; lakes were classified according to size and BEC based on the Riparian Management Guidebook.

Wetland data was acquired from several sources – VRI, TRIM, and BCTS. All these sources were combined, mapped, and forwarded to BCTS for verification. The wetlands were classified into W1 to W4 based on the wetland area and BEC and then further classified into wetland complexes (W5) using the guidelines in the Riparian Management Guidebook.

Table 8 summarizes the total areas and lengths of the riparian classes within the Pacific TSA.

Table 8: Riparian classes in the Pacific TSA

Riparian Class	Definition	Length (km)	Area (ha)
S1A	River >=100m wide	41	781
S1B	20-100m wide	374	1,941
S2	5-20m wide	888	1
S3	1.5-5m wide	594	
S4	<1.5m wide	1,822	
S5	> 3m wide, no fish	2,037	20
S6	<= 3m wide, no fish	19,572	
L1L	>1000 ha		717
L1	5-1000 ha		5,017
L2	1-5 ha (CDF, CWH ds, dm, xm)		4
L3	1-5 ha		370
L4	0.5-1 ha (CDF, CWH ds, dm, xm)		1
NCL	small lake		375
W1	>5 ha		938
W2	1-5 ha (CDF, CWH ds, dm, xm)		50
W3	1-5 ha		464
W4	0.5-1 ha (CDF, CWH ds, dm, xm)		13
W5	wetland complex		270
NCW	small wetland		182

5 Description of the Land Base

5.1 Timber Harvesting Land Base

Land base assumptions define the land base classification in the Pacific TSA. The different classes are a result of a land base netdown. The netdown is an exclusionary process. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of netdown factors (e.g. inoperable) is often greater than the net area removed; a result of overlapping resource issues.

The TSA is classified in the following classes:

Excluded Land Base (EXLB) — private lands, non-forested areas and roads are excluded from the land base. These areas are excluded because they do not contain forest or are not managed by the Crown.

Crown Forested Land Base (CFLB) – the CFLB is identified as the broader land base that contains forest and can contribute towards meeting both timber and non-timber objectives (i.e. biodiversity).

Timber Harvesting Land Base (THLB) - the THLB is the portion of the CFLB considered to be physically, environmentally, economically and socially available for timber harvesting. It is productive forest land that is harvestable according to current forest practices and legislation.

Non-Harvestable Land Base (NHLB) — this is the portion of the CFLB where harvesting is not expected to occur according to current forest practices and legislation. The NHLB includes some areas that are currently not harvestable due to economic considerations. There is a possibility that some or all of these areas could become harvestable under different economic conditions.

The land base netdown is shown in Table 9 with each reduction described below.

Table 9: Pacific TSA netdown summary

Netdown Category	Net Area (ha)	Gross Area (ha)
Total Area		**698,041**
Not Managed by Crown	9,931	9,931
Non-Forest	259,515	264,150
Non-Commercial Brush	30,839	31,199
Roads	4,198	4,598
Crown Forested Land Base Area	**393,559**	
Parks and Protected Areas	9,604	11,050
Ungulate Winter Range	18,777	25,395
Wildlife Habitat Areas	13,052	30,667
Marbled Murrelet Reserves	2,380	5,253
Class 1 Grizzly Bear Habitat (EBM)	592	725
Clayoquot reserves	3,112	5,526
Old Growth Management Areas	30,832	43,881
Preservation VQO areas	296	728
Terrain and ESA	45,440	70,093
Inaccessible Areas	28,806	244,132
Deciduous-leading Stands	2,932	5,083
Non-merchantable (low volume) Stands	43,740	386,422
Uneconomic Areas	74,708	137,773
Archeological Sites	661	840
Recreation Areas	513	2,840
Riparian Management Areas	5,616	28,313
High Value Fish Habitat (EBM)	64	81
Non-high Value Fish Habitat (EBM)	122	559
Active Fluvial Areas (EBM)	485	813
Red/Blue listed ecosystems (EBM)	475	1,470
Wildlife Tree Retention Areas	9,003	13,126
Karst	14	558
First Nations considerations (EBM)	152	208
Non-Harvesting Land Base Area	**291,372**	
Timber Harvesting Land Base Area	**102,187**	
Future Roads	970	
Future Timber Harvesting Land Base Area	**101,218**	

5.1.1 Not Managed by the Crown

Private lands, First Nations Reserves, Woodlots, and First Nations Woodland Licenses (FNWL) are excluded from management. These areas are shown in Table 10.

Table 10: Lands not managed by the Crown

Category	Area (ha)
FN Reserves	18
Woodlots	782
FNWL	4,379
Private Lands	4,752
Total	**9,931**

5.1.2 Non-Forest

Non-forest is defined using the updated VRI field FMLB, which indicates the productive forest based on site index, non-productive descriptor and logging history. (See section 4.2.5 for more information on how the FMLB field was updated.) All records where updated FMLB is "N" are removed as non-forest. Any water features (lakes, rivers and wetlands) that do not exist in the VRI are also removed as non-forest. The total area of non-forest in the Pacific TSA is 264,150 ha.

5.1.3 Non-Commercial Brush

Large areas in the Skeena business area (Blocks 28 and 29) were classified as non-commercial brush (NCBR) in the forest inventory. However, these areas have a site index > 5 and are considered forested by the FMLB definition. After consultation with BCTS, it was determined that these areas should not be considered forest, as it is assumed that they will never grow commercially viable trees. The total area is 31,199 ha.

5.1.4 Existing Roads

Existing and proposed road data was provided by BCTS as lines, which were buffered and added to the resultant semi-spatially. For each resultant polygon the percent of the area that is road was calculated. This approach is more accurate than a blanket aspatial reduction without adding a large number of small polygons to the resultant. The percent reduction for existing roads is applied in the netdown and the roads are removed from the CFLB. Table 11 shows the existing road classes with their widths, lengths, and estimated gross area. Roads were classified into types (highway, mainline, spur, etc.), and each Business Area provided an average width for each type. The estimated gross area was calculated by multiplying the length times the width for each road type, however, this calculation does not account for overlaps where the roads meet. The total net road area accounting for overlaps is 4,598 ha.

Table 11: Existing Roads in the Pacific TSA

Business Area	Road Type	Road R/W Width (m)	Length (km)	Estimated Gross Area (ha)
TSG	Branch	11	1,780	1,958
TSG	Highway	18	47	85

Business Area	Road Type	Road R/W Width (m)	Length (km)	Estimated Gross Area (ha)
TSG	LD_spur	13	1	1
TSG	Mainline	13	1,237	1,608
TSG	Spur	9	404	364
TSK	Branch	11	458	504
TSK	Mainline	15	239	359
TSK	Spur	11	111	122
TST	Branch	7	772	540
TST	Highway	14	8	12
TST	Mainline	12	240	288
Total			**5,297**	**5,840**

5.1.5 Parks and Protected Areas

All provincial parks, protected areas, ecological reserves, conservancies, and biodiversity, mining and tourism areas were removed from the THLB. The area of each protected area is shown in Table 12.

Table 12: Parks and Protected Areas in Pacific TSA

Protected Area Name	Area (ha)
San Juan Ridge Ecological Reserve	96
Sutton Pass Ecological Reserve	5
Namu Conservancy	10,253
Namu Corridor Conservancy	83
BMTA	613
Total	**11,050**

5.1.6 Ungulate Winter Range (UWR)

There are nine ungulate winter ranges that occur within the Pacific TSA. All are no harvest zones, except a part of u-2-004 which allows conditional harvest. The no harvest area and conditional harvest area netdowns are shown in Table 13. The conditional harvest units in u-2-004 are presented in Table 14. Conditional Harvest areas requiring 90% retention are 100% removed in the netdown.

Table 13: Ungulate Winter Ranges

UWR Number	Species	Area (ha)	Netdown Area (ha)
u-1-001	Roosevelt Elk and Black-tailed Deer	516	516
u-1-002	Black-tailed Deer	166	166
u-1-004	Roosevelt Elk and Black-tailed Deer	2,117	2,117
u-1-013	Roosevelt Elk and Black-tailed Deer	2,060	2,060
u-1-014	Roosevelt Elk and Black-tailed Deer	378	378

UWR Number	Species	Area (ha)	Netdown Area (ha)
u-2-003	Mountain Goat	203	203
u-2-004 no harvest	Mountain Goat	164	164
u-2-004 conditional harvest	Mountain Goat	2,612	2,157
u-6-001	Mountain Goat	17,619	17,619
u-6-003	Mountain Goat	16	16
Total		**25,851**	**25,395**

Table 14: Conditional Harvest in UWR u-2-004

UWR Unit #	Area (ha)	Required Retention	Netdown Area (ha)
LO 01	1,512	75%	1,134
LO 02	228	90%	228
LO 03	197	75%	148
WA 01	10	90%	10
TH 03	159	90%	159
TH 04	3	90%	3
TH 05	245	90%	245
TH 06	202	90%	202
TH A1	55	50%	27
Total	**2,612**		**2,157**

5.1.7 Wildlife Habitat Areas (WHA)

Wildlife habitat areas (WHA) have been legally established for northern goshawk, marbled murrelet, and red-tailed frog. There are also additional proposed WHAs for these species as well as for grizzly bear. For the TSR, all proposed WHAs that meet the intent of the FPPR Section 7 species at risk notice are treated as legal and removed from the THLB reflecting current practice. The proposed northern goshawk WHAs and red-legged frog WHAs without the FPRR Section 7 notice will remain in the THLB. The impact of their removal will be tested though sensitivity analysis. The total area removed for WHAs is 30,676 ha. The areas are summarized in Table 15.

Table 15: Wildlife Habitat Areas in Pacific TSA

WHA species	Legal Area (ha)	Proposed (Section 7 of SAR) Area (ha)	Total Removed from THLB (ha)	Proposed (Sensitivity Analysis) Area (ha)
Northern Goshawk	774		774	196
Grizzly Bear		26,926	26,926	
Marbled Murrelet	789	2,168	2,957	
Red-legged frog	19		19	26
Total	**1,582**	**29,094**	**30,676**	**222**

5.1.8 Northern Goshawk Reserves

Goshawk nest locations in the Pacific TSA were provided by BCTS and the Conservation Data Centre (CDC). Each nest not already within a WHA polygon received a 200 m buffer around it. These buffers are not legally established and will remain in the THLB in the base case. The total area of goshawk reserves in the Pacific TSA is 80 ha and their potential impact on the timber supply will be tested through sensitivity analysis.

5.1.9 Marbled Murrelet Reserves

In the TSG business area marbled murrelet reserve areas have been designated in addition to the WHAs listed above. These spatial areas have been set aside to meet the intent of the FPPR Section 7 species at risk notice, and often overlap with other reserves. These areas are removed from the THLB. Their total area is 5,253 ha.

5.1.10 Peregrine Falcon Reserve

There is one known peregrine falcon nest within the Pacific TSA. The impact of a 200 m buffer around this nest will be tested through sensitivity analyses. The total area of this reserve within the TSA is 10 ha.

5.1.11 Grizzly Bear Habitat (EBM)

In the CNC EBM order, grizzly bear habitat areas have been designated as class 1 or class 2. Class 1 areas are 100% removed from the THLB, and class 2 are 50% removed. The class 1 areas are shown in the netdown table (Table 9), the class 2 areas were assessed separately. As it was found that the class 2 reductions were accounted for with other reserves, no further reduction for class 2 Grizzly habitat was required. Table 16 shows the area in each class. All grizzly bear habitat areas in the Pacific TSA are in Block 25.

Table 16: Grizzly Bear Habitat

Grizzly Class	Area (ha)	Required Retention	Netdown Area (ha)
1	726	100%	726
2	669	50%	0[1]
Total	**1,395**		**726**

[1]Accounted for in other, overlapping reductions

5.1.12 Clayoquot Sound Reserves

A portion of Block 27 falls within the Clayoquot Sound Upper Kennedy Watershed. The associated watershed plan delineates a number of reserves, including riparian, old growth, recreation, marbled murrelet etc. All Clayoquot Sound reserve areas are removed from the THLB entirely. The total area is 5,526 ha.

5.1.13 Preservation VQO

As very limited harvesting is permitted in areas where the existing visual quality objective is P (preservation) these areas are removed from the THLB. Other VQO classes are handled using forest cover constraints and visual green-up in the timber supply model (section 6.3.2). There are a total of 728 ha of VQO = P in the Pacific TSA.

5.1.14 Old Growth Management Areas (OGMA)

In most of the Pacific TSA landscape units outside of the EBM areas, OGMAs have been delineated. There are legal, non-legal, and draft OGMAs in the TSA. Legal OGMAs are spatially defined and legally established spatial areas. Non-legal OGMAs are not legally established, but have a notice stating that they meet the requirements of Section 8 in the Old Growth Order. Draft OGMAs have been set aside to meet the non-spatial Old Growth Order requirements. According to BCTS their current practice accounts for all OGMA types, as even the draft OGMAs are accounted for in FSPs. For this reason all OGMAs will be removed from the THLB for the analysis. The OGMA areas are summarized in Table 17.

Table 17: OGMA in Pacific TSA

OGMA Category	Area (ha)
Legal OGMA	26,518
Non-Legal OGMA	12,671
Draft OGMA	4,691
Total	**43,881**

5.1.15 Unstable Terrain

Terrain stability mapping is available for the majority of the Pacific TSA. In areas where there is no terrain stability mapping, environmentally sensitive area (ESA) mapping will be used as a substitute. All terrain stability class V and ESA class ES1 areas will be 100% removed from the THLB. Terrain stability class 4 and ESA class ES2 will be partially removed with a 50% netdown in the TSG and TST business areas and 20% netdown in the TSK business area. Terrain stability class V within Clayoquot Sound is accounted for in the Clayoquot Reserves, however, terrain class IV in Clayoquot Sound is partially removed with a 50% netdown, as in the rest of TSG. These partial reductions reflect current practice in each business area. Table 18 shows the total area of these classes and the area removed in the netdown.

Table 18: Terrain Stability in Pacific TSA

Class	Area (ha)	Netdown Area (ha)
IV	74,118	28,966
V	40,850	40,850
ES1	52	52
ES2	447	224
Total	**115,468**	**70,093**

5.1.16 Recreation Areas

Recreation data for the Pacific TSA includes trails, huts, resorts, lakeshore management areas and recreation areas from Government Action Regulation (GAR) orders and BCGW. Trails were given a 20 m buffer, and huts a 40 m buffer. There is some overlap between the layers, however, the areas shown in Table 19 are mutually exclusive. The GAR orders for DCR and DSI natural resource districts and lakeshore management areas (from Sayward Land Use Plan) are legislated and removed from the THLB in the base case (2,850 ha); the trails, huts, and BCGW recreation areas are not legally required, however it is current practice in the TSA to exclude these from operations. The impact of these non-legally established areas will be tested through sensitivity analyses.

Table 19: Recreation Areas

Recreation Source	Removed from THLB (ha), Base Case	Non-Legal Recreation Areas (ha), Sensitivity Analysis
GAR order	2,848	
BCGW recreation		407

Recreation Source	Removed from THLB (ha), Base Case	Non-Legal Recreation Areas (ha), Sensitivity Analysis
Trail		203
Hut		1
Lakeshore Management	2	
Total	**2,850**	**611**

5.1.17 Permanent Sample Plots and Research Areas (Sensitivity Analysis)

Active permanent sample plots (PSP) and most active research installations remain in the THLB; however as harvesting in these areas may be altered or avoided their potential impact on timber supply is tested through sensitivity analysis. The areas are shown in Table 20.

Table 20: Permanent Sample Plots and Research Areas

Installation		Area (ha)
PSP	Active	1,369
	Inactive	96
Research	Active	389
	Russell Creek	3,159
	Complete	3

5.1.18 Inaccessible Areas

A road dataset consisting of all existing, deactivated, and proposed roads was provided by BCTS. Permanently deactivated roads were not included in the analysis. A slope dataset for the study area was derived from the TRIM DEM at 25 m resolution. Slope was used to classify conventional harvest areas into cable harvest areas and ground based harvest areas.

All roads were buffered by 300 m or 200 m. The 200 m buffer was used in areas with steeper slopes. Roads and coastlines were also buffered by 2,000 m to define the helicopter harvest areas. All areas more than 2,000 m from a road or the coast were considered inaccessible. These areas were mapped and forwarded to BCTS for review. Changes in the classification were made based on local knowledge.

Inaccessible areas were removed from the THLB. The total inaccessible area in the TSA is 244,132 ha. For more information on the economic operability assessment, see Appendix 3.

5.1.19 Deciduous Leading Stands and Non-Merchantable Timber

Deciduous leading stands in most Blocks, and stands with low volume are considered non-merchantable under current practices. Table 21 shows the minimum volume and height cut-offs. These areas are 100% removed from the THLB. An exception to this is alder-leading stands in Blocks 1, 2, 11-14, which are being harvested and therefore remain part of the THLB.

Table 21: Non-merchantable Criteria in the Pacific TSA

Business Area	Species	Minimum Volume	Minimum Height	Forest Area (ha)
all (except Blocks 1, 2, 11-14)	deciduous	all	all	4,568
TSK	conifer	300 m^3/ha at age 200	19.5 m at age 200	50,935
TST, TSG	all	300 m^3/ha at age 150	n/a	42,023
Total				**97,526**

5.1.20 Economically Inoperable Areas

Economically inoperable areas are not available for timber harvesting because they are not economically viable to access and harvest timber. An economic operability assessment was completed as part of this TSR (Appendix 3). The assessment used the following general approach

1. Conventional harvest areas were split into cable and ground:
2. The maximum working land base was defined.
   a. Non-forest, private lands, inaccessible areas, parks, etc. were excluded from the landbase.
3. Cost to harvest each stand was estimated:
   a. Average operating costs were standardized to per cubic meter based on information provided by Price Huber & Associates Inc. for each Pacific TSA Block. Some costs were adjusted in the TSK based on local knowledge.
   b. Road building costs (per km) by slope and major structure costs were provided by BCTS for each Pacific TSA Block;
   c. Road building and major structure costs were shared between the unharvested conventional stands accessed by that road.
4. Stand value was calculated for each stand in the maximum working land base. Stand value consists of:
   a. Volume by species in the current vegetation resource inventory (VRI);
   b. Grade by species; historic grade distributions were used to estimate the current grade distributions;
   c. Selling price by grade; average Vancouver Log Market (VLM) prices for the last 10 years were used to estimate the selling price.
5. Profit before road building costs was calculated for each stand. Profit consists of the difference between the estimated stand value and the estimated cost to harvest the stand. Stands with a positive profit are considered economic to harvest. All previously harvested stands were considered economic with the exception of previously harvested unroaded areas; these were assessed using helicopter harvesting related criteria.

6. Each road was assessed as to whether the total positive profit from the conventionally harvestable stands accessed by it covers the road and major structure building costs.
7. The economic operable land base can be expanded by harvesting profitable stands along with marginally unprofitable stands. This was simulated in the project by blending profitable stands with unprofitable stands after road costs were covered. Blending of stands can only occur within a woodshed. Woodsheds are spatially defined areas within the TSA that are tributary to the same appraised point of origin and are located within the same timber supply block.
8. Results were reviewed by operational staff. Changes were made where appropriate.

All areas deemed uneconomic for harvesting were removed from the THLB. The total netdown for economically inoperable areas was 137,773 ha. For more information on the economic operability assessment, see Appendix 3.

5.1.21 *Forest and Range Practices Act* (FRPA) Riparian Management Areas

Lakes, rivers, wetlands and streams were classified according to the Riparian Management Guidebook (see section 4.3), and buffered as shown in Table 22. The riparian management area is defined as the combined riparian reserve zone buffer plus the percent retention of the management zone buffer. For example, an S3 stream requires a 20 m reserve zone, and a 20 m management zone, with 50% retention in the management zone. This gives a riparian management area buffer of 20m + (20m * 0.5) = 30m. The total area of FRPA RMA reduction within the Pacific TSA is 28,285 ha.

Table 22: Riparian Management Areas

Riparian Class	Reserve Zone Width (m)	Management Zone Width (m)	Percent of RMZ retention	RMA width (m)
L1L	0	0	0	0
L1	10	0	0	10
L2	10	20	25%	15
L3	0	30	25%	7.5
L4	0	30	25%	7.5
S1A	0	100	50%	50
S1	50	20	50%	60
S2	30	20	50%	40
S3	20	20	50%	30
S4	0	30	25%	7.5
S5	0	30	25%	7.5
S6	0	20	5%	1
W1	10	40	25%	20
W2	10	20	25%	15
W3	0	30	25%	7.5
W4	0	30	25%	7.5
W5	10	40	25%	20

Block 21 contains approximately 2,000 ha of a conservation area for the Sechelt First Nation (Figure 3). In this area, the riparian management zone width is doubled. While not a legal requirement doubling the zone width reflects current practice according to BCTS. There are two L1 lakes and 54 km of streams (10 km of S5, 44 km of S6) within this conservation area. The L1 buffer did not change, as there is no riparian management zone for L1 lakes. The RMA buffer for S5 streams became 15 m and 2 m for S6 streams. This added 28 ha to the total RMA making a final total RMA area of 28,313 ha.

Figure 3: Sechelt First Nation Conservation Areas

5.1.22 EBM High Value Fish Habitat

In the EBM areas of the Pacific TSA, high value fish habitat (HVFH) is defined as critical spawning and rearing areas for anadromous and non-anadromous fish, including estuaries, wet floodplains, and marine interface areas. This analysis adopted a similar approach in modelling EBM high value fish habitat as the Mid-Coast TSA TSR (Forsite, 2009). Rivers and streams classified as S1 to S3 below 900 m elevation with a gradient of <=5% were classified as HVFH. These features are given a buffer of 1.5 times the dominant tree height.

Dominant tree height was determined using the area-weighted average height for all forested polygons from the VRI. Initially, average tree heights were calculated separately for each Block. As the average heights were found to be similar within the northern area (CNC) and the southern area (SCC), the average height for each of these areas was calculated. For the CNC (Blocks 25 and 26), the tree height used was 23 m. For the SCC (Blocks 1, 2, 11-17), the tree height was 35 m.

As FRPA riparian buffers also apply within the EBM areas, there is considerable overlap between the HVFH buffers and the FRPA buffers. The total area of HVFH within the EBM areas of the Pacific TSA is 933 ha, however, only 81 ha is outside the FRPA buffers.

Table 23: High Value Fish Habitat Buffers

EBM Order	Buffer required	Tree height	Buffer width (m)
CNC	1.5 x dominant tree height	23	34.5
SCC	1.5 x dominant tree height	35	52.5

5.1.23 EBM Not High Value Fish Habitat (NHVFH)

In the EBM areas, all lakes and wetlands, and all S1-S3 rivers and streams that are not HVFH are classified as not high value fish habitat (NHVFH). The buffers for these are shown in Table 24. The total area of NHVFH buffers within the EBM areas of the Pacific TSA is 3,182 ha, however, only 559 ha are outside of the FRPA buffers.

Table 24: Not High Value Fish Habitat Buffers

EBM Order	Feature	Buffer required	Tree height	Buffer width (m)
CNC	S1-S3 streams Lakes and wetlands > 1ha	90% of 1.5 x dominant tree height	23	31.05
	Lakes and wetlands 0.25-1ha	90% of 1 x dominant tree height	23	20.7
SCC	S1-S3 streams Lakes and wetlands > 0.25ha	90% of 1.5 x dominant tree height	35	47.25

5.1.24 EBM Active Fluvial Units

An active fluvial unit is an active floodplain, where water flows over land in a normal flood event. It includes low and medium benches and the hydro-geomorphic zone of an active fan (CNC, 2013). Floodplains and fans were defined using TEM site series and modifiers.

- In BEC CWHvh2, map codes SL, ST or AL in any decile indicate a floodplain;
- In BEC CWHvm1, map codes SS, CD, or CW in any decile indicate a floodplain;
- Site series modifier “n” indicates a fan;

The VRI data was overlaid and all stands >80% conifer and >200 years old were excluded to ensure that only the active part of the floodplain or fan is considered. The netdown reductions for active fluvial units are shown in Table 25. The total area of all active fluvial units including buffers is 1,129 ha. However, as some of these areas are already within FRPA riparian buffers or in HVFH or NHVFH, the net area is 813 ha.

Table 25: Active Fluvial Units Retention Requirements

EBM Order	Netdown requirement	Tree height	Buffer width (m)
CNC	100% of feature, plus 90% of 1.5 x dominant tree height	23	31.05
SCC	90% of feature (no additional buffer)	n/a	n/a

5.1.25 EBM Red and Blue Listed Ecosystems

Schedules 5 and 6 for the CNC and SCC provide red and blue listed plant communities based on TEM site series. Old forest stands (>200 years old) of these site series are considered likely to contain the endangered plant communities. A list of the red and blue listed site series that are present in the Pacific TSA EBM areas is provided in Table 26.

Table 26: Red and Blue Listed Site Series

EBM Order	BEC Variant	Site Series	Red/Blue
CNC	CWHvh2	08	red
	CWHvh2	07	blue
	CWHvh2	13	blue
	CWHvm1	03	blue
	CWHvm2	03	blue
SCC	CWHvm1	09	red
	CWHvm1	03	blue
	CWHvm1	04	blue
	CWHvm1	14	blue

TEM polygons may consist of up to three site series (deciles) and the endangered ecosystem may be represented by any of the deciles. For the TSR netdown, the percentage of red and blue listed ecosystems in each TEM polygon was calculated. The TEM data was combined with the VRI to locate old forest. The old forest in red ecosystems is 100% removed from the THLB while the old forest in blue ecosystems is 70% removed. The total netdown reduction for red and blue listed ecosystems is 1,470 ha (Table 27).

Table 27: Red and Blue Listed Ecosystems in the Pacific TSA

Endangered Ecosystem	Total Area (ha)	Area > 200 years old	Netdown reduction	Netdown Area
Red-listed	361	244	100%	244
Blue-listed	5,846	1,750	70%	1,225[1]
Total	**6,207**	**1,994**		**1,470**

5.1.26 EBM First Nations Considerations

The CNC and SCC EBM orders outline a number of objectives related to First Nations use of forests. These include traditional forest resources, heritage features, culturally modified trees and monumental cedar. Forest operations will observe these values and where possible cultural features are preserved through incorporation into other reserve areas (e.g. WTPs, RMA etc.); however their impact on timber supply is currently unknown.

After discussion with BCTS, an aspatial reduction of 1.3% was applied to the THLB to account for these First Nations values. This is considered an estimate of the impact of preserving cultural features that cannot overlap with other reserves. This reduction is consistent with the one employed in the Mid Coast TSA TSR (Forsite, 2009).

[1] Note that in the GBR Order CWHvm1/03 is no longer blue-listed. The effect of this change is a decrease in the total netdown area of 544 ha (926 ha instead of 1470 ha).

5.1.27 Archeological Sites

There are 597 known archeological sites within the Pacific TSA, covering a total area of 840 ha. This area will be removed from the THLB.

5.1.28 Wildlife Tree Retention

An aspatial reduction for wildlife tree retention (WTRA) will be applied at the end of the netdown to the THLB. The reduction percent is based on Block, landscape unit and BEC (Table 28). For most of the TSA, landscape unit plans and/or SRMP documents provide legal WTRA requirements. In the Kalum SRMP, there are WTRA objectives, which the FSPs follow. Where there are no landscape unit targets defined, the FSP adopts the FPPR requirement of 7% retention.

Note that while the VILUP does not specify WTRA levels for SMZs, it sets the maximum cut block size at 5 ha for these areas or recommends retention type harvesting approaches. The retention levels set for each SRM in Table 28 reflect this. The retention levels associated with VILUP SMZ areas are based on a summary of past practice and average retention in these zones.

WTRA areas can overlap with other aspatial reductions such as riparian management areas; to account for this, the WTRA reduction in the netdown will be the difference between the WTRA target and the previous netdown reductions. For example, if the WTRA target is 14%, and the polygon contains 10% riparian, the additional WTRA netdown in that polygon would be 4%.

Table 28: Wildlife Tree Retention Areas

Business Area	Block	SRMP	Landscape Unit	BEC	% WTRA
TSG	3	Renfrew	Nitinat	CWHmm	14
TSG	3	Renfrew	Nitinat	CWHvh	2
TSG	3	Renfrew	Nitinat	CWHvm	12
TSG	3	Renfrew	Nitinat	CWHxm	15
TSG	3	Renfrew	Nitinat	MHmm	4
TSG	4	Renfrew	Gordon	CWHmm	14
TSG	4	Renfrew	Gordon	CWHvm	10
TSG	4	Renfrew	Gordon	CWHvh	10
TSG	4	Renfrew	Gordon	CWHxm	13
TSG	4	Renfrew	Gordon	MHmm	5
TSG	5, 6	Renfrew	San Juan	CWHmm	11
TSG	5, 6	Renfrew	San Juan	CWHvm	12
TSG	5, 6	Renfrew	San Juan	CWHvh	12
TSG	5, 6	Renfrew	San Juan	CWHxm	7
TSG	5, 6	Renfrew	San Juan	MHmm	5
TSG	6	VILUP SMZ	San Juan	All	14
TSG	9		Burman	all	7*
TSG/TST	18, 19	Johnstone	Tsitika	all	7*
TSG/TST	18, 19	VILUP SMZ	Tsitika	all	19
TSG	18	VILUP SMZ	Tsitika	all	19
TSG	18	Johnstone	Adam-Eve	all	7*
TSG	18	Johnstone	Naka	all	7*
TSG	20	Campbell River	Sayward	CWHmm1	13
TSG	20	Campbell River	Sayward	CWHmm2	10
TSG	20	Campbell River	Sayward	CWHxm	14
TSG	20	Campbell River	Sayward	MHmm1	2
TSG	21	Sunshine Coast	Brittain	CWHdm	9
TSG	21	Sunshine Coast	Brittain	CWHvm1	13

Business Area	Block	SRMP	Landscape Unit	BEC	% WTRA
TSG	21	Sunshine Coast	Brittain	CWHvm2	13
TSG	21	Sunshine Coast	Brittain	MHmm1	19
TSG	21	Sunshine Coast	Brittain	MHmm2	19
TSG	21, 22	Sunshine Coast	Lois	CWHxm	12
TSG	21, 22	Sunshine Coast	Lois	CWHdm	14
TSG	21, 22	Sunshine Coast	Lois	CWHvm	14
TSG	21, 22	Sunshine Coast	Lois	MHmm	11
TSG	23	Sunshine Coast	Bunster	CDFmm	7
TSG	23	Sunshine Coast	Bunster	CWHxm1	8
TSG	23	Sunshine Coast	Bunster	CWHdm	10
TSG	23	Sunshine Coast	Bunster	CWHvm2	10
TSG	23	Sunshine Coast	Bunster	MHmm1	6
TSG	27	VILUP SMZ	Sproat	All	28
TSG	27	South Island	Sproat	CWHmm	7
TSG	27	South Island	Sproat	CWHvm	5
TSG	27	South Island	Sproat	CWHxm	12
TSG	27	South Island	Sproat	MHmm	0
TSG	27	VILUP SMZ	Nahmint	all	22
TSG	27		Nahmint	all	7*
TSG	27	VILUP SMZ	Cous	all	16
TSG	27		Cous	all	7*
TSG	27	LUOCS	Upper Kennedy	all	15
TSG	30		Cowichan	all	7*
TSG	30		Chemainus	all	7*
TST	1,2,11-14	SCCO	Gilford	all	15
TST	15,16,17	SCCO	Broughton	all	15
TST	7	VILUP SMZ	San Joseph	All	13
TST	7	North Island-Central Coast	San Joseph	CWHvh	6
TST	7	North Island-Central Coast	San Joseph	CWHvm	10
TST	7	North Island-Central Coast	San Joseph	MHmm	1
TST	8	North Island-Central Coast	Upper Nimpkish	CWHxm	13
TST	8	North Island-Central Coast	Upper Nimpkish	CWHmm	14
TST	8	North Island-Central Coast	Upper Nimpkish	CWHvm	9
TST	8	North Island-Central Coast	Upper Nimpkish	MHmm	3
TST	10	North Island-Central Coast	Lower Nimpkish	CWHxm	11
TST	10	North Island-Central Coast	Lower Nimpkish	CWHvm	9
TST	10	North Island-Central Coast	Lower Nimpkish	MHmm	1
TST	24	North Island-Central Coast	Tsulquate	all	7*
TST	25	CNCO	Nootum/Koeye	all	15
TST	26	CNCO	Yeo	all	15
TSK	28/29	Kalum	Hirsch	CWHvm	5
TSK	28/29	Kalum	Hirsch	CWHws	11
TSK	28/29	Kalum	Hirsch	MMmm	0
TSK	28/29	Kalum	Dala	CWHvm	3
TSK	28/29	Kalum	Dala	CWHws	0.5
TSK	28/29	Kalum	Dala	MHmm	0
TSK	28/29	Kalum	Horetzky	CWHws	2
TSK	28/29	Kalum	Horetzky	CWHvm	2
TSK	28/29	Kalum	Horetzky	MHmm	0
TSK	28/29	Kalum	Kemano	CWHvm	0
TSK	28/29	Kalum	Kemano	CWHws	1
TSK	28/29	Kalum	Kemano	ESSFmk	0

Business Area	Block	SRMP	Landscape Unit	BEC	% WTRA
TSK	28/29	Kalum	Kemano	MHmm	0
TSK	28/29	Kalum	Falls	CWHvm	1
TSK	28/29	Kalum	Falls	MHmm	0
TSK	28/29	Kalum	Hawkesbury Island West	CWHvh	0
TSK	28/29	Kalum	Hawkesbury Island West	MHwh	0
TSK	28/29	Kalum	Hawkesbury Island East	CWHvh	1
TSK	28/29	Kalum	Hawkesbury Island East	MHwh	0
TSK	29	Kowesas (draft)	Kowesas	all	7*

*These landscape units do not have Landscape Unit WTRA targets defined; FPPR 66, 67 are followed in the FSP

5.1.29 Karst

Karst polygons were defined based on known and predicted karst areas. There are a total of 6,974 ha of karst within the Pacific TSA. An 8% netdown (558 ha) was applied in all karst areas.

5.1.30 Future Roads

As noted in section 5.1.4, proposed roads (future roads) were provided by BCTS. Future roads were buffered with the same widths as existing roads (Table 11), added to the TSR resultant semi-spatially, and removed from the future THLB at the end of the netdown. The total reduction for future roads was 970 ha.

No reduction was applied for future in-block roads, as it is assumed that the total road area will remain relatively constant, with new roads being built and old roads being reforested over time.

5.2 Land Base Statistics

5.2.1 Climate

The climate in the TSA is coastal, with the dominant biogeoclimatic zone being the coastal-western hemlock (CWH), with some mountain hemlock (MH), some Englemann spruce-subalpine fir (ESSF), and alpine areas (BAFA, CMA). Table 29 shows the areas of biogeoclimatic variants in the Pacific TSA.

Table 29: Biogeoclimatic variants in the Pacific TSA

Subzone	CFLB (ha)	% of Total
Alpine	150	0.04%
CWHdm	14,619	3.68%
CWHmm1	15,059	3.79%
CWHmm2	3,786	0.95%
CWHvh1	7,230	1.82%
CWHvh2	43,915	11.04%
CWHvm1	105,865	26.62%
CWHvm2	48,450	12.18%
CWHws1	10	0.00%
CWHws2	84,424	21.23%

Subzone	CFLB (ha)	% of Total
CWHxm	794	0.20%
CWHxm1	786	0.20%
CWHxm2	7,376	1.85%
ESSFmk	8,940	2.25%
ESSFmkp	50	0.01%
MHmm1	46,751	11.76%
MHmm2	55	0.01%
MHmmp	697	0.18%
MHwh	55	0.01%
MHwh1	8,652	2.18%
MHwhp	10	0.00%

5.2.2 Species Profile

The CFLB in the Pacific TSA is dominated by western hemlock (Hw) mixed with balsam (Ba), western red cedar (Cw) and Douglas fir (Fd). The hemlock/balsam (HemBal) leading stands constitute approximately 71% of the CFLB. The share of Cw-leading stands is 11% while Fd is the dominant species on 9% of the land base (Figure 4).

HemBal leading stands also dominate the THLB (63% of the area); however the share of Fd leading stands is substantially higher on the THLB at 22% of the area (Figure 5).

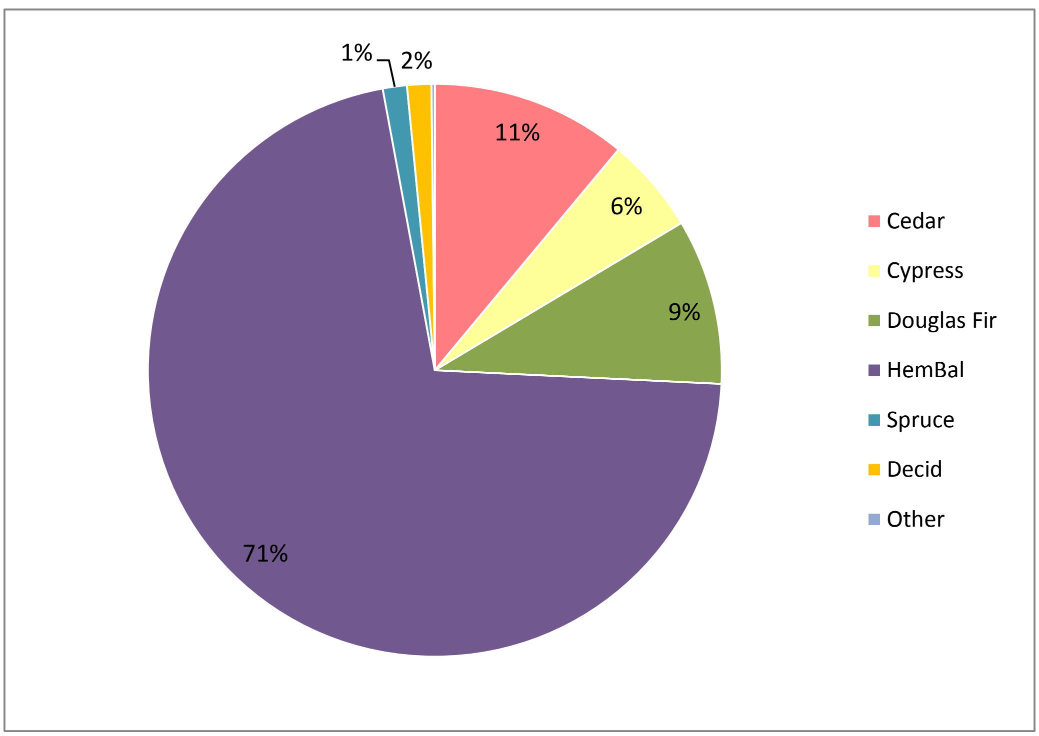

Figure 4: Leading species in the CFLB, Pacific TSA

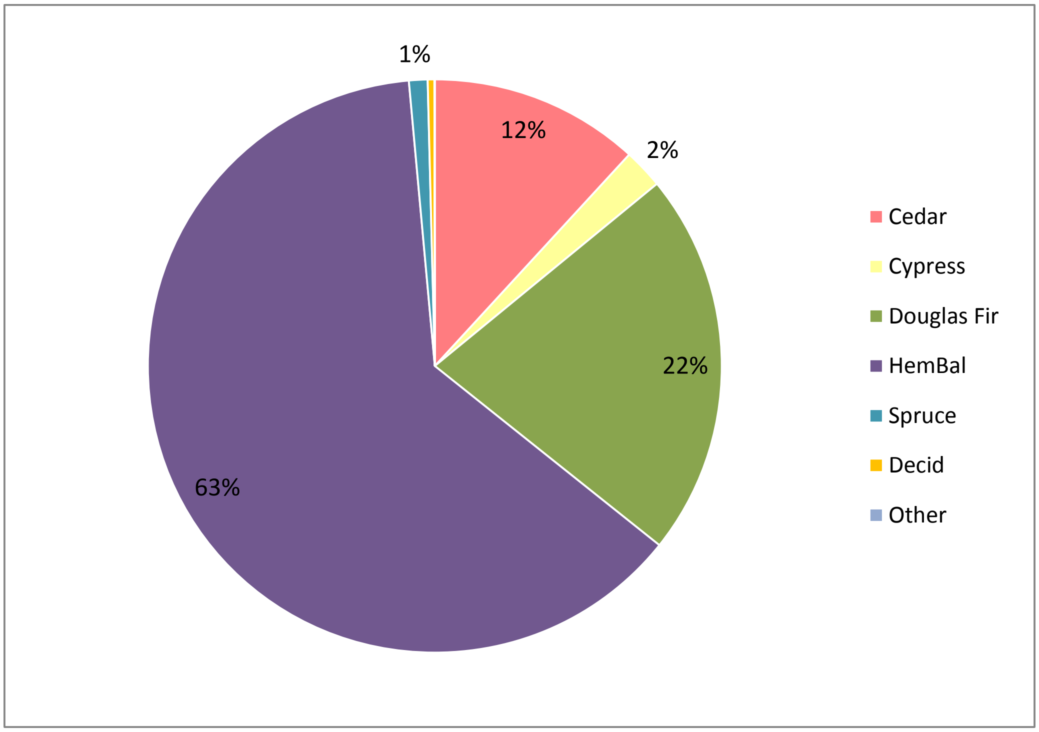

Figure 5: Leading species in the THLB, Pacific TSA

5.2.3 Age Class Distribution

While older age classes dominate the productive forest in the TSA, younger age classes are more prevalent in the THLB. Approximately 64% of the productive forest is older than 140 years; however only 23% of the THLB is older than 140 years. Approximately 50% of the stands in the THLB are younger than 40 years (Figure 6). Age classes 6 and 7 are not well represented; harvesting in short and medium term in the TSA will depend on the timber currently in age classes 2, 3, 4 and 5, and available timber in age classes 8 and 9.

The TSA age class distribution in the southern and mid-coast portions of the TSA (Figure 7) mirror that of the entire TSA, while almost all the land base in the TSK business area (83%) consists of age classes 8 and 9 with the majority of the THLB is in age classes 1 and 9 (Figure 8).

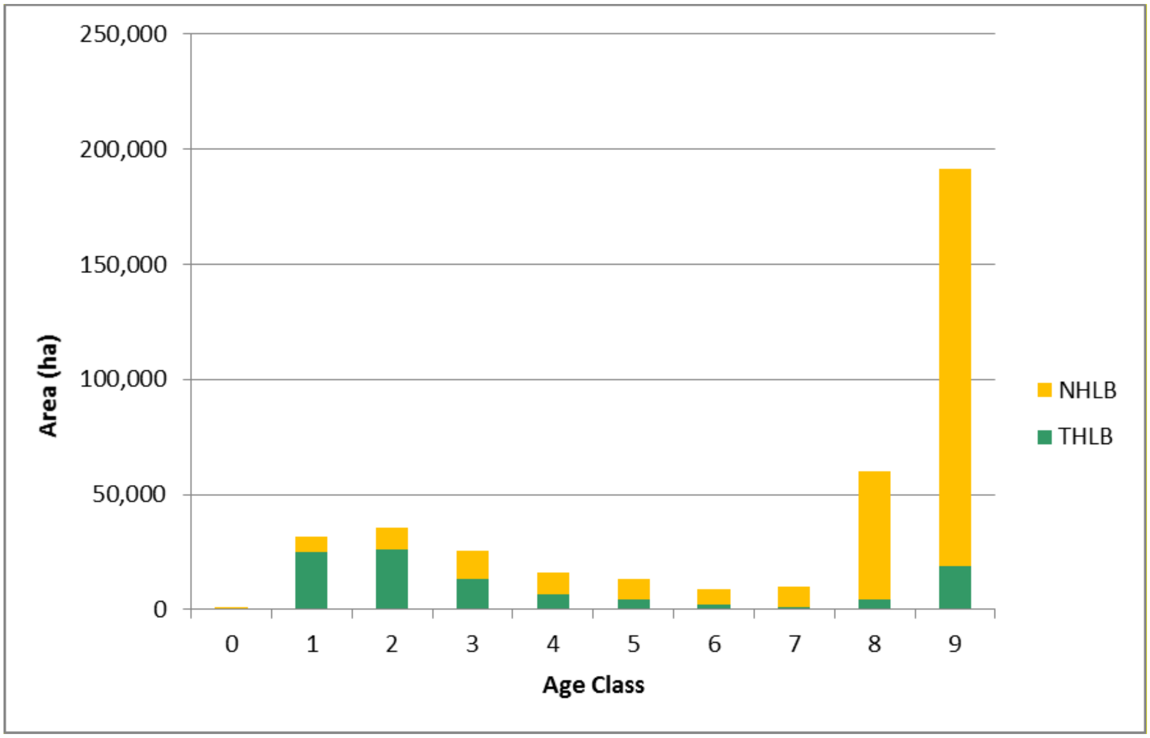

Figure 6: Age class distribution in the Pacific TSA

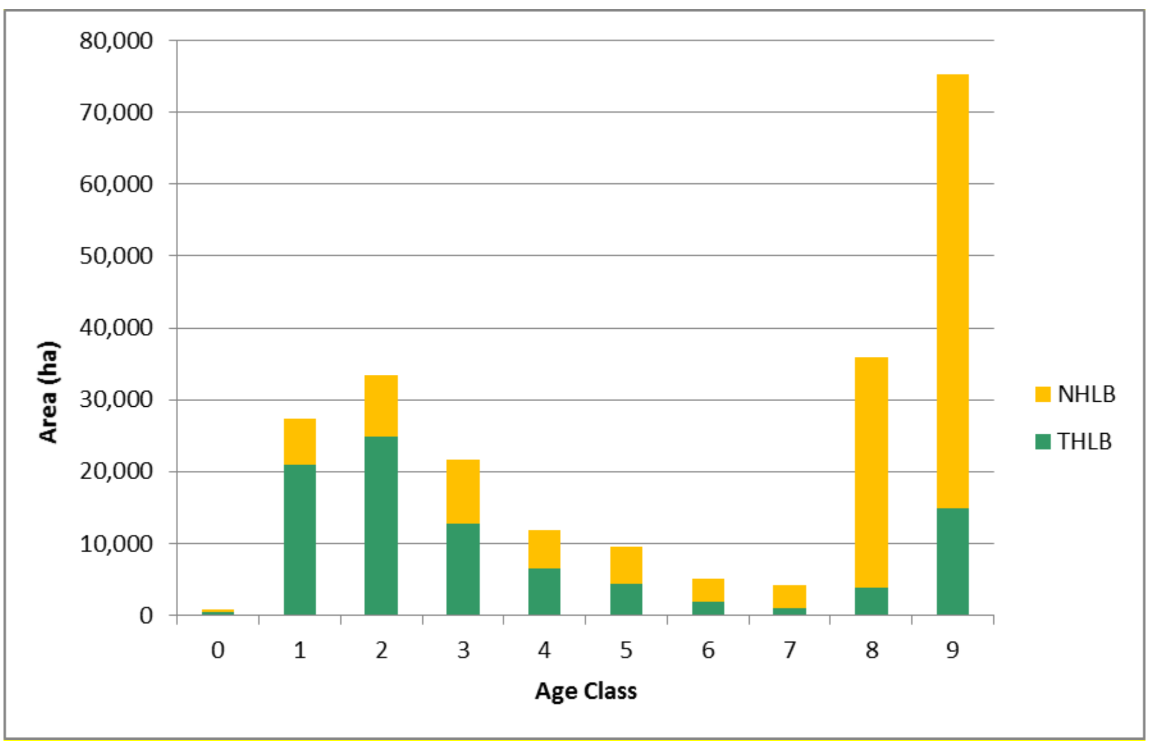

Figure 7: Age class distribution, TSG and TST business areas

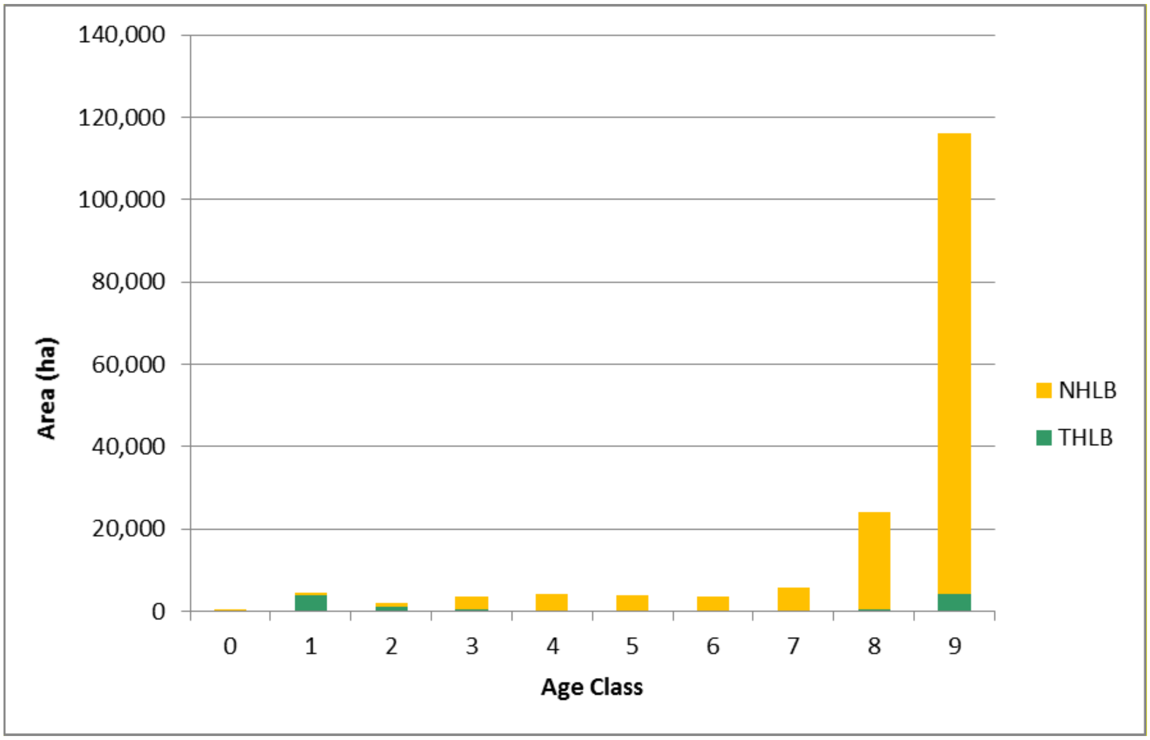

Figure 8: Age class distribution, TSK business area

5.2.4 Growing Stock

The total growing stock in the Pacific TSA is estimated at 27.8 million m^3. Approximately 84% or 23.4 million m^3 of this is currently estimated to be merchantable. HemBal volume forms the majority of the merchantable growing stock at around 13 million m^3 (57%). The shares of Cw/Yc and Fd volume are significant at 4.9 million m^3 (21%) and 4.4 million m^3 (19%) correspondingly (Figure 9).

The majority of the merchantable growing stock is older than 250 years (age class 9, 53%) consisting mostly of HemBal and Cw/Yc volume (Figure 10 and Table 30). Douglas fir is well represented in age classes 2, 3 and 4.

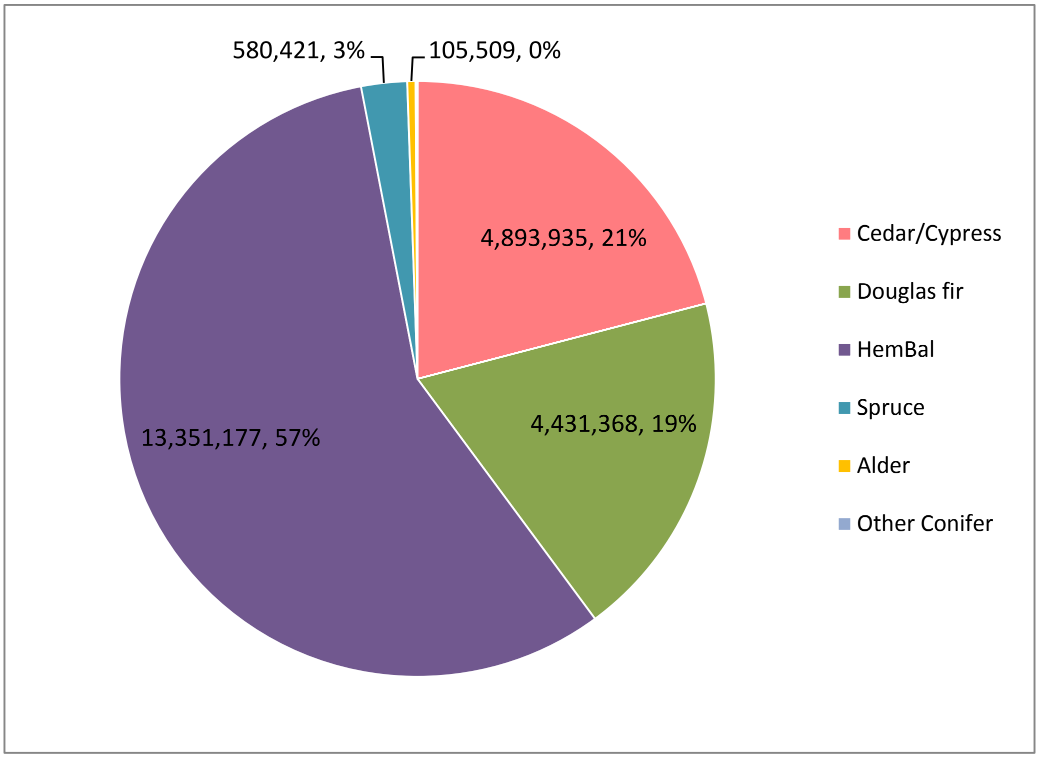

Figure 9: Merchantable growing stock by species in the Pacific TSA

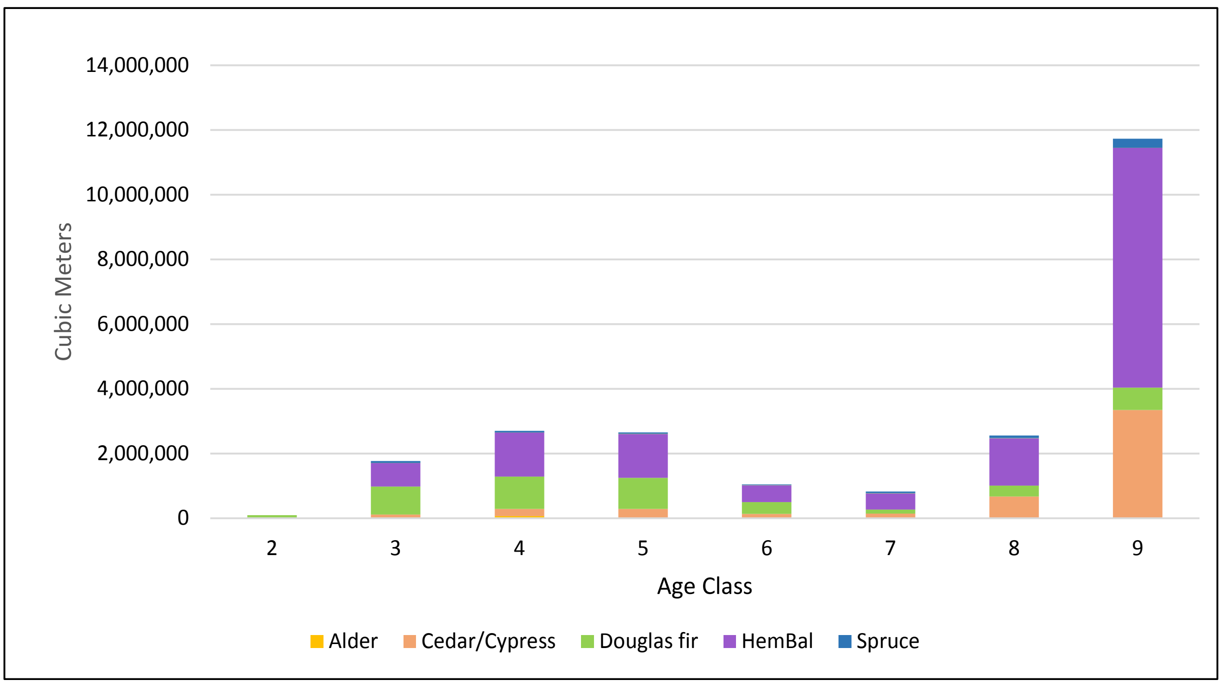

Figure 10: Merchantable growing stock by species and age class in the Pacific TSA

Table 30: Merchantable growing stock by species and age class in the Pacific TSA

Age Class	Alder	Cedar/ Cypress	Douglas Fir	HemBal	Other Conifer	Spruce	Total
2	0	32	95,685	0	0	0	**95,718**
3	10,814	103,930	863,562	736,714	859	55,662	**1,771,541**
4	64,745	221,814	1,002,856	1,360,971	3,172	48,014	**2,701,571**
5	20,264	268,603	962,076	1,354,799	4,330	43,922	**2,653,993**
6	7,724	129,067	368,065	518,874	2,362	23,234	**1,049,325**
7	1,319	145,157	124,172	502,870	885	50,037	**824,441**
8	371	676,875	330,801	1,466,085	4,078	80,387	**2,558,597**
9	272	3,348,456	684,150	7,410,865	8,149	279,165	**11,731,057**
Total	**105,509**	**4,893,935**	**4,431,368**	**13,351,177**	**23,834**	**580,421**	**23,386,243**

6 Integrated Resource Management

This section provides details on how non-timber resource values are integrated with timber objectives in modeling.

6.1 Land Use Direction

Several land use plans exist within the Pacific TSA, as described in section 1.3.1. Resource management in the TSA is directed by these plans; the land base under each plan is divided into management zones with set management objectives for each zone.

6.2 Management Zones and Multi-Level Objectives

Management zones are geographically specific areas that require unique management considerations. Areas requiring the same management regime or the same forest cover requirements are grouped into management zones. Table 31 lists the management zones for the Pacific TSA and the rationale used to define these zones. Multiple resource issues may be present in the same forest area. For example, a management zone that requires a minimum area of mature and old seral forest may also have areas that are visually sensitive and require specific visual objectives. Forest estate models can accommodate multiple overlapping resource layers by establishing target levels for each layer. The models then schedule harvest units which best meet the target levels for all resource layers together.

Table 31: Management Zones –Base Case

Management Zone	Total Area (ha)	CFLB Area (ha)	Criteria Used to Delineate	Notes
VILUP HLPO RMZ: Enhanced Forestry Zones (EFZ) General Management Zones (GMZ) Special Management Zones (SMZ)	 74,759 67,430 33,526	 63,253 52,788 29,513	Legally established in the VILUP HLPO Section 1.	Green-up is applied by RMZ. Green-up and maximum block size are modified in EFZ. SMZ have non-spatial mature and old seral stage targets.
Visual Quality Objectives: Retention (R) Partial Retention (PR) Modification (M) Maximum Modification (MM)	 4,426 97,084 28,058 79	 2,609 69,192 24,575 70	Scenic areas as per VILUP, FRPA, GAR.	Targets are applied to each VQO polygon separately. Visual green-up heights are based on slope.
Clayoquot Sound Scenic Areas: Small-scale alteration Minimal alteration Natural appearing	 931 2,170 143	 866 1,858 125	Clayoquot Sound Scientific Panel Report and Watershed Plans	Mapped and modeled to equivalent VQO class i.e. PR, PR,R.
Clayoquot Sound Sub-Basins Rate of Cut	11,348	9,058	Upper Kennedy Watershed Plan.	Defines a maximum rate of cut.
Clayoquot Sound Biodiversity	11,348	9,058	Clayoquot Sound Scientific Panel Report and Watershed Plans	Target of 40% old forest (>250 years old) by watershed sub-basin.
EBM Important Fisheries Watersheds.	20,841	17,568	SCC and CNC	ECA targets.
EBM Upland Streams	42,978	35,432	CNC	ECA targets for EBM upland stream areas.
EBM Biodiversity	56,006	48,458	GBR	Current and long-term targets for old forest (>250 years old) by landscape unit and site series grouping.
Kalum Watersheds: Brim Hugh Owyacumish Wahoo Wathlsto	 15,764 5,381 8,322 21,334 5,539	 2,501 3,675 2,191 4,500 3,952	Kalum South SRMP	Targets for old forest (>250 years old) based on PEM site series within undeveloped watersheds.
Sayward Potential Spring Forage	1.3	1.3	Sayward Land Use Plan	Sets cover constraints
Sayward Elk Visual Cover	17	9	Sayward Land Use Plan	Sets cover constraints
Landscape Units: 33 Landscape units in the Pacific TSA			Legally established under FRPA	Landscape units (33) are used to define specific land use objectives outside of VILUP, Clayoquot Sound or the Great Bear Rain Forest. Examples are non-visual green-up and non-spatial old growth objectives (if not achieved through OGMAs)
Fisheries Sensitive (FSW) and Assessed Watersheds: FSW f-1-008 FSW f-1-010	 2,700 9,320	 2,652 7,689	Fisheries sensitive watersheds have been established through GAR order.	Management of FSW is required by law. Current practice is to follow ECA recommendations for other assessed watersheds.
Community Watersheds: 910.012 930.021	 10,988 21,766	 7,475 18,155	Designated community watersheds.	Limit harvest to designated percent of area annually.

6.3 Forest Cover Requirements

Modern natural resources management requires that multiple forest characteristics are retained across the landscape. These multiple characteristics are often referred to as forest cover objectives or requirements. It is important to identify how the THLB, and the productive forest which does not contribute to the THLB, are accounted for in the forest cover requirements. The most common way to express forest cover requirements is through maximum allowable disturbance or minimum area retention.

6.3.1 Landscape Green-up

As a surrogate for spatial cutblock adjacency constraint, a landscape green-up constraint will be applied in the base case, specifying that no more than 25% of the THLB area in each landscape unit outside of VILUP may be below the green-up height of 3 m at any given time. The same constraint applies to the VILUP SMZ and GMZ; in the EFZ a shorter green-up height of 1.3 m is required.

6.3.2 Visual Resources outside of Clayoquot Sound

Visual quality objectives are managed on 96,843 ha (24%) of the CFLB. Forest cover requirements for visual quality objectives are composed of two values:

- Visually Effective Greenup (VEG)—the stand height at which regeneration is perceived as a newly established forest, above which the stand is considered to have no visual impact; and
- Percent Planimetric Denudation—the maximum proportion of the productive area of a visual polygon that can be below the VEG height.

6.3.2.1 Visually Effective Greenup (VEG)

VEG is calculated according to the *Procedures for Factoring Visual Resources into Timber Supply Analyses (*BC Ministry of Forests *et al*. 1998*)*. The procedures specify VEG tree heights for slope classes to account for the effect of slope on visual impact. This timber supply analysis will use the area-weighted average of these slope classes to calculate VEG height for each visual quality polygon. Table 32 shows the overall area - weighted average VEG tree height for the different slope classes.

Table 32: Visual Effective Green-up heights (m) by slope

Slope (%)	0-5	5.1-10	10.1-15	15.1-20	20.1-25	25.1-30	30.1-35	35.1-45	45.1-50	50.1-55	55.1-60	>60
VEG (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5

6.3.2.2 Percent Planimetric Denudation

The visual landscape inventory dataset field EVQO was used to determine the planimetric denudation limits. The limits are shown in Table 33. The targets are applied to the CFLB portion of each visual polygon separately. The allowable disturbance varies depending on the visual class and the visual absorption capability (VAC). The higher the VAC, the more disturbance is permitted.

Preservation VQO (EVQO = P) are removed from the THLB in the netdown (section 5.1.13). Polygons with no VAC provided are treated as moderate (VAC = M).

Table 33: Visual classes and maximum allowable disturbance

Visual Class	Visual Absorption Capability (VAC)	Maximum Allowable Disturbance	Number of polygons	Total CFLB Area (ha)
Retention (R)	L	1.1%	40	364
	M	3.0%	50	2,195
	H	5.0%	9	50
Partial Retention (PR)	L	5.1%	278	14,469
	M	10.0%	495	52,052
	H	15.0%	12	2,672
Modification (M)	L	15.1%	43	5,410
	M	20.0%	134	15,477
	H	25.0%	16	3,688
Maximum Modification (MM)	L	25.1%	12	5
	M	32.5%	1	1
	H	40.0%	1	64

6.3.3 Scenic Areas (Clayoquot)

The inventory of scenic resources Clayoquot Sound is different from visual inventories completed for the rest of British Columbia. Instead of VQOs, scenic class objectives (SCOs) are assessed in the inventory. These are unique to Clayoquot Sound. SCOs have been translated into provincial VQO classes for this analysis.

Table 34: Visual classes and maximum allowable disturbance in Clayoquot Sound

Class Name	VQO class	Maximum Allowable Disturbance	Green-up height	CFLB Area (ha)
Small-scale Alteration	PR	40%	6 m	866
Minimal Alteration	PR	30%	7 m	1,858
Natural Appearing	R	20%	8 m	125

6.3.4 Rate of Cut Restrictions (Clayoquot)

Part of the Upper Kennedy Watershed in Clayoquot Sound is within Block 27 of the Pacific TSA. This area consists of a number of sub-basins. For each sub-basin over 500 ha in size, the 5 year rate of harvest is limited to a maximum of 5% of the total sub-basin area. This constraint will be modelled by limiting the area that can be less than 5 years old to 5% in each sub-basin.

6.3.5 Watersheds

6.3.5.1 Fisheries Sensitive Watersheds

There are three fisheries sensitive watersheds (FSW) within the Pacific TSA: f-1-008 and f-1-010 in Block 27, and f-1-004 in Block 4. These watersheds require special management to preserve fish habitat. The entire area of Block 4 is within a watershed; however, Block 4 is small at 63 ha of CFLB and it covers only a small portion of the FSW (0.2%). Therefore, no constraints will be applied to this watershed in the analysis.

The other two watersheds have been assessed; the ECA targets are listed below in section 6.3.5.2. (Table 35). FSW f-1-008 is in the Mactush watershed and FSW f-1-010 has been divided into 7 separate assessed watersheds (Table 35).

6.3.5.2 ECA Watersheds

There are 67 watersheds in TSG where watershed assessments have been carried out. ECA limits ranging from 20% to 40% have been established for these watersheds. Apart from the FSW and the Sproat Community Watershed (930.021) - where management observes ECAs through forest stewardship plans - there is no legal requirement to follow these limits.

Eight of the assessed watersheds are within a FSW as discussed above; these are highlighted blue in Table 35 and will be modeled in the base case. The Sproat Community Watershed (930.021) sub-basins will also be considered in the base case (section 6.3.5.5). These are highlighted green.

Because operational planning accounts for the ECA limits in the remaining watersheds, their impact on timber supply will be tested through sensitivity analyses.

Table 35: Assessed Watersheds in TSG

Watershed Name	FSW	CWS	ECA Maximum (%)	CFLB Area (ha)
A1-2			30	199
Adam 0-0			25	543
Antler		930.021, base case	30	1,279
Arden			30	817
Burman-1&2			30	561
Burman-3			40	253
Burman-4			30	391
Cook			25	691
Cous			25	5,994
Eve 0-0			30	6,812
Eve 1-0			30	2,707
Eve 1-A			30	739
Eve 3-0			30	473
Eve 4-0			30	609
Eve 6-0			30	1,025
Friesen		930.021, base case	30	89
Gous			30	1,231
Gracie		930.021, base case	20	2,124
Gracie Lake	f-1-010, base case		30	485
Jacklah			30	3,392
Lower Taylor F		930.021, base case	30	479
Lower Taylor Residual A		930.021, base case	30	1,298
Lower Taylor Residual B		930.021, base case	30	1,764
Lower Taylor Residual B1		930.021, base case	30	532
Lower Taylor Residual C		930.021, base case	30	328
Lower Taylor Residual D		930.021, base case	30	154
Mactush	f-1-008, base case		25	2,588

Watershed Name	FSW	CWS	ECA Maximum (%)	CFLB Area (ha)
Nahmint 10	f-1-010, base case		30	1,212
Nahmint 3			30	476
Nahmint 4			30	513
Nahmint 5	f-1-010, base case		30	493
Nahmint 6	f-1-010, base case		30	435
Nahmint 8	f-1-010, base case		30	1,290
Nahmint 9	f-1-010, base case		30	892
Nahmint East Slope Residual			30	2,663
Nahmint Lower 1			30	331
Nahmint Lower 1 FN			30	3
Nahmint Lower 2			30	1,010
Nahmint Lower FN			30	44
Nahmint Lower Residual 1a			30	251
Nahmint Lower Residual B			30	598
Nahmint Lower Residual C			30	475
Nahmint Lower Residual D			30	199
Nahmint Upper	f-1-010, base case		30	2,903
San Juan			20	9,147
Snow		930.021, base case	30	719
South Sutton			30	6
Sproat B		930.021, base case	30	1,528
Sproat C		930.021, base case	30	369
Sproat D		930.021, base case	30	271
Sproat E		930.021, base case	30	1,805
Sproat F		930.021, base case	30	1,051
Sproat G		930.021, base case	30	623
St Andrew		930.021, base case	30	951
Sutton		930.021, base case	30	514
Teissum Creek			30	1,864
Tsitika 10-0			25	848
Tsitika 10-A			25	1,028
Tsitika 7-0			35	888
Tsitika 8-0			30	2,059
Tsitika 9-0			30	737
Tsitika 9-A			30	1,305
Tsitika 9-B			30	472
Upper Taylor Residual		930.021, base case	30	791
Upper Taylor Residual C		930.021, base case	30	543
Upper Taylor Residual D		930.021, base case	30	198
Upper Taylor Residual E		930.021, base case	30	658

6.3.5.3 Important Fisheries Watersheds (EBM)

In the EBM areas of the TSA, a number of important fisheries watersheds have been defined. In each of these watersheds, the maximum ECA is 20%. There are 8 different watersheds that have been delineated; however, there is considerable overlap between them. The total CFLB area within important fisheries watersheds is 17,568 ha.

6.3.5.4 Upland Streams (EBM)

In the CNCO, 70% or more of the forest within the upland streams watersheds must be maintained. This objective will be modelled as an ECA limit of 30% within each watershed. There are a total of 20 watersheds; their areas are shown in Table 36

Table 36: Upland Streams Watersheds

Watershed	CFLB Area (ha)
143	579
187	1,379
224	368
247	1,663
287	77
2584	1,669
2741	3,417
2760	1,813
2764	2,517
2772	2,219
2818	3,048
2819	3,571
2820	2,216
2821	1,079
2827	10
2828	2,845
2829	3,002
12409	659
12410	3,035
12411	267

6.3.5.5 Community Watersheds

There are two community watersheds within the Pacific TSA, 930.021 and 910.012, located in Blocks 27 and 29 respectively. Watershed 930.021 is managed using ECA targets described above (Table 35). Twenty two assessed sub-basins fall within community watershed 930.021.

Watershed 910.012, in Block 29 requires a maximum ECA of 20% within each sub-basin of the watershed. It contains three sub-basins as per the Fresh Water Atlas Assessment Watersheds layer. As these sub-basins are not TSG assessed watersheds, they are not shown in Table 35.

6.3.6 Biodiversity

Outside of EBM areas and in most landscape units of the Pacific TSA, landscape - level biodiversity is managed through OGMAs, as discussed above in section 5.1.14.

6.3.6.1 VILUP SMZ Mature and Old Seral Requirements

VILUP HLPO Section 2 (1) (a) specifies mature plus old forest cover objectives for all special management zones. The VILUP sets the mature and old targets between 25 and 33 % and defines the age of mature seral stage as 81 to 121 years depending on the stand type. If the targets are not currently met, a recruitment strategy must be implemented to achieve them in 50 years. The targets and mature seral age cut-offs are further defined in landscape units plans. Mature and old seral stage cover requirements in the productive forest are shown in Table 37.

Table 37: Mature+Old seral forest cover targets in SMZs

Landscape Unit	SMZ Number	SMZ Name	BEC Zone	Age of Mature	Forested Area	Mature/Old Now (ha)	Target (%)	Mature/Old Current (%)
San Josef	2	West Coast Nahwitti	CWH	81	2,877.33	1,459.27	25.0	50.7
Tsitika	7	Johnstone Strait	CWH	81	479.73	479.73	25.0	100.0
			MH	121	252.95	252.95	25.0	100.0
	8	Tsitika River	CWH	81	2,502.61	1,142.71	25.0	45.7
			MH	121	542.57	503.11	25.0	92.7
Cous	13	Nahmint	CWH	81	24.77	22.83	25.0	92.2
			MH	121	0.53	0.53	25.0	99.8
Nahmint	13	Nahmint	CWH	81	8,656.14	4,979.18	25.0	57.5
			MH	121	318.63	175.91	25.0	55.2
Sproat Lake	13	Nahmint	CWH	81	542.97	233.56	25.0	43.0
			MH	121	33.26	23.35	25.0	70.2
Clayoquot SMZ	17	Strathcona-Taylor	CWH	81	10.85	10.18	25.0	93.8
Sproat Lake	17	Strathcona-Taylor	CWH	81	2,232.56	456.55	25.0	20.4
			MH	121	16.68	10.93	25.0	65.5
San Juan	22	San Juan Ridge	CWH	81	92.68	53.75	25.0	58.0
			MH	121	92.63	91.43	25.0	98.7

6.3.6.2 EBM Old Seral Requirements

Division 2 Section 3 of the 2015 GBRO specifies minimum landscape level biodiversity targets (old seral stage) to be retained in the long term (old forest representation targets) and in the short term (minimum old forest retention levels). The targets are specific for Site Series Groups, and apply to the entire GBR. Within any specific landscape unit in the GBR, a minimum of 30 % of the Total forested area by site series group must be reserved, unless the exceptions listed under paragraph 3.2, 3.3 or 3.4 of the GBRO apply.

The GBRO is designed to function within the entire GBR area, while operations within the Pacific TSA occur only in some parts of the landscape units that form the GBR. For this reason the biodiversity targets had to be adjusted so that they could be modelled in the context of the Pacific TSA.

The adjustment had two phases:

1. First, the plan area targets referenced above were proportioned for each landscape unit. As part of the development of the GBR order, a preliminary assessment of the distribution of the plan area targets among the landscape units in the GBR (referred to as the risk allocation) was completed by the Joint Solutions Project (JSP[2]). The risk allocation provides the basis for setting biodiversity targets in timber supply analyses for individual management units, such as TFLs. While not legally binding, these targets are the best estimates of converting the GBR area targets to landscape unit level targets. The targets are listed in Table 38 under the heading "Landscape Unit Target".
2. The prorated targets were further adjusted for the site series groups that fall under the Pacific TSA. The adjustment accounted for parks and protected areas. The adjusted Pacific TSA biodiversity targets are shown in Table 38 under the heading "Adjusted Targets". There are 44 landscape unit/site series groupings represented within the Pacific TSA. These targets will be applied to the CFLB area outside of parks and protected areas.

[2] http://www.coastforestconservationinitiative.com/_About/joint_solutions.html

Table 38: Site Series Groupings

Landscape Unit	BEC	SSG	CFLB Area (ha)	Landscape Unit Target long-term (old in 250 years)	Landscape Unit Target short-term (old now)	Adjusted Target long-term (old in 250 years)	Adjusted Target short-term (old now)
Broughton	CWHvm1	01/06	1,028	55%	21%	41%	12%
Broughton	CWHvm1	02	9	73%	12%	61%	6%
Broughton	CWHvm1	03	640	48%	21%	36%	14%
Broughton	CWHvm1	04	140	32%	1%	32%	1%
Broughton	CWHvm1	05/07/08	3	73%	18%	72%	19%
Gilford	CWHvm1	00	1	94%	50%	94%	50%
Gilford	CWHvm1	01/06	6,146	39%	12%	38%	12%
Gilford	CWHvm1	02	4	82%	0%	82%	0%
Gilford	CWHvm1	03	3,091	37%	15%	35%	15%
Gilford	CWHvm1	04	12	30%	0%	30%	0%
Gilford	CWHvm1	05/07/08	1,767	34%	3%	33%	2%
Gilford	CWHvm1	12/13	78	51%	25%	51%	25%
Gilford	CWHvm1	14	45	65%	9%	65%	9%
Nootum/Koeye	CWHvh2	00	48	96%	21%	89%	43%
Nootum/Koeye	CWHvh2	01/03	13,847	79%	43%	46%	31%
Nootum/Koeye	CWHvh2	02	2	100%	5%	99%	97%
Nootum/Koeye	CWHvh2	04	5,162	63%	44%	32%	20%
Nootum/Koeye	CWHvh2	06/07	2,472	66%	49%	39%	22%
Nootum/Koeye	CWHvh2	08	417	90%	66%	81%	63%
Nootum/Koeye	CWHvh2	11/12	838	91%	33%	75%	35%
Nootum/Koeye	CWHvh2	13	284	86%	37%	68%	26%
Nootum/Koeye	CWHvm1	01/06	3	57%	31%	57%	31%
Nootum/Koeye	CWHvm1	03	6	84%	37%	84%	36%
Nootum/Koeye	CWHvm1	05/07/08	2	67%	39%	67%	39%
Nootum/Koeye	CWHvm1	12/13	1	74%	27%	74%	27%
Nootum/Koeye	CWHvm2	02	3	100%	25%	100%	26%
Nootum/Koeye	CWHvm2	03	5	96%	41%	95%	45%
Nootum/Koeye	MHmm1	00	12	100%	14%	100%	14%
Nootum/Koeye	MHmm1	01/04	2	99%	53%	99%	53%
Nootum/Koeye	MHmm1	02	14	99%	34%	99%	34%
Nootum/Koeye	MHmmp	00	2	100%	0%	100%	0%
Nootum/Koeye	MHwhp1	00	1,000	98%	13%	91%	20%
Nootum/Koeye	MHwhp1	01/04	1,718	63%	45%	45%	36%
Nootum/Koeye	MHwhp1	02	4,494	84%	58%	70%	60%
Yeo	CWHvh2	00	3	100%	21%	99%	8%
Yeo	CWHvh2	01/03	1,891	79%	19%	71%	13%
Yeo	CWHvh2	02	4	100%	20%	100%	20%
Yeo	CWHvh2	04	2,075	63%	27%	50%	18%
Yeo	CWHvh2	06/07	37	87%	50%	75%	33%
Yeo	CWHvh2	11/12	759	77%	2%	76%	1%
Yeo	CWHvh2	13	8	74%	34%	68%	25%
Yeo	CWHvh2	31/32	224	97%	2%	97%	1%
Yeo	MHwhp1	00	6	100%	32%	100%	24%
Yeo	MHwhp1	01/04	154	91%	14%	89%	12%

6.3.7 Biodiversity Targets (Kalum)

In the Kalum Sustainable Resource Management Plan (SRMP), there are five undeveloped watersheds with specific old seral stage targets based on PEM site series. The watersheds are Brim, Hugh, Owyacumish, Wahoo, and Wathlsto. The targets for each site series are shown in Table 39. Old seral stage is defined as greater than 250 years old. Some site series that are present in the data do not have a defined target; for these the target used was taken from an adjacent watershed or similar variant, as shown in the "Target used" and "Target source" columns of Table 39.

Outside of these undeveloped watersheds, legal OGMAs have been established to manage biodiversity in the Kalum SRMP area. The total CFLB area within these 5 watersheds is 16,819 ha.

Table 39: Old Seral Targets for Kalum Undeveloped Watersheds

Watershed	BEC	Site Series	CFLB Area (ha)	Kalum SRMP Target	Target used	Target source
Brim	CWHvm1	01	426	27%		
		03	71	28%		
		05	13	22%		
		06	281	26%		
		08	44	22%		
		12	1	28%		
		14	4	23%		
	CWHws2	01	487		26%	from Wahoo
		03	394		28%	from Wahoo
		06	105		21%	from Wahoo
		10	29		28%	from Wahoo
		11	13		23%	from Wahoo
	MHmm1	01	367	26%		
		02	132	28%		
		03	69	26%		
		04	26	28%		
		06	9	28%		
Hugh	CWHvm1	01	481	27%		
		03	121	28%		
		05	28	22%		
		06	538	26%		
		08	132	22%		
		12	69	28%		
		13	33	28%		
	CWHvm2	01	97	27%		
		03	186	28%		
		05	3	22%		
		06	44	26%		
		08	3	22%		
		10	6	21%		
	CWHws2	01	646	26%		
		03	309	28%		
		06	238	21%		

Watershed	BEC	Site Series	CFLB Area (ha)	Kalum SRMP Target	Target used	Target source
		10	55	28%		
		11	1		23%	from Wahoo
	MHmm1	01	344	26%		
		02	86	28%		
		03	161	26%		
		04	35	28%		
		06	10	28%		
Owyacumish	CWHvm1	01	120	27%		
		03	50	28%		
		05	11	22%		
		06	67	26%		
		08	2	22%		
		12	6	28%		
		13	2	28%		
		14	5	23%		
	CWHws2	01	794	27%		
		03	411	28%		
		06	57	21%		
		10	123	28%		
		11	11	23%		
	MHmm1	01	264	26%		
		02	149	28%		
		03	78	26%		
		04	3	28%		
		06	36	28%		
Wahoo	CWHvm1	01	112	27%		
		03	19	28%		
		05	1	22%		
		06	42	26%		
		08	24	22%		
		13	1	29%		
	CWHws2	01	2,308	26%		
		02	1	28%		
		03	567	28%		
		06	1043	21%		
		07	31	21%		
		10	105	28%		
		11	16	23%		
	ESSFmk	01	44	21%		
		02	93	21%		
		03	72	21%		
		04	16	21%		
		08	3	21%		
	MHmm1	02	1	28%		
Wathlsto	CWHvm1	01	280	27%		

Watershed	BEC	Site Series	CFLB Area (ha)	Kalum SRMP Target	Target used	Target source
		03	7	28%		
		05	28	22%		
		06	166	26%		
		08	7	22%		
		12	7	28%		
		13	5	28%		
	CWHws2	01	1,287	27%		
		03	101	28%		
		06	362	26%		
		10	490	21%		
		11	1	21%		
	MHmm1	01	214	26%		
		02	117	28%		
		03	302	26%		
		04	48	28%		
		06	527	28%		

6.3.8 Biodiversity (Clayoquot)

Landscape level biodiversity will be modelled by setting a 40% old seral target at the watershed level. Age of old is defined as 251 or older.

6.3.9 Special Management Zones (Clayoquot)

In addition to the extensive reserve network, special management zones have been delineated within the Upper Kennedy Watershed. These areas allow harvesting; however the harvest is constrained.

- Cultural SMZs require consultation with First Nations before harvest may occur; these areas were not accounted for in the analysis. There are 4,452 ha of CFLB, including 652 ha of THLB in Cultural SMZs.
- Recreation SMZs are located around lakes are managed similarly to scenic class 2 (minimal alteration) areas; in the analysis the harvest in these areas is modeled as per Table 34 in Section 6.3.3. Total CFLB area of recreation SMZ is 178 ha (12 ha of THLB).
- Deer Winter Range SMZs require consultation with a wildlife biologist before harvesting may occur; these areas were not accounted for in the analysis. There are 194 ha of deer winter range in the CFLB, none of which is in the THLB.

6.3.10 Wildlife

Wildlife habitat areas for ungulate range, northern goshawk territories, marbled murrelet nesting habitat and grizzly bear habitat are reserved from harvest and accounted for in the land base netdown. In the Sayward LUP (Block 20), there are specific requirements for maintaining elk habitat. Potential spring forage habitat has been identified adjacent to UWRs. In these areas, a maximum of 25% of the forest may be under 20 years of age at any time. Elk visual cover areas have also been delineated. In these areas, at least 50% of the forest must be taller than 5m. There are 1.3 ha of potential spring forage in the CFLB and 9 ha of visual cover.

7 Timber Harvesting

7.1 Initial Harvest Level

In the course of building the base case, various options for a sustainable harvest forecast will be tested. The first iterations in building the base case will use the current AAC of 1,521,071 m^3 per year as the initial harvest level. The resulting timber supply forecasts for the medium term and the long term will then demonstrate whether the current AAC or some other harvest level is appropriate as the initial harvest level for the final version of the base case.

7.2 Harvest Rule

Simulation models are rule-driven, and require harvest scheduling rules to control the order in which stands are harvested. It is important that these rules are able to organize the harvest in a way that realizes the productive potential of the land base in a reasonable manner to understand the impacts of the timber supply assumptions and constraints.

The relative oldest first rule is a commonly used harvest rule that will be used in the base case. In this rule, the age of a stand is related to its minimum harvestable age. Stands that have the greatest proportional difference between their actual age and their minimum harvest age are given priority for harvest, subject to forest cover requirements.

7.3 Harvest Priority, Harvest Deferrals and Minimum Volume Requirements

7.3.1 Harvest Priority

Harvest priority can be used to override the harvest rule. It can be used in modelling to reflect situations when it is known that some areas will be targeted for harvesting. Such targeting may be required to address forest health issues as an example. No areas will be prioritized for harvest in the base case.

7.3.2 Harvest Deferrals

Harvest deferrals can be used to override the harvest rule as well. They are used in cases where access to an area must be deferred for a period of time. In the base case, the harvest in Block 25 (Doc Creek) is deferred for 40 years. A detailed operational assessment by BCTS staff indicated that this area will not support economic harvest until the second growth stands are harvestable, approximately 40 years from now. The THLB for Block 25 is 2,795 ha.

7.3.3 Minimum Volume Requirements

Minimum volume requirements can be set for an area, when it is known that the financial viability of the harvest from that area requires a minimum harvestable volume. Due to the scattered and isolated nature of the Pacific TSA Blocks, many of them require a minimum harvest volume to reflect the operational reality associated with mobilization and demobilization. The following table shows all the TSA Blocks, or the combinations of Blocks that are subject to minimum volume requirements in the base case. The requirements are applied to a period of 5 years.

Table 40: Minimum 5-year harvest volume requirements

Pacific TSA Block	Area Name	Area (ha)	THLB Area (ha)	Minimum Harvest Volume m^3
1	East Cracroft Island	2,336	1,275	35,000
2	West Cracroft Island	1,017	776	35,000
3	Roseander	2,294	1,168	10,000
4, 5, 6	San Juan	10,507	4,831	10,000
7	Holberg	11,401	6,741	15,000
8	Vernon Lake	18,351	4,178	35,000
9	Burman	10,644	2,502	40,000
	Jacklah	5,979	1,566	40,000
10	Beaver Cove	798	615	20,000
11	Harbledown Island	3,459	1,779	30,000
12	Turnour Island	3,085	2,026	25,000
13	Village Island	645	314	35,000
14	Gilford Island	1,128	553	35,000
15	Kinnaird Island	259	111	35,000
16	Burley Bay	521	244	35,000
17	Watson Island	1,114	632	35,000
19	South Kaikash	1,350	29	35,000
20	Farewell Lake	834	424	10,000
21	Granville	5,855	2,837	20,000
	Lois	5,710	3,642	10,000
	Khartoum	9,038	2,973	30,000
23	Theodosia	3,719	1,325	30,000
24	Quatse	1,016	801	30,000
25	Doc Creek	37,566	2,795	Defer entire Block for 40 years. Minimum volume of 70,000m^3.
26	Yeo Island	5,476	1,040	40,000
30	Hill 60	2,070	1,603	10,000

7.4 Partitions

Partitions are used when a specific level of harvest is required from a geographic area. The partition can be a minimum or maximum. Minimums are often used to promote harvest when it is uncertain whether harvest in an area will occur at all. An example of this would be helicopter harvest areas within the THLB containing less valuable species such as hemlock and balsam. Maximums are used when there is a need to limit the rate of cut from a geographic area within a TSA.

Partitions can also be non-spatial, i.e. not tied to specific geographic areas. An example would be a maximum volume of harvest of a specific species within a TSA. Non-spatial partitions are usually more difficult to implement and monitor.

7.4.1 Helicopter Harvesting Partition

Helicopter harvest areas in the Pacific TSA THLB are considered marginally economic. It is assumed that harvest in these areas is economic only during the market cycles with high log prices, while conventional harvest areas are assumed to be economic in average market conditions. The base case will analyze the helicopter harvest area separately to determine a sustainable harvest level from these areas. The size of the THLB that falls within the helicopter harvest areas in the TSA is 9,367 ha.

7.4.2 Ecosystem Based Management Partition

Areas under EBM will be modeled separately, as it is likely that they will be managed under a partition. There are 11,544 ha of THLB in EBM areas within the Pacific TSA.

7.4.3 Clayoquot Sound Partition

The Clayoquot Sound area within Block 27 will be modeled separately as well due to its special nature. The size of the THLB within the Clayoquot Sound area is 1,769 ha.

7.5 Utilization Levels

The utilization level defines the minimum top diameter (inside bark) and minimum diameter (dbh) of stems that must be removed from harvested areas. It also specifies the maximum height of stumps that may be left. These factors are used to determine the merchantable stand volume in the analysis.

The utilization levels used in this analysis are shown in Table 41.

Table 41: Utilization levels used in the analysis

Leading species	Utilization		
	Minimum dbh (cm)	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Natural conifer >120 years of age	17.5	30	15
Natural conifer between 50 and 120 years of age	12.5	30	10
Managed conifer	12.5	30	10
Alder >45 years of age	17.5	30	15

7.6 Volume Exclusions

One or more species may be non-merchantable in mixed-species stands. As an example, deciduous species may not be harvested in a predominantly coniferous stand; the unharvested portion should not contribute to the estimated stand volume. In the Pacific TSA all deciduous species, except alder in Blocks 1, 2, 11-14, will be excluded from the estimation of stand volume. This reflects current utilization standards and performance.

7.7 Minimum Harvest Criteria

Minimum harvest criteria is the earliest age, volume per ha or other criterion such as DBH at which stands become eligible for harvest within the timber supply model. Minimum harvest criteria can have a profound effect on modeled harvest levels by creating acute timber supply shortages, or “pinch points”, that constrain the rest of the planning horizon.

For this analysis, the minimum harvestable criteria for stands in each analysis unit is the age at which the stand is predicted to reach a volume of 300 m^3/ha. In practice, most forest stands are harvested beyond the minimum harvest age due to economic considerations and constraints on harvesting which arise from managing for other forest values.

7.8 Harvest Profile

The base case will not target a specific harvest profile.

8 Growth and Yield

Growth and yield assumptions define the net volumes that are realized when natural and managed stands are harvested. They also describe various tree and stand attributes over time (i.e., volume, height, diameter, presence of dead trees, etc.).

8.1 Site Index

On the recommendation of Graham Hawkins, FLNRO, the provincial site productivity data layer will be used in the TSR to model the growth and yield of managed stands. Where there is no data in the provincial layer, the SIBEC site index for the leading TEM/PEM site series will be used. If there is no TEM or PEM data, or if there is no site index in SIBEC, the inventory site index will be used.

The growth and yield of natural stands will be modeled using the inventory site index. Table 42 compares the average site index values from VRI to those from the provincial site index layer.

Table 42: Average site productivity in the Pacific TSA, (leading species in VRI)

Business Area	Site Index Type	Cedar	Hemlock	Balsam	Douglas Fir	Spruce
TSG, TST	VRI Site Index Average (THLB):	17.5	21.3	16.9	28.5	28.1
	Provincial SI average (THLB):	21.1	25.5	23.4	31.2	28.9
TSK	VRI Site Index Average (THLB):	14.0	14.7	16.6	n/a	19.7
	Provincial SI average (THLB):	22.6	23.1	25.7	n/a	27.4

8.2 Analysis Units

An analysis unit is a grouping of similar forest area with the objective of simplifying the analysis and the interpretation of analysis results.

8.2.1 Natural Stands

Stands established prior to 1966 (>= 50 years old in 2014) are considered natural stands in this analysis. Their growth and yield will be modeled using the Variable Density Yield Prediction (VDYP7) yield model. Default Decay, Waste, and Breakage adjustments for VDYP7 will be incorporated. Inventory site index estimates are considered to be the most appropriate in modelling these stands.

The large number of natural stand yield curves (30,883 VRI stands in the FMLB) were aggregated into 1379 analysis unit yield curves. The grouping was completed based on TSA Business Area, species composition, inventory site index and the volume per ha at ages 75 and 150. Two ages were used for the volume grouping to account for yield curve shape. This aggregation methodology was designed to minimize the variation within analysis units. A comparison of the aggregated analysis unit curves and the individual stand curves is shown in Table 45.

The VRI stands were grouped into 44 species composition groups based on the leading species percent and the leading and secondary tree species. These groups are shown in Table 43. The objective was to keep the species composition of the final analysis units uniform. Stands were split into three broad leading species percent groups: >=70, >=50 and <70, and <50. Within these three groups stands were broken into 15 more groups based on the leading and secondary species. There were nine leading species: Ba, Cw, Yc, deciduous, Dr, Fd, Hw, pine, and Sx. All but the deciduous, Dr, and pine groups were broken into Hw and non-Hw groups based on the secondary species. Deciduous leading stands with >=50 percent leading species were combined into one group.

Table 43: CFLB Area of species groupings

Species Composition	Percent of Leading Species		
	>=70	>=50, <70	<50
Ba/Hw	3,372	16,369	4,256
Ba/Other	228	856	973
Cw/Other	670	4,426	7,301
Cw/Hw	2,878	12,902	8,445
Yc/Other	62	858	2,222
Yc/Hw	2,147	8,991	5,504
deciduous		474	97
Dr	1,466	691	275
Fd/Other	3,616	2,362	910
Fd/Hw	4,975	8,113	2,092
Hw/Ba	30,678	56,003	11,354
Hw/Other	24,884	56,161	21,155
pine	107	384	221
Sx/Other	264	150	196
Sx/Hw	1,109	1,919	730

The analysis units were further subdivided into three site index groups by each TSA Business Area and the nine leading species. A K-Means clustering method, weighted by CFLB area, was used to choose the break points for the SI groups. The clustering minimised the within group variance for each SI group. Table 44 presents the site index ranges and CFLB area weighted average for each site index group.

Table 44: SI ranges for each SI Group (CFLB area weighted averages)

Leading Species	SI Group	TSG		TST		TSK	
		Range	Ave	Range	Ave	Range	Ave
Ba	L	5 to 10.6	8.1	5.1 to 12.3	10.0	5.1 to 11.8	9.5
	M	10.7 to 16.5	13.3	12.5 to 19.2	14.8	11.9 to 16.4	14.2
	H	16.6 to 35.3	19.8	20.3 to 35.9	24.2	16.5 to 32.2	18.7
Cw	L	6.4 to 13.9	11.6	5.2 to 11.2	9.6	5.7 to 12.1	10.7
	M	14 to 18.8	16.4	11.3 to 16.1	12.9	12.1 to 15.3	13.5
	H	18.9 to 33.6	21.3	16.1 to 31	19.3	15.3 to 27.9	17.1
Yc	L	5.3 to 9.4	7.7	5 to 8.5	7.3	5.2 to 7.9	7.1
	M	9.5 to 13	11.1	8.6 to 13.6	9.9	8.2 to 10.1	9.1
	H	13 to 27.9	14.9	14 to 19.7	17.9	10.2 to 12.9	11.2

Leading Species	SI Group	TSG		TST		TSK	
		Range	Ave	Range	Ave	Range	Ave
decid	L	9.2 to 22.3	21.2			23.6 to 28.2	25.6
	M	24.3 to 29.2	26.5			28.9 to 33	31.2
	H	30.9 to 37.8	34.0			33.3 to 38.6	35.2
Dr	L	17.8 to 23.6	21.6	8.4 to 26.6	22.7	15.3 to 23.3	22.0
	M	23.9 to 28.2	25.8	27.9 to 34.2	30.7	23.9 to 26.7	25.3
	H	28.8 to 36.8	30.8	36 to 40	38.6	26.9 to 33.3	28.2
Fd	L	7.8 to 22.7	18.7	9.8 to 20.6	15.8	10.3 to 11.7	10.6
	M	22.9 to 30.6	26.9	21.9 to 32.8	27.5	12.9 to 15	14.3
	H	30.7 to 44.4	34.4	37 to 44.2	40.2	19 to 19.3	19.1
Hw	L	2.5 to 12	8.6	5.1 to 12.9	9.7	5.1 to 9.7	7.6
	M	12.1 to 20.3	15.5	13 to 22.2	16.3	9.7 to 14.1	11.7
	H	20.4 to 40.8	25.2	22.3 to 38	28.2	14.1 to 37.5	16.6
P	L	6.7 to 9.6	8.0	5.6 to 7.8	6.1	8.5 to 11.5	9.9
	M	10.9 to 13	11.6	8.3 to 11.4	10.2	11.8 to 14.6	13.4
	H	14.6 to 16.3	15.3	19 to 19	19.0	15.5 to 16.8	16.5
Sx	L	5.1 to 11.7	6.7	7.7 to 17.5	13.2	5.1 to 13	10.0
	M	17 to 29.1	26.1	18.6 to 25.6	22.4	13.2 to 20	16.3
	H	32 to 46.7	36.3	26.3 to 46.8	29.8	20.2 to 34.1	23.9

A further analysis unit subdivision was based on yield curve volumes to minimize the variance of the final analysis unit average yield curves. K-Means clustering of the yield curve volume at ages 75 and 150, weighted by CFLB area, was used to choose up to five volume groups within each business area, species group and SI group.

Finally, the analysis units in the THLB were averaged separately from those in the NHLB, and the THLB units were split based on utilization level. An example of the naming convention used for the analysis units is:

NA_TSG_>=50_Fd/Hw_M_4_util_12.5

This example is a THLB natural stand AU, in TSG. It consists of 50-70% Fd, with Hw as the second species. The site index is moderate (between 22.9 and 30.6), and the AU belongs to volume group 4. The utilization level is 12.5. i.e. the current age of the stand is between 50 and 120 (see Table 41).

8.2.1.1 Existing Timber Volume Check

The results of the existing timber volume check between the aggregated analysis unit volumes and the inventory polygon-specific volumes are presented in Table 45. The volumes presented for all natural stands in the CFLB (age in 2014 >= 50) with all stands projected to an age of 150.

Table 45: Existing timber volume check (CFLB, stand age 150)

Block	Polygon Specific Volume	Analysis Unit Volume	Difference (m^3)	Difference (%)
1	1,042,946	1,065,745	22,799	2.2%
2	531,406	534,995	3,589	0.7%
3	1,223,298	1,180,928	-42,371	-3.5%
4	29,495	30,060	565	1.9%
5	105,638	109,226	3,588	3.4%
6	4,427,270	4,465,062	37,793	0.9%
7	4,440,151	4,377,687	-62,465	-1.4%
8	3,991,746	3,932,113	-59,633	-1.5%
9	5,579,965	5,491,715	-88,250	-1.6%
10	312,912	313,184	272	0.1%
11	2,428,004	2,456,425	28,421	1.2%
12	1,170,473	1,153,433	-17,039	-1.5%
13	473,043	478,386	5,344	1.1%
14	653,331	648,340	-4,991	-0.8%
15	125,577	125,826	249	0.2%
16	230,541	233,619	3,078	1.3%
17	684,642	676,532	-8,110	-1.2%
18	15,231,151	15,129,557	-101,594	-0.7%
19	778,089	797,017	18,927	2.4%
20	643,819	634,619	-9,200	-1.4%
21	8,475,372	8,494,168	18,796	0.2%
22	961,065	945,252	-15,813	-1.6%
23	919,338	923,944	4,606	0.5%
24	626,117	630,164	4,047	0.6%
25	7,627,958	7,684,993	57,035	0.7%
26	1,924,307	1,932,783	8,476	0.4%
27	19,178,536	19,374,828	196,292	1.0%
28	54,989,902	54,999,478	9,577	0.0%
29	6,295,684	6,286,107	-9,577	-0.2%
30	1,277,743	1,273,331	-4,412	-0.3%

8.2.2 Managed Stands

Stands established after 1965 are considered managed stands in this analysis. Their growth and yield will be modeled using Tree and Stand Simulator (TASS). TASS is a three dimensional growth simulator that generates growth and yield information for even aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia. Provincial site productivity layer estimates of site index are considered to be the best estimates of site productivity for modelling managed stands.

Analysis units for managed stands are based on BEC groupings and site index as shown in Table 46. The aggregation of the data within each analysis unit was completed separately for the TSK Business Area (Table 47).

Table 46: Analysis units, TSG and TST Business Areas

BEC Group	Growth rating	Reference Species	
		Plant	Natural
1. CWH vm1	Good	Cw	Hw
	Medium	Cw	Hw
	Poor	Cw	Hw
2. CWH dm, mm1, xm, xm1, xm2	Good	Fd	Fd
	Medium	Fd	Fd
	Poor	Fd	Fd
3. CWH vh1, vh2	Good	Cw	Hw
	Medium	Cw	Hw
	Poor	Cw	Hw
4. CWH mm1, vm2, ws2	Good	Ba	Hw
	Medium	Ba	Hw
	Poor	Ba	Hw
5. MH mm1, mm2, wh, wh1	Good	Ba	Ba
	Medium	Ba	Ba
	Poor	Ba	Ba

Table 47: Analysis units, TSK Business Area

BEC Group	Growth rating	Reference Species	
		Plant	Natural
1. CWH vm1	Good	Cw	Hw
	Medium	Cw	Hw
	Poor	Cw	Hw
2. CWH vh1, vh2	Good	Cw	Hw
	Medium	Cw	Hw
	Poor	Cw	Hw
3. CWH mm1, vm2, ws2	Good	Ba	Hw
	Medium	Ba	Hw
	Poor	Ba	Hw
4. MH mm1, mm2, wh, wh1	Good	Ba	Ba
	Medium	Ba	Ba
	Poor	Ba	Ba

Assumptions for regeneration of these stands are described in section 8.4.2. Table 48 provides the definition for growth rating for each reference species group.

Table 48: Definition of growth rating for each leading species group

Leading species	Rating	SI (TSG, TST)	SI (TSK)
Cedar	1 – Good	>24.0	>= 23.0
	2 – Medium	>=19.5 and <=24	> 21.0 and < 23.0
	3 – Poor	<19.5	<= 21.0
Douglas-fir	1 – Good	> 34.5	n/a
	2 – Medium	>30 and <=34.5	n/a
	3 – Poor	<=30	n/a
Hemlock	1 – Good	> 27.0	>= 24.5
	2 – Medium	>= 24.0 and <= 27.0	> 20.5 and < 24.5
	3 – Poor	< 24.0	<= 20.5
Balsam	1 – Good	> 28.0	>= 27.0
	2 – Medium	>=23.0 and <=28	>22.0 and < 27.0
	3 – Poor	<23.0	<= 22.0
Cypress	1 – Good	> 20.0	n/a
	2 – Medium	>15.0 and <=20	n/a
	3 – Poor	<=15.0	n/a

A good productivity rating indicates that a stand falls approximately within the top 25% of its reference species group when ranked by site index; medium stands fall within the middle 50% while the poor stands fall within the bottom 25%. The rating applies to the forest management land base of the Pacific TSA.

8.2.2.1 Management Eras (Managed Stands)

Stands established after 1965 are considered managed stands in this analysis. Their growth and yield will be modeled using Tree and Stand Simulator (TASS).

8.2.2.1.1 Era 1; Stands established between 1966 and 1978

Stands established between 1966 and 1978 are considered existing managed stands. While many of these stands were planted, their current species composition is often reflective of naturally regenerated stands. These stands will be considered naturally regenerated in growth and yield modelling.

8.2.2.1.2 Era 2; Stands established between 1979 and 2003

Stands established between 1979 and 2003 are also considered existing managed stands. These stands were generally regenerated through planting with seedlings of no genetic worth. These stands will be modeled as planted with ingress in growth and yield modelling.

In the TSK Business Area this ERA extends from 1979 to 2009.

8.2.2.1.3 Era 3; Stands established between 2004 and 2009

Stands established between 2004 and 2009 were generally regenerated through planting with seedlings of modest genetic worth (in TSG and TST). These stands will be modeled as planted with ingress in growth and yield modelling.

8.2.2.1.4 Era 4; Stands established after 2009

Stands established after 2009 and those that will be planted in the future are considered future managed stands. These stands are regenerated through planting with seedlings of significant genetic worth (in TSG and TST). These stands will be modeled as planted with ingress in growth and yield modelling.

8.2.3 Operational Adjustment Factors in Managed Stand Yields

The yield tables generated by the Tree and Stand Simulator (TASS) are based on the data observed and collected in research plots established by FLNRO and industry. Historically, this research has been carried out in fully stocked, even aged stands with no significant incidences of pests and diseases.

Operational adjustment factors (OAF) are usually applied to the TASS generated yields to reflect average operational growing conditions.

OAF 1 allows for yield reductions associated with non-productive areas in the stand, uneven spacing of crop trees (clumping), and endemic and random loss. The standard OAF1 of 15 % is considered a province-wide approximation of the difference between research plots and actual yields, and is composed of the following estimates:

- Espacement 4%
- Non-productive 4%
- Random risk 3%
- Endemic losses 4%

The standard OAF 1 of 15% will be applied to all yield curves generated by TASS.

OAF 2 allows for increasing volume losses towards maturity, attributable to decay, waste and breakage, disease and pest factors. The standard OAF2 of 5 % is also a province-wide approximation of the difference between research plot yields and actual yields. As this difference increases with age, the impact of OAF 2 also accelerates with age.

Existing and future managed Douglas fir stands are susceptible to root disease and resulting volume losses. As laminated and armillaria root diseases are common in the TSA, the stand volume losses due to these diseases are accounted for in managed stands through revised OAF 2 values. As per the regional pathologist’s recommendation, it would be reasonable to increase OAF 2 from 5% to 12.5% for all existing managed Douglas-fir stands and to 10.0% for all future managed Douglas fir stands in CWH xm1 and CWH xm2 subzones; however, there is no data to support an increased OAF 2 in other BEC variants.

An area weighted average OAF 2 was calculated for the BEC group consisting of CWH dm, CWH mm1, CWH xm, CWH xm1 and CWH xm2. A 6.8% OAF 2 will be applied to all existing managed stands and a 6.2% OAF 2 will be applied to all future managed stands in this BEC group. A standard OAF 2 of 5% will be applied in other BEC groups (Table 49).

Table 49: Operational adjustment factors, managed stands

BEC Group	OAF 1 (%)	OAF 2(%)	
		Existing Managed Stands	Future Managed Stands
CWH vm1	15.0	5.0	5.0
CWH dm, mm1, xm, xm1, xm2	15.0	6.8	6.2
CWH vh1, vh2	15.0	5.0	5.0
CWH mm1, vm2, ws2	15.0	5.0	5.0
MH mm1, mm2, wh, wh1	15.0	5.0	5.0

8.3 Natural Disturbance Assumptions

8.3.1 Non-Harvestable Land Base

This analysis assumed no natural disturbance within the NHLB.

8.3.2 Timber Harvesting Land Base, Non-Recoverable Losses

Non-recoverable losses provide an estimate of the average annual volume of timber damaged or killed within the THLB and not salvaged or accounted for by other factors. These losses result from natural events such as insects, diseases, wind, wildfires, etc.

Data from on-going and recently completed TSRs that cover the Pacific TSA area were combined and prorated to develop an estimate for non-recoverable losses (NRL). The values shown in Table 50 indicate the estimated annual volume that will not be salvaged. The estimate is for all sources summed up. Non-recoverable losses are removed from the harvest volume for each timber supply forecast.

Table 50: Annual non-recoverable losses

Neighbouring TSA	NRL within THLB (m^3/yr)	THLB area (ha)	Pacific TSA THLB (ha)	THLB Ratio	Pacific TSA NRL (m^3/yr)
Arrowsmith	9,105	58,613	28,342	48%	4,403
Kalum	5,000	80,820	10,618	13%	657
Kingcome	16,666	75,066	20,043	27%	4,450
Mid-Coast	20,102	124,605	3,835	3%	619
Strathcona	43,150	162,873	27,360	17%	7,249
Sunshine Coast	12,650	222,894	11,979	5%	680
Total					**18,057**

8.4 Silviculture

8.4.1 Silviculture Systems and Harvesting Systems

Clear cut with reserves is the most common silvicultural system in the Pacific TSA. Retention levels vary throughout the TSA and are highest in SMZs, EBM areas and Clayoquot Sound. Trees are retained to meet riparian or wildlife habitat objectives or higher level plan objectives.

Reductions to account for retention are applied through land base netdowns as described in section 5.1.

8.4.2 Regeneration activities in managed stands

Regeneration assumptions for existing managed stands and future managed sands were developed in cooperation with BCTS staff. The regeneration assumptions for managed stands reflect current practise and analysis of RESULTS data using the following approach:

1. Split the managed stands to Eras as described above in section 8.2.2.1.
2. Silviculture survey data and free-growing data were analyzed.
3. Era 1; stands regenerated between 1966 and 1978: averages were developed for total stems per ha for each analysis unit at free-growing. It is assumed that these total densities are reached within a period of 15 years after harvest. The total densities at free growing and corresponding species distributions are used as inputs for TASS. The assumed regeneration method for these stands is natural regeneration.
4. Era 2; stands regenerated between 1979 and 2003: averages were developed for well-spaced stems per ha from regeneration survey data and for total stems per ha from free-growing survey data.

   The well-spaced densities from regeneration survey data were increased by 10% to reflect mortality between planting and the survey. The well-spaced stems per ha were assumed to have a two-year regeneration delay. The resulting density and species distribution, and regeneration delay are used as inputs for TASS.

   The total densities at free growing (less the well-spaced densities) and corresponding species distributions are also used as inputs for TASS to reflect ingress. It is assumed that it takes 10 years for the ingress to gradually occupy these sites.
5. Era 3; Stands regenerated between 2004 and 2009: regeneration assumptions for these stands were derived using the same methodology as for the Era 2 stands described above with the exception of genetic gain which was incorporated in the modelling of the planted stock where applicable.
6. Era 4; Stands regenerated from 2010 and into the future: regeneration assumptions for these stands were derived using the same methodology as for the Era 3 stands described above. It was necessary to separate these stands from Era 3 stands due to the significant differences in the genetic worth of the available planting stock.

Note that for the TSK business area Era 2 and Era 3 were combined. No genetic gain was applied to any of the managed stands in TSK.

Table 51, Table 52, Table 53, Table 54, Table 55 and Table 56 present regeneration assumptions that will be used in the analysis for modelling the growth and yield of managed stands.

Table 51: Regeneration assumptions for plantations established between 1966 and 1978

AU	Location	BGC variant	SI Species	Growth Rating	SI	Species Comp	Free Growing Age (years)	OAF1	OAF2	Method	Total Density at Free Growing	Distribution
33	TSG, TST	CWHvm1	Hw	Good	28.1	Hw60Cw19Ba15Ss6	15	15	5	N	4,425	Clumpy
34	TSG, TST	CWHvm1	Hw	Medium	25.8	Hw55Cw20Ba20Ss5	15	15	5	N	4,300	Clumpy
35	TSG, TST	CWHvm1	Hw	Poor	21.3	Hw40Cw40Ba20	15	15	5	N	3,700	Clumpy
25	TSG, TST	CWHdm/mm/ xm1/xm2	Fd	Good	35.8	Fd45Hw40Cw15	15	15	6.8	N	3,000	Clumpy
26	TSG, TST	CWHdm/mm/ xm1/xm2	Fd	Medium	32.5	Fd45Hw40Cw15	15	15	6.8	N	3,000	Clumpy
27	TSG, TST	CWHdm/mm/ xm1/xm2	Fd	Poor	28.1	Fd45Hw40Cw15	15	15	6.8	N	3,000	Clumpy
31	TSG, TST	CWHvh1/vh2	Hw	Medium	26.4	Hw50Cw35Ba10Ss5	15	15	5	N	6,500	Clumpy
32	TSG, TST	CWHvh1/vh2	Hw	Poor	21.7	Hw50Cw35Ba10Ss5	15	15	5	N	6,000	Clumpy
28	TSG, TST	CWHmm2/vm2/ ws2	Hw	Good	28	Hw55Ba25Cw10Yc10	15	15	5	N	4,900	Clumpy
29	TSG, TST	CWHmm2/vm2/ ws2	Hw	Medium	25.4	Hw55Ba25Cw10Yc10	15	15	5	N	4,900	Clumpy
30	TSG, TST	CWHmm2/vm2/ ws2	Hw	Poor	21.3	Hw55Ba25Cw10Yc10	15	15	5	N	4,900	Clumpy
36	TSG, TST	MHmm1/mm2/ mmp/whp/wh1	Ba	Medium	23.7	Ba45Yc30Hw15Hm10	15	15	5	N	6,000	Clumpy
37	TSG, TST	MHmm1/mm2/ mmp/whp/wh1	Ba	Poor	16.2	Ba45Yc30Hw15Hm10	15	15	5	N	6,000	Clumpy
70	TSK	CWHvm1	Hw	Good	25.4	Hw60Cw19Ba15Ss6	15	15	5	N	4,868	Clumpy
71	TSK	CWHvm1	Hw	Medium	23.3	Hw55Cw20Ba20Ss5	15	15	5	N	4,730	Clumpy
69	TSK	CWHvh1/vh2	Hw	Good	26.3	Hw45Cw35Ba10Ss10	15	15	5	N	7,700	Clumpy
66	TSK	CWHmm2/vm2/ ws2	Hw	Good	24.7	Hw55Ba25Cw10Yc10	15	15	5	N	5,390	Clumpy
67	TSK	CWHmm2/vm2/ ws2	Hw	Medium	22.4	Hw55Ba25Cw10Yc10	15	15	5	N	5,390	Clumpy
68	TSK	CWHmm2/vm2/ ws2	Hw	Poor	19.6	Hw55Ba25Cw10Yc10	15	15	5	N	5,390	Clumpy

Genetic gain = 0

Table 52: Regeneration assumptions for plantations established between 1979 and 2003, TSG and TST

AU	BGC variant	SI Species	Growth Rating	SI	Species Composition	Regen Delay (years)	OAF 1	OAF 2	Method	Initial Density	Ingress Species Composition	Ingress Period (years)	Ingress Density (Total)	Distribution
47	CWHvm1	Cw	Good	26.2	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw83Ba17	10	3,170	Clumpy
48	CWHvm1	Cw	Medium	21.8	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw77Ba23	10	3,077	Clumpy
49	CWHvm1	Cw	Poor	18.7	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw71Ba29	10	2,072	Clumpy
38	CWHdm/mm/xm1/xm2	Fd	Good	36.3	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
39	CWHdm/mm/xm1/xm2	Fd	Medium	32.3	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
40	CWHdm/mm/xm1/xm2	Fd	Poor	27.8	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
44	CWHvh1/vh2	Cw	Good	24.1	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw55Ba13Cw32	10	5,568	Clumpy
45	CWHvh1/vh2	Cw	Medium	21.4	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw58Ba12Cw30	10	5,443	Clumpy
46	CWHvh1/vh2	Cw	Poor	17.1	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw59Ba12Cw29	10	4,968	Clumpy
41	CWHmm2/vm2/ws2	Ba	Good	28.5	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
42	CWHmm2/vm2/ws2	Ba	Medium	25.0	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
43	CWHmm2/vm2/ws2	Ba	Poor	21.3	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
50	MHmm1/mm2/mmp/whp/wh1	Ba	Medium	24.5	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy
51	MHmm1/mm2/mmp/whp/wh1	Ba	Poor	18.2	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy

Genetic Gain = 0

Table 53: Regeneration assumptions for plantations established between 1979 and 2009, TSK

AU	BGC subzone	SI Species	Growth Rating	SI	Species Composition	Regen Delay (years)	OAF1	OAF2	Method	Initial Density	Ingress Species Composition	Ingress Period (years)	Ingress Density (Total)	Distribution
77	CWHvm1	Cw	Good	23.3	Cw45Ba23Ss23Hw9	2	15	5	P	1,241	Hw86Ba14	10	2,958	Clumpy
78	CWHvm1	Cw	Medium	22.2	Cw45Ba23Ss23Hw9	2	15	5	P	1,241	Hw79Ba21	10	2,864	Clumpy
79	CWHvm1	Cw	Poor	20.5	Cw45Ba23Ss23Hw9	2	15	5	P	1,241	Hw74Ba26	10	1,859	Clumpy
75	CWHvh1/vh2	Cw	Good	24.0	Cw46Ss24Yc18Hw7Ba5	2	15	5	P	1,218	Hw54Ba11Cw34	10	5,658	Clumpy
76	CWHvh1/vh2	Cw	Medium	22.8	Cw46Ss24Yc18Hw7Ba5	2	15	5	P	1,218	Hw57Ba11Cw32	10	5,533	Clumpy
72	CWHmm2/vm2/ws2	Ba	Good	27.5	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,100	Hw75Ba25	10	3,470	Clumpy
73	CWHmm2/vm2/ws2	Ba	Medium	25.0	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,100	Hw75Ba25	10	3,470	Clumpy
74	CWHmm2/vm2/ws2	Ba	Poor	20.8	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,100	Hw75Ba25	10	3,470	Clumpy
80	MHmm1/mm2/mmp/whp/wh1	Ba	Medium	23.4	Ba75Hm25	2	15	5	P	990	Hm54Ba22Yc12Hw12	10	5,100	Clumpy
81	MHmm1/mm2/mmp/whp/wh1	Ba	Poor	21.2	Ba75Hm25	2	15	5	P	990	Hm54Ba22Yc12Hw12	10	5,100	Clumpy

Genetic Gain = 0

Table 54: Regeneration assumptions for plantations established between 2004 and 2009, TSG and TST

AU	BGC subzone	SI Species	Growth Rating	SI	Species Composition	Regen Delay (years)	OAF1	OAF 2	Method	Initial Density	Ingress Species Composition	Ingress Period (years)	Ingress Density (Total)	Distribution
61	CWHvm1	Cw	Good	26.1	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw83Ba17	10	3,170	Clumpy
62	CWHvm1	Cw	Medium	21.7	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw77Ba23	10	3,077	Clumpy
63	CWHvm1	Cw	Poor	18.2	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw71Ba29	10	2,072	Clumpy
52	CWHdm/mm/xm1/xm2	Fd	Good	35.5	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
53	CWHdm/mm/xm1/xm2	Fd	Medium	33.1	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
54	CWHdm/mm/xm1/xm2	Fd	Poor	28.2	Fdc70Cw25Hw5	2	15	6.8	P	1,071	Hw63Fd37	10	1,820	Clumpy
58	CWHvh1/vh2	Cw	Good	24.1	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw55Ba13Cw32	10	5,568	Clumpy
59	CWHvh1/vh2	Cw	Medium	21.4	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw58Ba12Cw30	10	5,443	Clumpy
60	CWHvh1/vh2	Cw	Poor	17.4	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw59Ba12Cw29	10	4,968	Clumpy
55	CWHmm2/vm2/ws2	Ba	Good	28.5	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
56	CWHmm2/vm2/ws2	Ba	Medium	24.8	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
57	CWHmm2/vm2/ws2	Ba	Poor	21.6	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
64	MHmm1/mm2/mmp/whp/wh1	Ba	Medium	23.8	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy
65	MHmm1/mm2/mmp/whp/wh1	Ba	Poor	18.8	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy

Genetic Gain (Planted Stock):

Genetic Gain (Planted Stock):	Cw	4.39 %
	Fd	8.65 %
	Hw	1.93 %
	Yc	2.29 %

Table 55: Regeneration assumptions for future managed stands, TSG and TST

AU	BGC subzone	SI Species	Growth Rating	SI	Species Composition	Regen Delay (years)	OAF 1	OAF 2	Method	Initial Density	Ingress Species Composition	Ingress Period (years)	Ingress Density (Total)	Distribution
10	CWHvm1	Cw	Good	26.2	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw83Ba17	10	3,170	Clumpy
11	CWHvm1	Cw	Medium	21.8	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw77Ba23	10	3,077	Clumpy
12	CWHvm1	Cw	Poor	18.5	Cw54Fdc17Ba14Hw11Ss4	2	15	5	P	1,080	Hw71Ba29	10	2,072	Clumpy
1	CWHdm/mm/xm1/xm2	Fd	Good	36.1	Fdc70Cw25Hw5	2	15	6.2	P	1,071	Hw63Fd37	10	1,820	Clumpy
2	CWHdm/mm/xm1/xm2	Fd	Medium	32.4	Fdc70Cw25Hw5	2	15	6.2	P	1,071	Hw63Fd37	10	1,820	Clumpy
3	CWHdm/mm/xm1/xm2	Fd	Poor	27.1	Fdc70Cw25Hw5	2	15	6.2	P	1,071	Hw63Fd37	10	1,820	Clumpy
7	CWHvh1/vh2	Cw	Good	24.1	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw55Ba13Cw32	10	5,568	Clumpy
8	CWHvh1/vh2	Cw	Medium	20.8	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw58Ba12Cw30	10	5,443	Clumpy
9	CWHvh1/vh2	Cw	Poor	17.7	Cw66Ss20Hw7Yc7	2	15	5	P	1,103	Hw59Ba12Cw29	10	4,968	Clumpy
4	CWHmm2/vm2/ws2	BA	Good	28.5	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
5	CWHmm2/vm2/ws2	BA	Medium	24.8	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
6	CWHmm2/vm2/ws2	BA	Poor	20.7	Yc45Cw23Ba21Hw11	2	15	5	P	1,057	Hw72Ba28	10	3,612	Clumpy
13	MHmm1/mm2/mmp/whp/wh1	BA	Medium	24.0	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy
14	MHmm1/mm2/mmp/whp/wh1	BA	Poor	16.9	Yc57Ba39Hm3Hw1	2	15	5	P	1,035	Hw20Ba52Yc28	10	4,487	Clumpy

Genetic Gain (Planted Stock):

Cw	13.47 %
Fd	11.90 %
Hw	11.66 %
Yc	4.35 %

Table 56: Regeneration assumptions for future managed stands, TSK

AU	BGC subzone	SI Species	Growth Rating	SI	Species Composition	Regen Delay (years)	OAF 1	OAF 2	Method	Initial Density	Ingress Species Composition	Ingress Period (years)	Ingress Density (Total)	Distribution
20	CWHvm1	Cw	Good	23.8	Cw45Ba23Ss23Hw9	2	15	5	P	1,080	Hw86Ba14	10	2,958	Clumpy
21	CWHvm1	Cw	Medium	22.2	Cw45Ba23Ss23Hw9	2	15	5	P	1,080	Hw79Ba21	10	2,864	Clumpy
22	CWHvm1	Cw	Poor	20.5	Cw45Ba23Ss23Hw9	2	15	5	P	1,080	Hw74Ba26	10	1,859	Clumpy
18	CWHvh1/vh2	Cw	Good	23.8	Cw46Ss24Yc18Hw7Ba5	2	15	5	P	1,071	Hw54Ba11Cw34	10	5,658	Clumpy
19	CWHvh1/vh2	Cw	Medium	22.3	Cw46Ss24Yc18Hw7Ba5	2	15	5	P	1,071	Hw57Ba11Cw32	10	5,533	Clumpy
15	CWHmm2/vm2/ws2	Ba	Good	27.5	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,103	Hw75Ba25	10	3,470	Clumpy
16	CWHmm2/vm2/ws2	Ba	Medium	24.3	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,103	Hw75Ba25	10	3,470	Clumpy
17	CWHmm2/vm2/ws2	Ba	Poor	20.9	Ba38Cw37Ss15Hw8Hm2	2	15	5	P	1,103	Hw75Ba25	10	3,470	Clumpy
23	MHmm1/mm2/mmp/whp/wh1	Ba	Medium	23.7	Ba75Hm25	2	15	5	P	1,057	Hm54Ba22Yc12Hw12	10	5,100	Clumpy
24	MHmm1/mm2/mmp/whp/wh1	Ba	Poor	15.8	Ba75Hm25	2	15	5	P	1,057	Hm54Ba22Yc12Hw12	10	5,100	Clumpy

Genetic Gain = 0

8.4.3 Genetic Gain

Where available, class A seed from seed orchards is used for regeneration due to its advanced volume production. Genetic gain was applied to the yield curves of some existing and future managed stands in TSG and TST. No genetic gain was applied in TSK.

RESULTS data were used to calculate the proportion of trees planted from genetically improved seed (class A) for those existing managed stands established between years 2004 and 2009. No genetic gain was applied to older existing managed stands. The genetic gain for each seedlot was used to estimate the weighted average genetic worth for each species. These are shown in Table 57.

Table 57: Genetic gain for existing managed stands established between 2004 and 2009

Species	Weighted Average Genetic Gain of Seedlots Used	Percent Planted with Class A Seed	Genetic gain used in analysis
Cw	5.26	83.34	4.39
Fd	8.97	96.47	8.65
Hw	4.31	44.76	1.93
Yc	9.07	25.27	2.29

The same approach was used to estimate the genetic gain for future managed stands. The genetic gain data and planting information from the last 10 years was assumed to predict future genetic gains. The genetic gains applied in the analysis to future managed stands are shown in Table 58.

Table 58: Genetic gain for future managed stands (2010 forward)

Species	Weighted Average Genetic Gain of Seedlots Used	Percent Planted with Class A Seed	Genetic gain used in analysis
Cw	15.39	87.51	13.47
Fd	11.93	99.75	11.90
Hw	12.35	94.40	11.66
Yc	19.19	22.69	4.35

8.4.4 Not satisfactorily restocked (NSR) areas

In this analysis all NSR is considered current. It is assumed to regenerate within the regeneration delay detailed under section 8.4.2.

8.4.5 Fertilized, Pruned and Spaced Areas

No allowance will be made in the yield curves to account for past or future incremental silviculture.

9 List of Acronyms

Acronym	Description
AAC	Annual Allowable Cut
BCGW	BC Geographic Warehouse
BCLCS	BC Land Classification System
BCTS	BC Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
BMTA	Biodiversity, Mining, and Tourism Area
CDC	Conservation Data Centre
CFLB	Crown Forested Land Base
CNCO	Central and North Coast Order (EBM)
DBH	Diameter at Breast Height
DCR	Campbell River Natural Resource District
DIB	Diameter inside bark
DKM	Coast Mountains Natural Resource District
DNI	North Island Central Coast Natural Resource District
DRS	Draft Recovery Strategy for Northern Goshawk
DSC	Sunshine Coast Natural Resource District
DSI	South Island Natural Resource District
EBM	Ecosystem Based Management
ECA	Equivalent Clearcut Area
ESA	Environmentally Sensitive Area
EXLB	Excluded Land Base
FAIB	Forest Analysis and Inventory Branch, Ministry of Forests, Lands, and Natural Resource Operations
FC1	Former Forest Cover Inventory Standard
FESL	Forest Ecosystem Solutions Ltd.
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
FMLB	Forest Management Land Base
FPPR	Forest Planning and Practices Regulation
FRPA	Forests and Range Practices Act
FSOS	Forest Simulation and Optimization System (model used for analysis)
FSW	Fisheries Sensitive Watershed
GAR	Government Action Regulation
GBRO	Great Bear Rainforest Order (EBM)
GIS	Geographic Information Systems
HVFH	High Value Fish Habitat
IRM	Integrated Resource Management
LRMP	Land and Resource Management Plan
LU	Landscape Unit
LUOCS	Landscape Unit Order Clayoquot Sound
MOE	Ministry of Environment
MSYT	Managed Stand Yield Table

Acronym	Description
NCBR	Non-Commercial Brush
NHLB	Non-Harvesting Land Base
NHVFH	Non-High Value Fish Habitat
NRL	Non-recoverable Losses
NSR	Not Sufficiently Restocked
NTA	No Typing Available
NSYT	Natural Stand Yield Table
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
PEM	Predictive Ecosystem Mapping
PSP	Permanent Sample Plot
RMA	Riparian Management Area
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
SCCO	South Central Coast Order (EBM)
SIBEC	Site Index by BEC Site Series
SMZ	Special Management Zone
SRMP	Sustainable Resource Management Plan
SSG	Site Series Grouping
TASS	Tree and Stand Simulator
TEM	Terrestrial Ecosystem Mapping
TFL	Tree Farm License
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation for Stand Yields
TSA	Timber Supply Area or Timber Supply Analysis
TSG	BCTS Strait of Georgia Business Area
TSK	BCTS Skeena Business Area
TSR	Timber Supply Review
TST	BCTS Seaward/Tlasta Business Area
UWR	Ungulate Winter Range
VAC	Visual Absorption Capability
VDYP	Variable Density Yield Projection
VEG	Visually Effective Green-up
VILUP	Vancouver Island Land Use Plan
VRI	Vegetation Resource Inventory
VQO	Visual Quality Objective
WHA	Wildlife Habitat Area
WTRA	Wildlife Tree Retention Area

10 References

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Appendix 1 – Yield Tables

In the following tables, the column headings are the analysis unit numbers.

Table 59: Managed Stands Established between 1966 and 1978

Age	25	26	27	28	29	30	31	32	33	34	35	36	37	66	67	68	69	70	71
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	36.2	21.7	9.9	22.8	11	1.1	24	5.7	28.5	17.1	8.7	4.7	2.7	15.8	5.7	0.7	24.3	18.3	8.5
40	146.1	114.4	84.2	133.4	100.1	48.2	135.5	79.4	148	114.7	64.4	85.2	42.3	115	81.4	41	152.3	118.8	92.5
50	273.2	218.7	170.7	263.8	210.8	128.1	270.6	184	287.9	234.3	151.8	192.5	119.9	233.7	181.6	114.2	297.1	240	199.6
60	402.5	326.1	256.7	390.7	324	211.4	400.2	292.9	422.3	352.9	242	303.1	203.8	352.3	286.1	191.5	435	361.3	310.7
70	525.9	427.8	338.5	506.9	427.4	294.3	519.9	398.1	549.9	463.6	332.5	404.9	286	461.1	385.2	268.4	558.9	473.2	416.8
80	635.6	522.1	414.2	614	519.9	370.6	632.8	493.3	671.6	566.3	417.6	495.9	362.6	561.3	472.7	340.3	674.6	581.5	512.2
90	732.6	608.1	484.3	719.5	611.6	438.9	736.5	581	783	662.9	500.3	581.3	435.2	654.1	555.2	405.4	782	684.4	602.7
100	818.7	679.4	550.2	818.6	697.1	503.3	832.7	658.2	889.4	760.9	579.9	661.6	501.8	743.8	633	465.7	884.2	780.9	690.3
110	886.9	749.2	610.2	911.6	779.6	563.9	929.2	734.4	988.4	844.9	652.7	740.3	566.6	830.5	708	524.5	969.9	865.4	772.7
120	949.8	807.7	666.2	1005.2	856.3	624.3	1016.6	801	1079.9	924.3	721.1	811.3	626.7	911.6	780	580.6	1058.7	949.4	850.1
130	1009.3	861.1	714.3	1083.8	930	683.7	1090	862.9	1161.5	999.4	783.1	884.1	684.4	991.3	849.2	633.4	1138.3	1026	922.4
140	1056.3	904.9	758.3	1159.8	1008.3	740.5	1154.2	918.3	1238.9	1074.1	848	952.4	741.1	1064.4	910.8	685.3	1205.8	1100.3	986.4
150	1091.8	949.7	800.8	1226.1	1073.6	795.7	1217.5	974	1306.7	1141.2	908	1018.3	791.7	1130.8	973.9	737.6	1262.4	1161.3	1052.4
160	1130.3	984.3	840	1287.1	1134.5	846.1	1277	1029	1368.5	1194.9	961.4	1076.3	839.9	1193.1	1034.3	787.1	1321.2	1221.2	1112
170	1165.8	1018.7	870.5	1342.9	1186.3	892.1	1327.4	1075.2	1416.7	1252.2	1012.5	1132.1	888	1247	1091	830.4	1372	1278.7	1167.4
180	1201.5	1043.1	899.3	1390.9	1234.2	940.7	1369.7	1115.3	1468.5	1305	1058.9	1177.3	933	1298.4	1143.4	872	1424.6	1327.5	1215.5
190	1234.1	1067.5	927.1	1439.7	1281.6	987.7	1412.9	1158.9	1512.4	1351.7	1102.2	1225.5	973.1	1343.8	1192.3	914.9	1468.3	1375	1262.6
200	1251.1	1090.5	953.7	1485.4	1327.4	1029.9	1456.6	1201.7	1555.9	1394.2	1138.6	1271.2	1009.7	1386.4	1232.7	952.6	1512.2	1417.8	1307.4
210	1268.7	1109.7	971.3	1527.5	1371.4	1067	1486.1	1235.7	1593.1	1432.2	1174.7	1313.5	1046.7	1433.9	1272.8	991.4	1542.8	1459.3	1345.9
220	1281.2	1127.4	991.3	1563.4	1408	1105.8	1521.3	1271.7	1630.1	1467.3	1211.2	1344.6	1079	1468.4	1310.8	1028.7	1577.3	1490.8	1380.6
230	1286	1145.6	1011.2	1600.4	1445.3	1142.2	1553.7	1303.1	1663.8	1499.5	1246	1381.3	1110.5	1505.7	1344.4	1059.7	1612.3	1522.1	1417.7
240	1304.3	1162.3	1025.1	1633.1	1480	1176.8	1585.6	1332.7	1698	1533.5	1276.1	1417.9	1146	1540.9	1376.2	1092.9	1639.4	1554.9	1448.3
250	1320.9	1176.5	1040.4	1666.4	1512.9	1206.1	1615.3	1361.4	1729.5	1563.7	1308.3	1454.3	1177.5	1573.5	1410.3	1120.8	1667.7	1587.4	1480.8

Table 60: Managed Stands established between 1979 and 2003 in TSG and TST

Age	38	39	40	41	42	43	44	45	46	47	48	49	50	51
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	92.2	65.7	36	0.1	0.1	0	4.8	0.5	0.5	18.1	2.6	3.5	0	0
30	240.8	190.8	135.2	63.8	60.7	33.2	114.2	74.9	31.9	137.7	81.2	50	24.5	37.3
40	386.3	305.2	223.8	180	158.3	114.6	241.8	170.1	144.5	263.6	184.1	144.8	116	111.4
50	529.9	414.1	301.7	303.7	265.4	201.9	377.4	275.4	263.6	390.6	292.6	237.1	212.8	189.2
60	660.9	516.2	373.8	419.7	369.6	291.7	504	376.8	379.1	508.9	395.4	326.5	309.5	269.8
70	773.7	608.2	438.2	526.3	464.5	375.1	619.9	470.2	482.1	616.7	488.5	406.3	397.6	344.5
80	854.6	687.7	496.5	625.6	549.7	450.3	729.3	555.4	580.6	718.2	573.9	481.9	477.8	414.7
90	918.9	752.4	548.7	723	633.1	520.2	830.7	634.5	675.4	813.3	656.9	551.2	556.5	478.6
100	965.5	806.2	595.1	817	711.2	587.5	927.6	707.7	765.5	906.1	733.2	616.7	633	539.8
110	1018.1	840.4	635.8	908.4	785	653.3	1018.6	778.1	849.2	994.9	807.3	678.9	706.6	594.8
120	1059.9	871.9	668.8	997.4	860.6	715.9	1091.4	846.2	927.8	1071.8	878.7	736.5	772.8	650.3
130	1101	899.4	696.7	1075.6	928.8	778.9	1162.6	909.2	999.3	1145.4	942.4	791.3	839.7	702.6
140	1131.9	913.9	720.1	1146.2	994.4	838.5	1226.7	967.8	1068.3	1215.5	1000.8	839.5	904.7	751.1
150	1166	939.5	742.8	1211.1	1057.2	894.8	1281	1018.4	1130	1274.2	1056.1	885.2	965.7	799
160	1187.7	963.9	756.5	1269.2	1111.5	946.1	1332.6	1067.2	1188.1	1328.4	1106	922.4	1025.3	844.2
170	1207	983.4	766.1	1320.4	1162.5	996.7	1384.1	1113.3	1235.2	1378.7	1150.4	961.9	1073.8	888.3
180	1234.7	1002.4	775.2	1371	1212.4	1045	1429.6	1154.8	1282.7	1423.8	1194.2	999.3	1121	927.8
190	1254	1012.8	781.5	1416.4	1257.2	1084.9	1472.6	1194.4	1324.2	1461.3	1232.6	1034	1168.6	964.3
200	1268.3	1023.2	789.8	1453.5	1295.2	1127.3	1506.5	1228	1359.4	1497.1	1271.7	1062.8	1207.4	1000
210	1282.6	1027.4	796.3	1493.9	1333.3	1165.8	1541.6	1262.6	1393.7	1533.7	1306.5	1089.6	1242.9	1030.9
220	1298.4	1031.3	801.2	1535.4	1372.3	1202.9	1575.1	1296.3	1428.4	1573.5	1339.2	1113.2	1273.8	1066.5
230	1313.4	1038.1	800.6	1571.4	1406	1238.1	1608.8	1325.8	1453.4	1610.9	1368.2	1139.5	1310.5	1100.8
240	1319.3	1048	801.3	1607.5	1437.2	1269.3	1639.4	1352.5	1479.3	1646.5	1388.5	1156.3	1340.9	1132.8
250	1333	1050.4	803.9	1638.6	1467.6	1301.7	1667.9	1378.9	1509.9	1674.8	1414.6	1176.1	1370.3	1161.7

Table 61: Managed stands established between 1979 and 2009 in TSK

Age	72	73	74	75	76	77	78	79	80	81
10	0	0	0	0	0	0	0	0	0	0
20	15.1	5.3	0.1	3.9	2	1.3	0.4	0.1	1	0.1
30	122.6	91.7	40.1	111.3	97.4	98.5	85.6	66.2	62.3	40.5
40	245.7	194.3	109.9	234.1	216.3	198.8	184.4	160	148	111.9
50	373	303.8	186.2	363.1	341.8	307.9	291.8	256.1	246.5	194.4
60	489.4	407.2	263.7	484.8	460	411	394	350.4	343	278.4
70	596.8	500.6	337.5	595.2	568.6	505.8	486.4	435.6	432.7	357.8
80	696.5	588.7	405.2	698.4	669.1	593.4	572.7	515.3	514.4	430.7
90	789.2	669.4	468.7	795.6	765.3	674.7	654.1	589.3	591.9	498.2
100	874.7	745.7	526.4	883.5	852.6	753.2	731.6	659.9	663.5	560.2
110	954	817.7	581.8	967.9	934.3	826.2	805.3	729.3	731	619.2
120	1023.7	887	635.4	1046.6	1008	898.1	877.3	794.1	796.5	676.6
130	1097.3	948.9	686	1120.1	1076.6	966.4	944.6	852.2	855.1	728.5
140	1163.8	1008	732.5	1186	1139	1029.7	1008.9	909.4	915.6	782.3
150	1222.7	1065.7	777.7	1242.6	1191.7	1091	1065.7	964.2	970.8	833.8
160	1276.3	1119.4	820.3	1300.4	1245.8	1147.6	1121.5	1015.2	1023.6	878.3
170	1326.8	1167.5	862.8	1351.4	1290.7	1197.5	1172.2	1064	1076.7	923.7
180	1371.1	1211.2	905	1395.8	1333.3	1246.7	1218.9	1108.9	1124.6	968.8
190	1415.8	1252.4	941.6	1429.5	1373.1	1290.5	1261.2	1152.5	1167.1	1010.8
200	1459.9	1293.6	977.2	1459.6	1410.8	1331.7	1302.4	1190	1207.7	1052
210	1496.2	1332.8	1008.7	1491.2	1441.9	1370.2	1340.1	1227.3	1245.5	1086.6
220	1529.3	1368.4	1041.2	1525.1	1477.8	1409.7	1380.6	1262.3	1275.3	1123.9
230	1560.5	1398.1	1073.5	1558.4	1503.4	1446.6	1416.6	1298.3	1310.5	1156.8
240	1590.4	1429.8	1103.7	1587.1	1530	1483.2	1451.1	1328.6	1344.8	1186
250	1617.3	1460.7	1131.5	1614.3	1556.5	1516.1	1482.5	1359.4	1374.2	1214.8

Table 62: Managed stands established between 2004 and 2009 in TSG and TST

Age	52	53	54	55	56	57	58	59	60	61	62	63	64	65
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	85.2	70	37.6	0	0.1	0	4.7	0.6	0.6	17.4	3	2.3	0	0
30	227.7	199.3	138.1	58	58.1	14.7	113.3	76.9	34.5	136.4	81.9	42.4	50.6	51.5
40	363.8	319	228.5	174.7	154	92.3	237.7	174.6	147.9	260.9	184.6	128.5	137.7	124.5
50	497.4	433.5	308.1	299.6	259.3	177.8	370.6	281.5	268.5	386.7	291.5	212.6	233.7	201.2
60	620.1	541.5	381.8	416.7	362.3	263.6	497.2	385.4	385.7	502.7	392.8	295.4	330.1	281.7
70	727.8	639.5	449	522.7	454.5	345	611.4	482	490.6	607.3	485.8	371.4	417.1	355.3
80	816.5	718.8	509.9	621.6	538.9	417.1	715.7	570.2	589	705.5	570.8	439.3	496.8	423.5
90	874	784.6	564.3	720	620.6	483.9	814.3	653.2	683.2	801.4	650.3	503.2	572.5	487.3
100	923.7	833.5	612.1	814.5	698.2	548.3	907.4	730.3	774.7	892.6	726.9	566	646.3	543.8
110	953.8	871.2	653.2	903.2	773.5	611.6	992.6	802.8	858.9	978.2	799.1	622.3	716.6	598.7
120	1000.4	904	685.1	986.2	845.8	670.7	1071.8	872.9	937.7	1057.4	867.7	675.9	784.8	651.2
130	1045.1	923.7	712.8	1066.7	915.4	727	1141.3	936.1	1011.3	1126.2	931.6	726.8	847.4	699.1
140	1086.3	950.2	740.1	1138.2	981.3	785.6	1206.2	995.3	1072.1	1193.1	989.4	773.8	909.6	744
150	1116.6	972.2	759.9	1199.3	1042.5	840.5	1264.2	1051.6	1131.2	1252.3	1041.6	817	964.2	789.4
160	1141.2	997.1	770.6	1254.2	1100.1	894.5	1319.3	1100.8	1188	1306.2	1091.3	857.4	1017.7	832.6
170	1163.4	1014.4	784.4	1306.8	1149.2	944.1	1366.6	1147.5	1238.8	1356.8	1138	893.8	1070.2	873.9
180	1184.8	1034.8	796.5	1354.6	1200.4	990.6	1411.7	1188.9	1283.5	1405.3	1177.4	927.5	1117.6	911.9
190	1195.9	1053.5	806.8	1401.3	1239.5	1035.3	1452.1	1227.2	1329.7	1443.3	1215.9	957	1159.2	948.5
200	1198.9	1065.9	815	1445.2	1283	1078.2	1486.8	1259.4	1362.6	1478.2	1250.5	987.4	1196.3	984.4
210	1214.3	1081.3	823.4	1489.1	1319.4	1116.4	1521	1291.2	1397.8	1514.4	1282.7	1016.4	1236.4	1017.6
220	1231.3	1096.4	825.1	1529.6	1357.6	1151.6	1557.1	1322.1	1431	1555	1311	1042.6	1276.4	1054.9
230	1241.2	1107.9	829.9	1566.6	1395.5	1185.3	1590	1356.5	1465.7	1586.9	1339.8	1065.8	1307.9	1090.5
240	1245.1	1117.6	833.3	1603.2	1428.1	1216.8	1615.8	1385.2	1498.5	1623.1	1365.6	1087.9	1342.9	1125.4
250	1255.5	1119.5	836	1636.8	1455.9	1244.6	1645.1	1411.8	1528.9	1654.4	1390.3	1110.6	1375	1156

Table 63: Future managed stands in TSG and TST

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	90.6	65.9	31.3	0.1	0.1	0	4.9	0.3	0.1	18.1	2.3	3.1	0	0
30	239	191.6	127.5	68	58.4	28	113	66.3	28	136.5	82.3	47.5	33.8	17
40	382.7	307.2	213.5	184	156.8	106.5	235.9	153.7	116.8	261.4	185.5	137.2	121.4	78.7
50	524.6	419.2	288.4	309.5	263.6	187.8	368	250.2	212.3	386.7	293.6	226.5	215.8	142.2
60	655	523.7	358	427.3	366.9	272.3	491.5	345.4	308.4	503.4	394.1	314.7	311.8	207.5
70	765.6	618.9	422	534.1	460.5	350.6	604	433.2	397.4	608	486	394.2	398.5	271.4
80	853.5	700.5	480	635.9	546.6	421.7	708.3	514.6	477.3	707.8	571.6	469.2	479.5	330.4
90	911.7	766.6	531.1	732.3	628.1	489.1	808.7	589.2	553.7	803.2	652.8	539.7	556	385.7
100	957.5	819.5	577.5	829	705.6	551.3	902.5	658.5	623.2	895	728.3	609	627.9	437.2
110	998.3	854.3	617.7	917.4	784	611.2	989.2	724.3	688.8	981.4	799.8	670.2	697	485
120	1049.1	892.2	653.1	1005.3	858.8	668.4	1063.4	784	754.4	1061.3	865.4	729.7	763.3	531
130	1087.5	922.9	681.8	1080.4	926.9	724	1135.9	842.7	815.9	1127.1	931.2	784.8	834.2	574.1
140	1123.9	949	706.9	1151.3	994.8	779.7	1201	898.8	874.9	1191.9	990.1	833.9	899.7	616.1
150	1158.4	972.3	729.1	1215.4	1055.9	832.6	1261	953.7	929.9	1253.1	1042.9	880.8	955.2	656.3
160	1189.7	1003.6	749.9	1271.2	1110.6	882.2	1318.1	1004.8	982.3	1303.8	1094.6	923.4	1008.1	695.2
170	1215.5	1024.1	764.5	1326.3	1162.6	932.5	1362.8	1050.5	1031.1	1354.9	1141.4	958.8	1060.1	731.5
180	1241.1	1035.7	774.4	1373.9	1210.7	977.1	1408.9	1092.7	1074.7	1400.8	1180.2	995.5	1109.4	765.9
190	1256.2	1049.4	784.3	1425.2	1257.6	1019.7	1447.2	1130.2	1114.7	1434.8	1214.9	1026.7	1152.3	797.7
200	1274	1057	793.2	1466.2	1300.2	1061	1477.9	1166.5	1152.3	1468.4	1248.7	1053.7	1191.4	829
210	1285.3	1067.3	800.7	1504.2	1342.1	1097.6	1510.3	1198.8	1188.2	1503.1	1281.6	1077.8	1230.2	857.2
220	1298.2	1077.7	808.3	1539	1382.1	1131.9	1546.5	1234.4	1221.5	1543.3	1315.7	1106.6	1268.1	888
230	1311.6	1090.6	815.5	1579.8	1418	1164	1576.7	1265.5	1255.3	1578.7	1346.5	1131	1305.3	916.1
240	1327.8	1095.9	818.5	1607.8	1451	1194.4	1603.9	1295.7	1285.2	1615.6	1370.5	1155.1	1335.4	944.6
250	1337.4	1093.2	820.9	1638	1482	1224.6	1630.8	1323.4	1314.3	1648.8	1392.8	1178.3	1363	971.8

Table 64: Future managed stands in TSK

Age	15	16	17	18	19	20	21	22	23	24
10	0	0	0	0	0	0	0	0	0	0
20	15.2	3.6	0.1	2.9	1	1.9	0.4	0.1	1.2	0
30	122.6	84	41.3	107.9	90.9	104.9	85.1	67.2	65.2	3.1
40	246.6	181.2	113.4	226.6	202.8	208.3	183.9	162.2	151.9	36.5
50	373.4	286.2	191.2	353.2	322.9	320.3	290.3	260.3	247.8	83.5
60	491.8	387.7	271.7	472.7	436.3	425.8	392	356.9	342.8	132.8
70	600.6	479.8	348.2	581.3	539.2	521.4	484.1	445.4	430.5	182.5
80	700.1	566	417.9	684	637	610.9	569.3	525.8	511.7	231
90	789.4	645.4	482.5	780.1	725.9	695.6	649.6	602.5	587.6	276.9
100	877	719.3	543.6	871.3	807.6	777.3	728	675.6	659.5	320.2
110	959.5	788.8	600.5	958.2	887.8	853.7	797.2	747.7	724.7	360.4
120	1037.9	854.6	654.6	1034.9	964.4	925.6	869.3	815.5	788.2	398.9
130	1106	916.9	705.7	1101.1	1031.2	997.5	936.8	877	847.9	435.7
140	1171.5	980.5	754.5	1163.9	1089.2	1065.2	1000.3	935.5	904.1	470.3
150	1229.1	1036.2	804	1222.1	1144.7	1128.9	1057.4	991.5	957.9	501.5
160	1281.7	1090	849.6	1273.6	1197	1188.6	1110.6	1044.2	1010.3	533.3
170	1334.1	1142.7	893.5	1322.7	1243	1236.3	1160	1091.9	1061.1	563
180	1383.7	1188.4	934.7	1368.8	1285.4	1282.5	1208.6	1136.1	1101	591
190	1428.8	1230	977	1406.1	1323.5	1326.6	1253.3	1178.9	1144.4	618.3
200	1466.3	1269.8	1014.2	1444.1	1359.7	1366.7	1294.5	1216	1178.1	645.5
210	1507.6	1306	1049.2	1476.8	1394.8	1404.1	1330.3	1254.3	1214.1	672.7
220	1543.8	1340.3	1080.6	1514.7	1428.1	1446.6	1370.5	1289.8	1250.2	696.8
230	1572.2	1369	1112.2	1548.6	1459.5	1486.6	1407.1	1325.5	1282.9	720.6
240	1602.7	1400.6	1142.8	1581.3	1490.3	1520.9	1439.8	1357.3	1314.4	744.9
250	1632.8	1430	1174	1610.7	1515.9	1555.1	1471	1381	1345.8	765.4

There are over 1000 natural analysis units used in this project, only a subset are given here as examples. See Section 8.2.1 for the clustering methodology and naming conventions for natural stands.

Table 65: Natural Analysis Unit Examples

AU#	AU Name
894	NA_TSG_>=50_Fd/Hw_M_4_util_12.5
426	NA_TSG_<50_Hw/Other_M_3_util_17.5
816	NA_TSG_>=70_Fd/Other_M_3_util_12.5
321	NA_TSG_>=50_Hw/Other_M_3_util_17.5
830	NA_TSG_>=70_Fd/Hw_M_4_util_12.5
893	NA_TSG_>=50_Fd/Hw_M_3_util_12.5
918	NA_TSG_>=50_Hw/Other_H_1_util_12.5
829	NA_TSG_>=70_Fd/Hw_M_3_util_12.5
320	NA_TSG_>=50_Hw/Other_M_2_util_17.5
828	NA_TSG_>=70_Fd/Hw_M_2_util_12.5
306	NA_TSG_>=50_Hw/Ba_M_3_util_17.5
817	NA_TSG_>=70_Fd/Other_M_4_util_12.5
821	NA_TSG_>=70_Fd/Other_H_4_util_12.5
427	NA_TSG_<50_Hw/Other_M_4_util_17.5
305	NA_TSG_>=50_Hw/Ba_M_2_util_17.5
1047	NA_TST_>=70_Hw/Ba_H_3_util_12.5
1024	NA_TST_>=70_Cw/Hw_H_2_util_12.5
1045	NA_TST_>=70_Hw/Ba_H_1_util_12.5
1041	NA_TST_>=70_Hw/Ba_M_1_util_12.5
691	NA_TST_>=50_Cw/Hw_M_4_util_17.5
682	NA_TST_>=50_Cw/Other_M_3_util_17.5
690	NA_TST_>=50_Cw/Hw_M_3_util_17.5
611	NA_TST_>=70_Cw/Hw_M_3_util_17.5

AU#	AU Name
1054	NA_TST_>=70_Hw/Other_M_2_util_12.5
1021	NA_TST_>=70_Cw/Hw_M_2_util_12.5
731	NA_TST_>=50_Hw/Other_M_3_util_17.5
1046	NA_TST_>=70_Hw/Ba_H_2_util_12.5
1055	NA_TST_>=70_Hw/Other_M_3_util_12.5
720	NA_TST_>=50_Hw/Ba_M_3_util_17.5
1059	NA_TST_>=70_Hw/Other_H_3_util_12.5
523	NA_TSK_>=50_Hw/Ba_H_2_util_17.5
524	NA_TSK_>=50_Hw/Ba_H_3_util_17.5
522	NA_TSK_>=50_Hw/Ba_H_1_util_17.5
533	NA_TSK_>=50_Hw/Other_H_1_util_17.5
534	NA_TSK_>=50_Hw/Other_H_2_util_17.5
509	NA_TSK_>=50_Cw/Hw_H_1_util_17.5
506	NA_TSK_>=50_Cw/Hw_M_3_util_17.5
456	NA_TSK_>=70_Hw/Ba_H_2_util_17.5
505	NA_TSK_>=50_Cw/Hw_M_2_util_17.5
529	NA_TSK_>=50_Hw/Other_M_2_util_17.5
531	NA_TSK_>=50_Hw/Other_M_4_util_17.5
444	NA_TSK_>=70_Cw/Hw_M_4_util_17.5
447	NA_TSK_>=70_Cw/Hw_H_2_util_17.5
442	NA_TSK_>=70_Cw/Hw_M_2_util_17.5
511	NA_TSK_>=50_Cw/Hw_H_3_util_17.5

Table 66: Yield Tables for Natural Analysis Units in TSG

Age	305	306	320	321	426	427	816	817	821	828	829	830	893	894	918
10	0.00	0.00	10.60	3.39	0.00	11.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	15.74	3.92	0.16	19.15	1.51	5.79	36.81	0.49	1.84	8.97	0.58	5.96	0.19
30	0.05	0.06	21.10	5.90	1.14	31.35	63.50	84.16	174.15	50.47	74.73	99.02	70.47	96.88	44.14
40	18.75	30.39	45.16	33.30	31.05	80.63	145.68	187.47	334.20	122.33	169.73	220.23	158.25	207.56	104.83
50	63.41	86.00	84.15	81.40	87.03	152.55	226.72	288.67	488.26	195.37	265.18	338.03	241.51	314.11	172.98
60	124.28	161.15	132.61	143.23	157.96	239.73	305.18	384.87	640.47	266.35	354.83	451.21	319.55	413.12	243.45
70	195.84	244.23	184.91	211.77	232.81	328.12	380.44	474.22	778.70	333.00	437.26	554.57	391.13	499.93	312.21
80	269.36	325.44	235.76	280.23	304.23	410.87	453.52	559.05	906.01	398.67	509.55	648.36	456.69	576.98	377.06
90	339.13	399.78	282.67	344.75	369.30	485.45	519.92	639.43	1014.85	459.06	580.62	732.78	515.16	648.03	436.57
100	410.41	506.30	324.69	403.69	430.53	551.79	579.85	714.01	1111.24	514.32	647.93	810.91	565.70	709.82	491.49
110	467.76	569.81	361.85	456.69	482.82	610.30	633.85	780.57	1179.40	564.63	709.84	882.33	607.73	762.32	542.00
120	518.30	625.23	394.64	503.90	529.24	661.55	680.13	838.91	1230.54	609.97	765.19	945.50	644.08	807.17	588.84
130	562.62	673.57	423.47	553.82	570.40	706.65	720.54	889.21	1275.77	649.47	810.37	995.96	675.50	845.83	631.27
140	601.35	715.72	449.89	591.60	606.70	746.38	755.76	928.95	1315.57	684.49	849.63	1033.17	702.65	878.63	668.95
150	630.77	747.29	469.93	619.95	634.66	776.46	782.89	958.91	1346.32	711.86	880.05	1059.69	722.89	902.52	697.76
160	650.20	767.69	482.95	638.53	653.26	796.61	801.97	979.68	1366.99	731.99	900.87	1076.44	736.12	916.53	716.59
170	662.72	780.35	491.13	650.21	665.32	809.57	816.11	994.46	1380.53	747.73	915.65	1087.51	744.94	925.47	729.00
180	670.38	787.66	495.73	657.00	672.96	816.69	826.74	1005.44	1389.12	759.58	926.74	1094.86	750.32	931.03	736.66
190	674.71	791.23	497.64	660.51	677.32	820.58	834.80	1013.06	1394.28	768.53	934.96	1099.32	753.44	934.01	740.84
200	676.54	791.98	497.81	661.04	679.55	822.15	840.97	1015.98	1397.00	775.53	941.01	1101.31	754.80	935.36	742.43
210	673.61	787.46	495.59	657.65	677.59	819.29	842.99	1014.63	1394.17	778.17	942.83	1099.11	753.17	933.37	738.92
220	670.60	782.87	493.22	654.16	675.40	816.21	844.73	1013.25	1391.36	780.53	944.46	1096.71	751.45	931.32	735.23
230	667.54	778.30	490.79	650.86	673.04	812.97	846.29	1011.45	1388.56	782.61	945.67	1094.26	749.64	929.21	731.48
240	664.44	773.71	488.30	647.30	670.57	809.61	847.70	1009.65	1385.78	784.50	946.42	1091.81	747.73	927.05	727.68
250	661.29	769.08	485.96	643.69	667.90	806.18	848.96	1007.77	1383.01	786.20	946.73	1089.37	745.75	924.85	723.83
260	658.16	764.42	483.76	640.09	665.28	802.65	850.07	1005.76	1380.26	787.73	946.81	1086.93	743.71	922.61	719.94
270	655.03	759.74	481.54	636.41	662.59	799.16	850.76	1003.74	1377.53	789.12	946.76	1084.50	741.67	920.33	716.03
280	651.87	755.04	479.31	632.72	659.83	795.51	851.15	1001.72	1374.81	790.36	946.55	1082.08	739.68	918.03	712.09
290	648.77	750.41	477.08	628.78	657.03	791.79	851.41	999.71	1372.11	791.47	946.20	1079.67	737.65	915.71	708.14
300	645.63	745.76	474.84	625.06	654.17	788.04	851.57	997.65	1369.43	792.46	945.79	1077.20	735.58	913.36	704.20

Table 67: Yield Tables for Natural Analysis Units in TST

Age	611	682	690	691	720	731	1021	1024	1041	1045	1046	1047	1054	1055	1059
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	3.81	14.53	0.00	0.00	25.07
30	0.00	0.00	0.00	0.00	1.48	6.68	0.00	32.45	17.24	56.32	90.67	110.84	32.46	32.06	126.73
40	19.13	1.79	11.58	27.18	41.24	42.89	33.01	83.45	69.90	138.51	199.90	243.94	95.61	113.17	254.29
50	55.05	43.30	53.40	70.46	107.78	102.86	63.04	152.43	134.74	225.14	309.44	374.47	171.37	218.83	373.04
60	102.71	82.54	99.78	126.91	197.12	183.03	99.67	233.49	200.88	305.75	408.25	488.13	247.57	328.91	479.48
70	156.15	124.04	150.22	188.24	299.32	275.58	150.26	307.90	263.31	379.13	495.76	586.34	318.66	432.08	574.18
80	211.29	164.10	200.24	250.08	405.96	373.86	197.87	374.59	320.63	445.99	573.02	671.81	384.05	524.34	657.61
90	265.17	200.97	247.27	309.22	511.24	471.90	240.95	434.74	372.98	506.86	640.89	749.32	445.22	604.18	732.69
100	316.21	234.33	290.29	363.89	611.38	565.31	279.18	487.19	420.67	562.05	703.44	820.84	501.92	674.22	798.65
110	363.64	264.38	329.18	413.62	702.71	652.19	312.81	532.06	464.22	611.86	759.36	883.23	553.28	733.34	856.25
120	407.29	291.48	364.13	458.42	785.00	731.85	342.14	569.09	504.36	655.87	807.72	938.99	600.62	792.50	905.74
130	445.72	315.96	395.44	498.06	858.85	804.44	367.24	599.34	540.13	693.72	848.02	985.30	642.63	842.05	946.53
140	476.37	336.82	422.17	531.09	925.06	869.96	388.99	624.84	571.57	725.34	880.30	1022.20	679.35	882.88	979.51
150	499.28	353.15	443.04	557.51	971.39	919.37	405.85	645.00	594.96	746.77	900.56	1045.32	706.40	910.18	1001.64
160	515.79	365.07	458.04	576.34	997.28	951.18	417.74	659.97	609.61	757.61	908.83	1055.14	723.02	924.09	1012.09
170	527.54	373.59	468.43	589.50	1015.28	971.39	426.24	671.05	618.51	761.92	911.24	1057.95	732.94	930.84	1015.94
180	535.54	379.51	475.48	598.45	1024.95	983.43	432.35	678.77	623.48	761.98	909.54	1057.52	738.41	933.45	1015.82
190	541.92	383.73	480.50	604.96	1031.95	990.19	436.73	684.07	625.66	759.08	904.88	1055.40	740.73	933.58	1013.63
200	546.76	386.83	484.05	609.65	1037.12	994.21	439.89	687.67	625.83	754.07	898.29	1051.35	740.83	932.43	1009.78
210	550.03	388.83	484.70	610.91	1037.60	994.09	440.14	687.18	621.76	744.91	888.65	1042.76	736.14	926.52	1001.16
220	553.09	390.45	485.16	611.96	1037.61	994.15	440.32	686.60	617.63	735.77	880.05	1034.55	731.37	920.79	992.79
230	555.97	391.88	485.48	612.84	1037.60	993.95	440.38	685.85	613.46	726.72	872.29	1026.66	726.54	914.95	984.60
240	558.69	393.13	485.73	613.63	1037.91	993.61	440.35	684.97	609.28	717.74	864.77	1019.12	721.66	909.01	976.59
250	561.27	394.20	485.88	614.26	1038.09	993.34	440.23	683.97	605.08	708.84	857.41	1011.67	716.72	903.02	968.79
260	563.72	395.89	486.32	614.87	1038.27	993.13	440.02	682.90	600.87	700.00	850.32	1004.31	711.77	896.98	961.15
270	565.52	397.35	486.58	615.32	1038.43	992.68	439.74	681.71	596.66	691.23	843.40	997.01	706.79	890.92	953.65
280	563.42	398.65	486.72	615.65	1038.40	990.50	439.40	680.42	592.44	682.54	836.57	989.78	701.78	884.84	946.28
290	561.90	399.82	486.76	615.87	1038.39	988.55	438.99	679.05	588.23	673.90	829.81	982.65	696.75	878.76	939.02
300	560.85	400.87	486.66	616.00	1038.39	986.79	438.53	677.59	584.01	666.38	823.18	975.70	691.71	872.74	931.87

Table 68: Yield Tables for Natural Analysis Units in TSK

Age	442	444	447	456	505	506	509	511	522	523	524	529	531	533	534
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.17	2.61	5.05	0.00	0.00	0.51	1.89
40	3.52	4.40	26.57	28.46	11.02	14.27	26.40	39.30	22.35	33.26	45.33	3.17	15.85	22.07	32.69
50	31.97	42.28	63.72	70.05	41.05	47.98	60.91	86.28	58.16	81.85	108.09	24.11	46.54	54.82	78.10
60	60.81	85.75	111.68	127.00	73.88	86.29	105.04	144.01	108.07	146.10	187.95	49.10	88.07	99.81	138.19
70	93.83	136.52	162.26	192.68	110.66	128.95	151.91	203.43	166.20	216.88	272.48	79.81	136.89	151.72	204.73
80	128.19	189.62	211.56	260.07	148.55	172.72	197.85	259.97	226.30	286.44	352.67	114.17	188.99	205.59	271.25
90	161.75	241.47	257.35	324.15	185.32	215.06	240.62	311.40	283.93	350.33	424.24	149.81	240.35	257.66	333.74
100	193.25	290.10	298.86	382.22	219.64	254.54	279.33	357.14	336.79	406.86	486.17	184.84	288.62	305.93	390.44
110	222.15	334.71	336.12	433.43	250.94	290.56	313.82	397.36	384.05	455.97	539.08	218.08	332.67	349.61	440.99
120	247.18	375.20	369.44	477.98	280.09	323.03	344.61	432.53	425.79	498.37	584.16	248.98	372.55	388.67	485.68
130	272.76	411.79	399.24	516.50	306.10	352.08	371.79	463.21	462.49	534.92	622.61	277.19	408.05	423.86	525.10
140	295.58	444.82	425.91	549.77	329.24	377.98	395.77	489.96	494.74	566.54	655.64	302.79	439.57	455.18	559.89
150	313.93	471.65	447.38	574.67	347.70	398.12	414.70	510.78	519.54	590.35	680.10	323.18	464.32	479.73	586.91
160	327.20	490.82	462.92	590.43	360.96	413.53	428.10	525.17	536.19	605.72	694.97	337.46	481.41	496.60	605.09
170	336.51	499.91	472.40	599.90	370.51	424.64	437.57	535.03	547.05	615.33	703.50	347.36	493.10	507.95	617.00
180	342.64	506.28	478.00	605.05	377.35	432.43	444.23	541.70	553.88	620.98	708.05	354.10	501.00	515.39	624.05
190	346.68	510.73	481.85	607.24	382.25	438.06	448.87	546.08	557.90	623.90	709.88	358.33	506.18	520.04	628.16
200	349.57	514.17	484.68	607.35	385.75	441.99	452.02	548.84	559.93	624.94	709.83	361.05	509.44	522.65	630.05
210	350.61	515.86	485.55	603.06	386.33	442.75	452.11	548.09	557.69	621.83	705.76	360.58	508.56	521.01	627.54
220	351.42	517.32	486.24	598.79	386.73	443.29	452.06	547.22	555.40	618.72	701.69	360.01	507.55	519.28	624.97
230	352.11	518.59	486.78	594.54	386.95	443.67	451.87	546.22	553.06	615.60	697.63	359.35	506.43	517.49	622.35
240	352.68	519.68	487.19	590.30	387.06	443.92	451.57	545.13	550.69	612.48	693.59	358.61	505.22	515.64	619.69
250	353.15	520.61	487.47	586.10	387.05	444.05	451.17	543.94	548.29	609.36	689.57	357.81	503.93	513.74	617.00
260	353.37	521.33	487.09	581.96	387.01	444.08	450.60	542.69	545.86	606.17	685.55	356.98	502.55	511.73	614.25
270	353.51	521.93	486.66	577.82	386.86	444.01	449.94	541.37	543.39	602.97	681.55	356.08	501.10	509.68	611.49
280	353.61	522.43	486.23	573.72	386.67	443.86	449.23	539.99	540.92	599.80	677.58	355.15	499.61	507.62	608.71
290	353.68	522.83	485.80	569.66	386.41	443.63	448.48	538.56	538.45	596.66	673.63	354.17	498.07	505.55	605.93
300	353.72	523.15	485.36	565.64	386.09	443.32	447.68	537.07	535.97	593.55	669.72	353.15	496.49	503.47	603.13

Appendix 2 – Inventory Adjustment Reports

Pacific TSA Supply Block 7

Vegetation Resources Inventory Statistical Adjustment

Version 1.0

May 25, 2015

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1 Introduction

As part of the current timber supply review (TSR) for the Pacific TSA, the best available inventory and growth and yield data is being compiled. Supply Block 7 of the Pacific TSA was formerly part of Tree Farm Licence (TFL) 6. The TFL 6 phase 1 inventory that provided the basis for the Supply Block 7 Vegetation Resource Inventory (VRI) was originally completed in 1970 and then regularly updated for denudations and regeneration. The majority of the TFL 6 was re-inventoried in 2000 and further depletion updates were applied up to 2004.

As part of the 2000 re-inventory of TFL 6, an inventory adjustment to Age, Height and Volume (net volume adjustment factor) was completed in 2009. Ninety eight phase 2 ground plots were established in 2001 as part of that statistical adjustment. The original inventory adjustment and sampling was described in the following reports:

- Western Forest Products Inc. TFL 6 Vegetation Resources Inventory Statistical Adjustment, December 2009, Timberline Natural Resource Group Ltd.
- Tree Farm Licence 6: Quatsino Sound – North Vancouver Island Timber Emphasis VRI Ground Sampling Plan, February 2001

The original VRI phase 2 inventory adjustment was completed with VDYP 6. The growth and yield modeling for natural stands for the Pacific TSA TSR will use VDYP 7, the current Ministry of Forests, Lands and Natural Resource Operations (FLNRO) standard. Adjustment procedures for VDYP 7 require adjustment ratios to be calculated for age, height, density, basal area, lorey height and volume. This necessitated a re-calculation of the adjustment ratios so that they could be applied to the Supply Block 7 VRI for the Pacific TSA.

2 Methods

The methodology used for this adjustment was based on the following documents:

- Vegetation Resources Inventory, Interim Procedures and Standards for Statistical Adjustment of Baseline VRI Timber Attributes. Jan 2008
- Procedure for Adjusting VRI Attributes for VDYP7 Projection

Additional help was provided by Sam Otukol and his staff at the Forest Analysis and Inventory Branch (FAIB) of FLNRO.

2.1 Study Area

The Supply Block 7 has a total area of 11,401 ha, of which 11,239 ha is classified as forest management land base (FMLB). The adjustment population was the vegetated treed (BC Landcover Classification) portion of the Supply Block with an age greater than or equal to 30 (in 2001), excluding private lands, parks or other protected areas.

The Supply Block 7 VRI was composed of three sources: former TFL 6 inventory, some depletions and non-forest areas from BC Geospatial Warehouse (BCGW), and another inventory used to fill in some gaps between the new Block 7 boundary and old TFL 6 boundary. The adjustment was only applied to the VRI derived from the former TFL 6 inventory, which covered 10, 821 ha of Supply Block 7 (10,687 ha FMLB). The location of the Pacific TSA Block 7 is shown in Figure 1

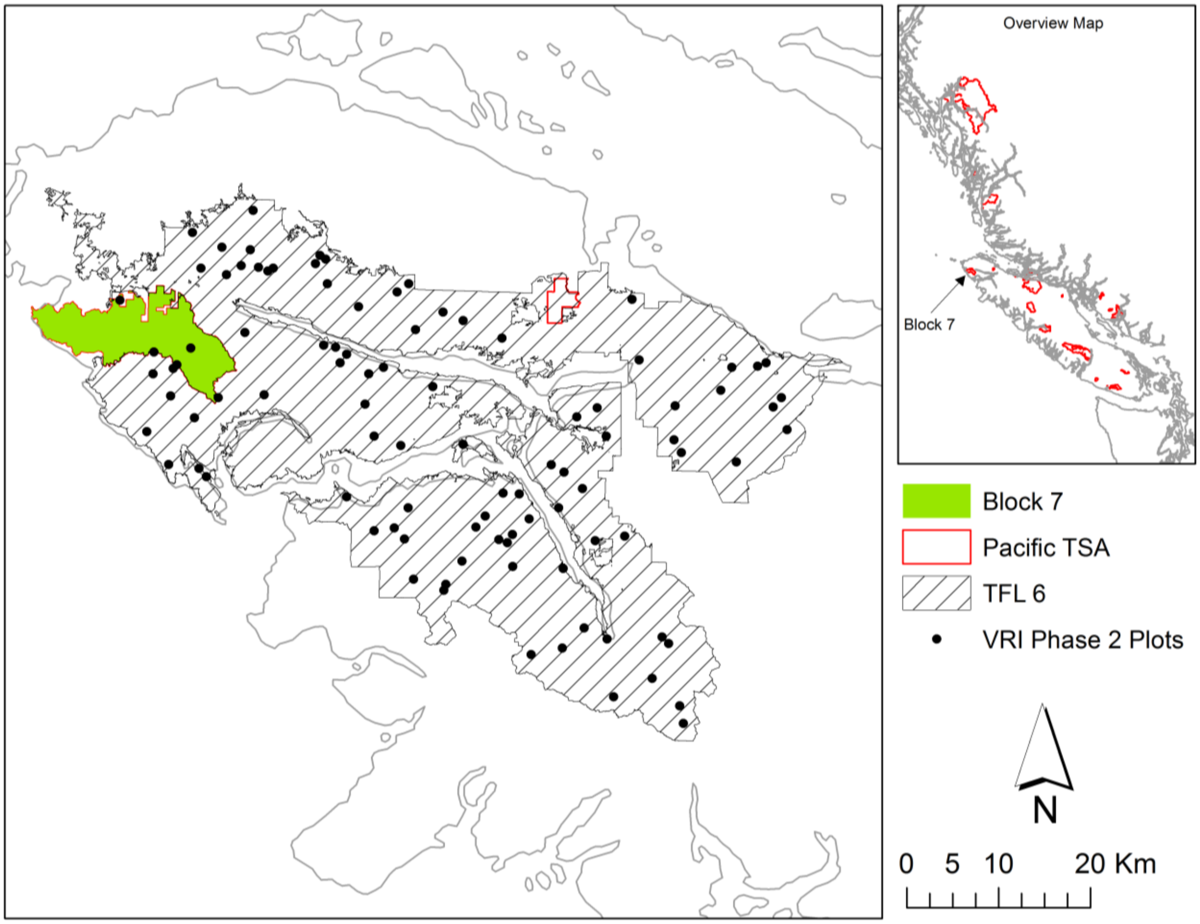


Figure 1: Location of the Pacific TSA Block 7, relative to TFL 6 and phase 2 ground plots.

The adjustment population was separated into two strata. The old strata were stands greater or equal to 140 years (2001) and the young strata included stands from 30 to 139 years old (2001).

The location of private lands and parks that was excluded from the adjustment population was not available, however a table of the previous adjustment that listed all adjusted inventory stands was available. This adjustment table was used to define the adjustment populations and their strata.

The Block7 VRI was updated with recent depletions. These areas were removed from the adjustment population as they are now young.

The Pacific TSA Block 7 VRI areas and adjustment population are described in Table 1.

Table 1: Pacific TSA Block 7 VRI Areas

Description	FMLB Area (ha)	Non-FMLB Area (ha)	Total Area (ha)
Block 7 VRI	11,239	162	11,401
Block 7 VRI Treed	10,879	42	10,922
Block 7 VRI Former TFL 6 inventory	10,687	134	10,821
Block 7 VRI former TFL 6 inventory, treed	10,340	33	10,373
Old Adjustment Strata	4,485	0	4,485
Young Adjustment Strata	1,788	0	1,788

2.2 Ground Sampling Data

Compiled data for the 98, 2001 phase 2 plots was provided by Bob Krahn of FAIB. The plot data contained 81 Timber Emphasis plus CWD plots and 17 Timber Emphasis plots. These plots consisted of a central plot and up to 4 satellite plots. The plot data was compiled to provide stand level values at 4, 7.5, 12.5, 17.5 and 22.5 cm utilization levels.

2.3 VRI Data

Only two of the phase 2 ground plots were located within Supply Block 7 and the rest fell within the current TFL 6 boundary.

Most of the Supply Block 7 VRI consisted of a TFL 6 inventory that had a projection year of 2005. Input VDYP 7 data from FAIB with a 2005 reference year provided the inventory data for these stands. This data only contained one rank 1 layer per stand with age and height data for only the leading species.

An inventory projected to 2006 was provided by Western Forest Products Limited that covered the remaining area of TFL 6. This inventory contained two layers and ages and heights for the leading and secondary species in each layer.

2.4 Plot Matching

The phase 2 plots were linked to the Supply Block 7 and TFL 6 inventories based on their UTM coordinates. A comparison to the adjustment table from the previous adjustment, which recorded the stands that linked to plots, showed that four plots linked to a different stand than in the previous adjustment. An examination of these plots showed that their UTM coordinates published in the previous adjustment were different than the UTM coordinates for plots in the new data. For these four plots, a link was made to the same inventory stand as in the previous adjustment.

Three plots where located in stands where the second layer was rank 1 and the plot was linked to layer 2.

Of the 98 plots, 14 were located in young stands (< 30 years old in 2001) and were excluded for being outside the adjustment population. A further four plots were located outside the target population and also excluded. After these exclusions, there were 80 plots left to use for the adjustment.

After the plots were linked, the match between the plot leading species and the inventory stand species was examined. Fifty nine of the plots matched the leading inventory species and were linked to the leading species age and height. Fifteen plots matched the secondary species of the inventory stands and were linked to the secondary species age and height. Finally, six plots had a leading species that did not match the leading or secondary species of the inventory stand. However, as all of these plots and the remaining inventory stands had a coniferous leading species, the plots were linked to the inventory using the plot leading conifer and the leading conifer in the inventory

2.5 Statistical Adjustment

The adjustment calculation involved the following steps:

1. Project the original 2005/2006 inventory stands with VDYP 7 to 2001 to match the ground plot date.
2. Project the inventory secondary species ages and heights with SiteTools to 2001 for the 15 inventory stands where the plot leading species matched the inventory secondary species.

3. Calculate adjustment ratios between the projected 2001 inventory values and phase 2 plot values for age, height, density and basal area
4. Apply the adjustment ratios to the 2001 age, height, density and basal area and project these values (at both 7.5cm and 12.5cm utilization levels) with VDYP 7 to produce attribute adjusted volumes (7.5cm and 12.5cm utilization levels) and lorey height (7.5cm utilization level).
5. Calculate adjustment ratios between the attribute adjusted volume and lorey height and the Net Volume Adjusted Factor (NVAF) plot volume and lorey height.
6. Project the Supply Block 7 inventory using the adjusted 2001 age, height, density and basal area. The adjustment ratios were applied to the volumes and lorey height; these adjusted values were included as inputs to VDYP 7, which applied the volume adjustment to the output.

The BEC zone used in the VDYP7 projections came from the two sources. Projections of the stands linked to plots used the BEC zone value from the plot data. The final application of the adjustment to the Supply Block 7 VRI used the BEC zone from the VRI.

Detailed adjustment procedures are provided in an Appendix at the end of this document.

3 Results

Of the 80 inventory plots established within the adjustment population for the original adjustment, 76 had ages and 74 had tree heights.

Table 2 details the statistics for the age, height, density, basal area, lorey height and volume adjustment. The phase 1 inventory underestimated the stand age slightly. The height was slightly overestimated in the old strata and underestimated in the young strata.

Table 2: Table of adjustment values

Attribute	*Stratum*	*n*	*Mean weighted Phase II value, by stratum*	*Mean weighted Phase I value, by stratum*	*Ratio of means adjustment factors*	*Sampling error %*
Age of 1st sp	Old	37	309.4	288.9	1.0708	14.1%
	Young	39	59.7	57.2	1.0450	14.1%
Height of 1st sp	Old	35	32.4	34.3	0.9465	8.0%
	Young	39	26.6	24.9	1.0662	8.2%
Trees/ha @7.5cm+ dbh	Old	41	619.8	343.0	1.8070	27.0%
	Young	35	1,101.8	847.5	1.3001	25.1%
Basal area/ha @7.5cm+ dbh	Old	41	70.6	68.2	1.0345	10.5%
	Young	35	52.7	46.9	1.1235	12.3%
Lorey height @7.5cm+ dbh	Old	41	29.6	30.3	0.9782	8.9%
	Young	38	23.5	23.3	1.0101	8.4%
Volume/ha net top, stump, decay & waste @12.5cm+ dbh	Old	41	783.2	669.6	1.1697	14.1%
	Young	38	452.4	478.6	0.9453	15.7%

Figure 2 to Figure 7 provide scatter graphs of the phase 1 inventory and phase 2 plot values for each stratum.

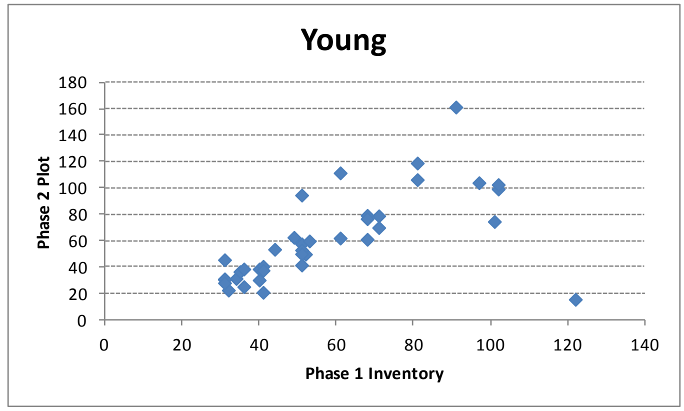
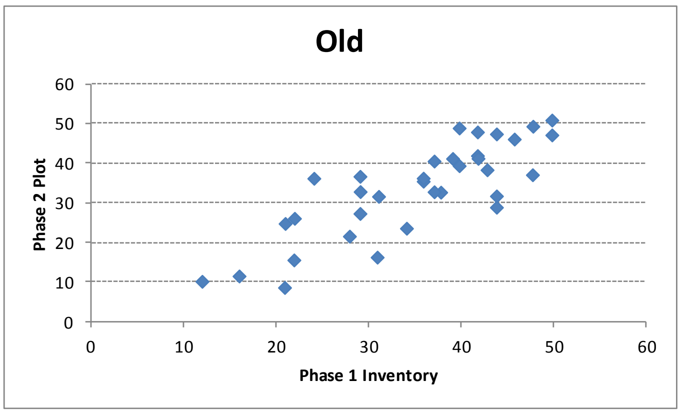


Figure 2: Phase 2 vs. Phase 1 age (yrs), by stratum.



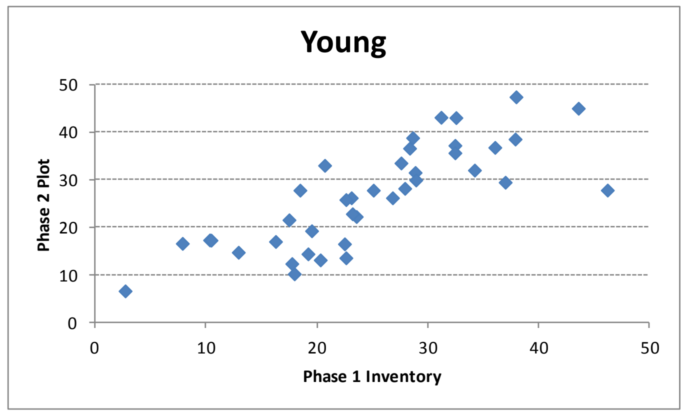


Figure 3: Phase 2 vs. Phase 1 height (m), by stratum.

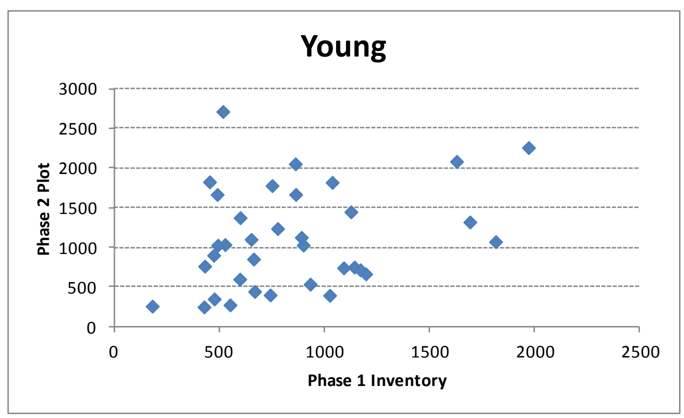


Figure 4: Phase 2 vs. Phase 1 density (stems/ha), by stratum.

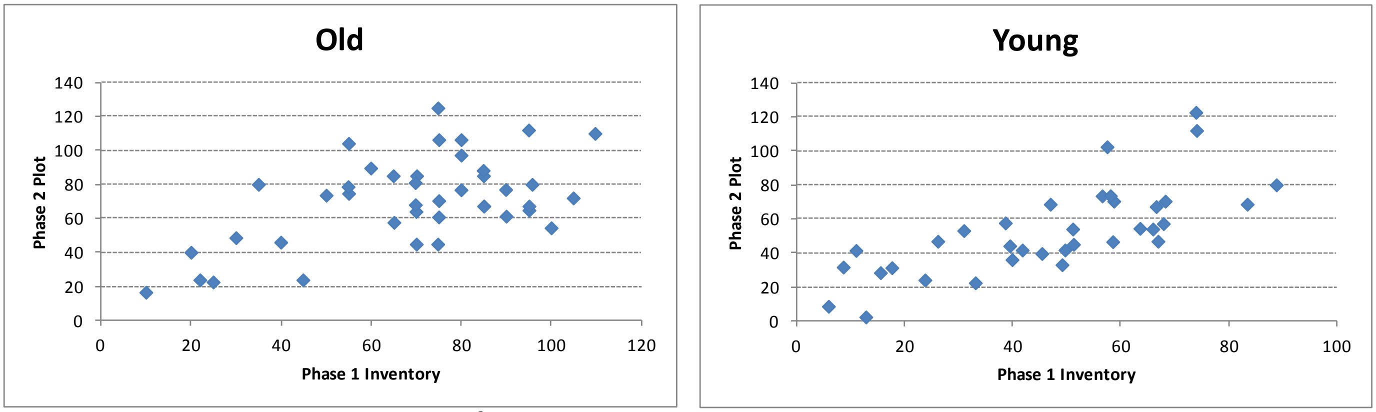


Figure 5: Phase 2 vs. Phase 1 basal area (m^2/ha), by stratum.

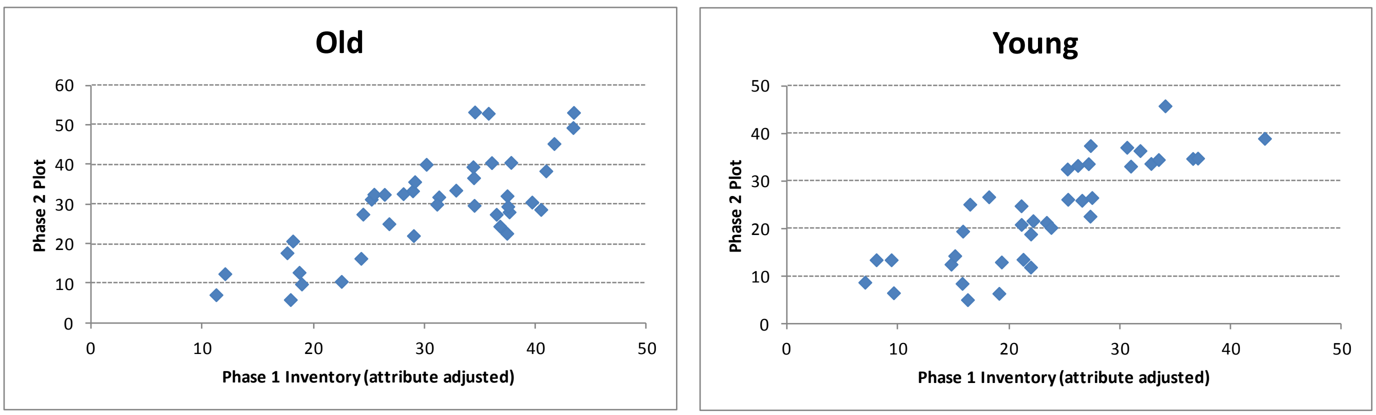


Figure 6: Phase 2 vs. Phase 1 (attribute adjusted) lorey height (m), by stratum.

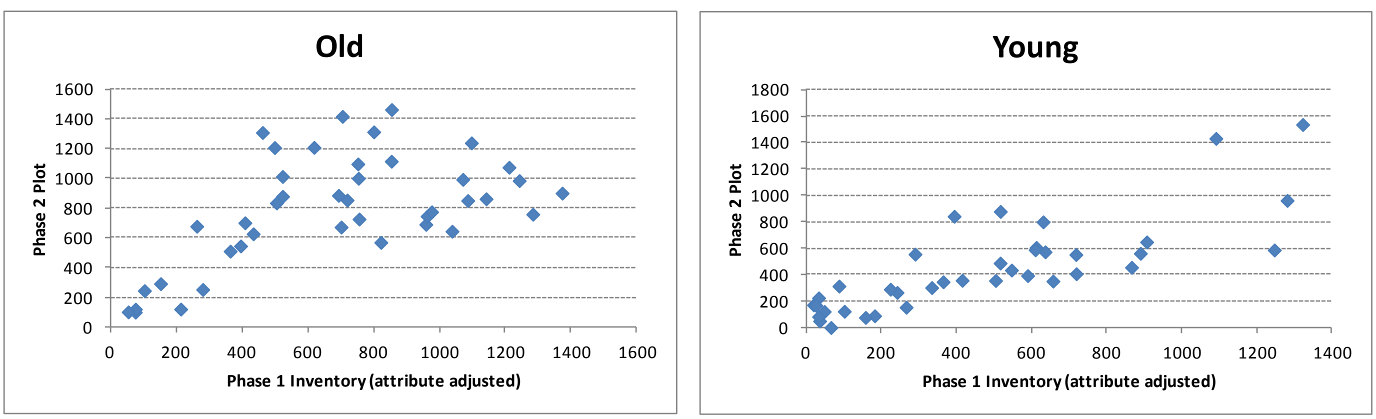


Figure 7: Phase 2 NVAF vs. Phase 1 (attribute adjusted) close utilization decay and waste volume (m^3/ha), by stratum.

The inventory adjustment increases the overall Supply Block 7 VRI volumes, as seen in Table 3 and

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	405	470	436	490	10,922

Table 4. The increase comes from the upward adjustment to both the young and old strata. The slight downward volume adjustment to the young stratum was offset by an increase to stand height (and site index).

The largest impact of the adjustment is to the 2001 reference year. As the inventory is projected farther from the reference year (2014), the adjustment effect is diluted. Also, the projected volume of old stands in VDYP 7 drops slightly over time, which further leads to a slight decrease in old stratum volumes.

Table 3: Block 7 VRI average adjusted and un-adjusted volume (12.5 cm utilization, decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	405	470	436	490	10,922

Table 4: Block 7 VRI average adjusted and un-adjusted volume, FMLB only (12.5 cm utilization, decay waste and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	669	808	667	775	4,485
Young Strata	355	406	446	506	1,788
Entire VRI (updated with depletions)	407	472	437	490	10,879

4 Discussion

There were a few differences between this adjustment and the previous 2009 adjustment.

The original adjustment excluded plots where the plot leading species did not match the leading or secondary species in the inventory stand (conifer/deciduous rule). This resulted in the original adjustment only using 68 plots for the height adjustment and 70 plots for the age adjustment. The six plots that only matched the inventory species at the coniferous level were included in this adjustment calculation.

A comparison of the phase 2 plot ages and heights, published in the original adjustment, showed that they are slightly different from the plot ages and heights used in this adjustment. This difference likely resulted from the plot data being compiled in a different manner than in the original adjustment.

The different number of plots used and different compilation of plots resulted in slightly different age and height adjustment ratios for this adjustment compared to the original adjustment. The basal area, trees per ha, and lorey height adjustment ratios were not part of the original adjustment done with VDYP 6 and therefore cannot be compared. The volume ratio in this adjustment was also different from the original adjustment, but they cannot be directly compared due to the change from VDYP 6 to VDYP 7.

The adjusted inventory values provide an unbiased estimate of the inventory attributes and volumes for the Supply Block 7 VRI and should be used in the preparation of growth and yield curves for the Pacific TSA TSR analysis.

Appendix: Detailed Methodology

The following procedure describes re-calculating the adjustment for TFL 6 and applying it to the inventory. The original adjustment was done for VDYP 6.

1) Obtained plot data from FLNRO. The data was in TFL6_VRIgroundData.xlsx and contained 4 worksheets:

- Samples – includes plot locations
- SMY_NCS – compiled plot data by species for 5 utilization levels (4, 7.5, 12.5, 17.5, and 22.5)
- SMY_NC - compiled plot data for 5 utilization levels (4, 7.5, 12.5, 17.5, and 22.5).
- Data_dictionary

The 98 plots include (separated by TYPE_CD): Timber Emphasis + CWD (D01) and Timber Emphasis (Q01) plots. Additionally the data contained 20 Net Volume Adjustment (N01) plots which we did not use.

Each plot included 4 satellite plots (total of 5). A call was made on the ground to determine which 4 satellite plots were within the inventory stand (some were in neighbouring stands). Outside plots were excluded.

The data has already been compiled to give per ha plot information (and the NVAF was applied). The following fields were required:

- CLSTR_ID - unique ID
- TYPE_CD - plot type (D01 was used)
- UTIL
- BGC_ZONE – BEC Zone
- SPB_CPCT – species composition – used for matching plots to inventory stands
- BA_HA - basal area live
- STEMS_HA - density live
- HT_MEAN1 - weighted mean ht (incl. broken top) - used for Lorey Ht adjustment
- HT_M_TLS - mean height of top, site, and second spp site height trees (T,L,S).
- AT_M_TLS - mean age of (T,L,S trees)
- NVL_NW2 - NVAF * Whole stem vol/ha less Top, Stump, Cruiser Decay and Waste (live)

2) Plots were linked to an original 2006 TFL 6 inventory and the supply block 7. Points were created from the UTM coordinates data and intersected with the inventories.

A list of inventory stands that linked to plots in the previous adjustment was available and showed that four plots linked to different stands than in the previous analysis. An examination of the plot coordinates showed that the plot data had slightly different UTM coordinates than those published in the 2009 adjustment. For consistency with the 2009 adjustment, the plots were linked to the same inventory stands as before.

3) Species attributes were compared to determine if inventory and plot layers match (4 cm utilization).

The result was that:

- 59 plot leading species matched to the inventory species 1
- 15 plot leading species matched to the inventory species 2

- 6 plots had a leading species that did not match inventory species 1 or 2 but the plots and inventory did match at the conif/decid level.

All plots linked to the rank 1 layer of the inventory. The block 7 VRI only had one rank 1 layer, but the TFL 6 inventory had up to two layers, and in three cases the second layer was the rank 1 layer.

Of the 98 plots, 14 were in young stands and a further 4 were in stands outside the target population. This left 80 plots for the adjustment.

Six plots were lacking height data and could not be included in the height ROM calculation, while 4 plots lacked age information and were not included in the age ROM.

The original adjustment stated that 12 plots did not have height information and 10 did not have age information. Most likely the 2009 analysis excluded the 6 plots that had a leading species that did not match the species 1 or 2 in the inventory. This adjustment is using different procedures and included these 6 plots.

4) Inventory is 2005/2006 and plots were measured in 2001. First the inventory needs to be projected to 2001 so it can be properly compared to the plots (also missing SPH and BA needs to be filled in by the VDYP7 FIP module).

The inventory values for the 80 plots were inserted into a VDYP 7 input template. Inv_Standard_Cd of "F" was used since the inventory is closer to an FC1 (with BA added) than a VRI. Reference year was 2005/2006.

BEC Zone was taken from the BEC Zone of the phase 2 plots.

This input file was run in VDYP 7 ("Step 1") at a 7.5 cm utilization. Multiple years (2001-2015) were run but only 2001 is needed.

Four plots in the young strata were too young/small for VDYP 7 to project. While they had age and dominant height generated, there was no basal area, density or volume for them.

5) 15 of the plots that linked to the second inventory species required the second species age and height in 2001 to compare the plot values to.

These stands had the site index of the second species calculated in SiteTools from the age and height of the second species at the stands reference year. The second species site index was then used to generate the height at the age in 2001.

6) Compute Age, Height, Basal Area, and SPH adjustment ratios.

There were two strata: young (30 to 139 yrs) and old (140 yrs +).

Adjustment ratio of means (ROM) were calculated for each strata between:

- 2001 inventory (VDYP 7) age and plot AT_M_TLS
- 2001 inventory (VDYP 7) PRJ_DOM_HT(7.5) and plot HT_M_TLS(7.5).
- 2001 inventory (VDYP 7) PRJ_BA(7.5) and plot BA_HA(7.5)
- 2001 inventory (VDYP 7) PRJ_TPH(7.5) and plot STEMS(7.5)

For the 15 stands linking to the inventories second species, the second species age and height was used instead of the VDYP 7 projected stand age and height.

The Ministry Excel Marco VRI Analysis1_Original.xlsm was used to calculate sampling error.

Sample weights were provided for each plot and were input into the adjustment spreadsheet.

7) Calculate attribute adjusted volumes (and Lorey Ht).

VDYP 7 was run a second time ("Step 2") with the same species composition and other fields, however the age, height, basal area and stems/ha (output from the "step 1" run) were adjusted using the calculated adjustment ratios. The Inv_Standard_Cd was set to "V" so that VDYP will use the basal area and SPH. The reference year was set to 2001.

The 4 young stands that lacked basal area and density from the "Step 1" output were run with a null basal area and density. VDYP 7 estimated BA and SPH for these stands. With the age and height adjustment, 3 of these young stands were now big enough for VDYP 7 to generate a basal area, sph, lorey height and volume.

VDYP 7 output is needed at both 7.5 and 12.5 cm utilizations (same input file is run twice with different util parameters).

8) Calculate volume and lorey height adjustment ratios.

Adjustment ratios for each strata were calculated between:

- Inventory (VDYP 7 Step 2) PRJ_LOREY_HT(7.5) and plot HT_MEAN1(7.5)
- Inventory (VDYP 7 Step 2) PRJ_VOL_DW(12.5) and plot NVL_NW2 (12.5)

The lorey height ROM is used to adjust the lorey height, while the same volume ROM gets applied to WSV7.5, WSV12.5, CUV12.5, VOL_NET_D12.5, and VOL_NET_DW12.5.

9) Calculate final adjusted volumes ("Step 3")

The same "Step 2" VDYP input file is run (which has adjusted age, ht, BA, sph), but the following fields are also filled in:

- R1_ADJ_INPUT_ID - id based on strata (must be non null)
- R1_LOREY_HEIGHT - adjusted PRJ_LOREY_HT (7.5)
- R1_BASAL_AREA_125 - **un**adjusted PRJ_BA (12.5)
- R1_VOL_PER_HA_75 - adjusted PRJ_VOL_WS (7.5)
- R1_VOL_PER_HA_125 - adjusted PRJ_VOL_WS (12.5)
- R1_CLOSE_UTIL_VOL_125 - adjusted PRJ_VOL_CU (12.5)
- R1_CLOSE_UTIL_DECAY_VOL_125 - adjusted PRJ_VOL_D (12.5)
- R1_CLOSE_UTIL_WASTE_VOL_125 - adjusted PRJ_VOL_DW (12.5)

The above values came from the "Step 2" output multiplied by the adjustment ROM.

When this input is run in VDYP 7, it will use the adjusted lorey height and volumes to apply a final volume adjustmet to the output values.

10) Apply the final adjustment to the supply block 7 inventory. Only the portions of the supply block that consisted of VRI from the TFL 6 inventory were adjusted.

The same steps need to be done:

a) project inventory to 2001 ("Step 1")

b) apply calculated age, height, BA, sph ROM to 2001 values and re-run VDYP to generate attribute adjusted values ("Step 2").

c) apply calculated lorey ht and volume ROM to attribute adjusted lorey ht and volumes. Input these as adjusted values and re-run VDYP to generate final adjusted volumes ("Step 3").

The adjustment population and strata was determined by linking the supply block 7 VRI to the adjustment table from the 2009 adjustment. This table already excluded private lands and parks which were outside of the adjustment population.

Pacific TSA Supply Block 8

Vegetation Resources Inventory Statistical Adjustment

Version 1.0

April 27, 2015

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1 Introduction

As part of the current timber supply review (TSR) for the Pacific TSA, the best available inventory and growth and yield data is being compiled. Supply Block 8 of the Pacific TSA was formerly part of Tree Farm Licence (TFL) 37. The TFL 37 phase 1 inventory that provides the basis for the Supply Block 8 Vegetation Resource Inventory (VRI) was completed in 1997 and has a 1996 reference date.

In support of the last TSR for TFL 37 (Management Plan 9), an inventory adjustment to Age, Site Index and Volume (net volume adjustment factor) was completed in 2004. Eighty phase 2 ground plots were established in 2001/2002 as part of that statistical adjustment. The original inventory adjustment was described in the following reports:

- Tree Farm Licence 37 Vegetation Resources Inventory Statistical Adjustment: Version 3.1, June 3, 2004 (revised December 6, 2004), J.S. Thrower & Associates Ltd.
- Tree Farm Licence 37 Net Volume Adjustment Factor Analysis: Version 2.0, June 3, 2004, J.S. Thrower & Associates Ltd.

The original VRI phase 2 inventory adjustment was completed with VDYP 6. The growth and yield modeling for natural stands for the Pacific TSA TSR will use VDYP 7, the current Ministrty of Forests, Lands and Natural Resourves Operations (FLNRO) standard. Adjustment procedures for VDYP 7 require adjustment ratios to be calculated for age, height, density, basal area, lorey height and volume. This necessitated a re-calculation of the adjustment ratios so that they could be applied to the Supply Block 8 VRI for the Pacific TSA.

2 Methods

The methodology used for this adjustment was based on the following documents:

- Vegetation Resources Inventory, Interim Procedures and Standards for Statistical Adjustment of Baseline VRI Timber Attributes. Jan 2008
- Procedure for Adjusting VRI Attributes for VDYP7 Projection

Additional help was provided by Sam Otukol and his staff at the Forest Analysis and Inventory Branch (FAIB) of FLNRO.

2.1 Study Area

The Supply Block 8 has a total area of 18,351 ha, of which 12,517 ha is classified as forest management land base (FMLB). The adjustment population was the economic and marginally economic, vegetative treed area where the stand age (in 1996) was greater than or equal to 36 years old (greater than or equal to 41 years old in 2001). Note that the economic and marginally economic area definitions are those of TFL 37, as per their Management Plan 9 (MP 9).

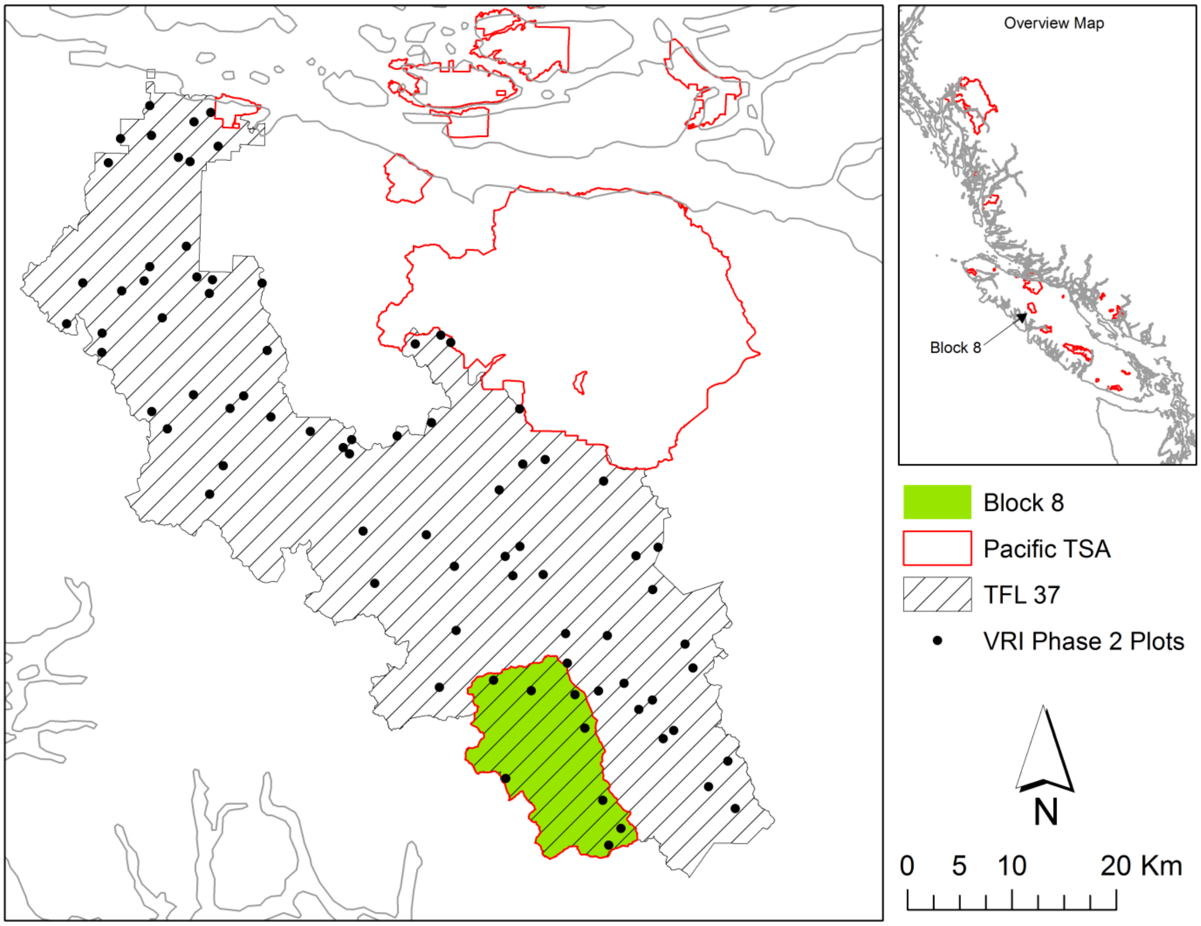

Figure 1: Location of the Pacific TSA Block 8, relative to TFL 37 and phase 2 ground plots.

The adjustment population was separated into two strata. The old strata were stands greater or equal to 300 years (1996) and the young strata included stands from 36 to 299 years old (1996). In the original inventory, all old growth stands older than 300 years old were assigned an age of 300 years.

The economic land base definition from the TFL 37 MP 9 analysis was not available; however, a forest inventory from MP 9 containing adjusted age and volume values was available. The adjusted portion of this inventory was used to define the economic and marginally economic areas that the original adjustment applied to.

The Block 8 VRI was updated with recent depletions. These areas were removed from the adjustment population as they are now young.

The Pacific TSA Block 8 VRI areas and adjustment population are described in Table 1.

Table 1: Pacific TSA Block 8 VRI Areas

Description	FMLB Area (ha)	Non-FMLB Area (ha)	Total Area (ha)
Block 8 VRI	12,517	5,835	18,351
Block 8 VRI Treed	12,006	1,399	13,406
Old Adjustment Strata	5,500	105	5,605
Young Adjustment Strata	930	30	960

2.2 Ground Sampling Data

Compiled plot data for the Eighty 2001/2002 VRI timber emphasis ground sample plots was provided by Sam Otukol of FAIB. These plots consisted of a central plot and up to 4 satellite plots. The plot data was compiled to provide stand level values at 4, 7.5, 12.5, 17.5 and 22.5 cm utilization levels. The plots were linked to the original TFL 37 inventory based on their UTM coordinates.

2.3 Statistical Adjustment

The adjustment calculation involved the following steps:

1. Project the original 1996 inventory with VDYP 7 to 2001 to match the ground plot date.
2. Calculate adjustment ratios between the 2001 inventory and plot values for age, height, density and basal area
3. Apply the adjustment ratios to the 2001 age, height, density and basal area and project these values (at both 7.5cm and 12.5cm utilization levels) with VDYP 7 to produce attribute adjusted volumes (7.5cm and 12.5cm utilization levels) and lorey height (7.5cm utilization level).
4. Calculate adjustment ratios between the attribute adjusted volume and lorey height and the Net Volume Adjusted Factor (NVAF) plot volume and lorey height.
5. Project the inventory using the adjusted 2001 age, height, density and basal area. The adjustment ratios were applied to the volumes and lorey height; these adjusted values were included as inputs to VDYP 7, which applied the volume adjustment to the output.

The BEC zone used in the VDYP7 projections came from the ecology data of the MP 9 analysis, which matches the BEC zone in Supply Block 8 VRI. Where a stand with a ground plot was covered by more than one BEC zone, the zone in which the plot centre landed was used.

Detailed adjustment procedures are provided in an Appendix at the end of this document.

3 Results

Of the 80 inventory plots established for the original adjustment, 58 were established in stands greater than or equal to 41 years old (2001) and had a leading species that matched the inventory stand leading species (at least to the conifer/deciduous level).

One plot in the old stratum did not have an age and six were missing height information.

Table 2 details the statistics for the age, height, density, basal area, lorey height and volume adjustment. The phase 1 inventory tended to underestimate age and overestimate height. The final volume adjustment increased the volume in the old stratum, but only applied a slight downward adjustment to the young stratum.

Table 2: Table of adjustment values

Attribute	***Stratum***	***n***	***Mean weighted Phase II value, by stratum***	***Mean weighted Phase I value, by stratum***	***Ratio of means adjustment factors***	***Sampling error %***
Age of 1st sp	Old	37	438.6	305.0	1.4382	13.9%
	Young	20	144.2	112.1	1.2861	20.8%
Height of 1st sp	Old	32	28.9	35.4	0.8174	10.2%
	Young	20	29.6	29.7	0.9971	11.6%
Trees/ha @7.5cm+ dbh	Old	38	768.9	585.7	1.3129	19.4%
	Young	20	989.8	932.1	1.0620	29.2%
Basal area/ha @7.5cm+ dbh	Old	38	74.1	67.1	1.1044	12.2%
	Young	20	55.8	54.8	1.0184	16.2%
Lorey height @7.5cm+ dbh	Old	38	26.0	25.0	1.0413	10.3%
	Young	20	26.6	26.0	1.0246	13.3%
Volume/ha net top, stump, decay & waste @12.5cm+ dbh	Old	38	738.0	573.7	1.2863	12.4%
	Young	20	511.0	519.5	0.9837	26.4%

Figure 2 to Figure 7 provide scatter graphs of the phase 1 inventory and phase 2 plot values for each stratum.

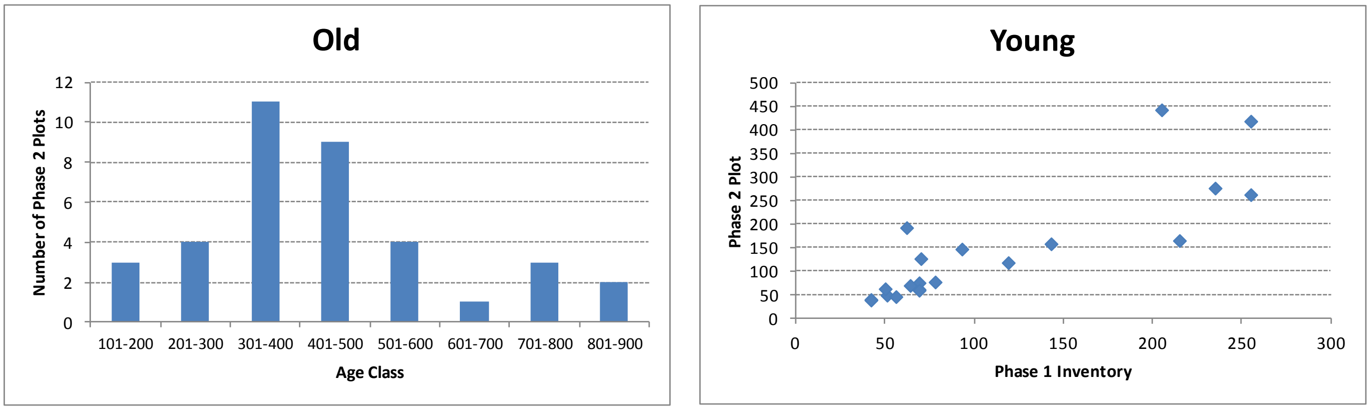

Figure 2: Phase 2 vs. Phase 1 age (yrs), by stratum. The phase 1 age within the old stratum was a constant value of 305 (year 2001).

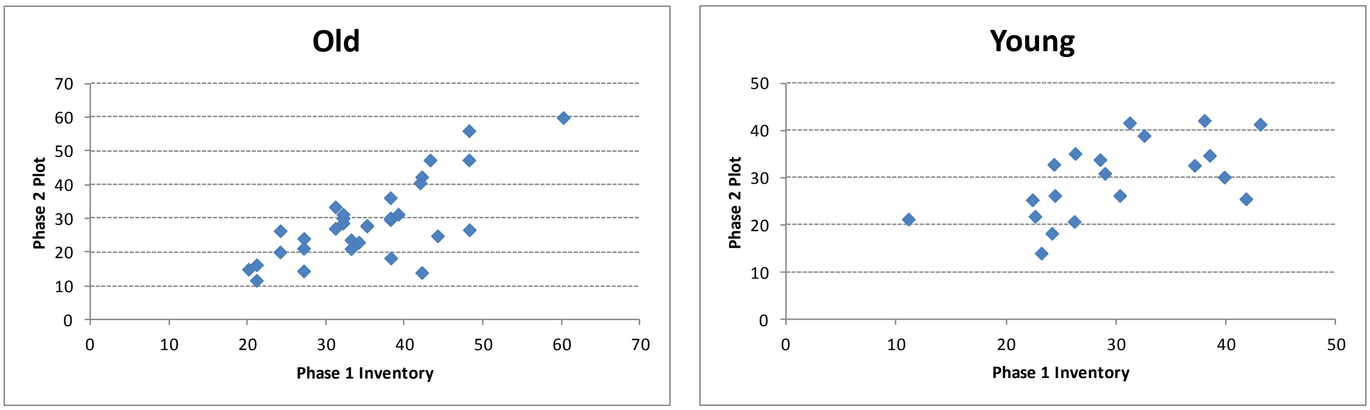

Figure 3: Phase 2 vs. Phase 1 height (m), by stratum.

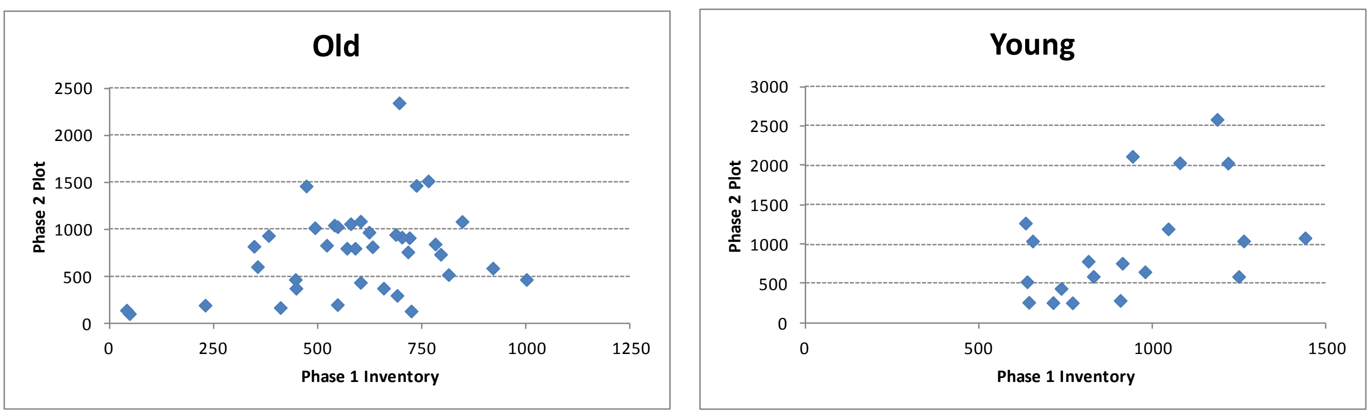

Figure 4: Phase 2 vs. Phase 1 density (stems/ha), by stratum.

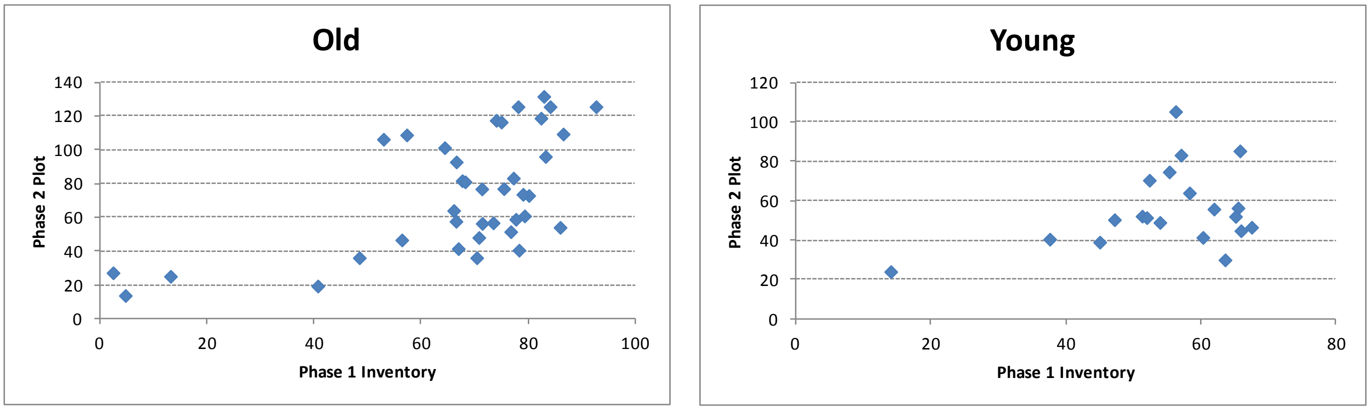

Figure 5: Phase 2 vs. Phase 1 basal area (m^2/ha), by stratum.

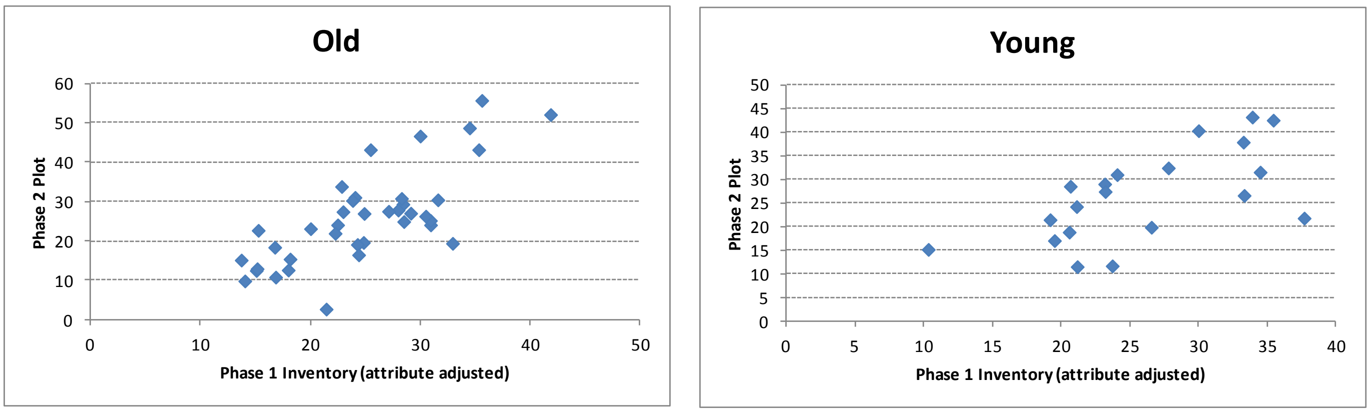

Figure 6: Phase 2 vs. Phase 1 (attribute adjusted) lorey height (m), by stratum.

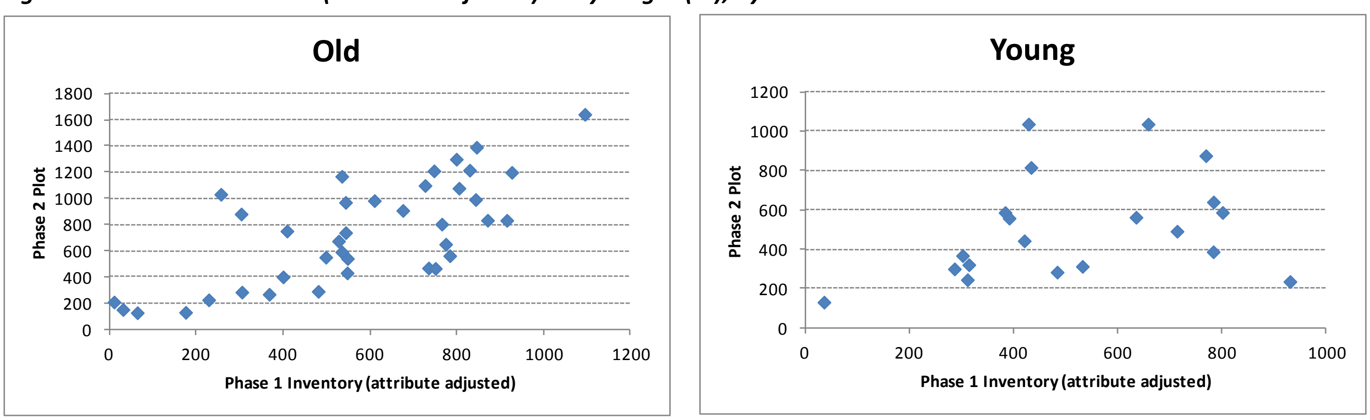

Figure 7: Phase 2 NVAF vs. Phase 1 (attribute adjusted) close utilization decay and waste volume (m^3/ha), by stratum.

The inventory adjustment slightly increases the overall Block 8 VRI volumes, as see in Table 3 and Table 4. The increase comes from the upward adjustment to the old stratum, which offsets the slight downward adjustment to the young stratum.

The largest impact of the adjustment is to the 2001 reference year. As the inventory is projected farther from the reference year (2014), the adjustment effect is diluted. Also the projected volume of old stands in VDYP 7 drops slightly over time, which further leads to a slight decrease to old stratum volumes.

Table 3: Block 8 VRI average adjusted and un-adjusted volume (12.5 cm utilization, decay wasted and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	649	703	645	663	5,605
Young Strata	324	321	415	384	960
Entire VRI (updated with depletions to 2013)	346	368	380	386	13,406

Table 4: 8 VRI average adjusted and un-adjusted volume, FMLB only (12.5 cm utilization, decay wasted and breakage)

Population	Average 2001 Volume (m^3/ha)		Average 2014 Volume (m^3/ha)		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Old Strata	657	711	652	670	5,500
Young Strata	335	331	428	396	930
Entire VRI (updated with depletions to 2013)	376	401	415	421	12,006

4 Discussion

There were a few inconsistencies between this adjustment and the original 2004 adjustment done for Management Plan 9:

- There were 37 plots available to use in the old stratum for the age adjustment, but only 36 were used in the original adjustment
- A slightly different average phase 2 age in the old and young strata was produced than in the original adjustment
- The adjusted forest inventory from the MP 9 analysis indicated that the adjustment was originally applied to stands with an age >= 30 years (1996). This was inconsistent with the adjustment report stating that the adjustment population was stand ages >=36 years old (1996).

The first two issues likely resulted from a slightly different compilation of the plot data between the original analysis and this analysis. The reason for the inconsistency on the age used to define the adjustment stratum is unknown. This adjustment elected to use the stated population from the 2004 adjustment report as it matches the range of plot data used for the adjustment calculation.

The adjusted inventory values provide an unbiased estimate of the inventory attributes and volumes for the Supply Block 8 VRI and should be used in the preparation of growth and yield curves for the Pacific TSA TSR analysis.

Appendix: Detailed Methodology

The following procedure describes re-calculating the adjustment for TFL 37 and applying it to the inventory. The original adjustment was done for VDYP 6, which is incomplete for VDYP 7.

1) Obtained plot data fromFLNRO. The data was:

- TFL_37_Cluster_Data.csv - compiled plot data for 5 utilization levels (4, 7.5, 12.5, 17.5, 22.5).
- UTM_Coordinates_etc.csv - includes plot locations

The 80 plots include (separated by TYPE_CD): Timber Emphasis + CWD (D01), Monitoring (M01), and Net Volume Adjustment (N01). We used the D01 plots.

Each plot included 4 satellite plots (total of 5). A call was made on the ground to determine which 4 satellite plots were within the inventory stand (some were in neighbouring stands). Outside plots were excluded.

The data has already been compiled to give per ha plot information (and the NVAF was applied). The following fields were required:

- CLSTR_ID - unique ID
- TYPE_CD - plot type (D01 was used)
- UTIL
- SPB_CPCT – species composition – used for matching plots to inventory stands
- BA_HA - basal area live
- STEMS_HA - density live
- HT_MEAN1 - weighted mean ht (incl. broken top) - used for Lorey Ht adjustment
- HT_M_TLS - mean height of top, site, and second spp site height trees (T,L,S).
- AT_M_TLS - mean age of (T,L,S trees)
- NVL_NW2 - NVAF * Whole stem vol/ha less Top, Stump, Cruiser Decay and Waste (live)

2) Plots were linked to an original TFL 37 inventory (1996 reference and projection year). Points were created from the UTM_Coordinates data and intersected with the inventory. FOREST_ID was used as the unique inventory ID.

3) Species attributes were compared to determine if inventory and plot layers match (4 cm utilization).

The result was that:

- 45plots matched at spp level
- 6 plots matched at genus level
- 27 plots matched at conif/decid level
- 2 plots did not match at conif/decid level and could not be used.

While the linkage is used to determine which inventory layer should be matched to the plot, we only have a single layer inventory.

Note, the original adjustment says only 58 (of 80) plots were used. The reason 78 plots are usable at this stage is because this includes young (<=35 years in 1996) plots. Excluding young plots the number is 58.

Only 20 plots in the young stratum can be used, since the other half are <=35 years old. The sampling targeted the entire population of stands, but the adjustment is only being done on >=36 year old (1996) stands.

4) Inventory is 1996 and plots were measured in 2001/2002. First the inventory needs to be projected to 2001 so it can be properly compared to the plots (also missing SPH and BA needs to be filled in by the VDYP7 FIP module).

The inventory values for the 80 plots were inserted into a VDYP 7 input template. Inv_Standard_Cd of "F" was used since the inventory is closer to an FC1 (with BA added) than a VRI. Reference year was 1996.

BEC Zone was taken from the TFL 37 MP 9 Ecology data (this is the BEC zone used in the Supply Block 8 VRI).

This input file was run in VDYP 7 ("Step 1") at a 7.5 cm utilization. Multiple years (1996-2015) were run but only 2001 is needed.

5) Compute Age, Height, Basal Area, and SPH adjustment ratios.

The original sample plan describes some very complex strata and sampling weights, however the original adjustment report just says “The sample was distributed evenly across the target population. Therefore each plot represented the same area/plot and had the same sampling weight.” Sam Otukol suggested we should use unweighted plots as originally done.

There were two strata: young (<300 yrs) and old (300 yrs). The original inventory just called all >=300 year old trees age 300.

Adjustment ratio of means (ROM) were calculated for each strata between:

- 2001 inventory (VDYP 7) age and plot AT_M_TLS (old strata just uses average age, no ratio)
- 2001 inventory (VDYP 7) PRJ_DOM_HT(7.5) and plot HT_M_TLS(7.5).
- 2001 inventory (VDYP 7) PRJ_BA(7.5) and plot BA_HA(7.5)
- 2001 inventory (VDYP 7) PRJ_TPH(7.5) and plot STEMS(7.5)

The Ministry Excel Marco VRI Analysis1_Original.xlsm was used to calculate sampling error.

While the average inventory age for the young strata matches the original adjustment, the average plot age does not (resulting in a new ROM of 1.286 vs the original 1.236). Most likely the plot compilation was slightly different between the original adjustment and the plot data used.

6) Calculate attribute adjusted volumes (and Lorey Ht).

VDYP 7 was run a second time ("Step 2") with the same species composition and other fields, however the age, height, basal area and stems/ha (output from the "step 1" run) were adjusted using the calculated adjustment ratios. The Inv_Standard_Cd was set to "V" so that VDYP will use the basal area and SPH. The reference year was set to 2001.

Only the 58 plots in the adjustment population were run. VDYP 7 output is needed at both 7.5 and 12.5 cm utilizations (same input file is run twice with different util parameters).

7) Calculate volume and lorey height adjustment ratios.

Adjustment ratios for each strata were calculated between:

- Inventory (VDYP 7 Step 2) PRJ_LOREY_HT(7.5) and plot HT_MEAN1(7.5)
- Inventory (VDYP 7 Step 2) PRJ_VOL_DW(12.5) and plot NVL_NW2 (12.5)

The lorey height ROM is used to adjust the lorey height, while the same volume ROM gets applied to WSV7.5, WSV12.5, CUV12.5, VOL_NET_D12.5, and VOL_NET_DW12.5.

8) Calculate final adjusted volumes ("Step 3")

The same "Step 2" VDYP input file is run (which has adjusted age, ht, BA, sph), but the following fields are also filled in:

- R1_ADJ_INPUT_ID - id based on strata (must be non null)
- R1_LOREY_HEIGHT - adjusted PRJ_LOREY_HT (7.5)
- R1_BASAL_AREA_125 - **un**adjusted PRJ_BA (12.5)
- R1_VOL_PER_HA_75 - adjusted PRJ_VOL_WS (7.5)
- R1_VOL_PER_HA_125 - adjusted PRJ_VOL_WS (12.5)
- R1_CLOSE_UTIL_VOL_125 - adjusted PRJ_VOL_CU (12.5)
- R1_CLOSE_UTIL_DECAY_VOL_125 - adjusted PRJ_VOL_D (12.5)
- R1_CLOSE_UTIL_WASTE_VOL_125 - adjusted PRJ_VOL_DW (12.5)

The above values came from the "Step 2" output multiplied by the adjustment ROM.

When this input is run in VDYP 7, it will use the adjusted lorey height and volumes to apply a final volume adjustmet to the output values.

9) Apply the final adjustment to the entire inventory.

The same steps need to be done:

a) project inventory to 2001 ("Step 1")

b) apply calculated age, height, BA, sph ROM to 2001 values and re-run VDYP to generate attribute adjusted values ("Step 2").

c) apply calculated lorey ht and volume ROM to attribute adjusted lorey ht and volumes. Input these as adjusted values and re-run VDYP to generate final adjusted volumes ("Step 3").

The adjustment population should be the economic land base that is >=41 years (2001). We do not have access to the original economic land base data, but do have the original TFL 37 TSR resultant with adjusted age/volume. The TSR resultant was used to determine the adjustment population.

An examination of the TSR resultant showed that stands >=30 (1996) were adjusted. This is inconsistent with the adjustment report stating that only stands >=41 (>=36 in 1996) were adjusted. We used the original adjustment report age (>=36 in 1996) to define the adjustment population.

Some old stands (>=36, 1996) were not adjusted in the TFL 37 TSR resultant. These were deemed the un-adjusted non-economic stands. They were extracted from the TSR resultant and rated into the TFL 37 inventory (50% rule). A few stands (< 100) were in the 25%-75% rating range.

Finally, the TSR resultant showed that no non-productive stands (NP_FOREST = “NP”) were adjusted.

The final adjustment was applied to the inventory where age (1996) >=36, not non-economic (in the old non-adjusted set), not non-productive, and the inventory had not been updated with a recent depletion.

May 25, 2015

To: Pacific TSA TSR Planning Team

From: Rueben Schulz, Forest Ecosystem Solutions Ltd.

RE: VRI Adjustment for Supply Blocks 28 and 29 (former TFL 41)

1 Introduction

As part of the current timber supply review (TSR) for the Pacific TSA, the best available inventory and growth and yield data is being compiled. Supply Blocks 28 and 29 of the Pacific TSA were formerly part of Tree Farm Licence (TFL) 41. The Vegetation Resource Inventories (VRI) for blocks 28 and 29 are based on a re-inventory of the TFL that took place between 1996 and 1998.

TFL 41 was originally inventoried between 1972 and 1976. This inventory was included in several timber supply analyses (completion dates in March of 1993 and February 1994).

Between 1993 and 1995, before the re-inventory, an inventory audit was completed on TFL 41. This audit consisted of 50 sample plots placed in mature stands (> 60 years old) of the forested land base in 1993. Eleven of these plots fell within the operable land base (as defined in the F_OPER FC1 map layer). Thirty additional plots were located in mature stands of the operable land base in 1995.

The audit report compared the 41 mature, operable plot volumes to the analysis unit yield curve volumes and VDYP 6 volume estimates from the 1994 TSR. The audit analysis determined that the analysis unit and VDYP 6 volumes were overestimated by about 200 m^3/ha. Approximately 60% of the bias was associated with the growth and yield model and 40% was associated with the inventory attributes. These comparisons were made to the original inventory volumes derived from the data collected between 1972 and 1976.

The 1996 to 1998 re-inventory of TFL 41 included a volume adjustment that was applied to age class 8 and 9 stands. The adjustment used updated 1974 sample strip plots to calculate a volume adjustment factor (VAF) between the updated strip plot volumes and inventory volumes estimated with VDYP 6. The adjustment was calculated and applied by leading species (Hemlock, Balsam, and Cedar). The overall adjustment factor was 0.7956, indicating that the VDYP 6 volumes were overestimated compared to the plot volumes

As the 1974 sample strip plot data were not available, the current inventory could not be adjusted as per the previous adjustment methodology. Instead, the 41 audit plots (1993-1995) in the mature, operable land base were used to adjust the inventory for supply blocks 28 and 29 of the Pacific TSA. The adjustment was completed on the current inventory (1996 - 1998) not the original inventory (1972 - 1976).

The re-inventory and inventory audit of TFL 41 were described in the following reports:

- Report on the Re-Inventory of Tree Farm Licence 41 1996-98, February 1999, Sterling Wood Group Inc., Victoria BC

- TFL 41 Inventory Audit, October 1997, Resources Inventory Branch, B.C. Ministry of Forests.

2 Methods

The 41 audit plots were provided by Sam Otukol of the Forest Analysis and Inventory Branch (FAIB) of the Ministry of Forests, Lands and Natural Resource Operations (FLNRO). Due to the lack of plot coordinates, they could not be directly linked to the stands in the inventory.

The spatial dataset F_OPER (FC1 operability data) was provided by Hubert Burger of the FAIB.

A volume adjustment factor (VAF) was calculated between the average audit plot volumes and the average mature, operable volume in the supply block 28 and 29 VRI. The VRI volume was back projected to 1995, the year of the majority of the plots.

Supply blocks 28 and 29 cover 426,733 ha, of which 201,178 ha is classified as Forest Management Land Base (FMLB); 169,572 ha of the FMLB is currently treed. Back projecting the VRI age to 1993 (the year of the first inventory audit plots) classified 155,199 ha of the FMLB as mature (>60 years old) forest. Of this mature forest, 41,363 ha were classified as operable in 1993. This operable mature forest formed the population for the inventory adjustment.

The VAF was only applied to current stands in the operable (F_OPER) land base that were > 140 years old (2014). While these old stands are only a subset of the audit population, the adjustment was limited to them to avoid bias due to the assumed increment of younger stands: at age 140 and older the stand yield curves are mostly static. Stands between the ages of 82 and 139 (2014) are assumed to grow and increase their volumes. The adjusted age class 8 and 9 stands form the majority of the mature operable land base at 38,788 ha (94% of the mature operable population).

The VAF, calculated at 17.5 cm utilization level was also applied to volumes at the 12.5 cm utilization level.

3 Results

The average audit plot volume was 504 m^3/ha (17.5cm utilization level, net decay, waste, and breakage). The VDYP 7 average volume in 1995 for the operable, mature land base was 700 m^3/ha. The calculated VAF between the audit plot and VRI VDYP 7 volumes was 0.72.

Table 1 shows the effect of the adjustment on the 2014 inventory volumes. Within the adjusted population, the average stand volume was decreased from 719 m^3/ha to 518 m^3/ha (12.5 cm utilization level). The adjustment impact is diluted when looking at the larger treed, FMLB portion of the VRI which saw average 12.5 cm utilization level volumes decrease from 437 m^3/ha to 391 m^3/ha.

Table 1: Blocks 28 and 29 unadjusted and adjusted 2014 volumes on the treed FMLB.

Population	Average 2014 Volume (m^3/ha) 12.5 cm util.		Average 2014 Volume (m^3/ha) 17.5 cm util.		Area (ha)
	Unadjusted	Adjusted	Unadjusted	Adjusted	
Adjusted Population	719	518	717	516	38,664
Entire VRI (updated with depletions)	437	391	432	386	169,572

4 Discussion

The calculated VAF at 0.72 is similar to the results of the audit report. The audit report calculated a 0.70 VAF between the audit plot volumes and inventory analysis unit volumes (17.5 cm utilization, net decay waste and breakage).

The average audit plot volume (17.5 cm utilization, net decay, waste, and breakage) of 504 m^3/ha had a 95% confidence interval of 460-548 m^3/ha. The 700 m^3/ha average 1995 VDYP 7 inventory volume is therefore likely an overestimate of the true volume within the mature, operable land base within the Pacific TSA supply blocks 28 and 29.

The 41 audit plots volumes were compared to the entire mature, operable land base in supply blocks 28 and 29. Comparing the audit plots to the inventory stands they fell within would likely yield a slightly different VAF; however linking the audit plots to inventory stands was not possible.

Supply blocks 28, 29 are located in the southern half of the former TFL 41. It is possible that there is a difference between the stand volumes in the north and south halves of the former TFL 41 area. If such a difference existed, the adjustment approach described above would not capture it.

The VRI has been updated for depletions since the inventory audit was completed. Harvesting has changed the original audit population as the harvested stands are now young and are no longer part of the adjustment population.

The results from the inventory audit suggest that the VDYP 7 volumes in the Pacific TSA supply blocks 28 and 29 are overestimated. Therefore, the adjusted inventory and related growth and yield inputs should be used in the preparation of growth and yield curves for the Pacific TSA TSR.

Appendix 3 – Economic Operability Report

Economic Operability Assessment

Analysis Report – Pacific TSA

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British Columbia | Ministry of Forests, Lands and Natural Resource Operations

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1 Introduction

An economic operability assessment was completed as part of the Pacific TSA timber supply review (TSR). The economically operable area forms one of the netdown items used to classify the timber harvesting land base (THLB) for the TSR. Areas that are classified as un-economic for harvest operations will be removed from the THLB.

The economic operability analysis is a strategic, landscape level analysis of the economically operable land base. It is not a detailed operational or tactical level analysis. The objective of the analysis is to determine the land base where - on average - operations are expected to be economic in average market conditions; it is likely that some individual stands may be incorrectly classified.

Care is needed to separate economic constraints from harvest scheduling constraints. Stands classified as un-economic are expected to remain as such given the assumptions and the data used in the analysis. Changes in market conditions and cost structure of operations will lead to a different economically operable land base and require an updated analysis.

Some harvest scheduling constraints are economic in nature. There are previously harvested areas with isolated remaining older age classes within the Pacific TSA that are clearly part of the economically operable land base. However, operations in these areas are not profitable until the immature stands reach maturity and can be harvested together with the older age classes.

The Pacific TSA economic operability analysis consisted of two main phases. The first phase used a coarse filter approach focusing on physical access. The second phase – a fine filter approach - assigned values and costs to each stand with the objective to identify stands with a positive net worth. The fine filter approach included gaming with blending; highly profitable stands were blended together with stands that were initially classified as un-economic to bring operational reality to the analysis. Sensitivity analyses were included testing the impact of changes in log prices on the economically operable land base.

2 Description of the Land Base

The Pacific Timber Supply Area (TSA) was established in July 2009 from an amalgamation of various tree farm license (TFL) areas taken back by the Province through the Forestry Revitalization Act (Bill 28, 2003). The Pacific TSA covers approximately 698,041 ha. It consists of 30 Blocks located on Vancouver Island, the Sunshine Coast, the Mainland Coast, and Douglas Channel (Figure 1). The Blocks range in size from 76 ha to 405,000 ha.

BC Timber Sales (BCTS) is the major operator in the Pacific TSA, holding approximately 93% of the AAC, with First Nations Tenures making up the remaining cut. At the time the TSR was initiated, the TSA was spread over three BCTS Business Areas (BA): Strait of Georgia (TSG), Seaward-Tlasta (TST), and Skeena (TSK). Since the analysis data set was prepared, the BCTS has initiated a transition of TSA Blocks in the Sunshine Coast (Blocks 21, 22, and 23) from the TSG BA to the Chinook BA (TCH). This transition will be complete by March 31, 2016. For the purposes of this analysis, all documentation associated with these Blocks will remain with a reference to TSG.

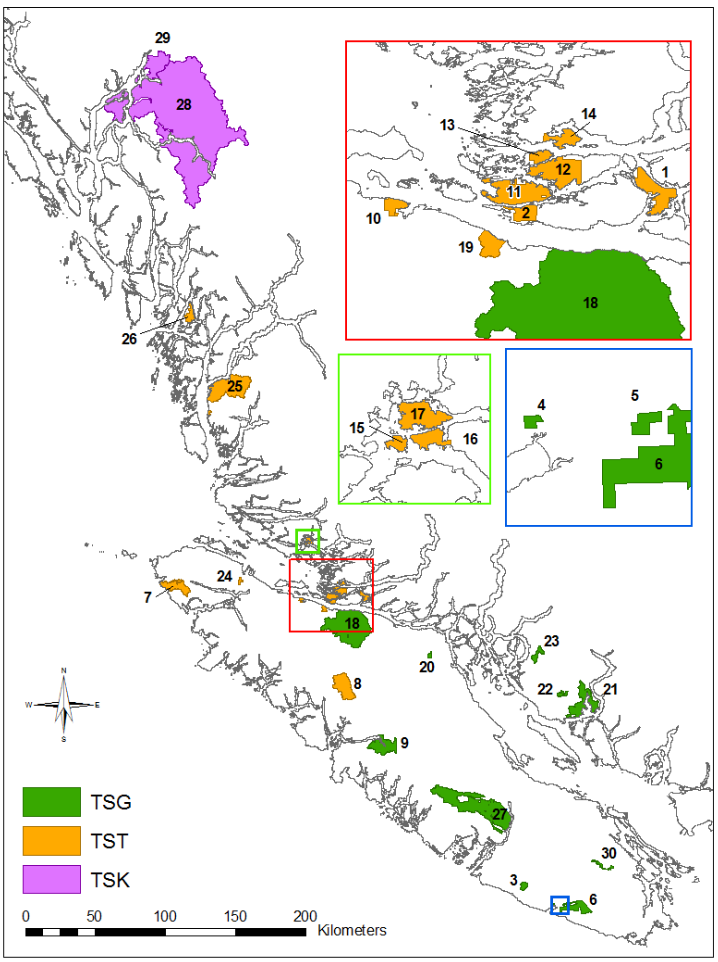

Figure 1: Pacific TSA Blocks

Due to the extent of the TSA, its terrain is variable including low elevation islands, outlying coastal mainland areas, inland regions of high mountains and productive valleys. The forests of the Pacific TSA are dominated by three main biogeoclimatic zones including Coastal Western Hemlock (CWH), Mountain Hemlock (MH) and alpine (CMA).

The southernmost portion of the Pacific TSA is more densely populated with a long harvest history, while the mid coast and north coast parts of the TSA are remote and sparsely populated.

3 Data Sources

This project was completed simultaneously with the Pacific TSA TSR and used the same data sources. The following data and data sources were used for the economic operability project:

Table 1: Spatial Data Sources

Layer Name	Description	Source	Vintage
pacific_tsa	Pacific TSA boundary	BCGW	2014
ogma	Legal, non-legal, and draft Old growth management areas	BCGW and BCTS	2014
f_own	Generalized ownership	BCGW	2014
wdlt_cf	Managed forests – woodlots, community forests, and First Nations Woodland Licenses	BCGW	2014
clab_ir	Federal Indian Reserves	BCGW	2014
parks	Provincial parks and protected areas	BCGW	2014
conserve	Conservancies	BCGW	2014
survey_pa	Survey parcels	BCGW	2014
clayoquot_reserves	Clayoquot sound no harvest areas	GEOBC	2011
terrain	Terrain stability and ESA mapping	BCTS	various
vqo	Visual quality objectives	BCGW and BCTS	2014
UWR	Ungulate winter ranges	BCGW	2014
WHA_legal	Wildlife habitat areas	BCGW	2014
ebm_grizzly	grizzly habitat	EBM	2013
water_polys	Lakes, Rivers and Wetlands	FESL (TRIM, VRI, BCTS)	2014
aoa_final	Archeological potential	FLNRO	2014
recreation	recreation areas (trails, huts, etc)	BCTS and BCGW	2014
arch_sites	Archeological and historic sites	BCTS (FNLR)	2014
vri_final	VRI plus depletions	FESL (BCGW, BCTS, FLNRO)	2014
rds_tsr	Roads	BCTS and FESL	2014
woodsheds	Woodsheds are spatially defined areas within the TSA that are tributary to the same appraised point of origin and are located within the same supply block.	FESL, based on BCTS notes	2015
25m DEM	Digital elevation model at 25m resolution	FESL, derived from TRIM	2014
roads	Existing, deactivated, and future roads	BCTS	2014
recent_harvest	Depletions from 2014 and 2015	BCTS	2015

4 Methodology

4.1 Summary

The following steps describe the overall methodology:

1. Accessible land base was defined using the existing and planned road network.
    a. Areas within a 200 to 300 m distance from a road were classified as conventional harvest areas;
    b. Areas outside of the conventional harvest areas were classified helicopter harvest areas, if they were located within 2,000 m from the coast or a road;
    c. Areas more than 2,000 m from a road or the coast were considered inaccessible.
    d. Results were reviewed by operational staff. Changes were made where appropriate.
2. Conventional areas were further split into cable and ground:
    a. If the slope was less than or equal to 40% and the distance to the nearest road was 20 m or less the harvest method was classified as ground;
    b. If the slope was greater than 40% or the distance to the nearest road was greater than 20 m, the harvest method was classified as cable;
    c. The general methodology was reviewed by operational staff.
3. The maximum working land base was defined.
    a. Non-forest, private lands, inaccessible areas, parks, etc were excluded from the landbase.
4. Cost to harvest each stand was estimated:
    a. Average operating costs were standardized to per cubic meter based on information provided by Price Huber & Associates Inc. for each Pacific TSA Block. Some costs were adjusted in TSK based on local knowledge.
    b. Road building costs (per km) by slope and major structure costs were provided by BCTS for each Pacific TSA Block;
    c. Road building and major structure costs were shared between the unharvested conventional stands accessed by that road.
5. Stand value was calculated for each stand in the maximum working land base. Stand value consists of:
    a. Volume by species in the current vegetation resource inventory (VRI);
    b. Grade by species; historic grade distributions were used to estimate the current grade distributions;
    c. Selling price by grade; average Vancouver Log Market (VLM) prices for the last 10 years were used to estimate the selling price.
6. Profit before road building costs was calculated for each stand. Profit consists of the difference between the estimated stand value and the estimated cost to harvest the stand. Stands with a positive profit are considered economic to harvest. All previously harvested stands were

considered economic with the exception of previously harvested unroaded areas; these were assessed using helicopter harvesting related criteria.

7. Each road was assessed as to whether the total positive profit from the conventionally harvestable stands accessed by it covers the road and major structure building costs.
8. The economic operable land base can be expanded by harvesting profitable stands along with marginally unprofitable stands. This was simulated in the project by blending profitable stands with unprofitable stands after road costs were covered. Blending of stands can only occur within a woodshed. Woodsheds are spatially defined areas within the TSA that are tributary to the same appraised point of origin and are located within the same timber supply block.
9. Results were reviewed by operational staff. Changes were made where appropriate.

4.2 Accessible Land Base (Coarse Filter)

The main input for defining the accessible land base was the road network. A road dataset consisting of all existing, deactivated, and proposed roads was provided by BCTS. Permanently deactivated roads were not included in the project. Deactivated roads that could be reactivated in the future were included in the analysis.

A slope dataset for the study area was derived from the TRIM DEM at 25 m resolution. Slope was used to classify conventional harvest areas into cable harvest areas and ground based harvest areas.

4.2.1 Road Buffers

All roads were buffered by 300 m or 200 m to delineate helicopter and conventional harvest areas. The 200 m buffer was used in areas with steeper slopes. The buffer widths for different Pacific TSA Blocks are shown in Table 2.

Table 2: Road buffers in different Pacific TSA Blocks

BCTS Business Area	Blocks with 200 m Road Buffer	Blocks with 300 m Road Buffer
TSG	9, 18, 21, 22, 23, 27	3, 4, 5, 6, 20, 30
TST	8, 19, 25, 26	1, 2, 7, 10, 11, 12, 13, 14, 15, 16, 17, 24
TSK	28, 29	

Roads and coastlines were also buffered by 2,000 m to define the helicopter harvest areas. These buffers were classified as follows:

1. Areas within 300 m of a road (or 200 m) are conventional harvest areas;
2. Areas between 300 m (200 m) and 2,000 m from a road are helicopter to land harvest areas;
3. Areas within 2,000 m of the coast are helicopter to water areas;
4. All areas more than 2,000 m from a road or the coast were considered inaccessible.

These areas were mapped and forwarded to BCTS for review. Changes in the classification were made based on local knowledge.

4.2.2 Slope Classification and Harvest Method

Once the review and required changes were complete, the conventional harvest areas (as defined above) were further split into cable or ground harvest, based on slope, as follows:

- If the slope was less than or equal to 40% and any part of the polygon was 20 m or less from the nearest road, the harvest method was classified as ground;
- If the slope was greater than 40% or the entire polygon was further than 20 m from the nearest road, the harvest method was classified as cable;

This classification was intended to ensure that gentle slopes with no direct access to a road were classified as cable.

The ground versus cable harvest areas were mapped and forwarded to BCTS for review. The results of removing inaccessible area (coarse filter) are presented in Table 3. In the TSR netdown, inaccessible areas are removed from the THLB.

Table 3: Harvest Method Area Summary

Block	Cable	Ground	Helicopter to land	Helicopter to water	Inaccessible	Total
1	449	1,559		328		2,336
2	52	950		15		1,017
3	1,129	859	306			2,294
4	0	70	5			76
5	14	184	0			198
6	3,406	5,421	1,403		2	10,233
7	2,948	7,831	621			11,400
8	2,919	3,296	11,622		514	18,351
9	3,200	1,971	7,148	3,198	1,107	16,623
10	74	724				798
11	459	2,699		300		3,459
12	192	2,659	20	214		3,085
13	50	584		11		645
14	151	862		115		1,128
15	55	201		3		259
16	155	327		38		521
17	279	704		131		1,114
18	14,430	17,899	26,590		225	59,145
19	103	48	990		209	1,350
20	54	694	86			834
21	4,900	6,122	4,714	4,676	192	20,604
22	161	1,420	119			1,700
23	977	645	2,074		23	3,719
24	15	998	2			1,015
25	3,979	4,598	18,772	6,496	3,720	37,565
26	520	1,510	1,051	2,396		5,476
27	17,402	16,541	27,831	350	2,169	64,293
28	10,641	13,849	102,551	47,892	230,346	405,279
29	1,130	1,526	10,139	3,032	5,626	21,454
30	385	1,670	14			2,070
Total	**70,230**	**98,426**	**216,060**	**69,193**	**244,132**	**698,041**

4.3 Fine Filter Analysis

The fine filter analysis introduces a fine filter to assign the total harvest costs and values to each stand. Both costs and values were applied in dollar amounts to facilitate direct comparisons and sensitivity analysis.

4.3.1 Maximum Working Land Base

Maximum working land base (MWLB) was used as the reference land base for the fine filter analysis. This land base represents a preliminary netdown, where only permanent, legally established and explicit 100% land base netdowns are applied. The following areas were removed from the TSA land base:

Table 4: Maximum Working Land Base Netdown

Description	Net Area (ha)	Gross Area (ha)
Total Pacific TSA	**698,041**	
Inaccessible Areas (from coarse filter)	244,132	244,132
Non-Crown	5,424	5,551
Non-Forest	82,602	264,157
Non-Commercial Brush	9,967	31,199
Parks and Protected Areas	7,264	11,050
Ungulate Winter Range	15,308	24,085
Wildlife Habitat Areas (legal)	1,217	1,582
EBM Grizzly Habitat Class 1	585	725
Clayoquot Reserves	3,075	5,526
Old Growth Management Areas (legal)	18,572	26,518
VQO Preservation Areas	25,878	728
Terrain Stability Class 5	324	40,903
Archeological Sites	743	840
Recreation Areas (legal)	632	2,892
Maximum Working Land Base	**282,318**	

The maximum working land base is a much larger area than the eventual THLB. Using a larger area for the fine filter analysis allows for future changes in the THLB netdown without the need to re-assess economic operability. Table 5 shows the area of the MWLB by Block.

Table 5: Maximum Working Land Base by Block

Block	MWLB (ha)		Block	MWLB (ha)
1	2,245		16	474
2	979		17	1,081
3	1,824		18	39,725
4	63		19	927
5	192		20	506
6	7,354		21	15,377
7	9,393		22	1,588
8	10,197		23	2,250
9	10,170		24	989

Block	MWLB (ha)		Block	MWLB (ha)
10	762		25	15,916
11	3,288		26	4,719
12	3,039		27	46,461
13	611		28	88,427
14	1,060		29	10,489
15	256		30	1,956
Total				**282,318**

4.3.2 Previous Harvest

All conventional stands that were previously harvested or established since 1965 were considered economic by default. In helicopter accessible areas, stands under 50 years old with at least 30% Douglas-fir, cedar or cypress were considered economic.

4.3.3 Costs

Harvest costs include all harvesting, transport and overhead costs, except stumpage costs. Cost information is based on the "Licencee Benchmark Logging Cost Project Report" by Price Huber & Associates Inc. completed in July 2010 and updated in March 2015.

The Licensee Benchmark Logging Cost Project Report was originally designed to assist BCTS staff to prepare logging cost estimates for timber sales. The information was acquired through surveys and interviews from a number of sources, which are confidential. The costs are based on generalized assumptions and they are provided for various operating areas within the Pacific TSA.

In TSK, the initial costs in the report were modified based on local knowledge. Costs for hauling, booming, towing, barging, engineering, and silviculture were adjusted.

Average harvesting and transport costs were assigned to each stand based on its Pacific TSA Block (location). The yarding costs were broken down based on the harvest method:

- Ground-based harvesting
- Cable harvesting
- Helicopter harvesting

Stands that require future road construction to provide access had road building costs assigned to them as per section 4.3.2.1.

The following costs were included (not all costs apply to every Block):

- Falling
- Chucking
- Yarding
- Helicopter drop
- Mechanical processing
- Loading
- Hauling
- Road maintenance
- Booming
- Towing
- Barging

- Mobilization
- Overhead
- Log brokerage
- Waste assessments
- Crew boat
- Crew services
- Camp costs
- Engineering
- Silviculture

All the costs listed above were applied on a per cubic meter basis.

Hauling costs were calculated based on an average distance from the Block to the nearest log dump or highway accessed mill and consisted of the following factors shown below with an example in Table 6.

Table 6: Example of hauling cost calculation

Factor	Value
Round trip distance on paved road:	8 km
Round trip distance on gravel road:	38 km
Time on paved road:	0.1 hr
Time on gravel road:	1.52 hr
Time to load/unload:	1 hr
Total time per load:	2.62 hr
Number of loads/day:	4
m^3 per load:	46
m^3/day:	184
cost/day:	$1,200
Cost/ m^3:	**$6.52**

The cost of $6.52/$m^3$ would then be applied to all stands within the Block as the hauling cost.

4.3.3.1 Road Construction

Road building costs were assessed separately from other costs. All proposed, deactivated, and semi-deactivated roads were split by Block and slope, and the total cost to build or reactivate each road was calculated. Road building costs attributable to sections of roads outside the Pacific TSA were deducted from the total costs for each road.

The total cost for each road was shared between all MWLB conventional areas that are accessed by that road. All conventional harvest polygons in the MWLB were linked to the closest road. The road building costs were shared by the stands accessed by that road.

Reactivation of deactivated and semi-deactivated roads in previously harvested areas was assumed to be economic in the TSG and TST business areas. This was based on the principle that previously harvested stands were considered economically operable in the future.

However, in the TSK business area many semi-deactivated roads were not originally built for timber harvesting. Rather, other industries required them for their operations. In TSK, only those semi-deactivated roads that access areas where more than 50% of the area is previously logged were assumed to be economic.

4.3.3.2 Structure Costs

Costs (by Block) to build bridges, install culverts, and reactivate or build new log dumps were received from BCTS. Point locations for all these features were also provided. The costs for larger bridges (over 10 m in length) were added to the road construction costs and shared by the stands accessed by the road. The costs of culverts, log dumps and bridges less than 10 m in length were ignored.

4.3.4 Values

Each stand in the Pacific TSA MWLB was assigned a value ($\$/m^3$) based on its species distribution, estimated grade distribution for each species, and historical average Vancouver log market values by species and grade. The data was provided by the Timber Pricing Branch of the Ministry of Forests, Lands and Natural Resource Operations (FNRO). Due to the lack of grade distribution data for second growth stands, only old growth grade distributions and prices were used in the analysis.

Values were calculated as:

Value ($) = Species Volumes ($m^3$/ha) x Area (ha) x Grade Distribution by Spp x Log Price by Spp and Grade Distribution ($\$/m^3$)

Stand species volumes were based on adjusted (where available) VRI volumes by species. Since previously logged roaded stands are assumed to be economic, only stands older than 50 years of age were assessed.

4.3.4.1 Grade Distributions

Grade distributions from 1995 to 2014 scale data for the Pacific TSA were acquired from the Timber Pricing Branch of FLNRO. Due to the changing makeup of the harvest over this time period, only grade data from 2005 onwards was used to represent the harvesting in the TSA. Scale data was linked to each TSA Block by its opening id.

The average harvested grade distributions were summarized for each species and TSA Block. In cases where there was limited past harvesting for a species in a Block, the species and Block were grouped with neighbouring Blocks with similar ecologies. At the end, 98 grade distributions were used for species in the 30 TSA Blocks. Table 7 presents the average grade distributions for the TSG and TST business areas. Table 8 shows the same for the TSK business area. Figure 2, Figure 3, and Figure 4 show the grade distribution by species for each business area.

Table 7: Average grade distributions by business area, TSG and TST

Business Area	Species	Coastal Grade Distributions															
		B	C	D	E	F	G	H	I	J	K	L	M	U	W	X	Y
TSG	Cw	0%	0%	3%	0%	2%	0%	29%	12%	21%	4%	6%	5%	10%	0%	5%	3%
	Cy	0%	0%	3%	0%	4%	0%	28%	10%	15%	0%	0%	0%	11%	0%	11%	18%
	Dr	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	82%	0%	18%

Business Area	Species	Coastal Grade Distributions															
		B	C	D	E	F	G	H	I	J	K	L	M	U	W	X	Y
	Fd	1%	5%	2%	0%	2%	0%	18%	16%	41%	0%	0%	0%	9%	0%	3%	3%
	HwBa	0%	0%	2%	0%	3%	0%	22%	11%	28%	0%	0%	0%	14%	0%	11%	9%
	Pine	0%	0%	1%	0%	1%	0%	21%	16%	21%	0%	0%	0%	22%	0%	9%	9%
	Ss	0%	0%	0%	0%	0%	1%	18%	20%	39%	0%	0%	0%	14%	0%	4%	3%
TST	Cw	0%	0%	2%	0%	1%	0%	27%	10%	17%	6%	10%	7%	11%	0%	4%	5%
	Cy	0%	0%	3%	0%	3%	0%	32%	11%	24%	0%	0%	0%	11%	0%	6%	10%
	Dr	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%	0%	25%
	Fd	1%	11%	3%	0%	3%	0%	24%	13%	27%	0%	0%	0%	11%	0%	3%	3%
	HwBa	0%	0%	1%	0%	2%	0%	21%	10%	40%	0%	0%	0%	14%	0%	7%	5%
	Pine	0%	0%	0%	0%	0%	0%	5%	2%	61%	0%	0%	0%	11%	0%	8%	13%
	Ss	0%	0%	2%	1%	1%	2%	32%	24%	17%	0%	0%	0%	10%	0%	4%	7%

Table 8: Average grade distributions by business area, TSK

Business Area	Species	Interior Grade Distributions				
		1	2	4	6	Z
TSK	Cw	32%	47%	21%	0%	0%
	Cy	33%	51%	16%	0%	0%
	Fd	14%	82%	4%	0%	0%
	HwBa	32%	40%	28%	0%	0%
	Pine	0%	39%	61%	0%	0%
	Ss	34%	52%	15%	0%	0%

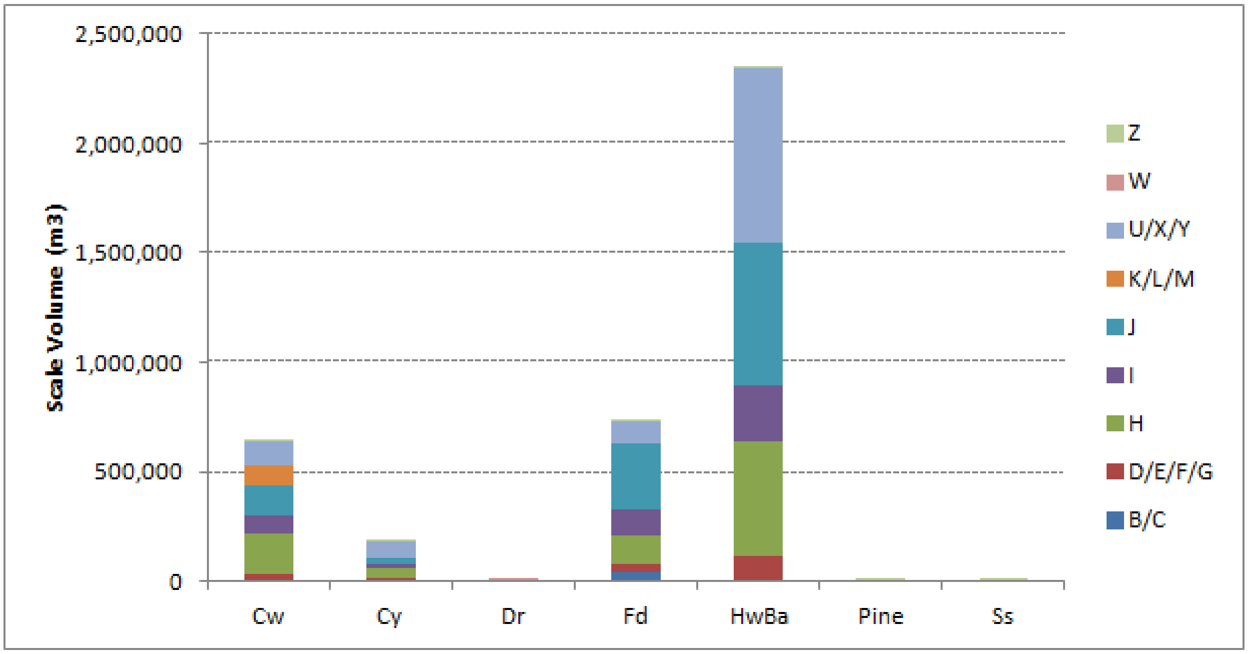

Figure 2: Grade Distribution by Species, TSG Business Area

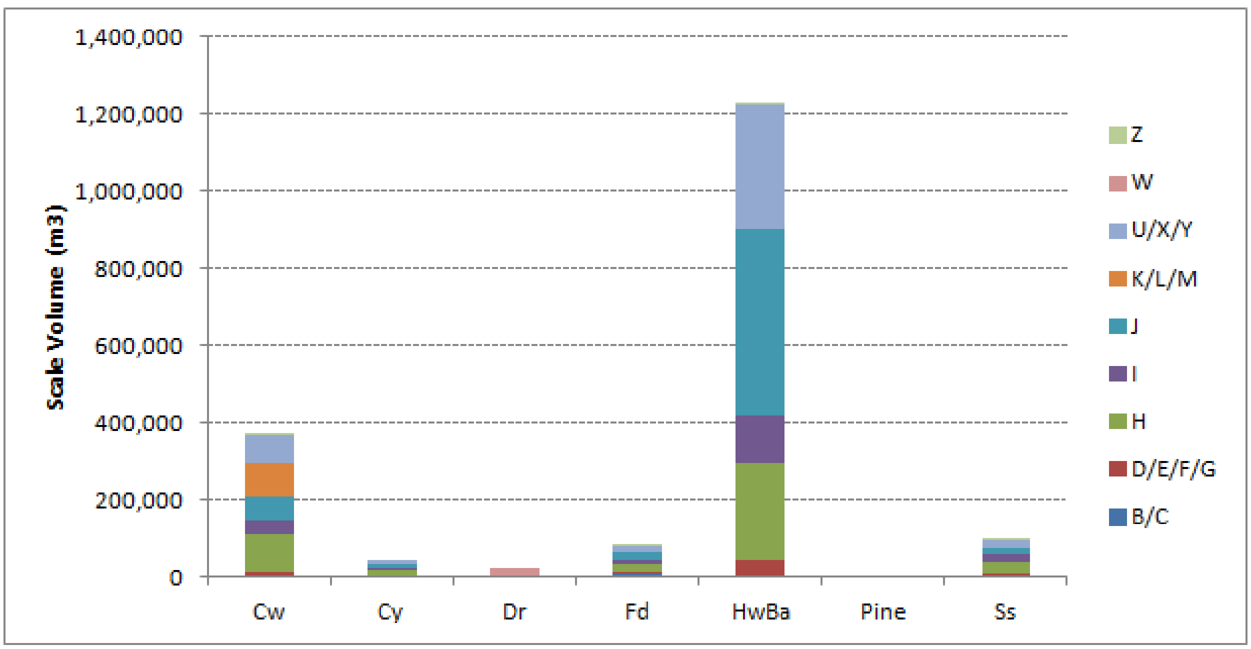

Figure 3: Grade Distribution by Species, TST Business Area

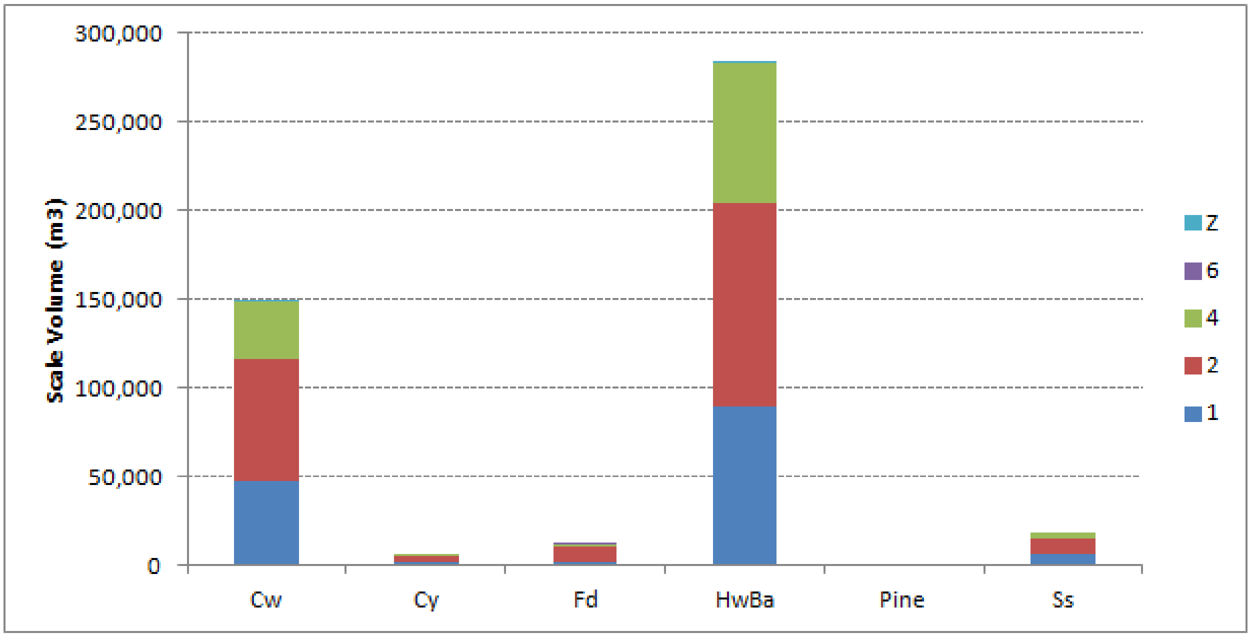

Figure 4: Grade Distribution by Species, TSK Business Area

4.3.4.2 Log Values

FLNRO coastal domestic monthly log prices by species and grade from 2005 to 2014 where used to generate the average log prices used in the analysis. Prices were adjusted for inflation using Statistics Canada Consumer Price Index values, and averaged for the period of 2005 to 2014 (Table 9). The averages were volume weighted. This minimizes the impact associated with small or zero volumes in some months.

Prices for Skeena interior grades (numbers) were generated by weighted averages of coastal grade prices. Sawlog grades (grades 1 and 2) were assumed to equate to coastal sawlog grades B to M, and grade 4 was assumed to be composed of coastal U, X and Y grades. The weighting between the coastal prices was based on the relative amounts of these coastal grades in the mid-coast Blocks (Blocks 25 and 26).

Table 9: Old growth log prices by species and grade (2005 – 2014)

Species	Business Area	Grade	Average Price $/m^3	Standard Deviation $/m^3
HwBa	TSG, TST	D	147.76	23.85
		F	109.94	11.04
		H	72.12	7.52
		I	54.82	6.01
		J	52.85	5.77
		U	43.52	4.40
		X	42.23	4.88
		Y	40.56	5.05
Cw	TSG, TST	D	300.92	51.72
		F	262.53	49.06
		H	184.05	30.83
		I	129.43	28.88

Species	Business Area	Grade	Average Price $/m³	Standard Deviation $/m³
		J	144.00	30.97
		K	176.65	31.53
		L	143.50	27.64
		M	99.67	22.08
		U	68.71	26.04
		X	50.67	18.95
		Y	9.14	3.54
Cy	TSG, TST	D	477.54	138.62
		F	286.47	59.09
		H	148.63	23.25
		I	96.39	16.68
		J	80.27	14.42
		U	51.34	9.55
		X	47.40	17.02
		Y	16.43	5.21
Fd	TSG, TST	B	214.94	41.59
		C	153.33	25.87
		D	402.70	68.52
		F	275.46	38.70
		H	142.78	19.96
		I	96.84	20.77
		J	80.81	16.23
		U	52.18	7.71
		X	38.39	5.20
		Y	33.23	6.71
Ss	TSG, TST	D	419.93	105.12
		E	346.95	84.55
		F	303.94	80.72
		G	237.52	54.20
		H	126.64	39.09
		I	76.09	17.00
		J	69.72	10.19
		U	47.03	5.89
		X	42.97	8.45
		Y	41.55	8.90
Dr	TSG, TST	X	69.56	13.12
		Y	41.88	19.17
Pine	TSG, TST	D	0.00	0.00
		F	154.28	94.27
		H	116.33	68.29
		I	75.38	41.20
		J	57.75	32.69
		U	55.08	21.42
		X	46.14	18.56
		Y	45.11	18.06
Cw	TSK	1	158.68	30.39

Species	Business Area	Grade	Average Price $/m³	Standard Deviation $/m³
		2	158.68	30.39
		4	47.53	17.97
Cy	TSK	1	108.52	18.86
		2	108.52	18.86
		4	37.24	9.92
Fd	TSK	1	133.31	22.64
		2	133.31	22.64
		4	46.24	7.10
HwBa	TSK	1	63.82	7.03
		2	63.82	7.03
		4	42.01	4.79
Ss	TSK	1	131.13	34.72
		2	131.13	34.72
		4	43.94	7.62

4.3.4.3 Log Exports

The log export market is an important market for logs produced from many of the Pacific TSA Blocks. All logs – with the exception of cedar and cypress – produced within the Pacific TSA are exportable under the Forest Act and current policies, provided that they fall under a blanket exemption, or that an exemption permit is issued under the surplus criteria.

Certain areas of the Province are covered by blanket export exemptions issued under Order-In-Council (OIC). Blocks 25 and 26 of the Pacific TSA fall under the Mid Coast Blanket OIC. Under this OIC, 35% of the volume harvested under any tenure in any single year may be exported (other than Cedar and Cypress). Volumes harvested above this percentage may be exported under the surplus criteria.

Blocks 28 and 29 of the Pacific TSA fall under the Northwest Interior Blanket OIC. Under this OIC 20% of the volume harvested (other than cedar and cypress) may be exported. Volumes harvested above this percentage may be exported under the surplus criteria.

Billed volume data from 2008-2014 was compared to 2008-2014 BCTS export data for each business area, tree species and grade. The percent of the billed volume for each tree species and grade that was exported was calculated for each business area (Table 10).

The log prices were increased by an export premium multiplied by the percent of the exported grade to create a blended average price between domestic and exported logs. This analysis tested the impact of $30/m³ price premium on the economically operable land base.

Table 10: Estimated export percent 2008 - 2014

Business Area	Species	Export percent for Grade														
		1	2	4	6	D	E	F	G	H	I	J	U	W	X	Y
TSG	Fd									39%	39%	29%	3%		0%	1%
	HwBa					16%		19%		50%	31%	43%	4%		0%	0%
	Ss									39%	85%	53%	4%			
TSK	HwBa	52%	40%	4%	0%											
	Ss	75%	45%	17%	0%											
TST	Fd									47%	44%	14%	2%		0%	
	HwBa					20%		25%		42%	25%	38%	4%		0%	0%
	Ss					5%	13%	10%	17%	65%	66%	40%	7%		1%	0%

4.3.4.4 High markets and low markets

Two market price sensitivity analyses were completed: the low price sensitivity used the average domestic price subtracting 2 standard deviations from it. The high prices sensitivity analysis added two standard deviations to the average price.

Two standard deviations around the mean were considered a reasonable indicator of market fluctuations after investigating the log value data. For most species and grades, two standard deviations captured the highs and the lows of the market cycles. Figure 5 provides an example for HemBal grade H inflation adjusted price between 2005 and 2014.

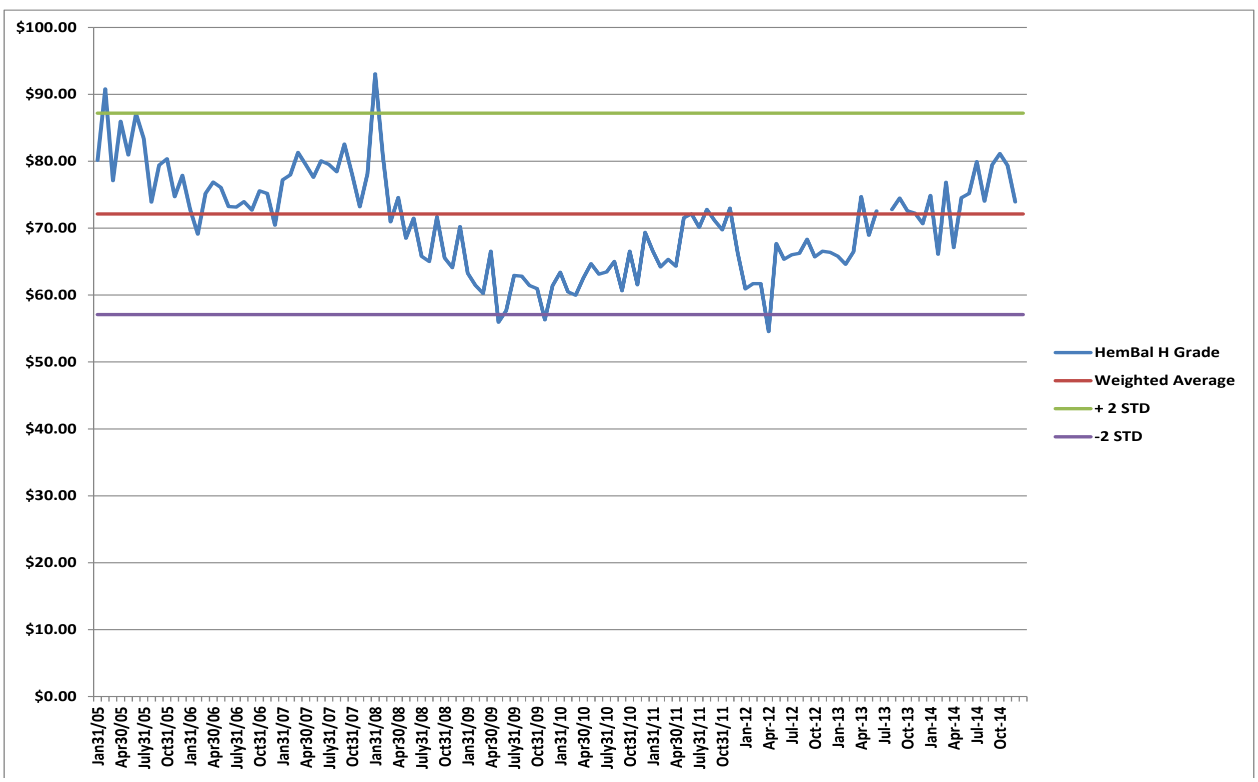

Figure 5: Volume weighted inflation adjusted average price for HemBal, H-grade, 2005 – 2014

4.3.4.5 Stand Values

Final value inputs for the Pacific TSA stands were based on the species and grade values in Table 9, and the grade distributions in Table 7 and Table 8. The impact of log exports was tested by adjusting the values by export percentages (Table 10) and by adding an export premium of 30$/m^3 to each exported cubic meter for grades shown in Table 10. Each stand in the TSA was assigned a value reflecting its volume and species distribution, historic grade distribution and historic average price.

4.3.4.6 Profit or Net Stand Value before Blending

Projected harvest costs – before road building costs – per polygon (forest stand) were subtracted from stand values for each polygon. This calculation was completed for each polygon in the MWLB resulting in an estimate for an economically operable land base by polygon, before road construction costs.

4.3.4.7 Blending

Net stand value estimates of individual polygons do not reflect tactical and operational reality, because in operations the harvest of marginally economically inoperable stands is often made possible by the harvest of valuable, economically operable timber. This practise is called blending and it can occur in spatially defined units (woodsheds). BCTS faces the same cutblock blending rules as the major licensees; the cutblocks must meet the requirements outlined in the Coast Appraisal Manual (TSG, TST) and the Interior Appraisal Manual (TSK). The areas within which cut block blending is allowed are called woodsheds in this analysis. Table 11 lists all the woodsheds in the analysis. The first part of the woodshed name denotes the Block(s) it covers. Some of the larger Blocks are split into several woodsheds, while smaller Blocks may be grouped together to form a woodshed.

Table 11: Woodsheds in the Pacific TSA

Woodshed	Area (ha)	MWLB Area (ha)		Woodshed	Area (ha)	MWLB Area (ha)
1	2,336	2,245		28A-5	925	727
10-19	2,148	1,689		28A-6	17,410	6,459
11	3,459	3,288		28A-7	174,791	20,928
12	3,085	3,039		28A-8	100,347	28,601
13	645	611		28B-1	20,697	4,691
14	1,128	1,060		28B-2	52,279	2,701
15-16-17	1,894	1,810		28C-1	1,077	944
18 - EvNa	23,140	15,618		28C-2	412	324
18 - Tsit	36,004	24,107		28C-3	4,846	2,216
2	1,017	979		28C-4	2,752	1,447
20	834	506		28C-5	6,272	3,196
21 - 1	10,739	7,351		28D	4,157	3,426
21 - 2	5,710	4,835		28E	1,135	1,010
21 - 3	5,855	4,780		28F	889	879
23	3,719	2,250		28G	530	413
24	1,015	989		28H	93	93
25	37,565	15,916		29	21,454	10,489
26	5,476	4,719		3	2,294	1,824
27 - 1	52,767	41,592		30	2,070	1,956
27 - CLAY	11,526	4,869		4, 5, 6	10,507	7,609
28A-1	1,526	1,414		7	11,400	9,393

Woodshed	Area (ha)	MWLB Area (ha)		Woodshed	Area (ha)	MWLB Area (ha)
28A-2	2,826	1,146		8	18,351	10,197
28A-3	2,549	1,642		9 - BURM	10,644	6,038
28A-4	9,767	6,171		9 - JACK	5,979	4,131

This analysis simulated cut block blending by ranking the negative profit stands in descending order of profit/ha and then using the positive profits from the economically operable stands to cover their harvesting costs. In areas where road building or reactivation was not required, the negative profit stands were added to the economically operable land base until the positive profit was used up.

In areas where road construction was required, the road building and re-activation costs were covered first before any profits from economically operable stands were assigned to negative profit stands.

4.3.4.7.1 Land Base for Blending

Areas that were expected to be removed from the land base in the final land base netdown were not allowed to contribute to blending.

4.3.4.7.2 Conventional Harvest Areas

Existing and deactivated roads (with some exceptions in TSK) were considered economic. All positive profit stands accessed by these roads were available to support other marginally uneconomic areas within the same woodshed.

For proposed roads and those deactivated roads that were assessed, all positive profits from stands attached to each road were summed up and compared to the road building costs for that road. If the profit was adequate to cover the road building costs, the remaining profit (if any) was used to support other roads and stands within the woodshed.

If the positive profits were not adequate to cover the road building costs, the positive profit stands attached to the planned road were grouped as one blending unit. This blending unit could then receive funding from other areas within the woodshed to determine whether the road could be paid for or not. If the road could be paid for by blending, any remaining negative profit stands along the road entered the pool of stands needing to be supported by economically operable stands.

If no positive profit stands existed on the planned road, all stands accessed by that road were grouped together to form a blending unit. Profits that remained from other areas could be used to support these blending units. If the road could not be built after this support, the road was deemed uneconomic to build and all stands attached to that road were classified as uneconomic.

The negative profit stands and road blending units were all ranked by profit/ha and funded by the profitable stands within the woodshed.

4.3.4.7.3 Helicopter Harvest Areas

In helicopter harvest areas all positive profits from economically operable stands were summed up by woodshed. These stands were available to support others within the same woodshed. The negative profit stands were added to the economically operable land base until the positive profit was used up.

Helicopter to land polygons were classified as uneconomic if the road building through conventional harvest areas to access these polygons were deemed uneconomic as per section 4.3.3.7.2.

4.3.4.8 Notes

- Previously harvested stands (conventional harvest) were considered economic by default. They were not used to support any other stand in a woodshed.
- It was expected that operational review would reveal any previously harvested stands that may not be economically operable.
- Previously harvested helicopter polygons were considered economic by default only if more than 30 % of the stand consisted, or was predicted to consist, of any combinations of Yc, Cw or Fd. Otherwise the stands were classified as uneconomic.
- As discussed before in this document, reactivation of roads within previously harvested areas was assumed to be economic with some exceptions (TSK).
- There was no blending of cut blocks between conventional harvest areas and helicopter harvest areas.

5 Results

5.1 Scenarios

Two scenarios were completed; one at a $0/m^3 export premium and the other at $30/m^3 export premium. For both scenarios the economically operable land base was determined at low, average and high historic prices; it was also determined separately for conventional and helicopter harvest areas.

Table 12 and Table 14 show the economically operable MWLB for each scenario by harvest method.

Table 13 and Figure 6 show a break-down of the economically operable MWLB area by leading species for the $0 export premium scenario. Figure 7 and Table 15 show the same break-down by leading species for the $30 export premium scenario.

In all cases, 60% or more of the economically operable area is hemlock or balsam leading.

Table 12: Economically Operable MWLB area, $0 export premium

Block	Low Prices			Avg Prices			High Prices		
	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total
1	781		**781**	985		**985**	1,594		**1,594**
2	385		**385**	595		**595**	943		**943**
3	1,660	10	**1,670**	1,702	10	**1,712**	1,702	94	**1,795**
4	11		**11**	18		**18**	60		**60**
5	26		**26**	140		**140**	192		**192**
6	3,843	18	**3,862**	6,495	18	**6,513**	6,694	18	**6,712**
7	5,466	19	**5,485**	8,964	19	**8,983**	9,141	101	**9,242**
8	4,017	558	**4,575**	5,004	558	**5,562**	5,135	660	**5,795**
9	2,074	243	**2,317**	4,065	243	**4,307**	4,440	1,558	**5,998**
10	407		**407**	560		**560**	754		**754**
11	541		**541**	735		**735**	1,426		**1,426**
12	1,696		**1,696**	1,741		**1,741**	2,166		**2,166**
13			**0**	28		**28**	366		**366**
14	364	11	**374**	611	11	**621**	938	11	**948**
15	69		**69**	161		**161**	249		**249**
16	207		**207**	314		**314**	456		**456**
17	283		**283**	764		**764**	971	7	**978**
18	19,019	1,208	**20,227**	25,532	1,208	**26,741**	27,893	1,660	**29,554**
19			**0**	34		**34**	146		**146**
20	104		**104**	506		**506**	506		**506**
21	5,683	1,069	**6,752**	9,891	1,100	**10,991**	10,039	2,449	**12,488**
22	539	2	**542**	1,494	2	**1,496**	1,501	39	**1,540**
23	974	58	**1,033**	1,479	58	**1,538**	1,526	171	**1,697**
24	348		**348**	947		**947**	987	0	**988**
25	3,215	617	**3,831**	5,391	617	**6,008**	7,034	617	**7,651**

Block	Low Prices			Avg Prices			High Prices		
	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total
26	539	39	**579**	1,360	39	**1,400**	1,912	125	**2,036**
27	19,095	2,524	**21,619**	28,230	2,524	**30,755**	30,010	3,657	**33,667**
28	5,747	1,158	**6,904**	8,741	1,158	**9,899**	15,816	1,416	**17,232**
29	96	34	**130**	847	34	**881**	1,940	77	**2,017**
30	327	0	**328**	1,944	0	**1,944**	1,949	0	**1,949**
Total	**77,518**	**7,570**	**85,088**	**119,278**	**7,600**	**126,878**	**138,485**	**12,661**	**151,146**

Table 13: Economically Operable MWLB Area by Leading Species, $0 export premium

Leading Species	Economically Operable Area (ha)		
	Low Price	Average Price	High Price
Cedar	9,078	18,766	22,516
Hemlock/ Balsam	50,671	71,757	88,694
Douglas Fir	18,701	28,582	31,089
Other	6,638	7,773	8,848
Total	**85,088**	**126,878**	**151,146**

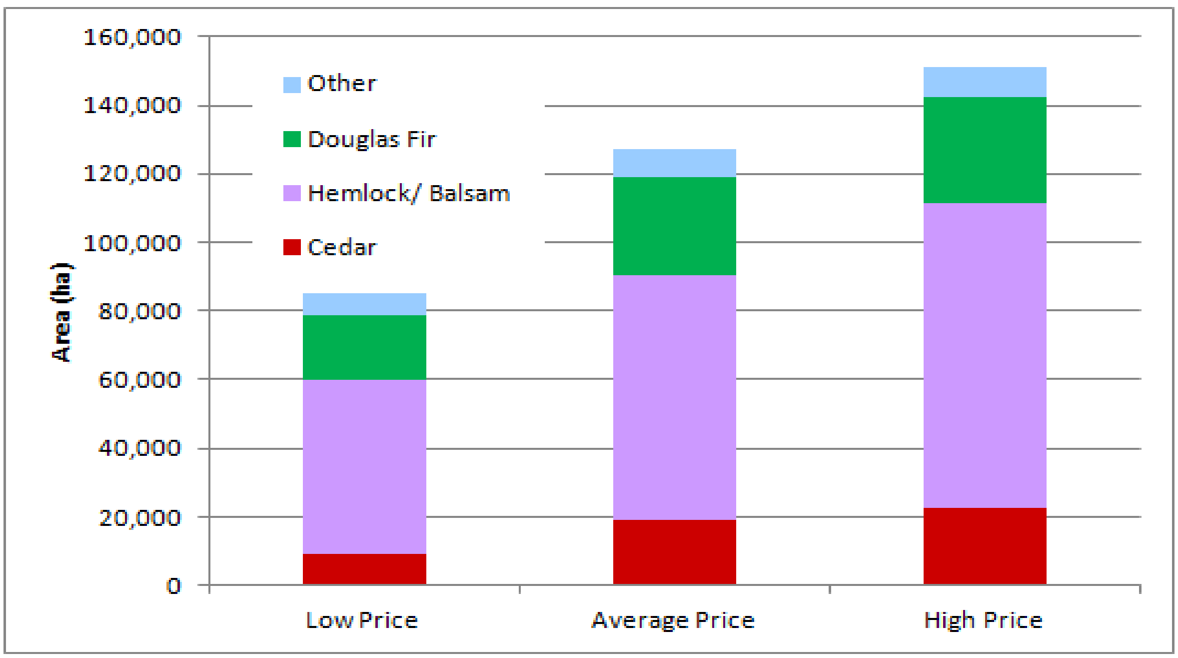

Figure 6: Economically Operable Area by Leading Species, $0 Export Premium

Table 14: Economically Operable MWLB area - $30 export premium

Block	Low Prices			Average Prices			High Prices		
	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total	Conventional Harvesting	Helicopter Harvesting	Total
1	781		**781**	1,064		**1,064**	1,791		**1,791**
2	385		**385**	649		**649**	966		**966**
3	1,695	10	**1,705**	1,702	10	**1,712**	1,702	101	**1,803**
4	11		**11**	47		**47**	60		**60**
5	26		**26**	145		**145**	192		**192**
6	3,904	18	**3,922**	6,589	18	**6,607**	6,694	19	**6,713**
7	5,618	19	**5,637**	9,019	19	**9,038**	9,183	116	**9,299**
8	4,163	558	**4,721**	5,093	558	**5,651**	5,150	694	**5,844**
9	2,219	243	**2,462**	4,195	309	**4,504**	4,474	1,869	**6,343**
10	407		**407**	721		**721**	754		**754**
11	541		**541**	814		**814**	2,250		**2,250**
12	1,696		**1,696**	1,764		**1,764**	2,638		**2,638**
13			**0**	38		**38**	473		**473**
14	364	11	**374**	683	11	**694**	979	11	**989**
15	69		**69**	191		**191**	249		**249**
16	207		**207**	356		**356**	456		**456**
17	283		**283**	880		**880**	971	9	**980**
18	19,466	1,208	**20,674**	26,852	1,208	**28,061**	27,963	1,804	**29,766**
19			**0**	40		**40**	147		**147**
20	104		**104**	506		**506**	506		**506**
21	6,996	1,069	**8,065**	9,967	1,115	**11,082**	10,046	2,993	**13,039**
22	1,081	2	**1,083**	1,495	2	**1,497**	1,501	57	**1,558**
23	1,065	58	**1,124**	1,489	58	**1,548**	1,530	201	**1,731**
24	400		**400**	947		**947**	987	0	**988**
25	3,215	617	**3,831**	5,684	617	**6,301**	7,045	617	**7,661**
26	539	39	**579**	1,473	39	**1,512**	1,912	130	**2,041**
27	21,436	2,524	**23,961**	29,447	2,524	**31,971**	30,072	4,404	**34,476**
28	5,747	1,158	**6,904**	11,172	1,158	**12,330**	17,065	1,713	**18,778**
29	280	34	**315**	1,837	34	**1,871**	1,944	114	**2,058**
30	420	0	**421**	1,947	0	**1,947**	1,949	0	**1,949**
Total	**83,120**	**7,570**	**90,689**	**126,804**	**7,682**	**134,486**	**141,648**	**14,851**	**156,499**

Table 15: Economically Operable MWLB area by leading species, $30 export premium

Leading Species	Economically Operable Area (ha)		
	Low Price	Average Price	High Price
Cedar	9,627	19,444	23,045
Hemlock/ Balsam	52,276	78,340	92,425
Douglas Fir	22,135	28,725	31,904
Other	6,651	7,977	9,125
Total	**90,689**	**134,486**	**156,499**

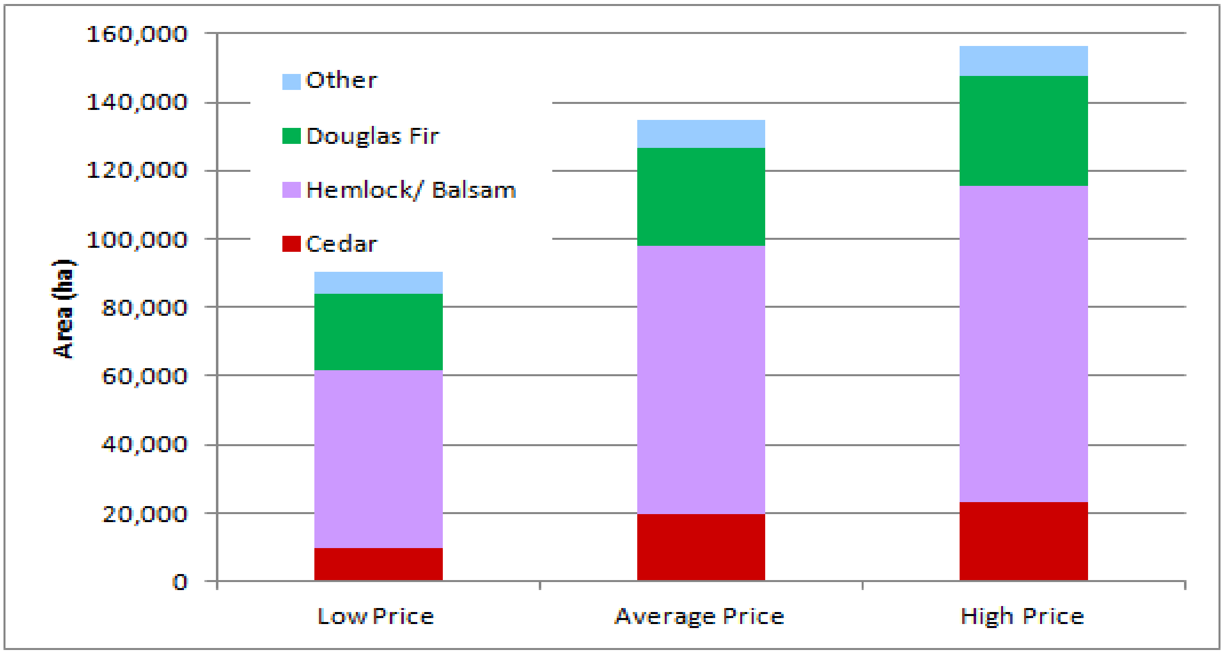

Figure 7: Economically Operable MWLB area by leading species, $30 export premium

5.2 Review of Results by Operational Staff

Spatial results for both the $0/m^3 and the $30/m^3 export premium scenarios using average historic prices were forwarded to the BCTS field staff for review. It was generally found that the $30/m^3 premium scenario was closest to operational reality; the somewhat larger economically operable land base often matched past harvest areas and recently laid-out harvest blocks better. The field teams flagged areas that were known to be economic or uneconomic. These changes were incorporated into the economic operability base case layer. No changes were made for areas that the operational staff was not familiar with.

In TSG only minor changes were made. In TST, more areas were changed to economically operable; the depletion coverage had missed some previously harvested stands and there were other stands that the analysis had classified uneconomic due to slightly overestimating the harvest costs. In TSK, additional areas were deemed uneconomic based on field review. The net result of the field team reviews was an increase in the overall economically operable land base of just under 3,000 ha.

Table 16 and Table 18 show the economically operable area after the field team reviews for the $0 and the $30 export premium scenarios. Table 17, Table 19, Figure 8, and Figure 9 show the economically operable area by leading species.

Table 16: Economically Operable MWLB area after field team review, $0 export premium

Block	Low Prices			Average Prices			High Prices		
	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total
1	1,429		**1,429**	1,633		**1,633**	1,870		**1,870**
2	712		**712**	920		**920**	978		**978**
3	1,660	10	**1,670**	1,702	10	**1,712**	1,702	94	**1,795**
4	11		**11**	18		**18**	60		**60**
5	26		**26**	140		**140**	192		**192**
6	3,843	18	**3,862**	6,495	18	**6,513**	6,694	18	**6,712**
7	5,466	19	**5,485**	8,964	19	**8,983**	9,141	101	**9,242**
8	4,017	549	**4,566**	4,979	549	**5,528**	5,110	627	**5,737**
9	2,074	243	**2,317**	3,956	243	**4,199**	4,301	1,254	**5,554**
10	407		**407**	560		**560**	754		**754**
11	1,980		**1,980**	2,173		**2,173**	2,534		**2,534**
12	2,517		**2,517**	2,562		**2,562**	2,719		**2,719**
13	383		**383**	410		**410**	582		**582**
14	408	11	**418**	655	11	**665**	938	11	**948**
15	69		**69**	161		**161**	249		**249**
16	207		**207**	314		**314**	456		**456**
17	283		**283**	764		**764**	971	7	**978**
18	19,117	1,347	**20,464**	25,350	1,347	**26,697**	27,577	1,760	**29,337**
19			**0**	34		**34**	146		**146**
20	104		**104**	506		**506**	506		**506**
21	5,683	1,069	**6,752**	9,891	1,100	**10,991**	10,039	2,449	**12,488**
22	539	2	**542**	1,494	2	**1,496**	1,501	39	**1,540**
23	974	58	**1,033**	1,479	58	**1,538**	1,526	171	**1,697**
24	348		**348**	947		**947**	987	0	**988**
25	3,215	617	**3,831**	5,391	617	**6,008**	7,034	617	**7,651**
26	543	85	**629**	1,364	85	**1,450**	1,912	121	**2,033**
27	19,132	2,631	**21,763**	28,262	2,631	**30,892**	30,010	3,758	**33,768**
28	5,746	1,158	**6,904**	8,723	1,158	**9,881**	14,998	1,403	**16,401**
29	96	34	**130**	847	34	**881**	1,940	77	**2,017**
30	327	0	**328**	1,944	0	**1,944**	1,949	0	**1,949**
Total	**81,317**	**7,851**	**89,168**	**122,639**	**7,882**	**130,521**	**139,376**	**12,507**	**151,883**

Table 17: Economically Operable MWLB area by leading species, after field team review, $0 export premium

Leading Species	Economically Operable Area (ha)		
	Low Price	Average Price	High Price
Cedar	9,188	18,768	22,284
Hemlock/ Balsam	54,490	75,252	89,807
Douglas Fir	18,734	28,612	30,967
Other	6,756	7,888	8,825
Total	**89,168**	**130,521**	**151,883**

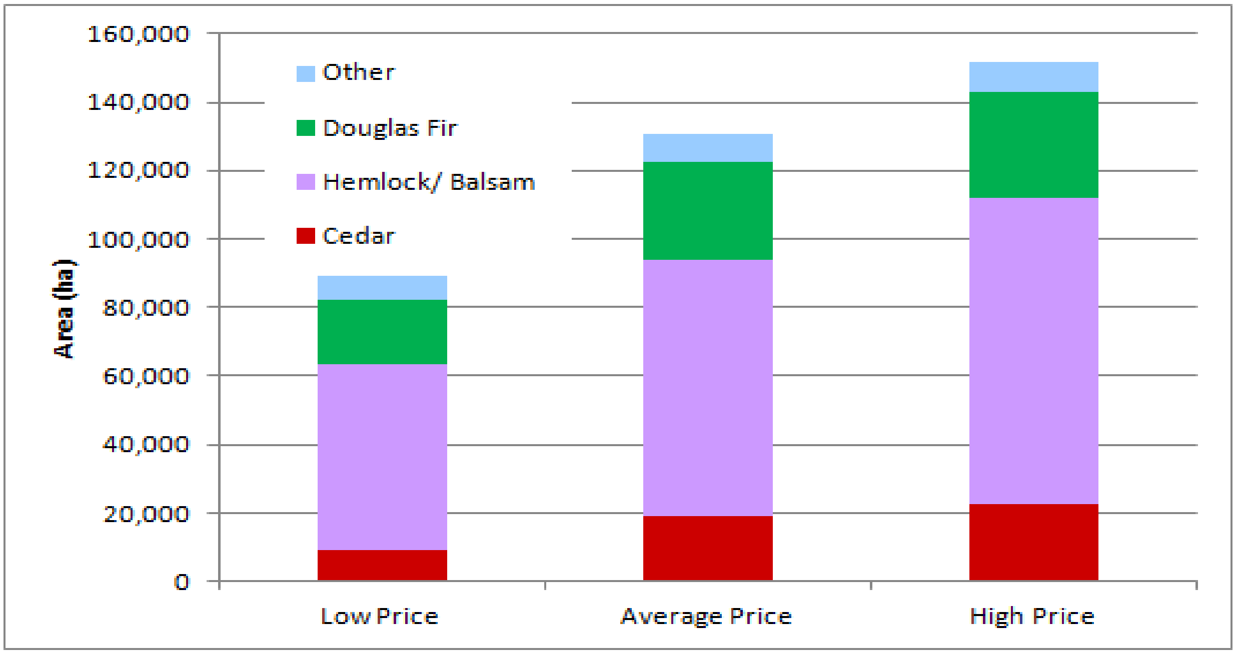

Figure 8: Economically operable MWLB area by leading species, after field team review, $0 export premium

Table 18: Economically Operable MWLB area, after field team review, $30 export premium

Block	Low Prices			Average Prices			High Prices		
	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total
1	1,429		**1,429**	1,712		**1,712**	1,905		**1,905**
2	712		**712**	972		**972**	978		**978**
3	1,695	10	**1,705**	1,702	10	**1,712**	1,702	101	**1,803**
4	11		**11**	47		**47**	60		**60**
5	26		**26**	145		**145**	192		**192**
6	3,904	18	**3,922**	6,589	18	**6,607**	6,694	19	**6,713**
7	5,618	19	**5,637**	9,019	19	**9,038**	9,183	116	**9,299**
8	4,156	549	**4,705**	5,068	549	**5,616**	5,125	659	**5,784**
9	2,219	243	**2,462**	4,055	302	**4,356**	4,334	1,496	**5,830**
10	407		**407**	721		**721**	754		**754**
11	1,980		**1,980**	2,245		**2,245**	2,813		**2,813**
12	2,517		**2,517**	2,571		**2,571**	2,842		**2,842**
13	383		**383**	421		**421**	595		**595**
14	408	11	**418**	727	11	**738**	979	11	**989**
15	69		**69**	191		**191**	249		**249**
16	207		**207**	356		**356**	456		**456**
17	283		**283**	880		**880**	971	9	**980**
18	19,548	1,347	**20,895**	26,669	1,347	**28,017**	27,646	1,895	**29,541**
19			**0**	40		**40**	147		**147**
20	104		**104**	506		**506**	506		**506**
21	6,996	1,069	**8,065**	9,967	1,115	**11,082**	10,046	2,993	**13,039**
22	1,081	2	**1,083**	1,495	2	**1,497**	1,501	57	**1,558**
23	1,065	58	**1,124**	1,489	58	**1,548**	1,530	201	**1,731**
24	400		**400**	947		**947**	987	0	**988**
25	3,215	617	**3,831**	5,684	617	**6,301**	7,045	617	**7,661**

Block	Low Prices			Average Prices			High Prices		
	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total	Conventional Harvest	Helicopter Harvest	Total
26	543	85	**629**	1,473	85	**1,558**	1,912	121	**2,033**
27	21,473	2,631	**24,104**	29,478	2,631	**32,109**	30,072	4,504	**34,576**
28	5,746	1,158	**6,904**	10,997	1,158	**12,155**	16,020	1,684	**17,704**
29	280	34	**315**	1,837	34	**1,871**	1,944	114	**2,058**
30	420	0	**421**	1,947	0	**1,947**	1,949	0	**1,949**
Total	**86,897**	**7,851**	**94,748**	**129,948**	**7,956**	**137,905**	**141,136**	**14,597**	**155,733**

Table 19: Economically Operable MWLB area by leading species, after field team review, $30 export premium

Leading Species	Economically Operable Area (ha)		
	Low Price	Average Price	High Price
Cedar	9,737	19,443	22,757
Hemlock/ Balsam	56,074	81,639	92,179
Douglas Fir	22,169	28,748	31,720
Other	6,769	8,074	9,077
Total	**94,748**	**137,905**	**155,733**

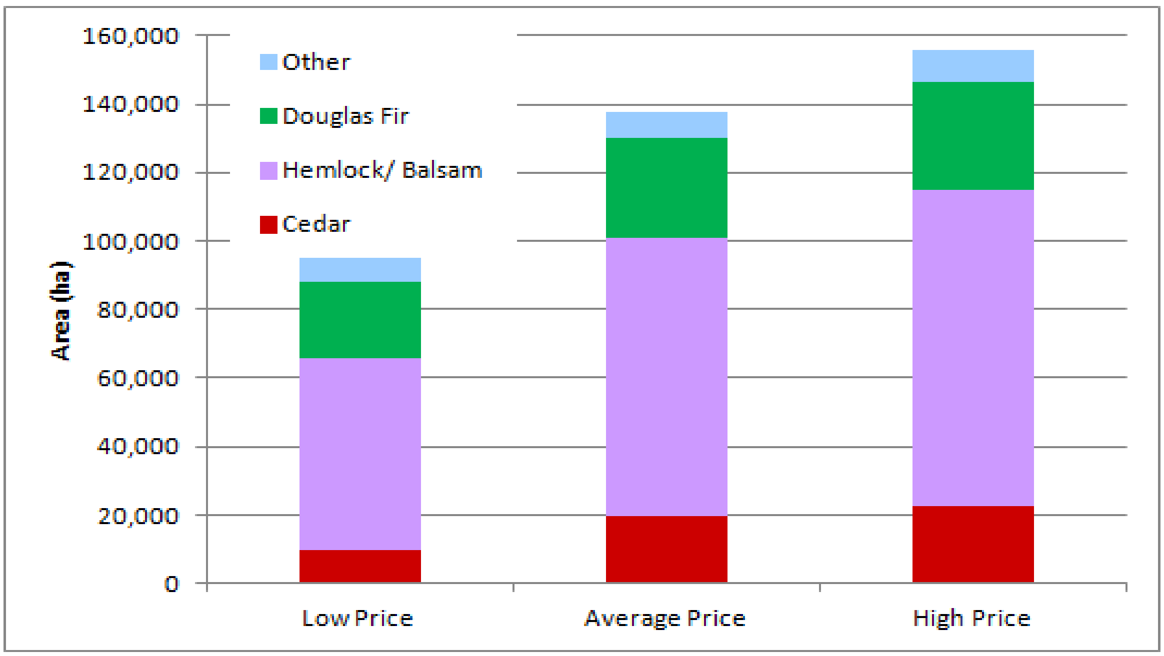

Figure 9: Economically Operable MWLB area by leading species, after field team review, $30 export premium

5.3 Synopsis and Application in TSR

5.3.1 Synopsis

The land base of the Pacific TSA of 698,041 ha was analyzed. A total of 244,132 ha were deemed to be inaccessible.

The maximum working land base was defined by removing stands that can never be candidates for harvesting, such as non-forest, private lands, parks, etc. from the land base. The total reduction was 415,757 ha; however, as this reduction overlapped with already reduced inaccessible areas, the net land base reduction was less at 171,591 ha with 282,318 ha remaining as the maximum working land base.

Costs and stand values were calculated for each forest stand; profit consists of the difference between the estimated stand value and the estimated cost to harvest the stand. Stands with a positive profit are considered economic to harvest. The economic operable land base can be expanded by harvesting profitable stands along with marginally unprofitable stands. This was simulated in the project by blending profitable stands with unprofitable stands after road costs were covered. Blending of stands can only occur within a woodshed. Woodsheds are spatially defined areas within the TSA that are tributary to the same appraised point of origin and are located within the same timber supply block. In this phase, 140,663 ha of forest were deemed inoperable and removed from the land base with 141,655 ha remaining as economically operable.

Results were reviewed by operational staff. Changes were made where appropriate. The changes resulted in a net increase of 2,891 ha bringing the economically operable land base to 144,546 ha. Not this entire land base is harvestable, as it includes areas that need to be removed as per current practises and legislation. These removals reduce the available land base for harvesting by 42,386 ha to 102,178. The remaining land base is called the THLB. A detailed description of the land base netdown is provided in the Pacific TSA Timber Supply Review Information Package, (Forest Ecosystem Solutions, 2015).

Table 20: Simplified area netdown, Pacific TSA

Description	Net Area (ha)	Gross Area (ha)
Total Pacific TSA	**698,041**	
Inaccessible Areas (from coarse filter)	(244,132)	(244,132)
Apply permanent, legally established and explicit 100% netdowns.	(171,591)	(415,757)
Maximum Working Land Base	**282,318**	
Economically Inoperable Area After Analysis	(140,663)	(140,663)
Area Added After Field Review	2,891	2,891
Economically Inoperable Area After Field Review	(137,773)	(137,773)
Economically Operable Land Base	**144,564**	
Complete THLB Netdown	(42,386)	(527,281)
Timber Harvesting Land Base	**102,178**	

5.3.2 Application in TSR

According to the BCTS operational staff, the scenario based on the $30.00 per m^3 export premium reflects their operational reality well. In the conventional harvest areas, the results from this scenario using average market prices will be used as the basis for the on-going timber supply review for the Pacific TSA and the associated THLB netdown.

Helicopter harvest areas in the Pacific TSA are generally considered marginally economic. It is assumed that harvest in most of these areas is economic only during the market cycles with high log prices. The TSR base case will analyze the helicopter harvest area separately to determine a sustainable harvest level from these areas. The economically operable land base for all helicopter areas will be based on the high historic prices and a $30.00 per m^3 export premium, with the assumption that a helicopter partition will be applied.

The total economically operable land base for use in TSR is 144,546 ha, made up of 129,948 ha of conventional harvest areas and 14,597 ha of helicopter harvest areas. As discussed above, the total economically operable land base is reduced to 102,178 ha, once a full land base netdown is applied to the TSA. The THLB of 102,178 ha consists of 92,811 ha conventional THLB and 9,367 ha of helicopter harvest THLB. The economically operable area and the THLB by Block are shown in Table 21. Table 22 summarizes the operable area and the THLB by leading species.

Table 21: Economically Operable Land Base for TSR

Block	Maximum Working Land Base (ha)			Timber Harvesting Land Base (ha)		
	Conventional Harvest	Helicopter Harvest	Total Economically Operable	Conventional Harvest	Helicopter Harvest	Total
1	1,712		**1,712**	1,275	0	**1,275**
2	972		**972**	776	0	**776**
3	1,702	101	**1,803**	1,102	66	**1,168**
4	47		**47**	5	0	**5**
5	145		**145**	62	0	**62**
6	6,589	19	**6,608**	4,755	10	**4,765**
7	9,019	116	**9,135**	6,663	79	**6,741**
8	5,068	659	**5,727**	3,731	448	**4,178**
9	4,055	1,496	**5,551**	3,070	998	**4,068**
10	721		**721**	615	0	**615**
11	2,245		**2,245**	1,779	0	**1,779**
12	2,571		**2,571**	2,026	0	**2,026**
13	421		**421**	314	0	**314**
14	727	11	**738**	544	8	**553**
15	191		**191**	111	0	**111**
16	356		**356**	244	0	**244**
17	880	9	**889**	631	0	**632**
18	26,669	1,895	**28,564**	21,440	1,400	**22,840**
19	40		**40**	29	0	**29**
20	506		**506**	424	0	**424**
21	9,967	2,993	**12,960**	7,629	1,823	**9,452**
22	1,495	57	**1,552**	1,154	48	**1,202**
23	1,489	201	**1,691**	1,162	163	**1,325**
24	947	0	**947**	800	0	**801**
25	5,684	617	**6,301**	2,450	346	**2,795**
26	1,473	121	**1,594**	966	74	**1,040**
27	29,478	4,504	**33,982**	18,095	2,646	**20,741**
28	10,997	1,684	**12,681**	7,862	1,188	**9,050**
29	1,837	114	**1,950**	1,499	69	**1,568**
30	1,947	0	**1,947**	1,602	0	**1,603**
Total	**129,948**	**14,597**	**144,546**	**92,811**	**9,367**	**102,178**

Table 22: Economically Operable Land Base by leading species

Leading Species	MWLB		THLB	
	Area (ha)	**Percent**	**Area (ha)**	**Percent**
Cedar	21,396	15%	13,984	14%
Hemlock/ Balsam	83,012	57%	62,485	61%
Douglas Fir	31,712	22%	21,555	21%
Other	8,425	6%	4,154	4%
Total	**144,546**	**100%**	**102,178**	**100%**

References

Ministry of Forests, Lands and Natural Resource Operations, Timber Pricing Branch, January, 2014. Coast Appraisal Manual. Includes Amendments 1 (March 2014), 2 (April 2014), 3 (August 2014) 4 (March 2015) and 5 (April 2015).

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