Appendix B: Timber Supply Analysis

BRITISH COLUMBIA

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Mr. Mike Davis, RPF
Planning Forester
Western Forest Products Inc.
118 – 1334 Island Highway
Campbell River, British Columbia
V9W 8C9

Dear Mr. Davis:

Thank you for submitting the Timber Supply Analysis Report and updated Information Package included in Tree Farm Licence (TFL) 6 Management Plan 10 dated May 30, 2011. I have reviewed the Management Plan documents along with other Ministry of Forests, Lands and Natural Resource Operations (FLNR) staff in the West Coast Region and North Island – Central Coast District.

As the FLNR Timber Supply Analyst responsible for reviewing this timber supply analysis report, I accept the document for use in the support of the allowable annual cut (AAC) determination for TFL 6. I wish to thank you for the cooperative working relationship during the data collection and analysis review process.

I wish to point out that this letter does not mean that the FLNR endorses every aspect of this timber supply analysis report. During the AAC determination information session; FLNR staff will advise the Chief Forester regarding the implications of assumptions and technical validity of the analysis and results. The Chief Forester may consider this advice as he develops the rationale for his determination of the AAC for TFL 6.

Yours truly,

Michael Clarkson, RPF
Timber Supply Forester
Forest analysis and Inventory Branch

Ministry of Forests, Lands and Natural Resource Operations
Forest Analysis and Inventory Branch
Mailing Address:
PO BOX 9512 Stn Prov Govt
Victoria, BC V8W 9C2
Tel: 250-356-5947
Fax: 250-387-5999
Website: www.gov.bc.ca/for

pc: Sharon Hadway, Regional Executive Director, West Coast Operations
Andrew Ashford, District Manager, North Island – Central Coast District
Kathy DesRochers, First Nations Liaison Officer, North Island – Central Coast District
Bud Koch, Senior Analyst – TFLs, Forest Analysis and Inventory Branch
Andy Waines, Stewardship Forester, North Island – Central Coast District

Western Forest Products Inc.

Tree Farm Licence 6

Timber Supply Analysis

MANAGEMENT PLAN 10

Version 1

May 2011

REGISTERED PROFESSIONAL FORESTER
PROVINCE OF BRITISH COLUMBIA
MICHAEL J. DAVIS
NO. 2465

Mike Davis, *R.P.F*
Planning Forester
Western Forest Products Inc.

Executive Summary

This analysis examines timber supply projections for Tree Farm Licence 6 located on northern Vancouver Island.

Woodstock, a pseudo-spatial harvest model, was used to model current management practices for protection and maintenance of ecological values and to estimate the residual timber potential through the year 2258.

After allowances for non-recoverable losses, the modelling of current management practice as set out in the associated Information Package suggests an AAC of 1,160,000 m^3/year (a reduction of 7.6%). This represents a reasonable harvest level that accommodates ecological and social concerns in the short and longer terms. The modelling suggests that a minimum of 24,100 ha (16%) of productive forest area will be maintained in old forests (>250 years old) and a minimum of 34,000,000 m^3 of growing stock will be maintained on the timber harvesting landbase throughout the 250-year planning horizon. These forests are expected to contribute significantly to biodiversity conservation and complement protected areas within and adjacent to the Tree Farm Licence.

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1.0 Introduction

1.1 Background

Tree Farm Licence (TFL) 6 is located on northern Vancouver Island in the vicinity of Quatsino Sound and is managed by Western Forest Products Inc. (WFP). Figure 1 indicates the current extent of TFL 6 for this analysis. Since the last analysis several land deletions have occurred: areas were recently removed to form part of a Community Forest for Port Alice, Port McNeill and Port Hardy; an area was removed from TFL 6 and added to the Pacific Timber Supply Area to create an operating area for BC Timber Sales (BCTS); and finally, it the private managed forest lands were removed from TFL 6 in 2007 (see the Information Package for further details). The TFL encompasses 171,441 ha of which 107,811 ha is estimated to be available for long term timber production. The allowable annual cut (AAC) for this landbase is currently set at 1,255,536 m^3 per year.

1.2 Objective

The primary objective of this report is to estimate reasonably achievable timber flows for consideration by the Provincial Chief Forester in making the determination of the allowable annual cut for the term of Management Plan #10. More specifically:

1. The management of non-timber values such as fish and wildlife habitat, biodiversity, visual quality, and terrain stability is accounted for. Protection of non-timber values will be satisfied by land base reserves, rate-of-harvest constraints and/or by maintaining a percentage of the landbase in older stands.
2. Timber flow is estimated by considering harvestable inventory, growth potential of present and future stands, silvicultural treatments, potential timber losses, and operational and legislative constraints.
3. Impacts of declining timber flow on community stability and employment are to be lessened by keeping rates of decline per decade as low as possible without inducing undue impacts on other values or long-term timber sustainability.

1.3 Timber Supply Model

Timber supply optimizations were completed with Woodstock software developed by Remsoft. Woodstock is a pseudo-spatial supply model and is described in more detail in the associated Information Package (IP) dated February 2011.

The inventory database was current to January 1, 2009 for harvesting depletion and silviculture treatments and assessments. The model was constructed using 50 5-year periods for a total optimization horizon of 250 years. Since AAC's are now effective for up to 10 years, the model was constructed such that harvest volumes over successive pairs of 5-year periods had to be equal (i.e. harvest levels in Periods 1 and 2 had to be equal; harvest levels in Periods 3 and 4 had to be equal; etc.). This report presents results by 10-year intervals.

Analysis units (grouping of forest stands) and associated timber volume yield curve parameters are described in more detail in the associated IP.

Figure 1 - TFL 6

2.0 Base Case (or Current Management Option)

The Base Case (or Current Management option) includes the following assumptions and modelling parameters that are described in more detail in the associated IP (February 2011):

- The operable forested landbase accessible using conventional and non-conventional (helicopter) harvesting methods with restricted performance in the non-conventional landbase.
- Exclusion of uneconomic forest stands.
- Harvesting of both mature and immature stands.
- Silviculture to meet free growing requirements is carried out on all regenerated stands. Known tree improvement gains are applied to existing stands ≤ 10 years old and future regenerated stands.
- Visual quality objectives (VQOs) are modelled based on the VQOs established and made effective for TFL 6 on September 24, 2010 with upper range disturbance assumed.
- Green-up heights for cutblock adjacency are assigned based on Resource Management Zones established in the Vancouver Island Higher Level Plan. Special and General zones have a 3m green-up requirement while Enhanced zones have a 1.3m green-up height.
- Future Wildlife Tree and other stand-level retention within the THLB are accounted for by a percentage area reduction.
- Biodiversity and Landscape Units – Established Old Growth Management Areas (OGMAs) in the San Josef and Marble landscape units are removed from the THLB. Also removed are draft OGMAs in Holberg, Keogh, Mahatta and Neroutsos landscape units. Mature seral targets are incorporated for the two Special Management Zones within TFL 6.
- Established Ungulate Winter Ranges (UWRs) and Wildlife Habitat Areas (WHAs) are removed from the THLB. As per the accepted IP, no additional netdown is assumed for full implementation (potential future WHAs) of the Identified Wildlife Management Strategy (IWMS).
- Riparian management based on the FSP results/strategies and the results of a review of riparian management zone retention for cutblocks harvested between 1997 and 2008.
- Minimum harvest age criteria based on minimum average stand diameter-at-breast-height (DBH) that varies by harvest system and minimum volume per hectare. Both minimum diameter and minimum volume requirements had to be met before a stand could be harvested.
- Restriction on volume sourced from heli operable stands and requirement to harvest second growth beginning in the first decade.
- Woodstock was set up to maximize harvest volume over the entire 250-year analysis period subject to maintaining a relatively stable conventionally operable growing stock on the THLB over the final 100 years. This growing stock constraint was not applied to the heli-operable growing stock due to the harvest volume constraint applied to that portion of the landbase.

The Base Case harvest flow is presented in Table 1 and Figure 2. All harvest volume figures are net of non-recoverable losses of 7,000 m^3/year.

Table 1 - Base Case Harvest Levels

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)	% Change from Previous Period
1	2009	2018	1,160,000	-7.6%
2	2019	2028	1,101,600	-5.0%
3	2029	2038	1,046,200	-5.0%
4	2039	2048	993,500	-5.0%
5 - 7	2049	2078	943,500	-5.0%
8	2079	2088	978,100	+3.7%
9	2089	2098	1,028,000	+5.1%
10 - 25	2099	2258	1,060,700	+3.2%

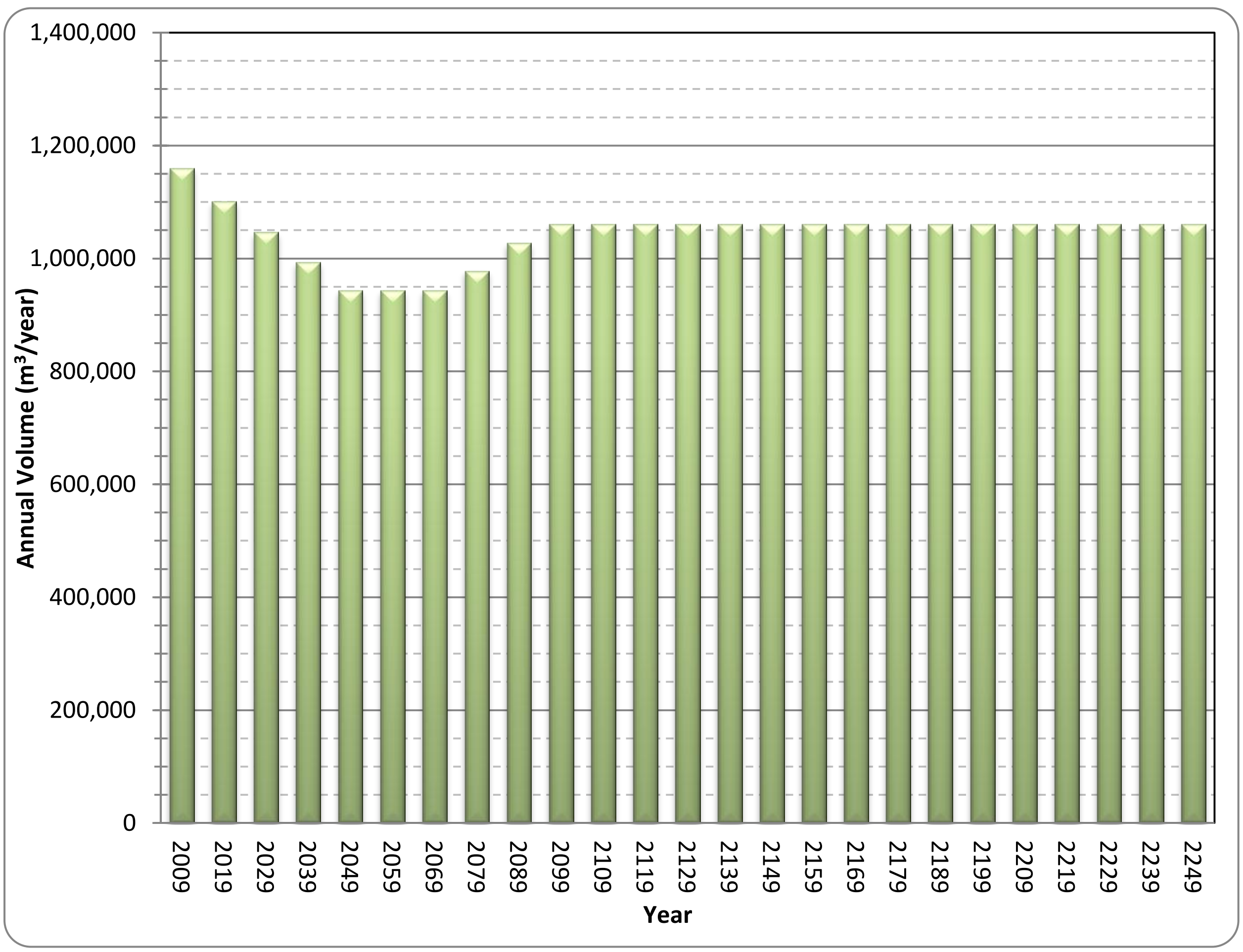

Figure 2 - Base Case Harvest Schedule 2009-2258

The projected harvest schedule declines 25% over the next 40 years to a low of 943,500 m^3/year through to 2078 before gradually increasing to the current long-term harvest level (LTHL) estimate of 1,060,700 m^3/year. The mid-term timber supply “dip” occurs during the transition from natural second growth stands to managed stands with their higher volumes (mainly due to genetic gain values but also fertilization assumptions). The total volume harvested over the 250 years is roughly 261 million m^3. The schedule resulted in heli harvest levels of approximately 12,000 m^3/year throughout the 250 years with the balance of the volume being conventional harvest.

Figure 3 indicates the contribution to the total harvest volume by period from each of the four broad stand types used to define the analysis units. As expected, old growth stands contribute the greatest proportion of volume in the short-term (first 20 years). In the subsequent 10 years natural second growth provides the largest proportion of the volume as old growth harvest continues to decline. Beginning in the fourth decade (2039 – 2048) current managed stands provide the greatest volume and do so for forty years. During this time there is still some old growth harvested. Future managed stands contribute some volume in the fifth and seventh decades (2049 – 2058 and 2069 - 2078) and provide the majority of the harvest volume as of the eighth decade (2079 – 2088).

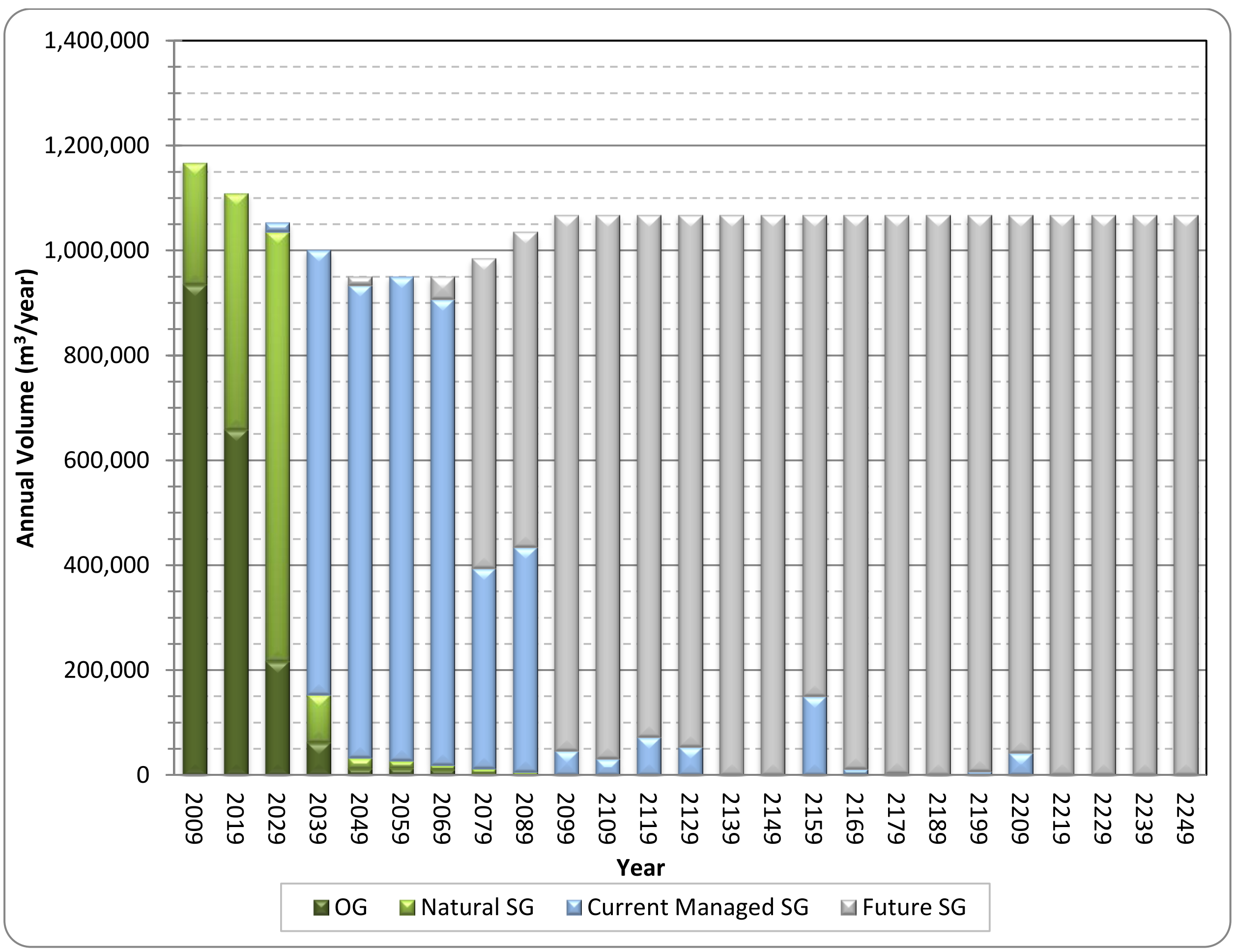

Figure 3 – Stand Types’ contribution to Base Case harvest

Age class distributions over time based on the 5-year age groupings used in Woodstock are examined in Figure 4 and Figure 5. Age class “zero” only exists in the first time period (2009) due to the presence of NSR lands (and stands established in 2007 and 2008) whereas in future time periods the model “regenerates” harvested stands immediately (a 1-year regeneration delay is incorporated in the yield tables). Within the productive forest the oldest age class declines by slightly more than 45% and then increases to 95% of the current amount as younger reserved timber ages into the old growth age class (see Figure 4).

Figure 4 - Age class distribution of productive forest area

The total THLB area in Age Classes 1-4 increases initially until a relatively balanced age class distribution is achieved (refer to Figure 5).

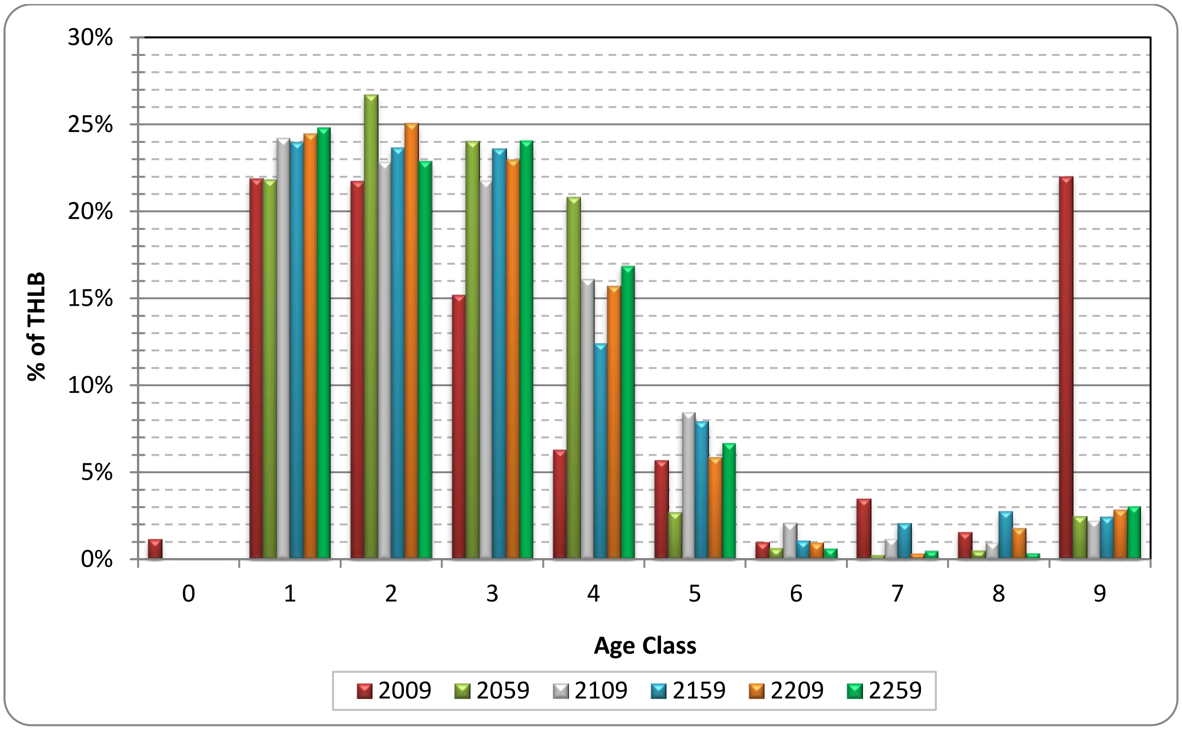

Figure 5 - Age class distribution of timber harvesting land base

Figure 6 illustrates harvestable (i.e. meets minimum harvest criteria) and total growing stock (including the ground-based / cable / heli split) levels for the timber harvesting landbase. Total THLB growing stock declines by about 17% until the transition to second growth harvesting is nearly completed (in fourth decade) and then returns to current levels as future stands begin to acquire merchantable volume but harvesting is occurring mainly in existing stands (between fourth and eighth decade). Refer to Figure 3 for the contribution of each stand type to the total harvest level over time.

Once the transition to future stands is completed, operable growing stock is steady at approximately 40 million m^3. Ground-based THLB growing stock is fairly constant over time at roughly 15 million m^3. Cable THLB growing stock initially declines as the majority of the currently operable old-growth is found on this portion of the landbase. As the cable old-growth is harvested and second growth stands begin acquiring merchantable volume, the cable THLB inventory increases to above current levels and then averages approximately 23 million m^3. Heli THLB growing stock changes very little over time due to the harvest constraint applied to that part of the landbase.

The longer term distribution of the THLB growing stock by harvesting system relates directly to differences in harvest age (based on different minimum harvest age criteria). Cable THLB is 49% of the total THLB but in the longer term holds, on average, 58% of the growing stock; while ground-based THLB is 48% of the total and in the longer term averages 38% of the THLB growing stock.

The minimum harvest age is substantially older for cable-based logging areas than for ground-based areas, with minimum average DBHs of 37 cm and 30 cm respectively for the two systems. Hence longer-term there is more growing stock on cable areas.

Harvestable (i.e. meets minimum harvest criteria) volume declines significantly over the first 70 years as old growth and existing second growth stands are harvested and replaced with managed stands. Once the transition to future stands is complete, harvestable volume fluctuates between 6 and 10 million m^3, averaging about 7.4 million m^3.

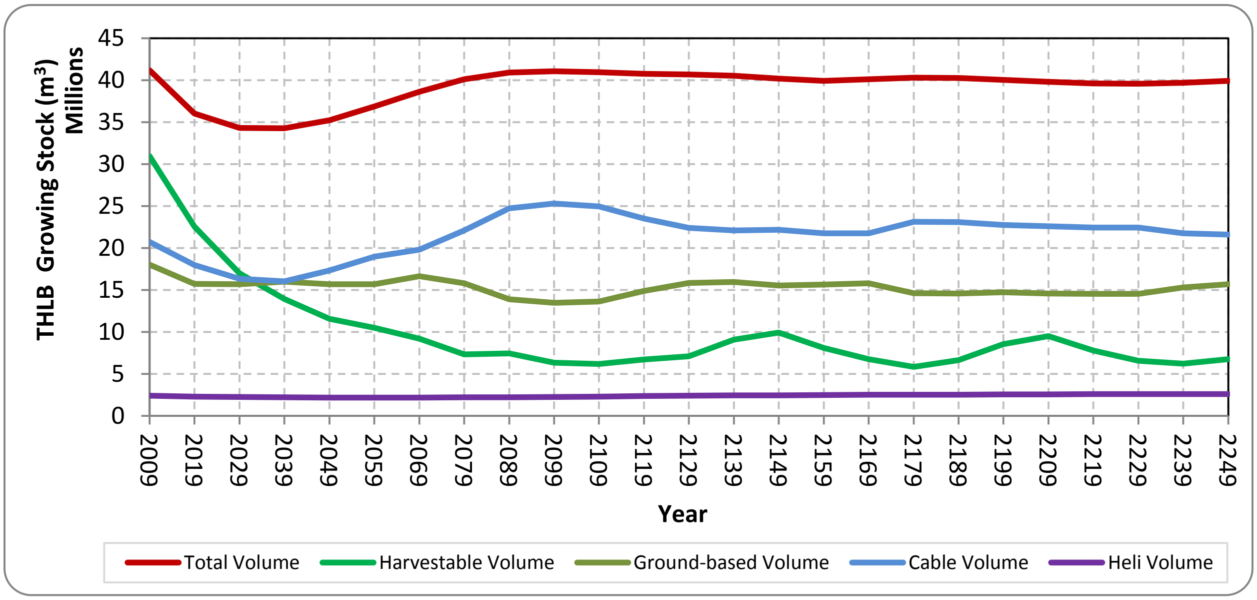

Figure 6 -THLB Growing stock

Figure 7 provides average statistics for timber harvested through the harvest projection. As expected, the mean age of stands harvested declines rapidly as the transition to second growth harvesting occurs. The average age of second growth (SG) harvested in the first 30 years is 109 years (ranging between 55 and 140 years old). For the remainder of the optimization period second growth harvested averages 84 years old.

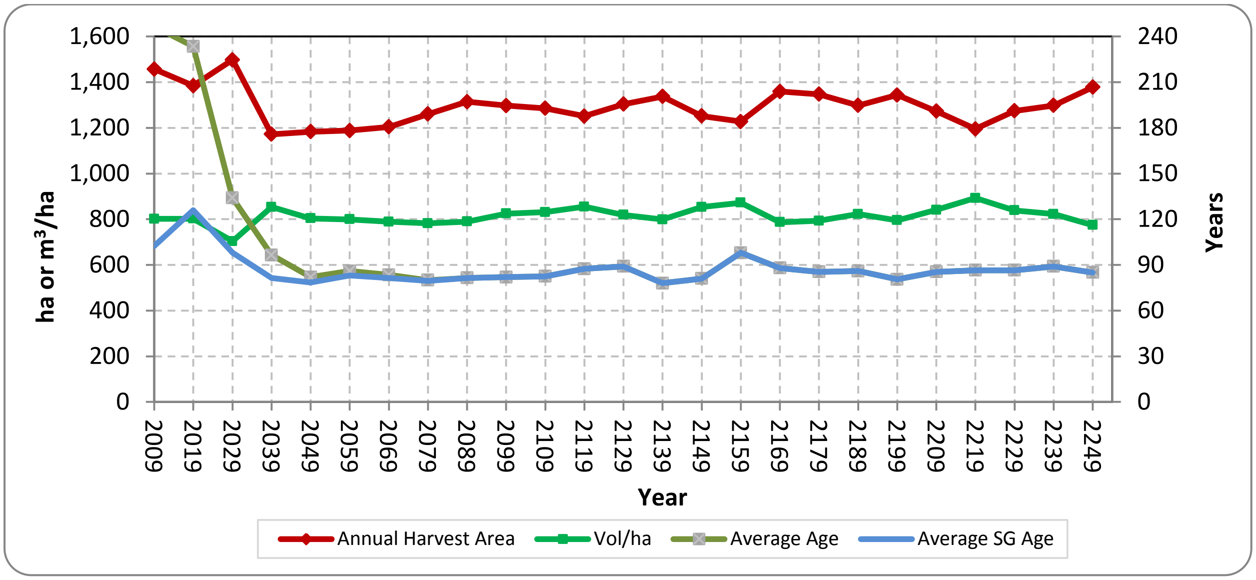

Figure 7 - Harvest Statistics 2009 – 2258

Annual area harvested fluctuates between 1,400 and 1,500 hectares for the first three decades in conjunction with the decline in harvest volume and the varying yields available for old growth and natural second growth. Once the transition to primarily managed second growth harvesting occurs (fourth decade), annual area harvested generally ranges between 1,200 and 1,350 hectares. Merchantable volume per hectare initially declines from 800 m^3/ha to 700 m^3/ha with the transition from old growth to natural second growth harvesting; it then increases as harvesting shifts to managed stands such that it averages about 825 m^3/ha once the shift to future managed stands is made.

The minimum harvest age modelled for stands varied by harvesting system (see Section 10.3.1 of the IP). Figure 8 indicates the contribution by harvesting system to total annual harvest volume and average harvest age.

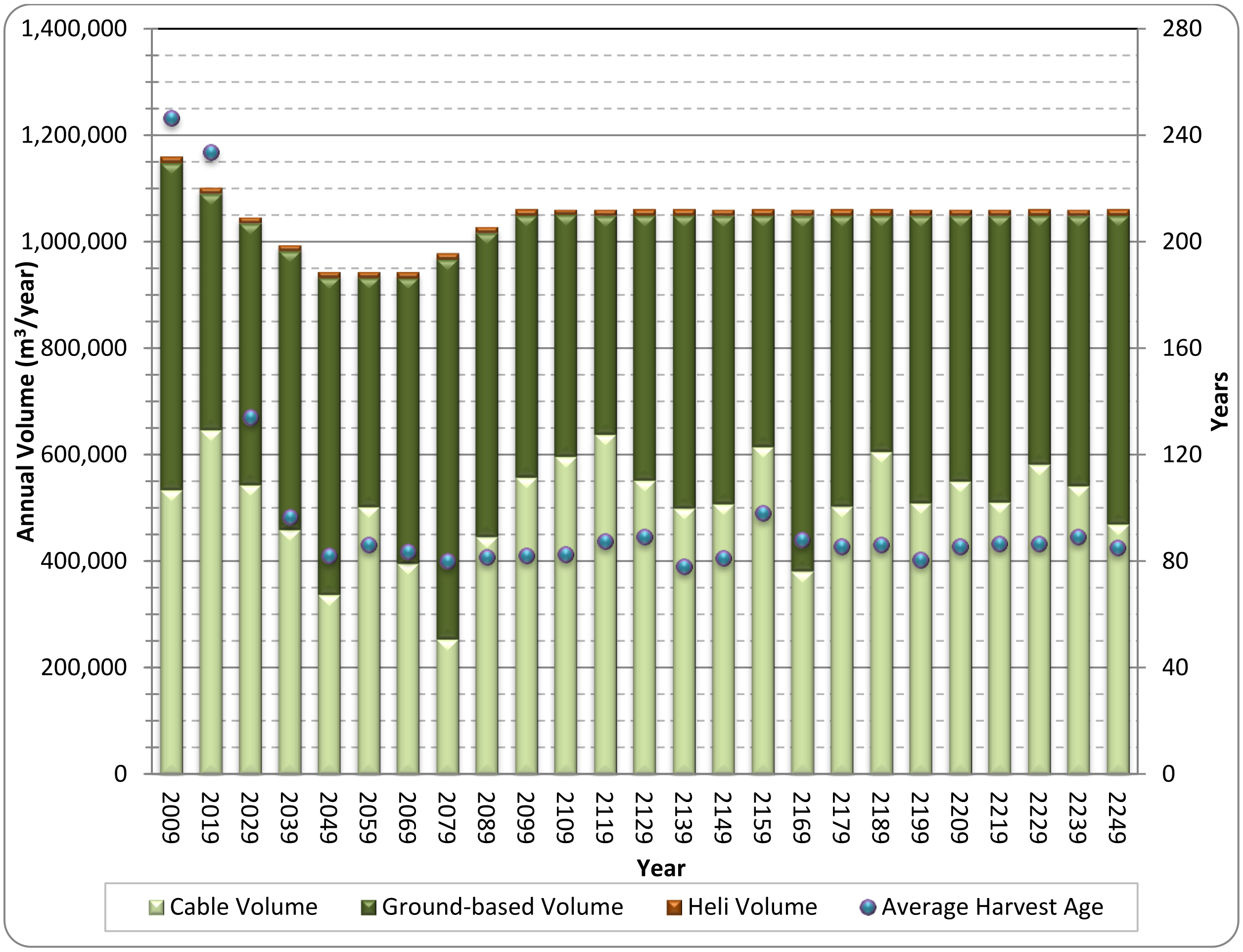

Figure 8 - Volume Contribution by Harvesting System

As would be expected, once the majority of the volume is sourced from managed stands there is generally a positive relation between the amount of cable harvesting and the average harvest age: as the cable contribution increases, so does the average harvest age. This is due to the substantially older harvest ages on cable-based areas compared to ground-based areas discussed earlier in this section. Of course site quality of the stands harvested is also a factor in determining the average age.

2.1 Western Red Cedar and Yellow Cedar Projections

Traditional and cultural uses of cedar (red and yellow) are important to First Nations. Opportunities for accessing and managing cedar have been increased through the allocation of AAC to First Nations. Within TFL 6 there is a significant volume of cedar.

Figure 9 indicates the estimated volume (at the beginning of each 10-year period) of red and yellow cedar on the THLB and within the total productive forest associated with the Base Case harvest schedule. These estimates are based on the red and yellow cedar component of natural stands and TIPSY curves generated for the cedar component of managed stands. The latter was done to account for the generally lower site index for Cw and Cy within managed stands – Cw and Cy usually grow slower than the other species (Ba, Fd and Hw); therefore at average harvest ages Cw and Cy will usually contribute less to the mixed species stand volume than their proportion at the time of stand establishment.

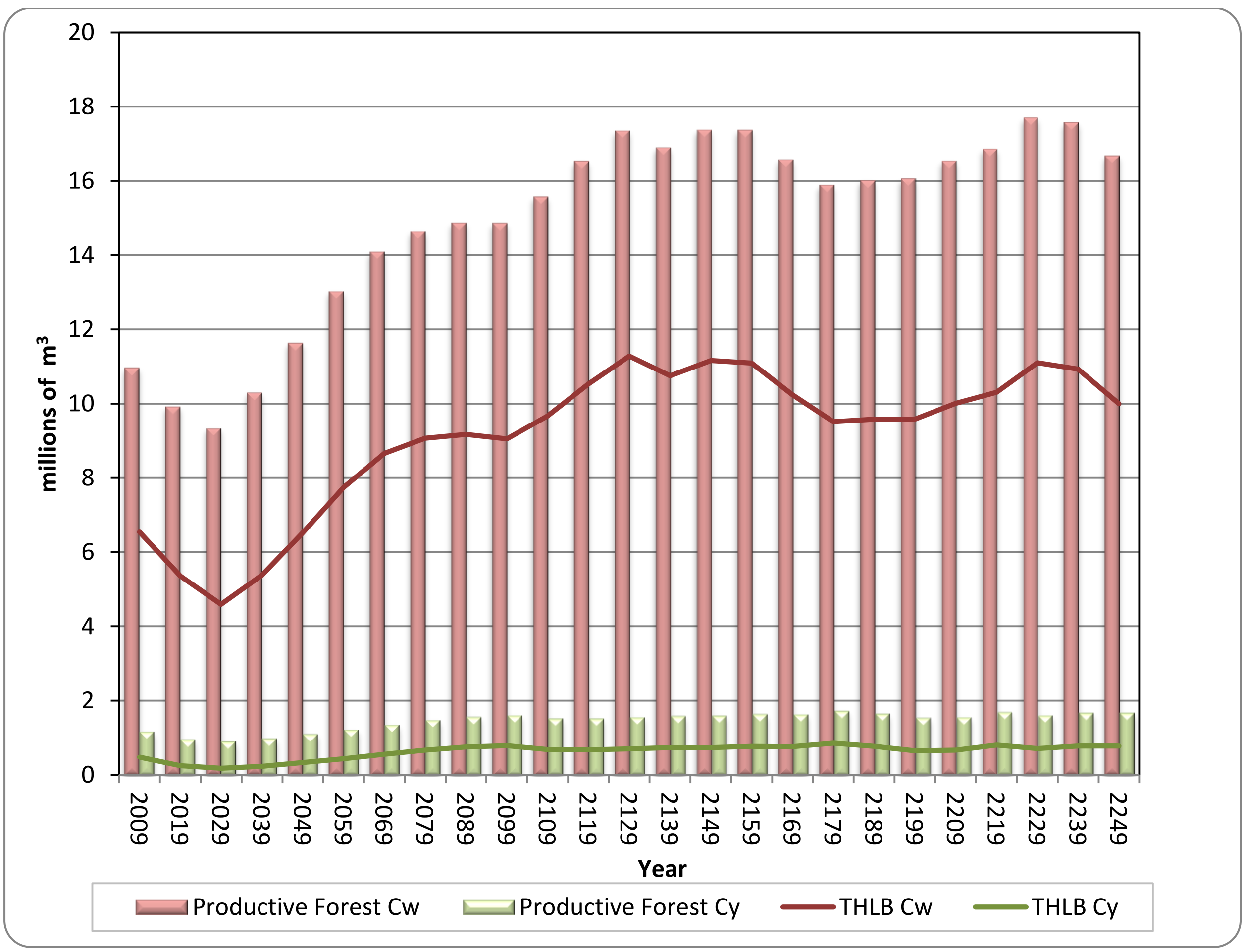

Figure 9 – Base Case cedar volume estimates over time

As expected, the amount of cedar (red and yellow) on the THLB declines over the first 30 years as the remaining old growth is harvested. During this time the amount of cedar within the total productive forest declines by about 16%; however the volume never falls below 10.2 million m^3

(9.3 million m^3 of Cw and 0.9 million m^3 of Cy) – this indicates there is a large inventory of Cw and Cy within the non-contributing landbase (reserves and netdowns). The relative absence of Cw and Cy in the older second growth stands (mainly natural regeneration) also contributes to the decline (see Table 26 in the IP for Cw/Cy distributions in these stands).

By the fourth decade (2039 - 2048) cedar volumes begin to recover as managed stands with significant Cw and Cy components begin to acquire volume (see Tables 27 and 28 in the IP for Cw/Cy distributions in such stands). Total cedar volume equals the current volume within 50 years and averages in excess of 17.5 million m^3 from then until the end of the schedule.

As the cedar within the non-contributing landbase will generally be older (due to no harvesting occurring) this cedar inventory would be more likely to contain a supply of larger trees suitable for canoes, buildings, carving, etc. (“monumental cedar”).

3.0 Alternate Harvest Flows

This section examines two alternate flow scenarios.

3.1 Maintain current AAC

Table 2 and Figure 10 represent an attempt to maintain the current AAC for the first 10 years. The results indicate that, compared to the Base Case, an additional 1,638,000 m^3 (4.9%) can be harvested over the next 30 years with a total of approximately 1,853,000 m^3 (2.7%) less being harvested over the following 70 years.

Table 2 - Harvest levels with maintaining current AAC

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Maintain current AAC	Difference
1	2009	2018	1,160,000	1,255,500	+ 95,500
2	2019	2028	1,101,600	1,154,500	+ 52,900
3	2029	2038	1,046,200	1,061,600	+ 15,400
4	2039	2048	993,500	976,100	- 17,400
5 - 6	2049	2068	943,500	897,400	- 46,100
7	2069	2078	943,500	908,700	- 34,800
8	2079	2088	978,100	958,700	- 19,400
9	2089	2098	1,028,000	1,008,700	- 19,300
10	2099	2108	1,060,700	1,058,700	- 2,000
11 - 25	2109	2258	1,060,700	1,060,700	0

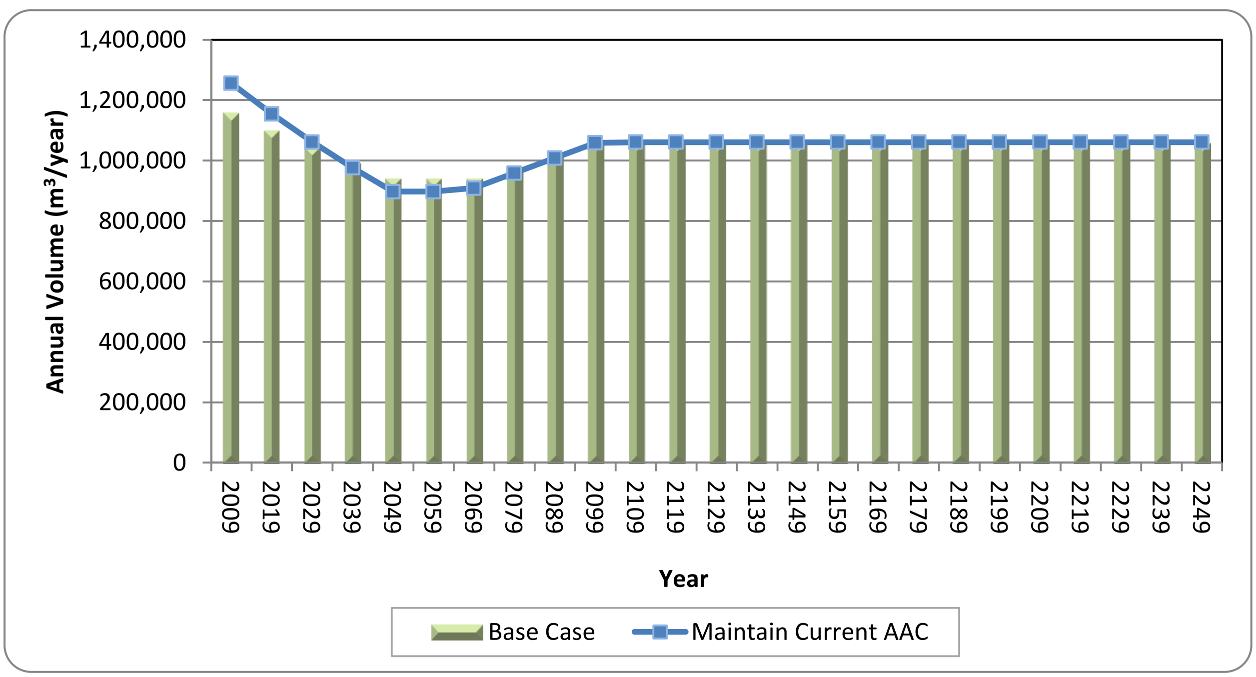

Figure 10 – Harvest levels with maintaining current AAC

Alternatively it is possible to produce a schedule where the mid-term timber supply is greater (closer to the Base Case level) with a LTHL that is approximately 4,900 m^3/year less than the LTHL of the Base Case (see the red line in Figure 11 below). In this schedule the total harvest over the 250 years is approximately 892,000 m^3 less than the Base Case.

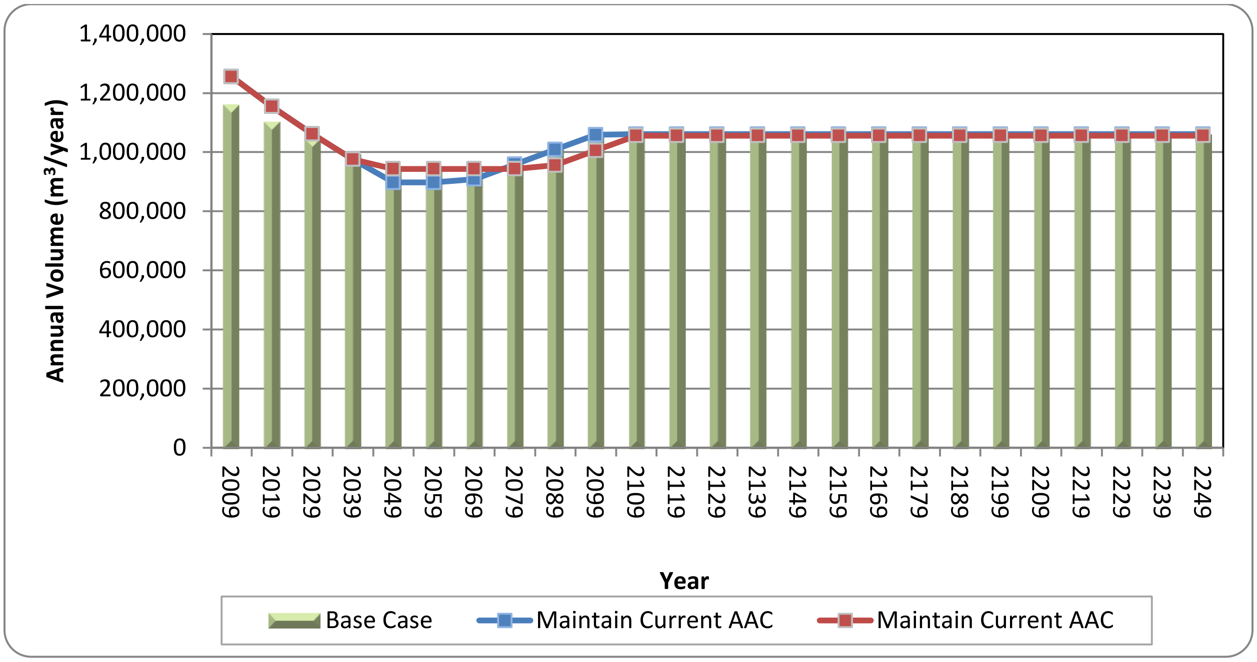

Figure 11 – Alternate harvest levels with maintaining current AAC

3.2 Non-declining even flow

Table 3 and Figure 12 show the impact of immediately dropping to a non-declining even flow (NDEF) harvest level. Short term harvest levels are significantly lower than the Base Case while the mid-term timber supply “dip” is eliminated. The LTHL is 29,700 m^3/year (2.8%) lower. Over the entire 250 years approximately 3.36 million m^3 (1.3%) less timber is harvested and in the long-term the harvest level is less than the growth rate within the forest; thereby foregoing opportunities.

Table 3 – Harvest levels with non-declining even flow

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	NDEF	Difference
1	2009	2018	1,160,000	1,031,000	- 129,000
2	2019	2028	1,101,600	1,031,000	- 70,600
3	2029	2038	1,046,200	1,031,000	- 15,200
4	2039	2048	993,500	1,031,000	+ 37,500
5 - 7	2049	2078	943,500	1,031,000	+ 87,500
8	2079	2088	978,100	1,031,000	+ 52,900
9	2089	2098	1,028,000	1,031,000	+ 3,000
10 - 25	2099	2258	1,060,700	1,031,000	- 29,700

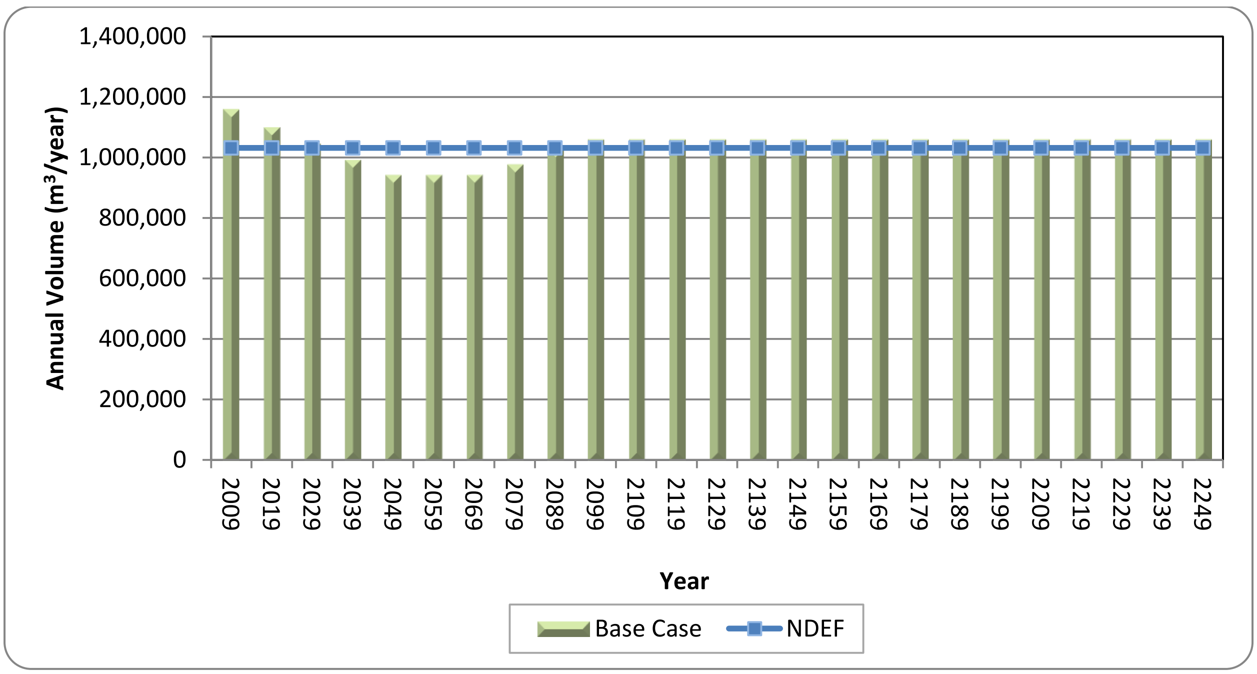

Figure 12 – Harvest levels with non-declining even flow

4.0 Sensitivity Analyses

Sensitivity analysis provides a measure of the upper and lower bounds of the Base Case harvest forecast, reflecting the uncertainty of assumptions made in the Base Case. By developing and testing a number of sensitivity issues, it is possible to determine which variables most affect results. This in turn facilitates the management decisions that must be made in the face of uncertainty. As Woodstock was used as an optimization tool to generate the Base Case, it is expected that the results will be sensitive to any changes to the inputs.

To allow meaningful comparison of sensitivity analyses, they are performed by varying (from the Base Case) only the assumption being evaluated.

In general, sensitivities with negative impacts were run with the goal of keeping the short term harvest as close as possible to the harvest in the Base Case. Where impacts were positive, flow request adjustments were made to (1) raise the short and medium term flow, and optionally (2) increase the long term harvest level.

Sensitivity issues are summarized in Table 4. The timber supply impacts are illustrated in Sections 4.1 through 4.14.

Table 4 – Current Management Sensitivity Analyses

Issue	Sensitivity tested summary	Section
Landbase available for harvesting	Exclude all class V (unstable) terrain plus helicopter operable landbase	4.1
Growth and Yield	Natural stands yields overestimated by 10%	4.2
	Natural stands yields underestimated by 10%	4.3
	Managed stands yields overestimated by 10%	4.4
	Managed stands yields underestimated by 10%	4.5
	Use SIBEC Site Index estimates	4.6
Forest management / Silviculture	Exclude future fertilization	4.7
	Less planting of western hemlock	4.8
Operability	Remove heli harvest constraint	4.9
	Exclude helicopter operable landbase	4.10
Visual Quality	Reduce the percent disturbed within each VQO polygon	4.11
Wildlife habitat / Biodiversity	Retain old forests to full target to maintain marbled murrelet habitat in EFZ #8 (Mahatta–Neroutsos) – VILUP objective #16	4.12
Minimum harvest criteria	Increase minimum harvest DBH criteria	4.13
Summary	Summary of sensitivity impacts	4.14

4.1 No harvesting on unstable terrain or by helicopter

This sensitivity was run for two reasons:

a) As a way of indicating timber supply sensitivity to the estimate of the THLB; and more specifically,

b) To indicate the sensitivity of timber supply to contribution from operationally uncertain areas.

As several of the landbase netdowns used to derive the THLB (see Section 6 of the IP) are estimates and therefore subject to uncertainty, this sensitivity tests the impact of reducing the THLB. Rather than reduce the THLB uniformly (e.g. reduce every polygon by 5%) the approach taken was to remove areas that are often difficult to operate on – unstable terrain for environmental management reasons (risk of landslide) and helicopter operable areas (economically challenging due to high costs). No netdown for terrain stability was used to derive the THLB other than the areas removed via the operability inventory and unstable terrain found within the other netdown areas such as OGMAs, UWRs and riparian management areas.

Table 5 provides the breakdown of these land areas. Excluding these areas from the operable landbase reduces the THLB by 4.9% and the initial THLB inventory by 8.3%. The volume impact is greater than the area impact due to these portions of the TFL having less harvest history and therefore more old growth timber.

Table 5 – Unstable and heli operable land within TFL 6

Landbase	Total area (ha)	Productive Forest Area (ha)	Operable Area (ha)	THLB Area (ha)	THLB Volume (m^3)
Unstable terrain (Class V)	9,003	7,646	4,463	2,486	1,418,650
Heli operable	6,041	5,814	5,400	3,141	2,391,801
Total (accounting for overlap)	14,030	12,482	8,934	5,274	3,517,178
% of TFL 6	8.2%	8.5%	6.6%	4.9%	8.3%

Table 6 and Figure 13 indicate the results of trying to maintain the same initial harvest level as the Base Case.

Table 6 – Harvest levels with unstable and heli operable lands removed

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	No Class V or Heli	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,090,000	- 11,600
3	2029	2038	1,046,200	1,024,200	- 22,000
4	2039	2048	993,500	962,300	- 31,200
5 - 7	2049	2078	943,500	904,100	- 39,400
8	2079	2088	978,100	908,200	- 69,900
9	2089	2098	1,028,000	958,200	- 69,800
10	2099	2108	1,060,700	1,008,300	- 52,400
11 - 25	2109	2258	1,060,700	1,026,300	- 34,400

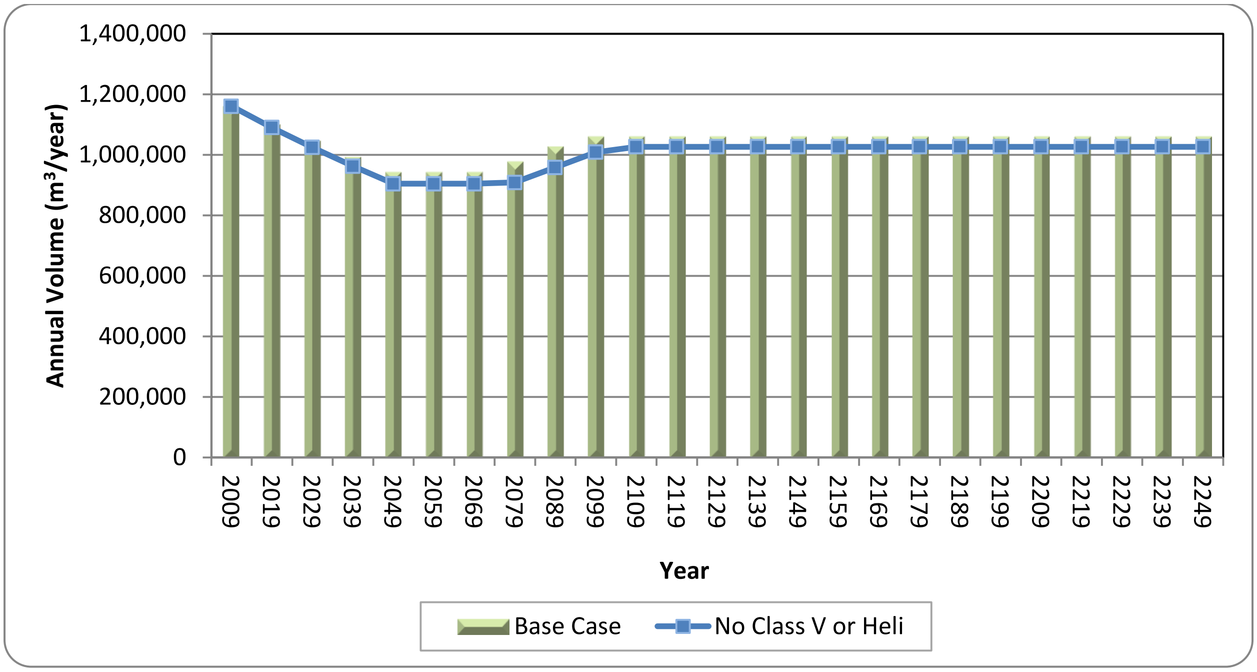

Figure 13 – Harvest levels with unstable and heli operable lands removed

Over the 250 years, a total of 8.9 million m^3 (3.4%) less is harvested and the LTHL is 34,400 m^3/year (3.2%) less. The timber supply impacts are less than the THLB impact of 4.9% partially due to the heli volume constraint (12,000 m^3/year) in the Base Case mitigating the impact of removing the heli operable landbase from the THLB. The impacts of the heli constraint and the heli landbase by itself are explored in the sensitivity analyses summarized in sections 4.9 and 4.10 respectively.

There is a history of harvesting in Class V terrain - spatial logging history records indicate that a total of 1,725 ha of Class V terrain have been logged in the current TFL 6 - equal to 1.9% of the total area logged. Class V terrain comprises 2.3% of the THLB used in this analysis; therefore, history suggests that the contribution of Class V terrain is represented reasonably in the Base Case.

4.2 Natural stands yields overestimated by 10%

The sensitivity of timber supply to natural stands (older than 50 years) volume estimates was tested by decreasing (this Section) and increasing (Section 4.3) these volumes by 10%. The volumes in these stands were estimated from the recently completed Vegetation Resources Inventory (VRI) and the Ministry of Forests, Lands and Natural Resource Operations' (MFLNRO) *Variable Density Yield Projection* (VDYP) version 6.6d.

Natural stands provide nearly the entire volume in the first 30 years of the Base Case schedule (see Figure 3). This sensitivity removes 3.4 million m^3 (8.3%) from the current THLB inventory. These results (Table 7 and Figure 14) indicate the harvest levels achieved when setting the initial harvest level at the same amount as the Base Case results.

Table 7 – Harvest levels with decreased natural stands yields

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Lower natural yields	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,078,300	- 23,300
3	2029	2038	1,046,200	1,002,300	- 43,900
4	2039	2048	993,500	931,700	- 61,800
5 - 6	2049	2068	943,500	866,000	- 77,500
7	2069	2078	943,500	901,700	- 41,800
8	2079	2088	978,100	951,600	- 26,500
9	2089	2098	1,028,000	1,001,600	- 26,400
10	2099	2108	1,060,700	1,051,600	- 9,100
11 - 25	2109	2258	1,060,700	1,060,600	- 100

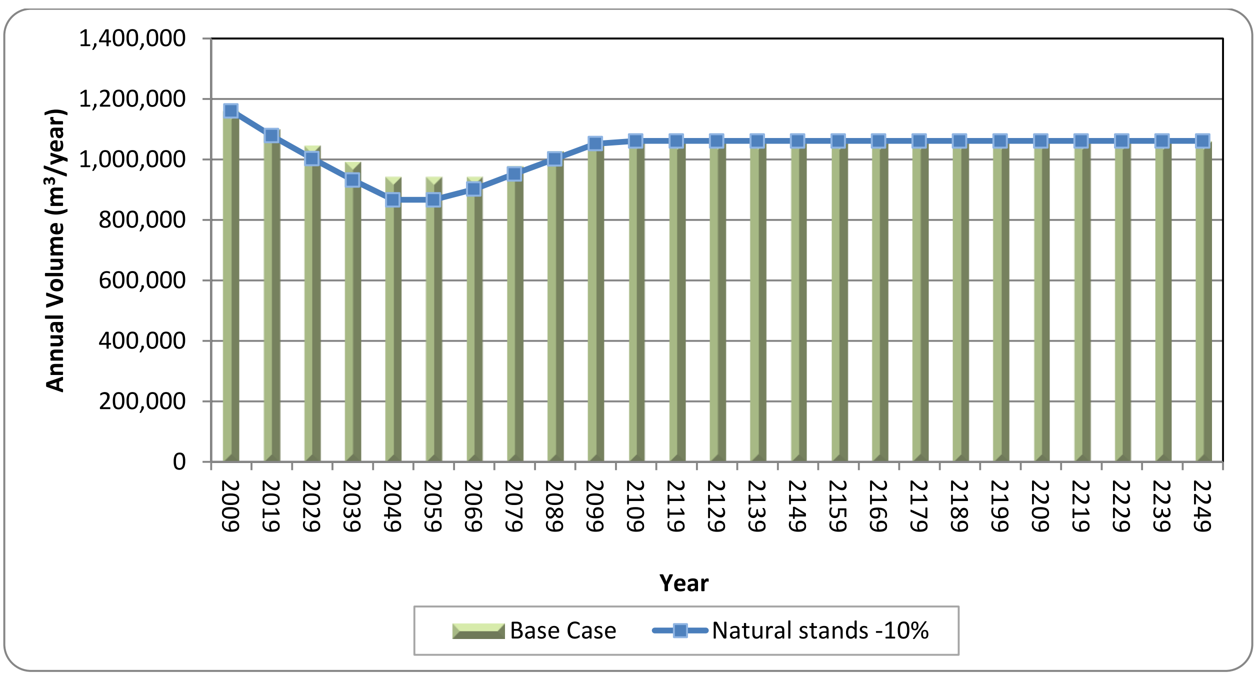

Figure 14 – Harvest levels with decreased natural stands yields

As expected, with the reduction in currently operable inventory and attempting to maintain the same initial harvest level, mid-term harvest levels must be reduced. This mid-term reduction is required in order to delay harvesting of managed stands until they meet the minimum harvest criteria (see section 10.3.1 of the IP).

Total harvest over the entire 250 years is 3.9 million m^3 (1.5%) less than the Base Case.

4.3 Natural stands yields underestimated by 10%

The increased yields result in approximately 3.4 million m^3 (8.3%) more inventory on the THLB today when compared to the Base Case; of which nearly 3.1 million m^3 is available immediately (i.e. meets minimum harvest criteria). Table 8 and Figure 15 indicate the results of trying to reduce the rate of decline in the short and medium-term while achieving approximately the same LTHL.

Table 8 – Harvest levels with increased natural stands yields

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Higher natural yields	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,125,000	+ 23,400
3	2029	2038	1,046,200	1,091,000	+ 44,800
4	2039	2048	993,500	1,058,100	+ 64,600
5 - 7	2049	2078	943,500	1,026,100	+ 82,600
8	2079	2088	978,100	1,026,100	+ 48,000
9	2089	2098	1,028,000	1,026,100	- 1,900
10	2099	2108	1,060,700	1,026,100	- 34,600
11 - 25	2109	2258	1,060,700	1,056,400	- 4,300

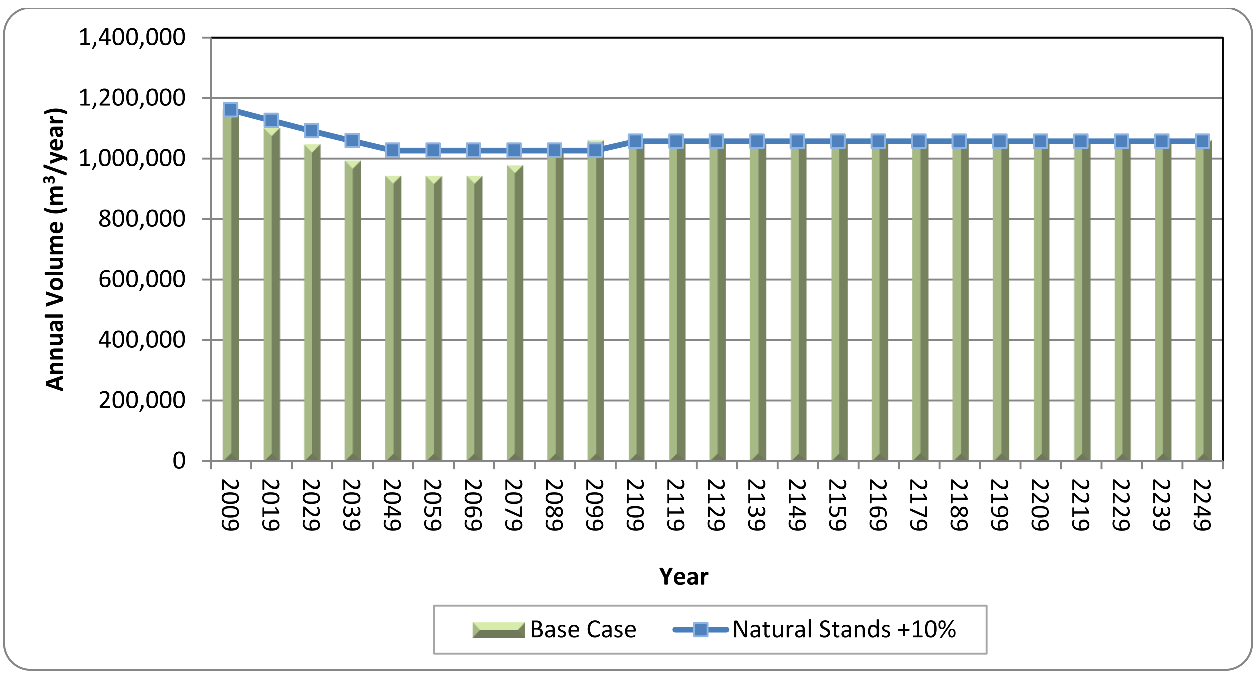

Figure 15 – Harvest levels with increased natural stands yields

The LTHL is 4,300 m^3/year (0.4%) less than the Base Case while roughly 3.3 million m^3 more timber is harvested over the 250 years. The marginally lower LTHL is a result of reduced inventory levels resulting from the higher mid-term harvest levels.

Alternatively, the additional natural stands inventory could be used to delay the transition to managed stands and allow the shift to the LTHL to occur sooner – see the red line in Figure 16 below. This schedule results in a LTHL approximately 2,000 m^3/year (0.2%) higher than the Base Case and about 3.7 million m^3 (1.4%) more timber harvested over the 250 years.

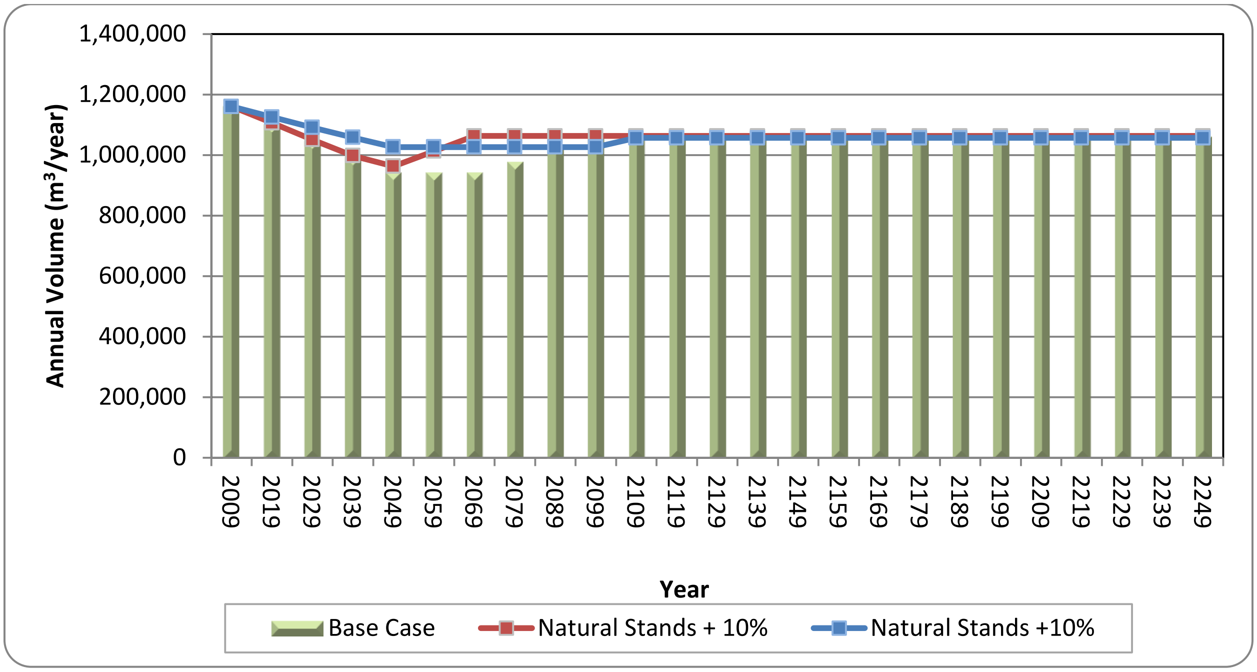

Figure 16 – Alternate harvest levels with increased natural stands yields

4.4 Managed stands yields overestimated by 10%

The sensitivity of timber supply to managed stands (50 years old and younger) volume estimates was tested by decreasing (this Section) and increasing (Section 4.5) these volumes by 10%. Volumes in these younger stands were estimated from attributes and assumptions detailed in section 8 of the IP and the MFLNRO's *Table Interpolation Program for Stand Yields* (TIPSY) version 4.1.

Table 9 and Figure 17 indicate that with decreased managed yields and the initial harvest level set at the same amount as the Base Case, both mid and long term harvest levels are significantly affected. This is logical as managed stands provide the majority of the volume to the Base Case harvest levels beginning in the fourth decade (see Figure 3) – harvest levels must decline faster to accommodate the lower inventory levels. This run results in approximately 22.5 million m^3 (8.6%) less harvest than in the Base Case over the 250 year planning horizon. The long term harvest level is 9.9% lower than in the Base Case, slightly less than 10% lower due to the annual heli harvest restriction reducing the impact of the lower volumes within the heli portion of the THLB.

Table 9 – Harvest levels with decreased managed stands yields

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Lower managed yields	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,066,600	- 35,000
3	2029	2038	1,046,200	980,700	- 65,500
4	2039	2048	993,500	901,700	- 91,800
5 - 6	2049	2068	943,500	829,000	- 114,500
7	2069	2078	943,500	900,300	- 43,200
8	2079	2088	978,100	955,300	- 22,800
9	2089	2098	1,028,000	955,300	- 72,700
10 - 25	2099	2258	1,060,700	955,300	- 105,400

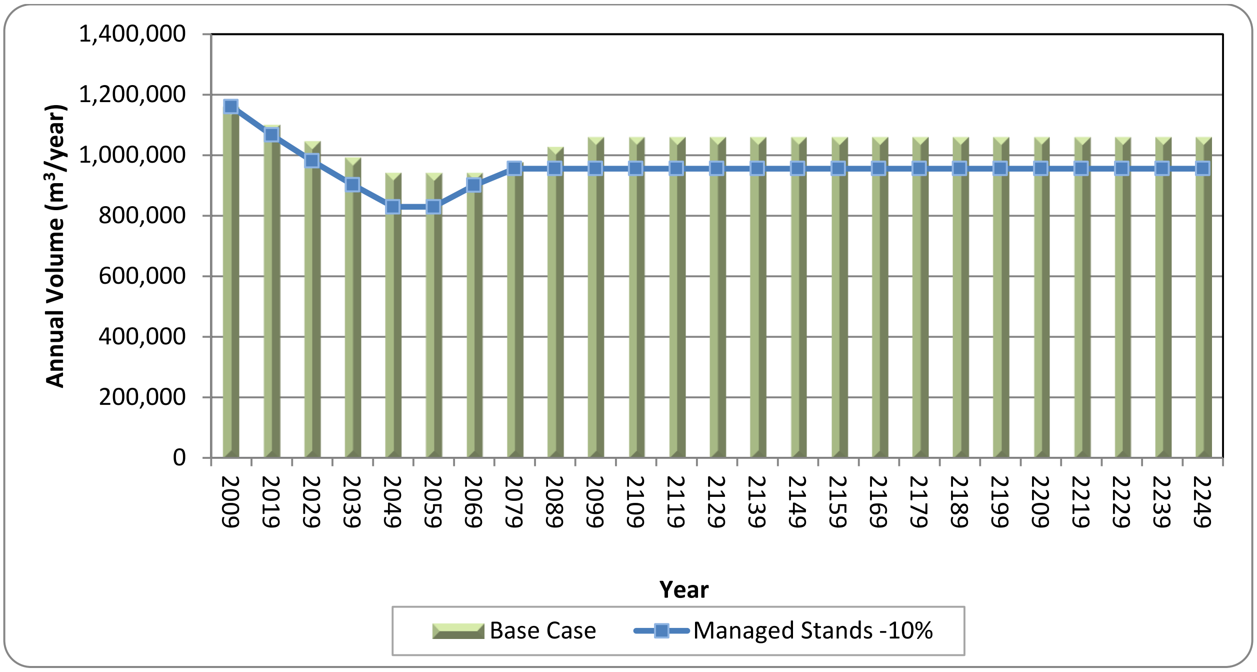

Figure 17 – Harvest levels with decreased managed stands yields

4.5 Managed stands yields underestimated by 10%

With immature stands yields increased by 10%, short term harvest levels need not decline as rapidly to allow the transition to the higher mid and long term harvest levels (relative to the Base Case schedule): a maximum decline rate of 3% per decade can be managed. The long term harvest level is 107,900 m^3/year (10.2%) higher than the Base Case results (see Table 10 and Figure 18). The long term harvest level is more than 10% greater due to the short and mid-term harvest levels being less than 10% greater than the Base case. These relatively lower short and mid-term harvest levels allow sufficient inventory to grow that the relatively higher LTHL is possible. Over the entire 250 year planning horizon, 22.9 million m^3 (8.8 %) more is harvested in this sensitivity.

Table 10 – Harvest levels with increased managed stands yields

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3) Base Case	Higher managed yields	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,125,000	+ 23,400
3	2029	2038	1,046,200	1,091,000	+ 44,800
4	2039	2048	993,500	1,058,100	+ 64,600
5 - 7	2049	2078	943,500	1,026,100	+ 82,600
8	2079	2088	978,100	1,068,600	+ 90,500
9	2089	2098	1,028,000	1,118,600	+ 90,600
10 - 25	2099	2258	1,060,700	1,168,600	+107,900

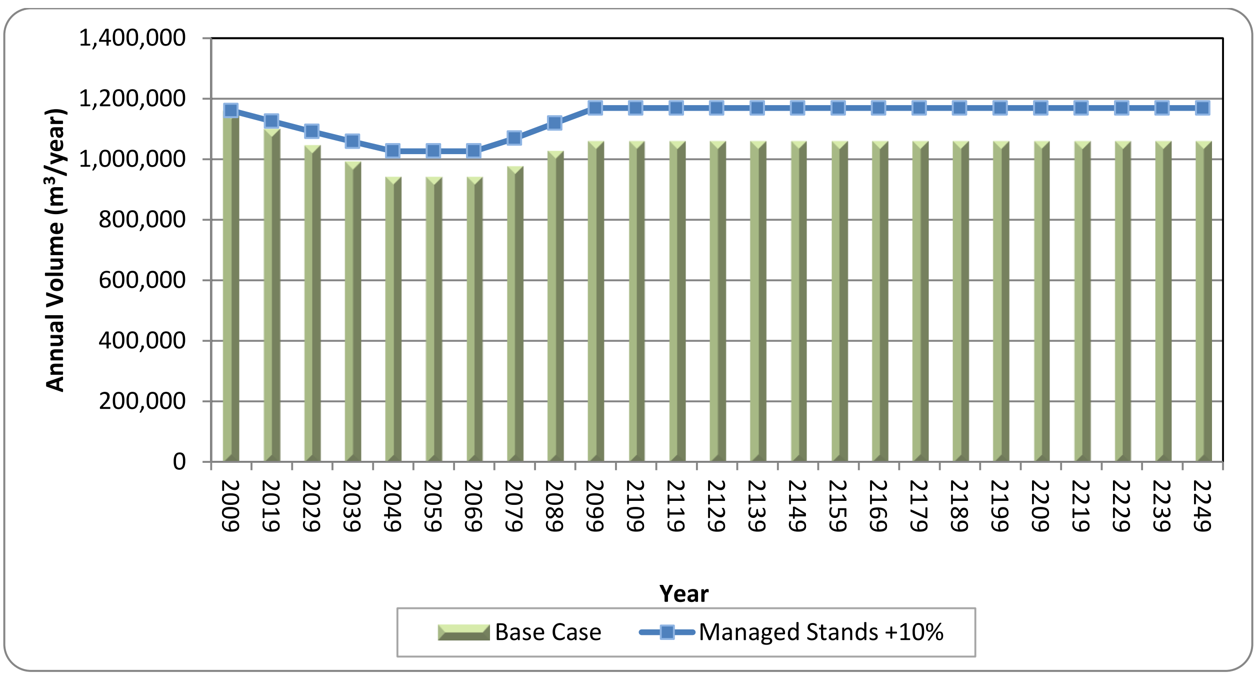

Figure 18 – Harvest levels with increased managed stands yields

4.6 Use SIBEC Site Index estimates

The Base Case used WFP site indexes to estimate site productivity. These site index values are statistically-based estimates of average site index for the major commercial tree species and ecosystems in TFL 6 and were estimated from randomly located plots within the productivity groups (see section 8.1 of the IP for details). A frequently used approach for estimating site productivity is to use Terrestrial Ecosystem Mapping (TEM – site series mapping) and the associated SIBEC (Site Index by Biogeoclimatic Ecosystem Classification site series) site index estimates. Normally the use of TEM and SIBEC depends on an accuracy assessment having been done for the TEM. No such assessment has been done for the TFL 6 TEM, but this analysis was run to indicate the sensitivity of timber supply to site productivity estimates.

The ecological inventory and terrain classification for TFL 6 was completed in 1985 by Dr. Terry Lewis. These eco-units are not named the same as BEC units; however, there is a very close relation between the two systems and for most units, boundaries are identical. The Lewis system was designed for TFL 6 and thus recognizes local ecosystems not included in BEC.

To use SIBEC, the Lewis eco-units were translated into BEC site series and then area-weighted average SIBEC values were determined by species within each productivity group (based on SIBEC values by species for BEC site series within each productivity group). Table 11 compares area-weighted average WFP and SIBEC site index estimates by species based on future stand species assumptions (i.e. only where a species was present in the future AUs). The differences that have the greatest impact on volume estimates for managed stands are:

a) decreases for all species on the most productive sites (PG 1);

b) increases for balsam and Douglas-fir on medium sites (PG 2); and

c) increases for western red cedar on poor sites (PG 4).

Table 11 – Average future site index estimates by species

Landbase	Site Index Estimate Source	Ba SI (m)	Cw SI (m)	Cy SI (m)	Fd SI (m)	Hw SI (m)	Ss SI (m)
PG1	SIBEC	29.2	-	-	-	27.7	31.6
	WFP	30.1	-	-	-	33.7	35.2
PG 2 (and 3)	SIBEC	28.9	22.6	20.2	36.0	27.6	24.8
	WFP	26.2	23.8	23.8	31.4	28.0	31.0
PG 4	SIBEC	20.7[1]	20.9	15.9	32.2	17.4	-
	WFP	20.7	19.2	19.2	22.6	20.1	-
Area-weighted average	SIBEC	28.9	21.5	19.6	35.3	27.3	26.3
	WFP	26.5	20.8	23.2	29.7	27.9	31.9

[1] No SIBEC value was available for Ba within PG4 so TIPSY conversion equations were used. The WFP value is used to complete this table. The area involved is only 312 ha in AU 9510 so it has no material effect on the average presented here.

The SIBEC site indexes result in a 144,000 m^3 (0.4%) increase in THLB inventory at the beginning of the analysis and overall, increase managed stands yields by approximately 1-2% on average (at average harvest ages). These increased yields create greater timber supply in the mid and long term (when comparing against the Base Case). Overall, there is 3.9 million m^3 (1.5%) more harvested. The long term harvest level is approximately 0.9% more than the Base Case level (refer to Table 12 and Figure 19).

Table 12 – Harvest levels with yields based on SIBEC values

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	SIBEC-based yields	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,113,300	+ 11,700
3	2029	2038	1,046,200	1,068,500	+ 22,300
4	2039	2048	993,500	1,025,500	+ 32,000
5 - 7	2049	2078	943,500	984,200	+ 40,700
8	2079	2088	978,100	1,007,500	+ 29,400
9	2089	2098	1,028,000	1,057,500	+ 29,500
10 - 25	2099	2258	1,060,700	1,069,700	+ 9,000

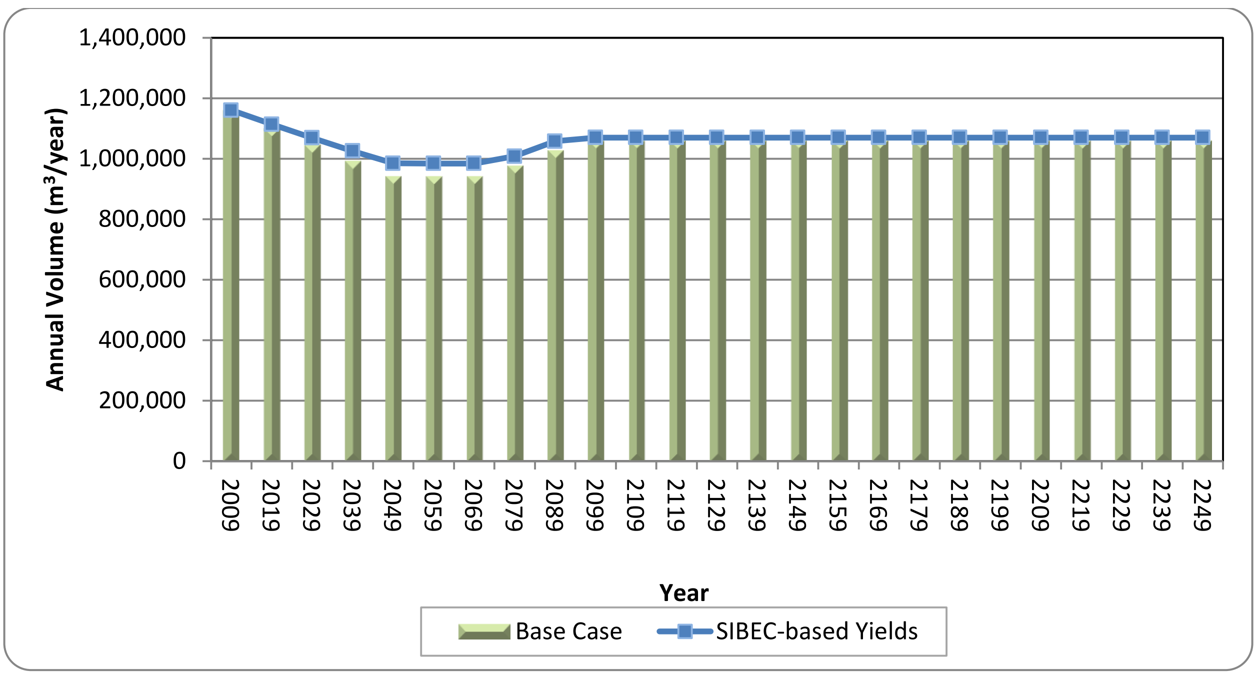

Figure 19 – Harvest levels with yields based on SIBEC values

Alternatively, the additional managed stands inventory could be used to allow the shift to the LTHL to occur sooner – see the red line in Figure 20 below. This schedule results in a LTHL approximately 11,300 m^3/year (1.1%) higher than the Base Case and about 4.2 million m^3 (1.6%) more timber harvested over the 250 years.

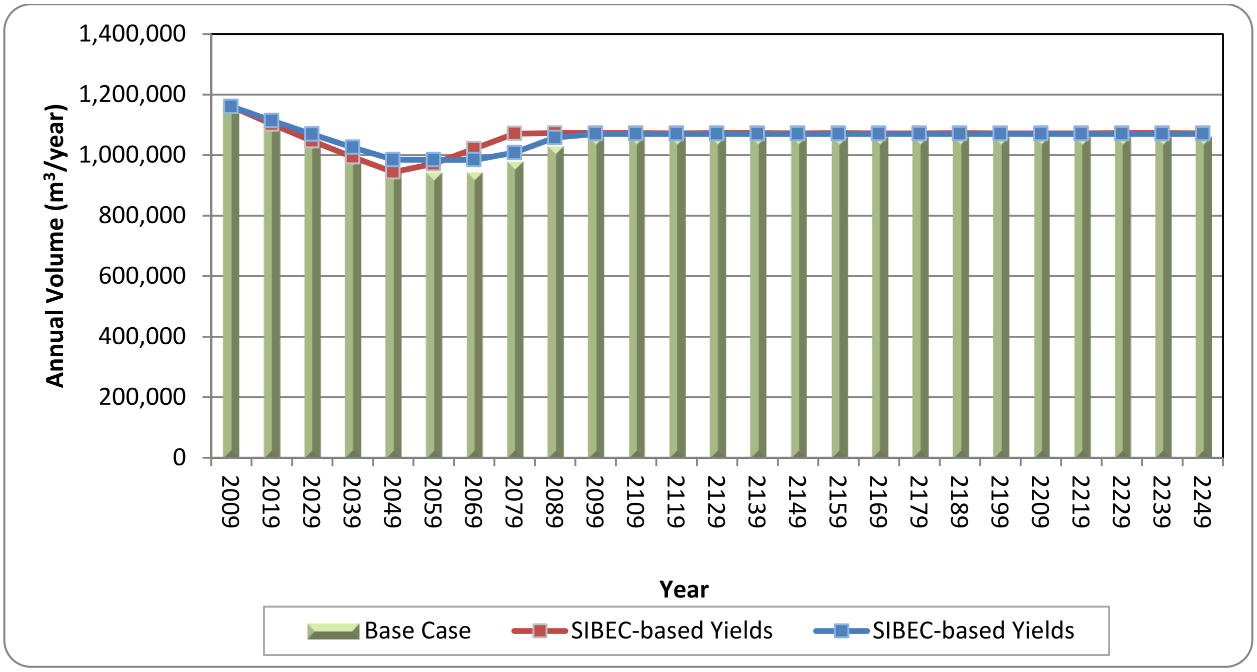

Figure 20 – Alternate harvest levels with SIBEC-based yields

4.7 Exclude future fertilization

The Base Case includes yield gains from fertilization (applied through TIPSY yield model) of a portion of future managed stands on the S1CH eco-sites (see section 8.6.2 of the IP for details). This sensitivity tests the impact on timber supply if this silviculture activity to improve yields did not occur.

Table 13 and Figure 21 indicate that the fertilization assumption is not contributing to timber supply for the first 70 years. This is logical as no future stands with fertilization are available for harvest until then. In the long term, the lack of fertilization generates harvest levels about 2.3% lower than the Base Case. Overall approximately 4.7 million m^3 (~1.8%) less is harvested over the 250 years.

Table 13 – Harvest levels with no future fertilization

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	No future fertilization	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,101,600	0
3	2029	2038	1,046,200	1,046,200	0
4	2039	2048	993,500	993,500	0
5 - 7	2049	2078	943,500	943,500	0
8	2079	2088	978,100	943,500	- 34,600
9	2089	2098	1,028,000	988,300	- 39,700
10 - 25	2099	2258	1,060,700	1,036,100	- 24,600

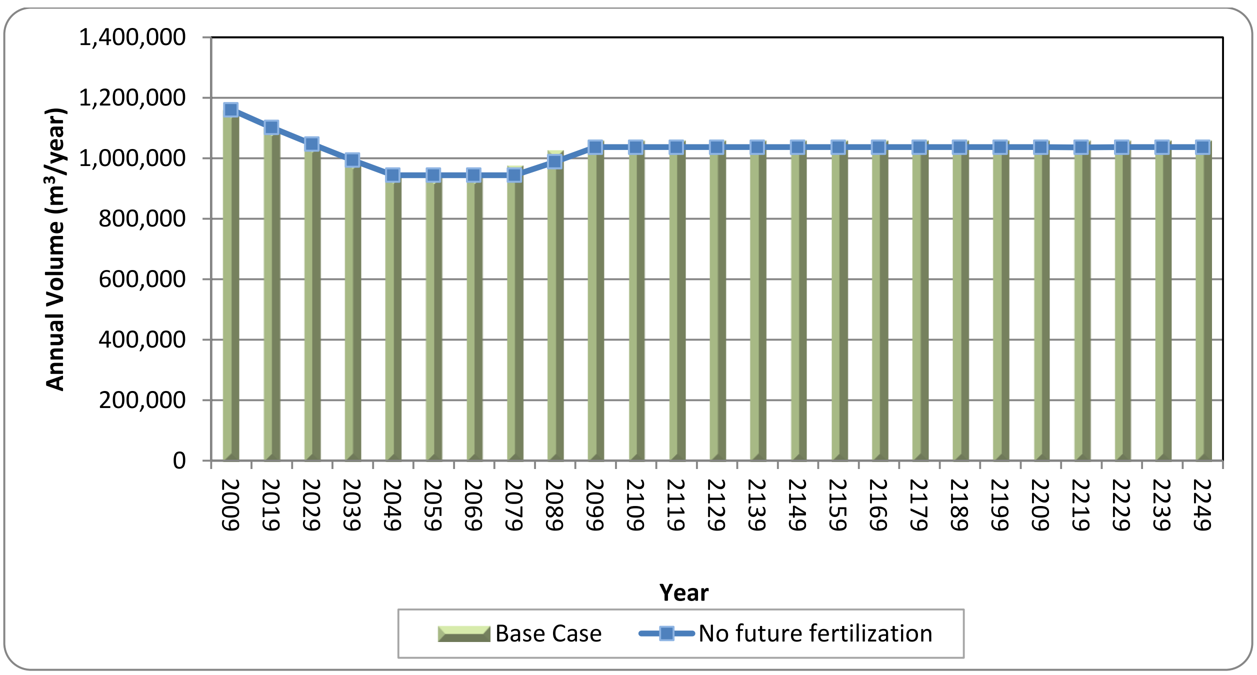

Figure 21 – Harvest levels with no future fertilization

4.8 Less planting of western hemlock

During the review of the draft Information Package, a question was raised by the MFLNRO regarding the amount of western hemlock that had been planted in the last 10 years and the assumptions for planting that species in the future – the concern being the amount of genetic worth (GW – often referred to as "genetic gain") applied for hemlock may be optimistic and therefore overestimate timber supply. The Base Case yields were generated with GW values for hemlock of 10% on low elevation sites and 6% on high elevation sites. These values were reduced from the GW values of planted hemlock (14% and 10% respectively) to reflect the fact that not all hemlock sites were planted and that naturally regenerated hemlock will likely form part of the harvested stand even on sites where hemlock was planted.

To address the question it was agreed to run this sensitivity in which the GW for hemlock is reduced to 4% for the largest analysis unit (AU) in the 1-10 year old and future age ranges (AU 1150 and 1500 respectively). Rather than generating new yield tables for these analysis units, the approach taken was to generate a volume at age 80 years (approximately the average harvest age) for AU 1500 with hemlock GW set at 4% and compare that value to the volume at age 80 years for AU 1500 with hemlock GW set at 10%. This ratio (0.972 – i.e. reducing the hemlock GW from 10% to 4% reduced the yield at 80 years by 2.8%) was then used as a scaling factor against the original yield tables for AU 1150 and 1500 (with hemlock GW set at 10%).

As AU 1500 is approximately 38% of the future THLB (41,399 ha of the total 107,811 ha), one would expect the LTHL to be reduced by roughly 1.1% (38% of THLB * 2.8% average yield reduction). As the yield changes impact mainly future stands there is no short term timber supply impact. The schedule shown in Table 14 and Figure 22 indicates the LTHL achieved is 1.2% lower than the Base Case and roughly 2.4 million m^3 (0.9%) less is harvested over the 250 years.

Table 14 – Harvest levels with less hemlock planting

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Less planted hemlock	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,101,600	0
3	2029	2038	1,046,200	1,046,200	0
4	2039	2048	993,500	993,500	0
5 - 7	2049	2078	943,500	943,500	0
8	2079	2088	978,100	960,900	- 17,200
9	2089	2098	1,028,000	1,010,900	- 17,100
10 - 25	2099	2258	1,060,700	1,047,900	- 12,800

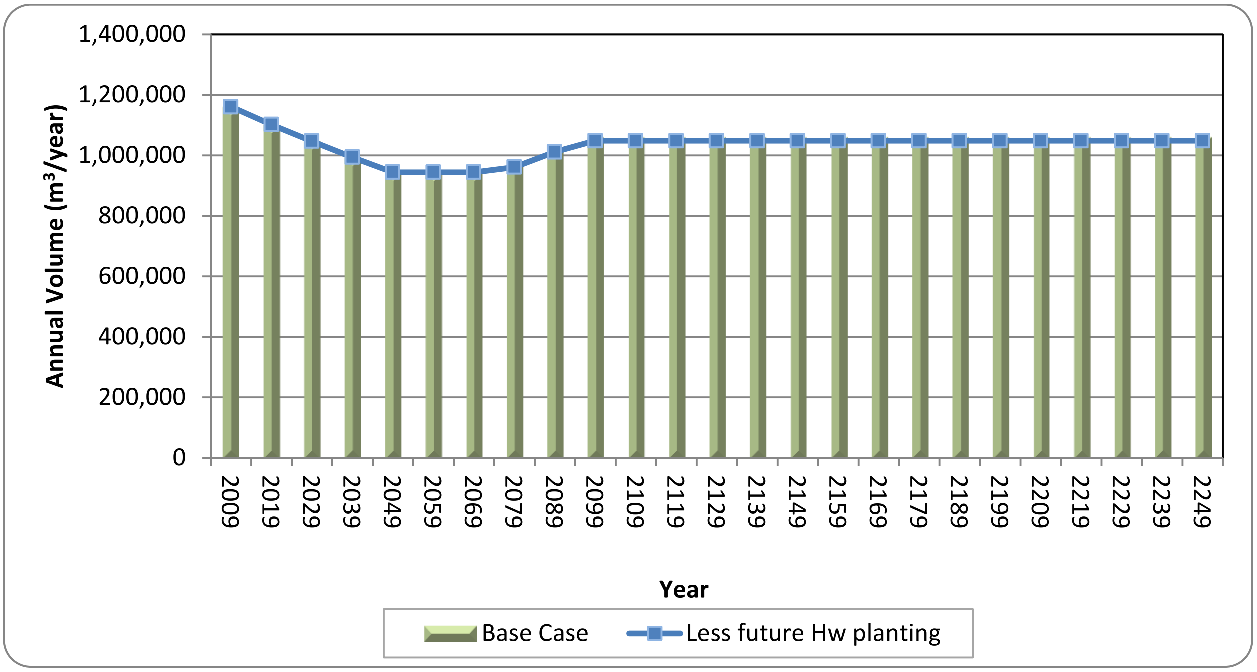

Figure 22 – Harvest levels with less hemlock planting

To further explore the sensitivity of timber supply to the planting of hemlock in the future a further analysis was conducted which assumed no planting within the S1HA sites (59,142 ha of THLB – nearly 55% of the total). These are the sites most likely to successfully regenerate naturally. To accomplish this, AU 1500 was eliminated from the future stands and all S1HA sites were regenerated to AU 1510 (a naturally regenerated stand - see Table 29 in the IP for the details of this AU). Yields for AU 1150 (1-10 year old existing stands) were set as in the Base Case.

Table 15 and Figure 23 indicate the results of this run (indicated by the red line) together with the schedule from Figure 22 above. The reduced future yields result in a LTHL of 1,034,200 m^3/year (2.5% lower than the Base Case). The transition to this lower LTHL requires a reduced mid-term timber supply due to lower inventory levels combined with older minimum harvest ages on more than half the forest (it takes 15 years longer to meet the minimum DBH criteria on both ground-based and cable-based areas for AU 1510 compared to AU 1500). Compared to the Base Case, approximately 8.0 million m^3 (3.1%) less is harvested over the 250 years.

Table 15 – Harvest levels with no planting of S1HA sites

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Less planted hemlock	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,090,000	- 11,600
3	2029	2038	1,046,200	1,024,100	- 22,100
4	2039	2048	993,500	962,300	- 31,200
5 - 7	2049	2078	943,500	904,100	- 39,400
8	2079	2088	978,100	904,100	- 74,000
9	2089	2098	1,028,000	946,800	- 81,200
10	2099	2108	1,060,700	996,800	- 63,900
11 - 25	2109	2258	1,060,700	1,034,200	- 26,500

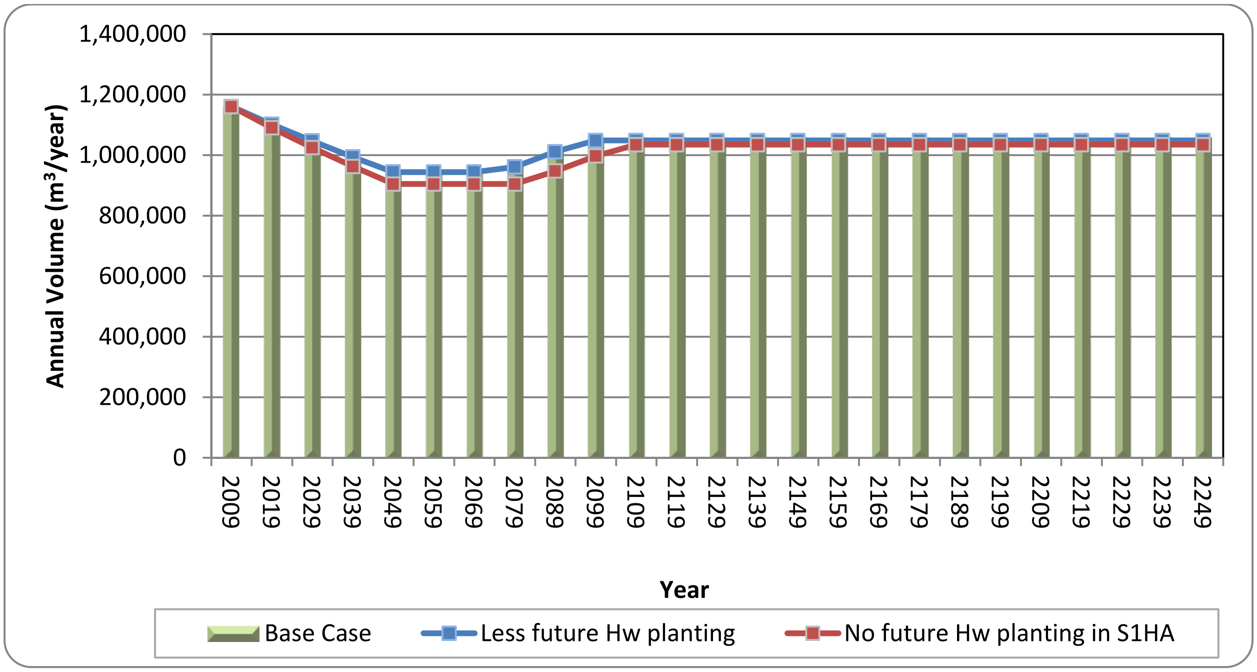

Figure 23 – Harvest levels with no planting of S1HA sites

The Base Case yields reflect recent planting of hemlock and the current expectations for its establishment in the future. Any significant changes to the amount of hemlock planted between now and the next timber supply analysis will be reflected in the next analysis with little risk to timber supply as this analysis indicates that short term timber supply is unaffected by the assumptions used.

4.9 Remove heli volume constraint

The Base Case includes a constraint that limits the amount of heli volume harvested in a year to 12,000 m^3. This constraint was included to reflect recent performance in the non-conventional portion of the THLB and to reflect the expectation that economics will continue to restrict the amount of volume accessed from these heli stands. This analysis tests the impact that constraint has on harvest levels achieved in the Base Case.

The approach taken was to set the initial harvest level such that it and the LTHL differed by approximately the same amount (percentage) when compared to the corresponding harvest level in the Base Case. In this analysis the "stable" growing stock constraint is applied to the total THLB growing stock (rather than only the conventional THLB growing stock as done in the Base Case) because in this sensitivity the entire THLB is being utilized to provide a sustainable timber supply, whereas in the Base Case the conventional THLB is being utilized to provide a sustainable timber supply while the timber supply from the heli THLB is restricted.

As the heli THLB is approximately 2.9% of the total THLB, this would be the expected long-term contribution to timber supply. Table 16 and Figure 24 indicate that with the heli harvest constraint removed the initial harvest level can be 23,000 m^3/year (2.0%) higher. The LTHL is also approximately 2% higher, with the total heli contribution being roughly 3.0% ((12,000 m^3/year in base case + incremental 20,600 m^3/year) from total of 1,081,300 m^3/year). Over the entire 250 years approximately 5.0 million m^3 (1.9%) more is harvested.

Table 16 – Harvest levels with no heli constraint

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	No heli constraint	Difference
1	2009	2018	1,160,000	1,183,000	+ 23,000
2	2019	2028	1,101,600	1,123,500	+ 21,900
3	2029	2038	1,046,200	1,067,000	+ 20,800
4	2039	2048	993,500	1,013,300	+ 19,700
5 - 7	2049	2078	943,500	962,300	+ 18,800
8	2079	2088	978,100	991,500	+ 13,400
9	2089	2098	1,028,000	1,041,400	+ 13,000
10 - 25	2099	2258	1,060,700	1,081,300	+ 20,600

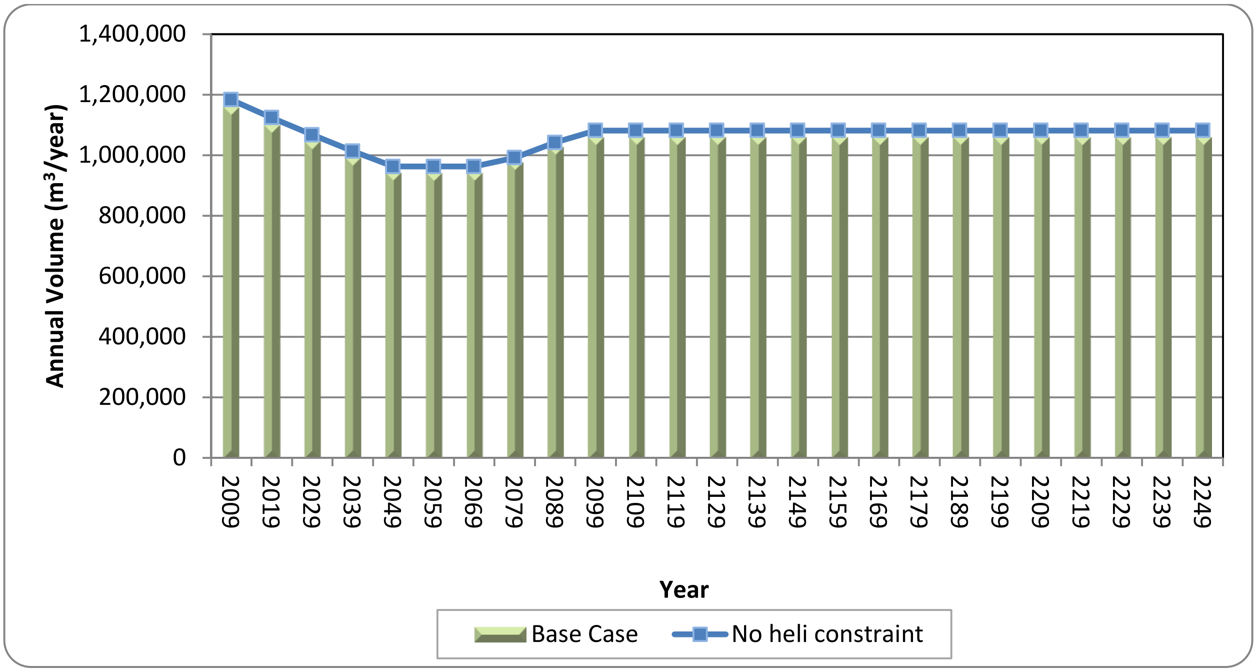

Figure 24 – Harvest levels with no heli constraint

4.10 Exclude heli operable landbase

In recent years, harvest in the high cost non-conventional (heli) mature inventory has been significantly less than its contribution to the current merchantable inventory. A substantial portion of this volume is hemlock and balsam of relatively low value in recent markets. The sensitivity analysis discussed in section 4.1 removed both unstable (Class V) terrain and the heli operable landbase. This analysis tests the sensitivity of timber supply to the exclusion of the heli operable landbase. The heli THLB contains approximately 2.4 million m^3 of inventory – equal to 5.6% of the total.

The simple approach would be that the heli landbase contributes 12,000 m^3/year to timber supply as this is the constraint applied in the Base Case and the results indicate this level was, for the most part, achieved throughout the planning horizon. For this sensitivity analysis the model was set up to follow the Base Case schedule as long as possible.

Table 17 and Figure 25 indicate the results of this sensitivity - harvest levels are the same as those of the Base Case for the first 70 years. Afterwards lower harvest levels are required due to lower available inventory levels and a smaller operable landbase. The LTHL is 13,900 m^3/year (1.3%) less than that achieved in the Base Case and the total volume harvested over the 250 years is 3.3 million m^3 (1.3%) less. The differences are greater than 12,000 m^3/year and 3.0 million m^3 (12,000 m^3/year * 250 years) respectively due to sustaining the Base Case harvest levels for the first 70 years.

Table 17 – Harvest levels with heli THLB excluded

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	No heli logging	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,101,600	0
3	2029	2038	1,046,200	1,046,200	0
4	2039	2048	993,500	993,500	0
5 - 7	2049	2078	943,500	943,500	0
8	2079	2088	978,100	943,500	- 34,600
9	2089	2098	1,028,000	976,600	- 51,400
10	2099	2108	1,060,700	1,026,600	- 34,100
11 - 25	2109	2258	1,060,700	1,046,800	- 13,900

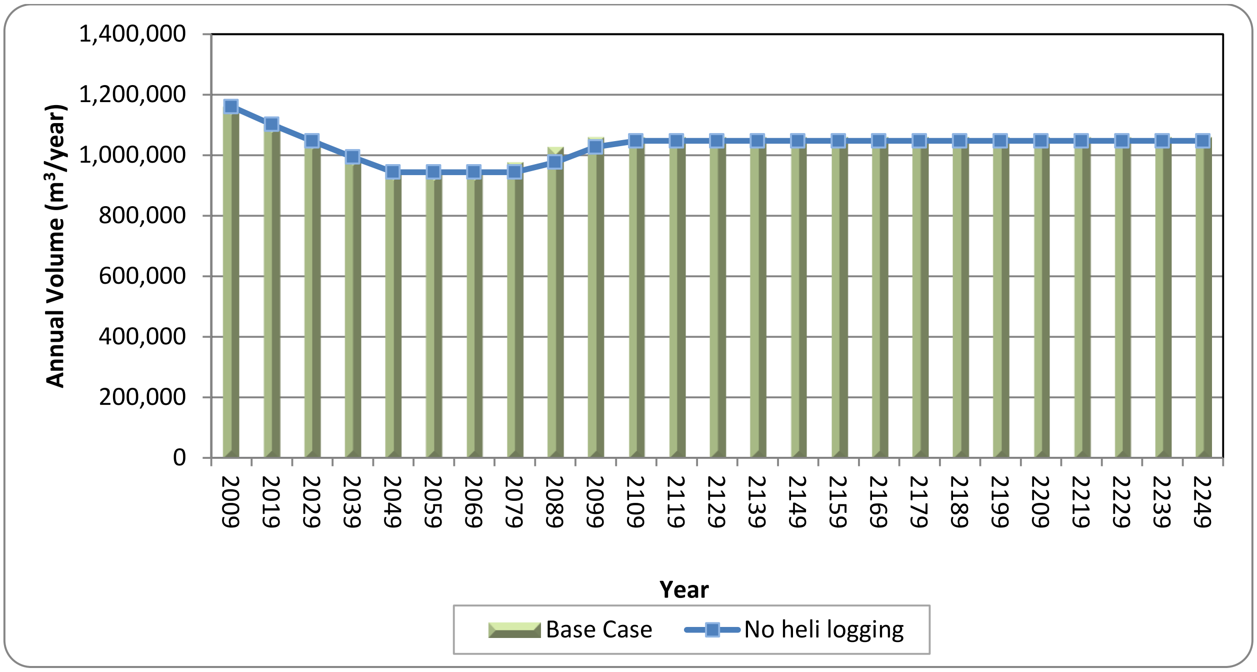

Figure 25 - Harvest levels with heli THLB excluded

4.11 Reduce the percent disturbed within each VQO polygon

To test the sensitivity of timber supply to the assumptions used for managing visual quality objectives (VQOs), this sensitivity uses the mid-point of the disturbance range for each VQO class rather than the upper limit as in the Base Case (Table 18). The model was set such that no more than the applicable listed percentage of each VQO class within each Resource Management Zone (RMZ) could be occupied by stands less than 15 years old (i.e. visually effective green-up (VEG) is reached in 15 years). When these limits were applied to individual VQO polygons, solving time for the model was several days. When the VQO polygons were grouped by class within each RMZ solutions were generally generated in less than 3 hours. A solution was generated with the disturbance limits applied to individual VQO polygons rather than the aggregated polygons and there was no material difference in harvest volumes achieved. This indicates that the aggregation of the VQO polygons had no significant impact on timber supply results.

Table 18 – Maximum disturbance by VQO class

VQO	Maximum disturbance %	
	Base Case	Sensitivity
Modification (M)	25%	20%
Partial Retention (PR)	15%	10%
Retention (R)	5%	2.5%

Table 19 and Figure 26 indicate the results of this sensitivity. Short term harvest levels are unaffected as there is sufficient inventory outside the visually sensitive areas to maintain the Base Case harvest levels. Commencing in 2079 the more restrictive visual quality management assumptions (relative to the Base Case) begin having a timber supply impact. The LTHL is reduced by only 600 m^3/year.

Table 19 - Harvest levels with more restrictive visual quality management

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	VQOs more restrictive	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,101,600	0
3	2029	2038	1,046,200	1,046,200	0
4	2039	2048	993,500	993,500	0
5 - 7	2049	2078	943,500	943,500	0
8	2079	2088	978,100	960,100	- 18,000
9	2089	2098	1,028,000	1,010,000	- 18,000
10 - 25	2099	2258	1,060,700	1,060,100	- 600

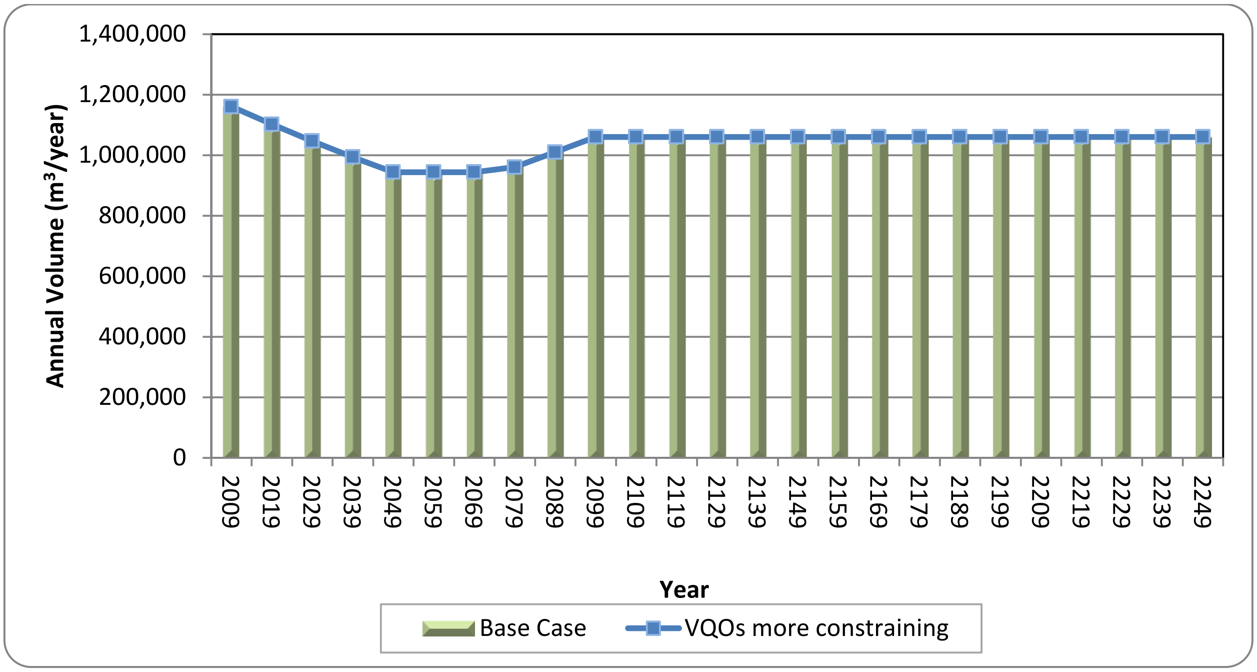

Figure 26 - Harvest levels with more restrictive visual quality management

Visual impact assessments are used to guide cutblock design in order to mitigate the visual impact of cutblocks and roads and therefore reducing the timber supply impact of visual quality management. The screening effect of strategically located stand level retention can be used to effectively reduce the visual impact of cutblocks. These practices allow for higher disturbance percentages to be achieved within a VQO polygon and therefore support using the higher percentage limits for timber supply modelling.

4.12 VILUP Order Objective #16

Objectives #15 and #16 of the *Vancouver Island Land Use Plan Higher Level Plan Order* (VILUP Order) applies to Enhanced Forestry Zone (EFZ) #8 (Mahatta-Neroutsos) within TFL 6. The objectives state:

> "*15. Retain old growth forests to meet old seral targets and marbled murrelet habitat requirements in the non-contributing land base to the fullest extent possible.*
>
> *16. Beyond retention in the non-contributing land base, retain old forests in the timber harvesting land base, up to the full target amount, if the district manager and the designated environmental official determine that such retention is required to maintain critical marbled murrelet habitat."*

EFZ #8 falls within the Mahatta and Neroutsos landscape units, each which were assigned a low biodiversity emphasis (BEO) by the *Order Establishing Provincial Non-Spatial Old Growth Objectives* (NSOG Order). The NSOG Order states that for landscape units with a low BEO the old forest retention percent (Old Growth Management Area (OGMA) allocation) may be reduced by up to 2/3 to address timber supply impacts. Therefore the OGMAs need only meet 1/3 of the full OGMA allocation and VILUP Objective #15 would still be met. VILUP Objective #16 however would supersede the 2/3 OGMA reduction if it was determined that retaining the full OGMA allocation is required to maintain critical marbled murrelet habitat. No such determination has been made yet.

The final draft OGMAs identified within the Neroutsos landscape unit meet the full OGMA allocation and were drafted to capture a significant portion of the identified marbled murrelet habitat. The draft OGMAs (preliminary and TFL 6 portion only) identified within the Mahatta landscape unit do not meet the full OGMA allocation (overall they meet 73% of the full allocation) but they were drafted to capture a portion of the identified marbled murrelet habitat. To address VILUP Objective #16 this sensitivity analysis was run with the full OGMA allocation required to be met immediately (rather than after 3 rotations as in the Base Case). This constraint reduces the current THLB within the CWHvm1 by 390 ha.

Table 20 and Figure 27 indicate the results of this sensitivity. If this is the proper interpretation of VILUP Objective #16 the modelled timber supply impact of meeting full OGMA allocation within EFZ #8 today is minimal.

Table 20 - Harvest levels with full OGMAs in EFZ #8

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Full OGMAs in EFZ 8	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,101,600	0
3	2029	2038	1,046,200	1,046,200	0
4	2039	2048	993,500	993,500	0
5 - 7	2049	2078	943,500	943,500	0
8	2079	2088	978,100	976,500	- 1,600
9	2089	2098	1,028,000	1,026,500	- 1,500
10 - 25	2099	2258	1,060,700	1,060,700	0

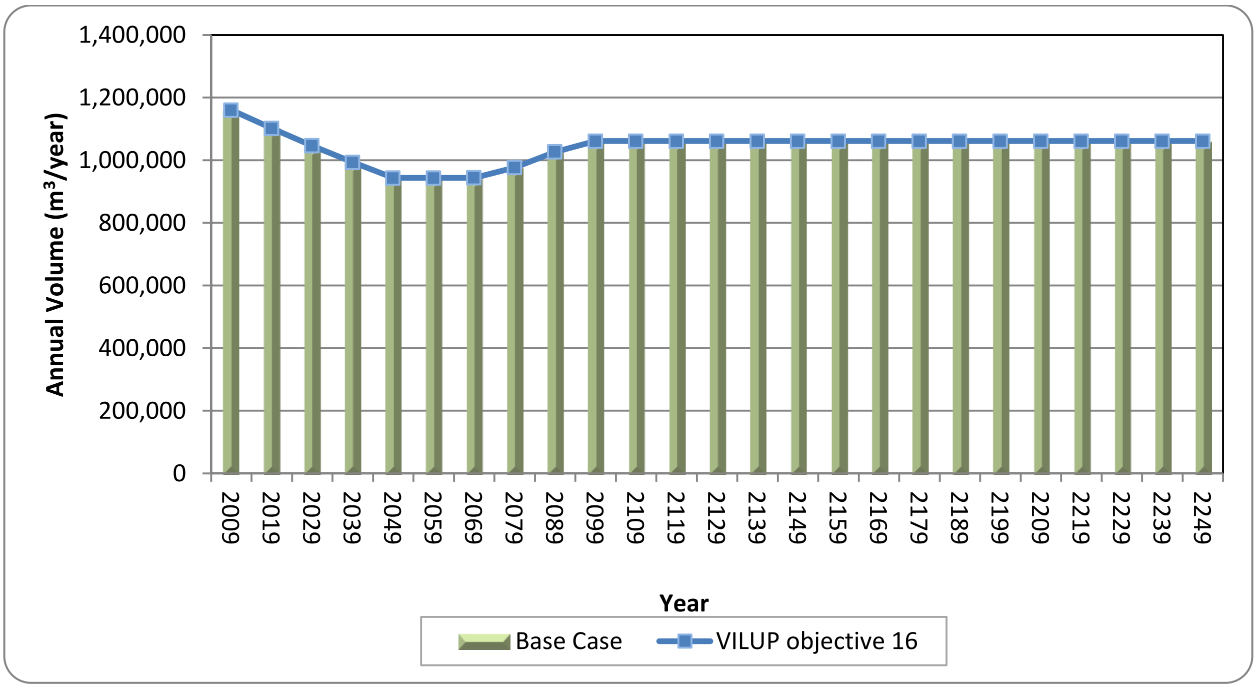

Figure 27 - Harvest levels with full OGMAs in EFZ #8

Short-term operational impacts of this interpretation of VILUP Objective #16 would be greater than modelled timber supply impacts due to a loss of mature operable inventory.

4.13 Increase minimum harvest DBH criteria

Minimum harvest criteria are simply the minimum criteria for use in the timber supply model – stands are not available for harvest by the model until the minimum criteria are met. Actual harvesting occurs in some stands below the minimum modelled criteria while other stands are not harvested until well past the minimum criteria due to managing for other resource values. Minimum criteria are often specified by an age and a minimum volume per hectare. This analysis used a minimum average stand diameter-at-breast-height (DBH) that varied by harvesting system and a minimum volume per hectare (see section 10.3.1 of the IP). The concept is that larger diameters in general reflect higher net values.

Table 21 indicates the minimum average stand DBH used in the Base Case and in this sensitivity analysis. WFP has successfully operated within ground-based stands with average DBHs of 30 cm so this minimum DBH was not changed. The minimum DBHs for cable and heli were increased by 2 cm for the sensitivity analysis. In terms of years, this delays harvest eligibility from 5 to 40 years depending on the analysis unit, with the average delay being slightly more than 10 years (for the cable/heli portion of the landbase).

Table 21 - Minimum Harvest Criteria

Harvest System	Minimum Average DBH	
	Base Case	Sensitivity
Ground	30 cm	30 cm
Cable	37 cm	39 cm
Heli	42 cm	44 cm

The larger DBH criteria reduce the initial available inventory by 1.03 million m^3 (3.3%). Table 22 and Figure 28 indicate the results of maintaining the initial Base Case harvest level and then allowing the mid-term and LTHL to adjust to the reduced available inventory. The delayed availability of stands necessitates reduced mid-term harvest levels in order to allow sufficient inventory to build such that the LTHL is affected minimally (0.5% lower). Overall 4.4 million m^3 (1.7%) less is harvested in this sensitivity analysis.

Table 22 - Harvest levels with larger minimum DBH criteria

Period (Decade #)	Start Year	End Year	Annual Harvest Volume (m^3)		
			Base Case	Larger DBH criteria	Difference
1	2009	2018	1,160,000	1,160,000	0
2	2019	2028	1,101,600	1,090,000	- 11,600
3	2029	2038	1,046,200	1,024,200	- 22,000
4	2039	2048	993,500	962,300	- 31,200
5 - 7	2049	2078	943,500	904,100	- 39,400
8	2079	2088	978,100	913,200	- 64,900
9	2089	2098	1,028,000	963,200	- 64,800
10	2099	2108	1,060,700	1,013,200	- 47,500
11 - 25	2109	2258	1,060,700	1,055,400	- 5,300

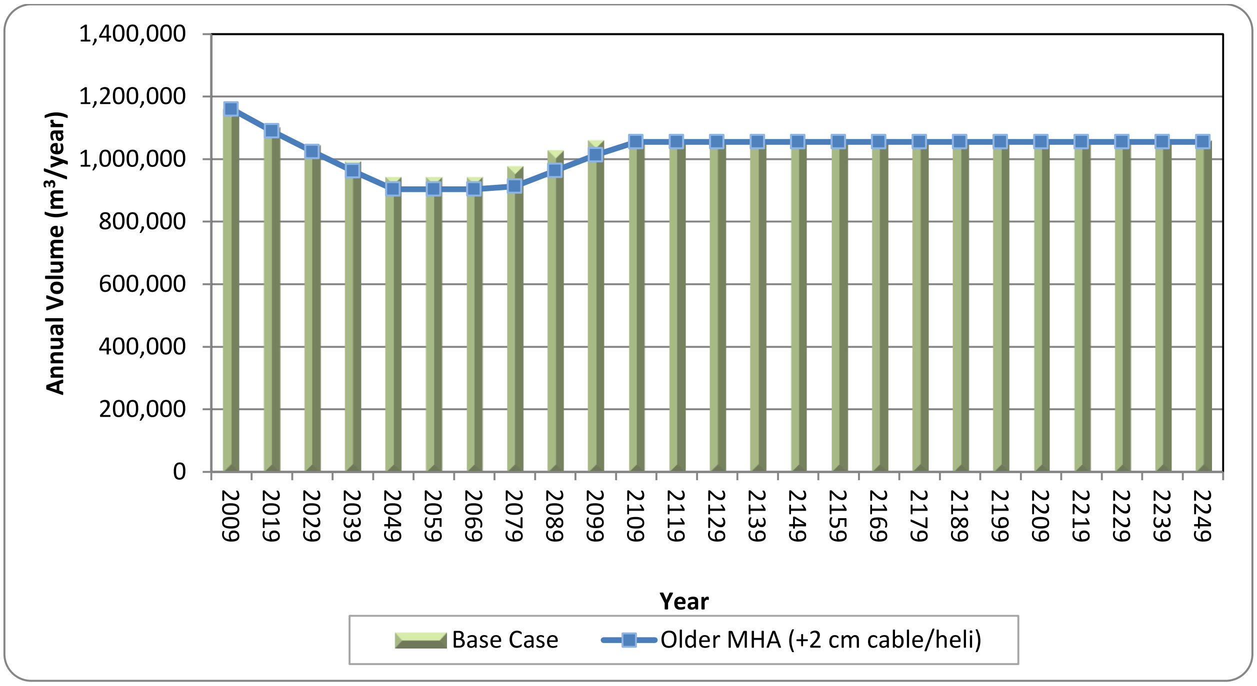

Figure 28 – Harvest levels with larger minimum DBH criteria

4.14 Summary of sensitivity impacts

Table 23 provides a summary of the impacts of the sensitivity issues explored. Impacts shown indicate the aggregate differences over the defined time periods and are rounded to the nearest tenth of a percent. Values in parentheses refer to alternate schedules presented for the associated sensitivity analysis.

Table 23 – Summary of sensitivity analyses harvest impacts

		Harvest Interval (years)		
		1 – 40	**41 – 90**	**91 - 250**
	Base Case total net harvest level (m^3)	43,013,000	48,366,000	169,712,000
Issue tested	**Sensitivity**	**Percentage Impact**		
Available landbase	Exclude unstable terrain plus heli operable landbase	-1.5%	-5.3%	-3.3%
Growth and yield	Natural stands yields decreased by 10%	-3.0%	-5.2%	-0.1%
	Natural stands yields increased by 10% (short term gain) (alternate: mid-long term gain)	+3.1% (+0.3%)	+6.1% (+6.8%)	-0.6% (+0.2%)
	Managed stands yields decreased by 10%	-4.5%	-7.6%	-9.9%
	Managed stands yields increased by 10%	+3.1%	+8.9%	+10.2%
	Use SIBEC Site Index estimates (short term gain) (alternate: mid-long term gain)	+1.5% (0.0%)	+3.7% (+5.0%)	+0.8% (+1.1%)
Forest management / Silviculture	Remove benefits of future fertilization	0.0%	-1.5%	-2.3%
	Less hemlock planting (alternate: no Hw planting on S1HA)	0.0% (-1.5%)	-0.7% (-5.7%)	-1.2% (-2.7%)
Operability	Remove heli harvest constraint	+2.0%	+1.7%	+1.9%
	Exclude heli landbase	0.0%	-1.8%	-1.4%
Visual Quality	Reduce allowable percent disturbed	0.0%	-0.7%	-0.1%
Wildlife habitat / Biodiversity	Retain old forests to full target to maintain marbled murrelet habitat in EFZ #8 (VILUP objective #16)	0.0%	-0.1%	0.0%
Minimum harvest criteria	Increase minimum DBH by 2 cm for cable and heli land base	-1.5%	-5.1%	-0.7%

Since all sensitivities, other than "remove heli harvest constraint" (section 4.9), begin with the same initial harvest level as the Base Case, a negative timber supply impact in the first 40 years is associated with a greater rate of decline in harvest levels than is achieved in the Base Case. A positive timber supply impact in this time period is associated with a gentler rate of decline in harvest levels than the Base Case (refer to Table 1 for Base Case harvest level decline rates).

5.0 Analysis Summary and Proposed AAC

5.1 Changes since MP #9

There have been considerable changes in the TFL 6 landbase and timber supply analysis assumptions since MP #9. Main changes include:

- Deletion of BCTS, private land and Tri-Port Community Forest areas has occurred. The current TFL 6 AAC of 1,255,536 m^3/year reflects these changes.
- Landscape unit planning (OGMAs) and increased allowances for riparian areas and stand retention have decreased the THLB on the remaining TFL 6 by approximately 12.5%.
- A new forest inventory (Vegetation Resources Inventory (VRI)) has reduced estimates of mature timber volumes by close to 10%.
- The definition of minimum harvest ages has been changed to relate to harvest system rather than the site productivity basis used in MP #9. Overall the long-term average harvest age has decreased from 103 years to 84 years.
- Harvest scheduling uses optimization compared to the simulation approach in MP #9

5.2 MP #10 Base Case Initial Harvest

The starting harvest level of 1,160,000 m^3/year in the Base Case reflects both the reduced TFL 6 landbase and the projected reductions in harvest according to the MP #9 Base Case option.

- As noted above, the current TFL 6 AAC of 1,255,536 m^3/year accounts for area deletions from the TFL.
- The 7.6% decrease from the current AAC of 1,255,536 m^3/year to the initial harvest level of 1,160,000 m^3/year in the MP #10 analysis corresponds to the projected percentage decrease in harvest in the MP #9 Base Case schedule from the 2001-2005 period to the average of the 2011-2015 and 2016-2020 periods.

5.3 Economic Access

The main uncertainty is with economic access in the short and medium-terms (the next 60 years). The significance of economic operability has increased due to the following:

- A substantial reduction in merchantable inventory has occurred during the last 10 to 20 years through the establishment of protected areas and reserves (netdowns) for non-timber values (e.g. the establishment of OGMAs during MP #9), combined with on-going harvest. The result is a decrease in flexibility to maintain harvest levels in poor markets. Reduced harvest flexibility can also be accentuated by land use planning or First Nations interests that restrict access to areas of merchantable inventory.

- Recent market conditions and the current outlook. Hembal prices have been relatively low for more than ten years. The current market downturn has been the most severe in recent decades and recovery in the USA market has been slow.

These issues apply to TFL 6, although to a lesser extent than for many other Coastal forests. Overall, TFL 6 is more accessible and has less difficult terrain. The AAC has been harvested in recent years. Still, recent reductions to the THLB, for example for OGMAs reduce planning flexibility.

Reduced harvest flexibility and poor market conditions create uncertainties for economic access, in particular:

- In mature forest there is uncertainty of harvest and rate of harvest from helicopter accessible areas (especially lower valued stands) and from conventional areas of low value and/or high access costs.
- In second-growth forest there is uncertainty of harvest and harvest ages in more difficult (costly) terrain.

In addition the simplistic approach used in modelling (for practical reasons) introduces some uncertainty, although this may include offsetting factors. For example:

- Operational scheduling of harvests will be different from the modelled approach. This may result in somewhat reduced harvest flexibility in the mid-term.
- Harvest history and reserves have resulted in fragmentation of a portion of the THLB. For example, a Stanley spatial analysis using the first 25 years of the Woodstock Base Case schedule identified 1.5% of the THLB is in areas of less than 2 ha in size and 3.3% in areas of less than 5 ha in size. It is possible that some of these small areas will not be harvested or harvest will be delayed until adjacent area is merchantable.
- Some small additional volumes will likely be available over time from practices such as single-stem harvesting in areas netted down in the analysis; for example in areas classified as uneconomic or unstable terrain.

Plans are to develop an improved basis for consideration of economic access at the strategic level. The current TFL 6 data set includes the approach used in previous analyses and generally used in analyses of other forests: that of making a broad allowance for economic operability based on inventory information, rather than on economic data (costs and values). WFP is planning a more detailed assessment of economic operability including consideration of harvest systems, costs and timber values; an approach similar to that applied recently for some forests (tenures) in BC.

5.3.1 Allowances made in the Base Case

The Base Case has made allowances for some of the concerns on economic access:

- Areas of mature forest with low volumes (lower height and stocking classes) classified as having “economic constraints” have been excluded.
- The Base Case constrained harvest from helicopter accessible stands to a maximum of 12,000 m^3/year based on recent performance. A sensitivity analysis shows that without this constraint an additional 20,000 m^3/year might be harvested over much of the 250 year forecast.
- Higher minimum harvest ages for areas classified as accessible by more costly harvest systems, cable and helicopter.

5.4 Sensitivity Analyses

Sensitivity analyses have explored timber supply impacts of several of the issues (uncertainties) individually. This includes:

- A sensitivity excluded the helicopter accessible stands and areas classified as class V (unstable terrain). Although harvesting is occurring in these areas, (refer to sections 6.6 and 10.3.3 in the Information Package) and harvesting in helicopter areas is constrained in the Base Case, this sensitivity assesses timber supply impacts of not being able to access some area of difficult timber types. The excluded area contributes 4.9% and 8.3% of the Base Case THLB and current growing stock respectively. The result is a slightly steeper 6% per decade decline in harvest from the starting 1,160,000 m^3/year, a deeper mid-term trough in harvest by 70,000 m^3/year and a LTHL reduced by 3.2%. The impact is reduced by the already constrained timber supply from helicopter areas in the Base Case.
- A sensitivity analysis of minimum harvest ages increased the minimum average DBH for cable and heli areas by 2cm (on average delaying eligibility by 10 years). The initial harvest level remained at 1,160,000 m^3/year, but the medium-term (41 to 90 years) harvest is reduced by an average of 5.1%. Experience with ground based harvest systems has shown harvesting occurring in stands with trees of average 30cm DBH, the criteria used to define minimum harvest ages. Experience is lacking for testing the 37cm and 42 cm average stand DBH criteria for minimum harvest ages in harvesting second-growth with cable and helicopter systems. The overall average harvest age for second-growth of over 80 years is greater than in recent analyses for TFL 19 and TFL 44.
- A number of sensitivity analyses examined the timber supply impacts of higher and lower volume projections or of management and other factors contributing to uncertainty on forest growth. Comments include:
    - VRI volume estimates for mature (older than 140 years) THLB average approximately 10% less than for the previous inventory applied in the MP #9 analysis.

- SIBEC site productivity estimates result in a slightly higher timber supply, particularly in the mid-term.
- Changes in natural stand (currently greater than 50 years old) volume estimates impact timber supply most in the medium-term, while changes to managed stand yields (currently aged less than 51 years and future stands) are greatest in the long-term, but still substantial in the mid-term.

5.5 Conclusions and Recommendations

Compared to the MP #9 analysis, changes in minimum harvest ages largely offset the negative impacts of reductions in THLB and mature volume on short-term and medium-term (next 90 years) timber supply.

The analysis shows that the initial harvest level for the Base Case is robust across the individual sensitivities.

An AAC of 1,160,000 m^3/year (the initial harvest level of the Base Case) is proposed for TFL 6 during the next ten years. The 1,160,000 m^3 includes 11,578 m^3 allocated to First Nations.