Tree Farm Licence 57 – Management Plan #2

Timber Supply Analysis Report

Version 2.1

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Project 988-2

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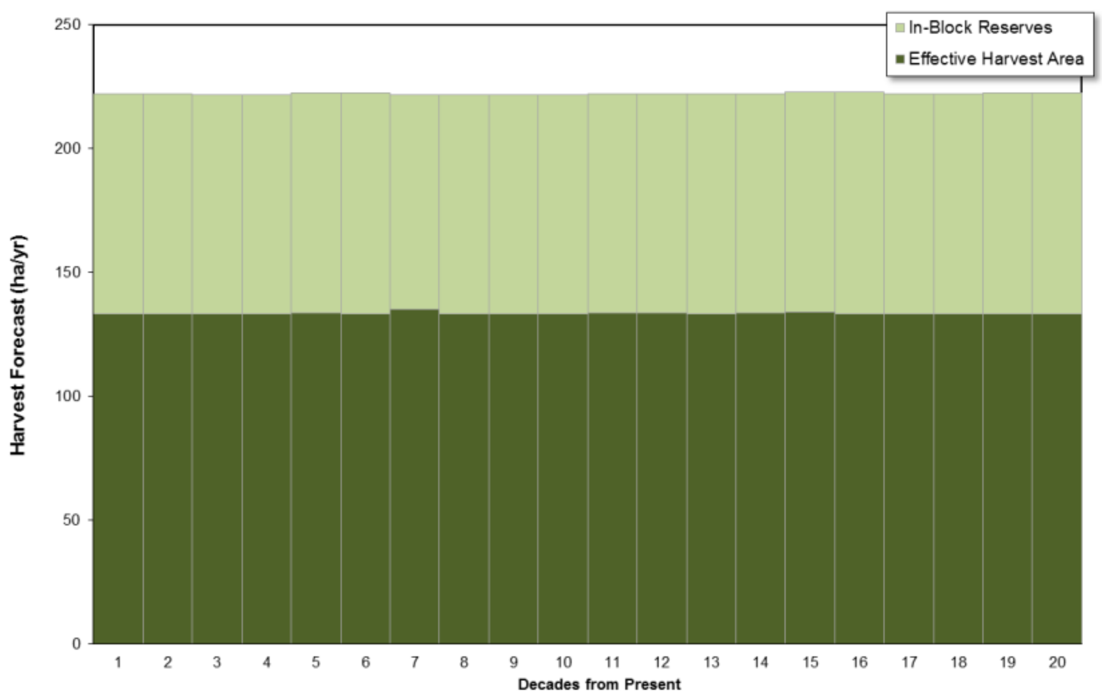
Executive Summary

This document describes the timber supply analysis specific to Tree Farm Licence 57 (TFL 57) held by Iisaak Forest Resource Ltd (Iisaak). The general objective of the analysis process is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TFL.

For TFL 57, an area-based approach to harvest regulation is utilized through the Tree Farm Licence Area-based Allowable Annual Cut (AAC) Trial Program Regulation. An area-based AAC defines the area of land that can be harvested annually rather than the amount of volume. This analysis focuses on a forest management scenario that reflects current management practices (i.e., Base Case). This becomes the basis for comparing sensitivity analyses that assess the impact of uncertainties in data or assumptions. Together, these analyses provide a foundation for discussions with the government and stake holders in the determining an appropriate harvesting level.

This timber supply analysis demonstrated that a Base Case harvest level that complies with the management intent for individual watershed plans established under the Clayoquot Land Use Order. This harvest level was achieved without violating non-timber management constraints imposed on the land base, including: watershed rate of cut, scenic areas, and mature-plus-old seral stage.

Accordingly, Iisaak recommends an AAC of 222 ha/yr of total harvest planning area, as depicted in the figure below.



Sensitivity analyses conducted showed that harvest rates are very sensitive to rotation age and must be carefully considered as this can ultimately affect the harvested products expected. Economic operability was another key driver affecting the harvest level as it affects the timber harvesting land base (THLB). As expected, reductions to the THLB have a negative effect on harvest levels.

In addition to many other sources of information, the Deputy Chief Forester will consider this timber supply analysis in determining an appropriate AAC for this licence.

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1 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in our forests such as wildlife, biodiversity, watershed health, recreational opportunities, etc.

A formal review of the projected timber supply is typically completed once every five to ten years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TFL. The previous analysis was completed in November, 2003 with a final Allowable Annual Cut (AAC) determination on January 1, 2005. The current allowable annual cut (AAC) for TFL 57 is 381 ha per year of which 92 and 289 ha per year are attributed to even-aged and uneven-aged harvest operations, respectively.

This document describes the timber supply analysis specific to Tree Farm Licence 57 (TFL 57) held by Iisaak Forest Resource Ltd. The general objective of the analysis process is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TFL. It summarizes the results of the timber supply analysis, recommends a harvest forecast, provides a focus for public review and First Nations referrals and is ultimately submitted to the provincial Deputy Chief Forester for her consideration in determining an appropriate AAC for the next management plan period.

The detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis was provided in the Information Package[1] made available for review and comment in September 2013. Both the Information Package and this Timber Supply Analysis are required components to the TFL Management Plan process.

For TFL 57, an area-based approach to harvest regulation is utilized through the *Tree Farm Licence Area-based Allowable Annual Cut Trial Program Regulation.* An area-based AAC defines the area of land that can be harvested annually rather than the amount of volume. This analysis focuses on a forest management scenario that reflects current management practices (i.e., Base Case) that becomes the basis for comparing sensitivity analyses that assess the impact of uncertainties in data or assumptions. Together, these analyses form a solid foundation for discussions with the government and stake holders in the determining an appropriate harvesting level.

[1] Forsite Consultants Ltd. 2013. Tree Farm Licence 57 – Management Plan #2 Information Package. Version 2.0. March 2014. Prepared for Iisaak Forest Resources Ltd. Unpublished Report. 12 p.

2 Current Description of TFL 57

Table 1 provides a summary of the land base by netdown category while Figure 1 shows an overview of the major contributing classifications. TFL 57 is approximately 87,140 ha in total. For this project, the analysis area was expanded to include portions of provincial parks that are adjacent to the TFL as they contribute to forest cover constraints such as seral stage distribution. Accordingly, the total area under assessment for this analysis is approximately 109,676 ha. Of this area, approximately 77% is within the Crown Forested Land Base (CFLB) and 20% is considered to be Timber Harvesting Land Base (THLB).

Table 1 Land base area summary – Base Case

	Total	Schedule A	Schedule B	Total Effective Area (ha)	Percent of Total Area	Percent of CFLB
Total Area	**87,143**	**17,827**	**69,316**	**87,143**	**100.0%**	
less:					0.0%	
Non-Forest / Non-Productive	9,106	205	8,901	9,106	10.4%	
Existing Roads, Trails, and Landings	936	288	6,481	6,769	7.8%	
Crown Forest Land Base		**17,333**	**53,934**	**71,267**	**81.8%**	**100.0%**
less:					0.0%	
Parks	22,376		92	92	0.1%	0.1%
Clayoquot Protected Reserve Network						
Hydro-riparian reserves	21,561	3,348	11,402	14,750	16.9%	20.7%
Terrain Stability	11,112	288	6,481	6,769	7.8%	9.5%
Marbled murrelet	7,356	160	3,881	4,041	4.6%	5.7%
Recreation / tourism	3,876	158	285	443	0.5%	0.6%
Sensitive soils	10,035	298	2,793	3,091	3.5%	4.3%
Floodplains	1,604	49	168	217	0.2%	0.3%
Non-Veg / scrub-herb	223	5	4	9	0.0%	0.0%
Red and Blue listed	3,152	62	76	139	0.2%	0.2%
Non-Merchantable (Deciduous-Leading)	2,453	241	401	642	0.7%	0.9%
Uneconomic	44,911	2,642	17,932	20,575	23.6%	28.9%
Low Productivity	16,792	54	1,147	1,200	1.4%	1.7%
Meares Island	3,534	3,471	35	3,506	4.0%	4.9%
Timber Harvesting Land Base		**6,499**	**15,298**	**21,797**	**25.0%**	**30.6%**
Less aspatial netdowns:						
Permanent Stand Level Retention (@40%)		2,600	6,119	8,719	10.0%	12.2%
Effective Timber Harvesting Land Base		**3,899**	**9,179**	**13,078**	**15.0%**	**18.4%**
Less future aspatial netdowns:						
Future Roads, Trails, and Landings (@5%)		195	459	654	0.8%	0.9%
Future Timber Harvesting Land Base		**3,704**	**8,720**	**12,425**	**14.3%**	**17.4%**

** Aspatial netdowns are applied in the model but are not reflected in the GIS dataset areas.*
***Approximately 22,520 ha of adjacent parks (Clayoquot Arm Park, Clayoquot Plateau Park, Dawley Passage Park, Flores Island Park, Gibson Marine, Park, Kennedy Lake Park, Kennedy River Bog Park, Strathcona Park, Sydney Inlet Park, and Tranquil Creek Park) of which 13,120 ha is forested was included in the analysis to contribute towards non-timber constraints. The 92 ha of effective area of park removed in the netdown table is a result of discrepancies with the spatial park boundaries and the TFL boundary originating in the data obtained from the LRDW.*

By comparison, this THLB is 5,088 ha (18.9%) less the reported THLB in MP1 (26,885 ha). Major differences in areas between MP1 and this analysis are due to updated Clayoquot Sound Watershed reserves and updated economic operability (2008).

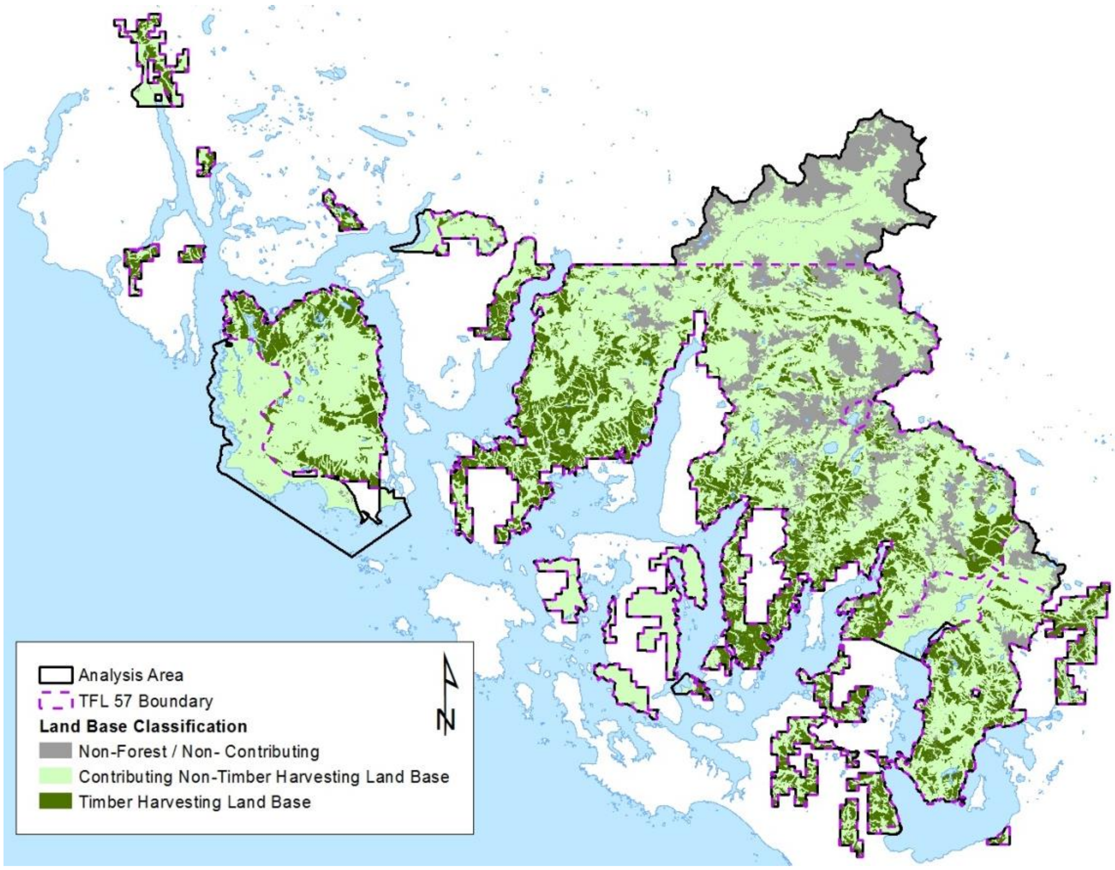

Figure 1 Map of land base classifications

The three dominant species on the TFL are western red cedar, western hemlock, and yellow cedar while Amabilis fir, Douglas-fir, red alder, lodgepole pine, Sitka spruce, big leaf maple, and willow occur as minor species (Figure 2).

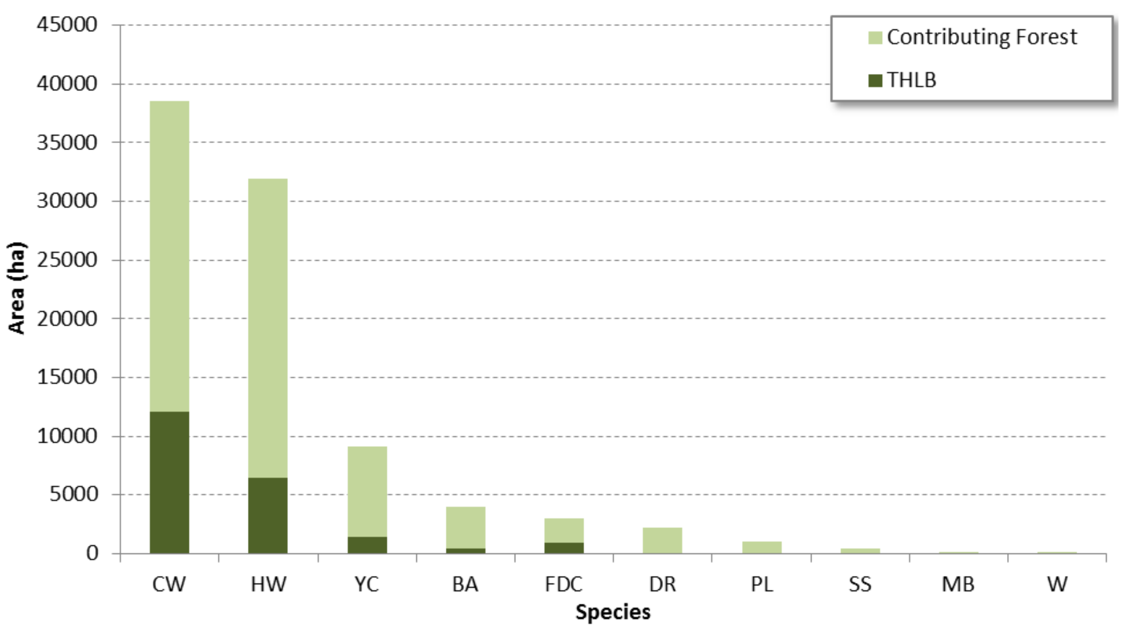

Figure 2 Current area by leading species

The age class structure is shown in Figure 3. For the most part, stands available for timber harvesting are split into two age classes: less than 50 years old and the majority of the area greater than 250 years old. There are very few stands with ages between 60 and 200 years.

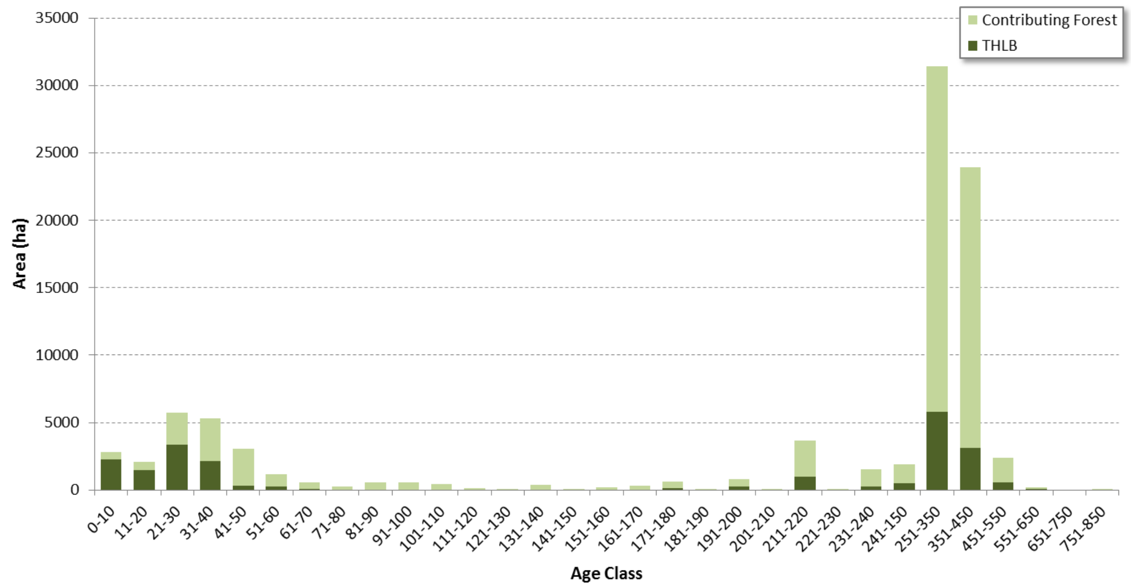

Figure 3 Current age class distribution

The inventory site index distribution is provided in Figure 4 while the managed stand site index (SIBE- adjusted) distribution for the THLB is shown in Figure 5. Overall, the weighted average inventory site index on the THLB is 16.5 m. This increases by 5.3 m when SIBEC-adjusted site indices are used.

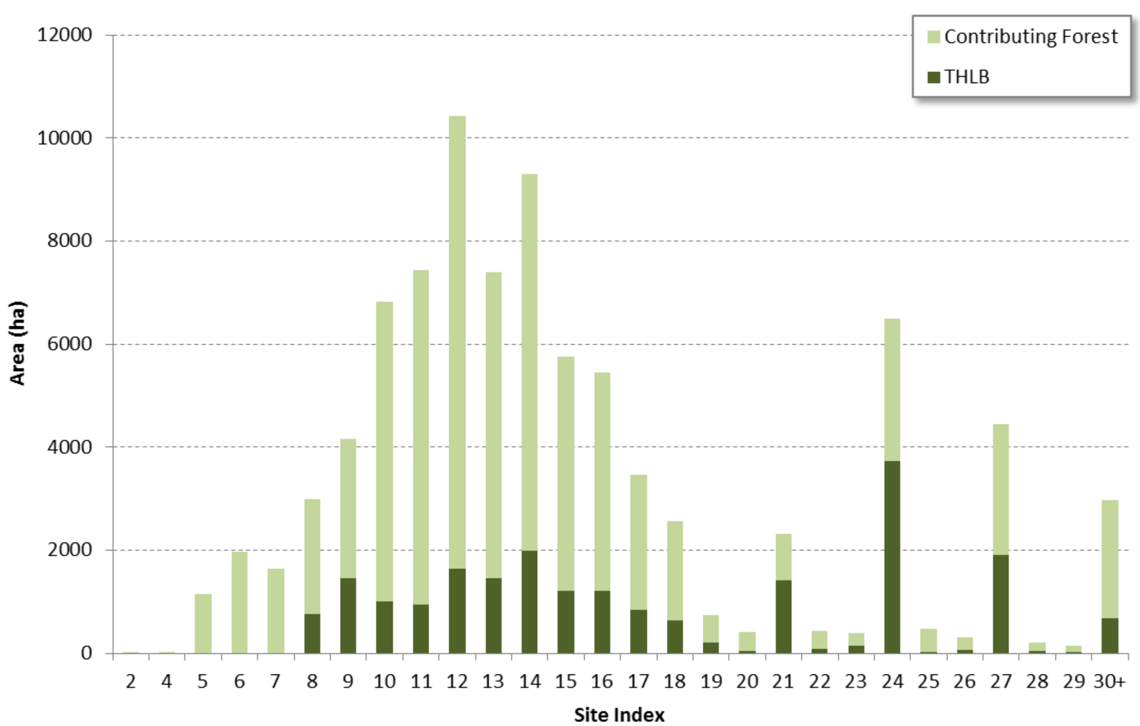

Figure 4 Current site index distribution by contributing classification (Inventory)

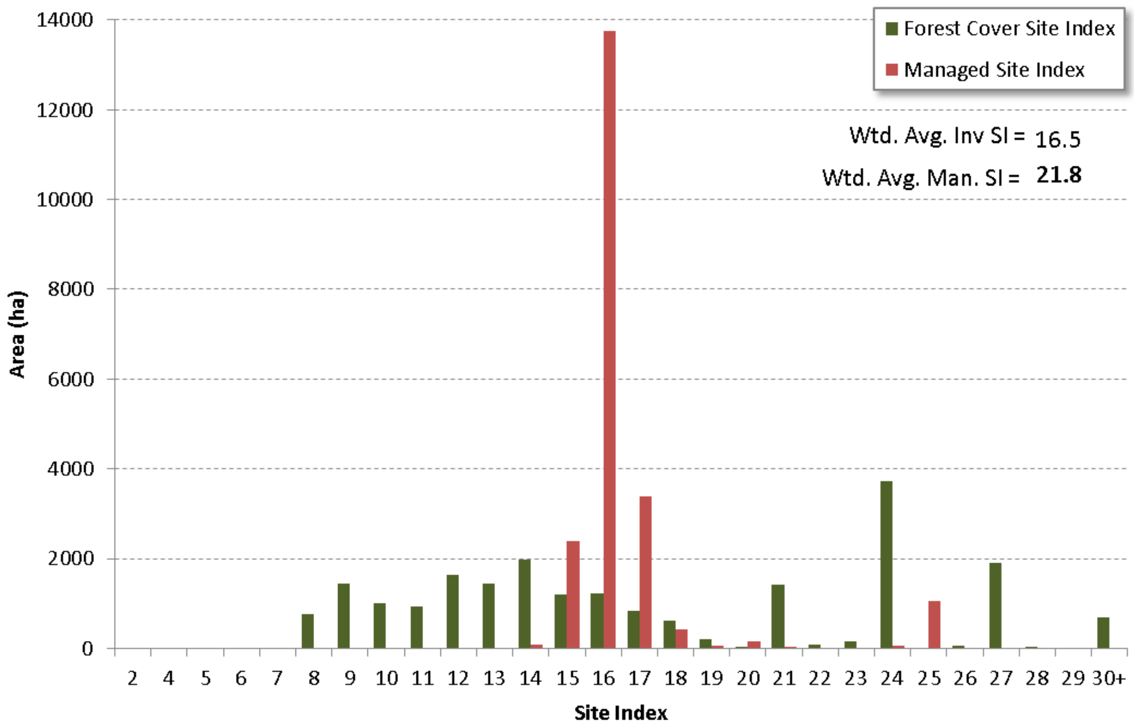

Figure 5 Comparison of inventory and managed site index distribution

3 Base Case Analysis

The Base Case scenario is based on the best available information that reflects current management practices across TFL 57. As mentioned above, the information package documents the data and management assumptions used to develop the Base Case scenario.

Contrary to the harvest systems imposed with the current AAC partition, all harvest operations employ variable retention where the level of retention on each cutblock varies based on site-specific assessments and sensitivities. The overall retention level averages 40% (over and above all other spatial netdowns).

3.1 Base Case Harvest Forecast

The timber supply forecast modeled for TFL 57 (Figure 6) shows a total area harvest level of 222 ha per year and an effective area harvest level (dark green) of 133 ha per year can be maintained throughout the entire planning horizon. As expected, in-block reserves (light green) set aside during operational harvest planning represent 40% of the total area harvested.

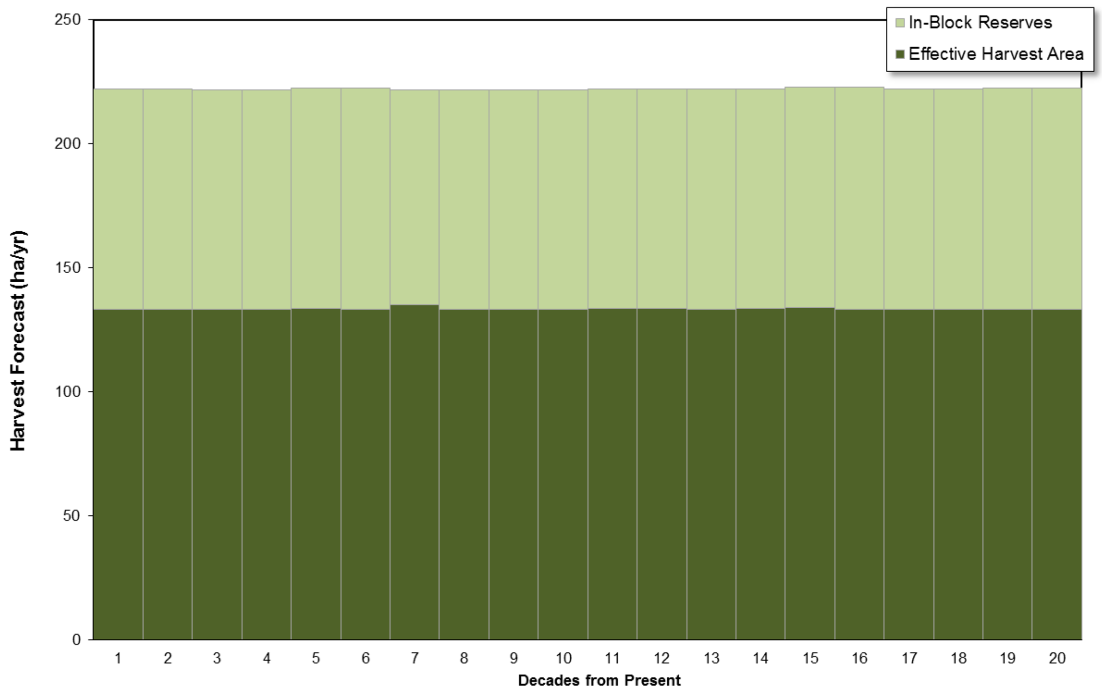

Figure 6 Harvest area over time – Base Case

This harvest forecast is the maximum even-flow level that can be sustained across all periods. A deficiency in any period was handled by lowering the harvest level until it was resolved. The model showed that a notable deficiency occurs 70 years from now.

3.2 Base Case Attributes

To assist in understanding and evaluating the base case harvest forecast, this section describes the stands being harvested and the state of the forest over time. Forest management assumptions modeled in the Base Case impact the forest condition through time. The information presented in this section helps to validate these assumptions and review their impact on the overall forest composition.

3.2.1 Analysis Units

Figure 7 shows the harvest level by analysis units modeled over time. Both the modeled harvest assumption (relative oldest-first) and distribution of analysis units across stand ages contribute to the fluctuating harvest of analysis units.

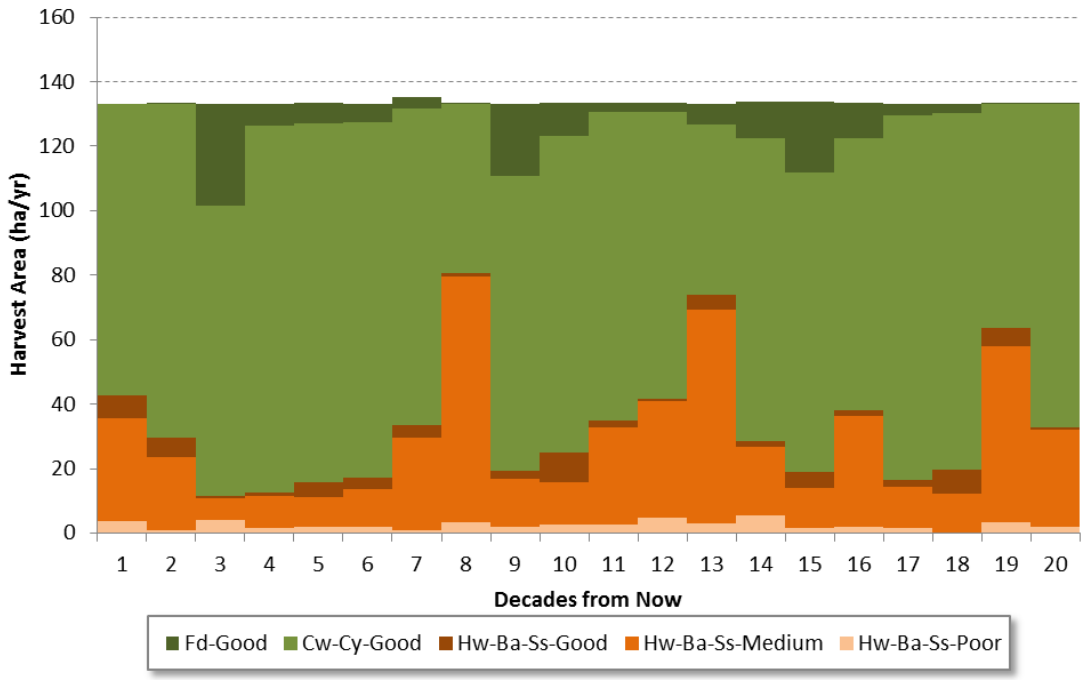

Figure 7 Harvest level by analysis unit – Base Case

3.2.2 Average Harvest Age

The average harvest age by analysis unit (Figure 8) declines rapidly during the initial "set-up" rotation until a more even age class structure is established and the effective THLB becomes regulated (even area in each age class) by the 10th decade.

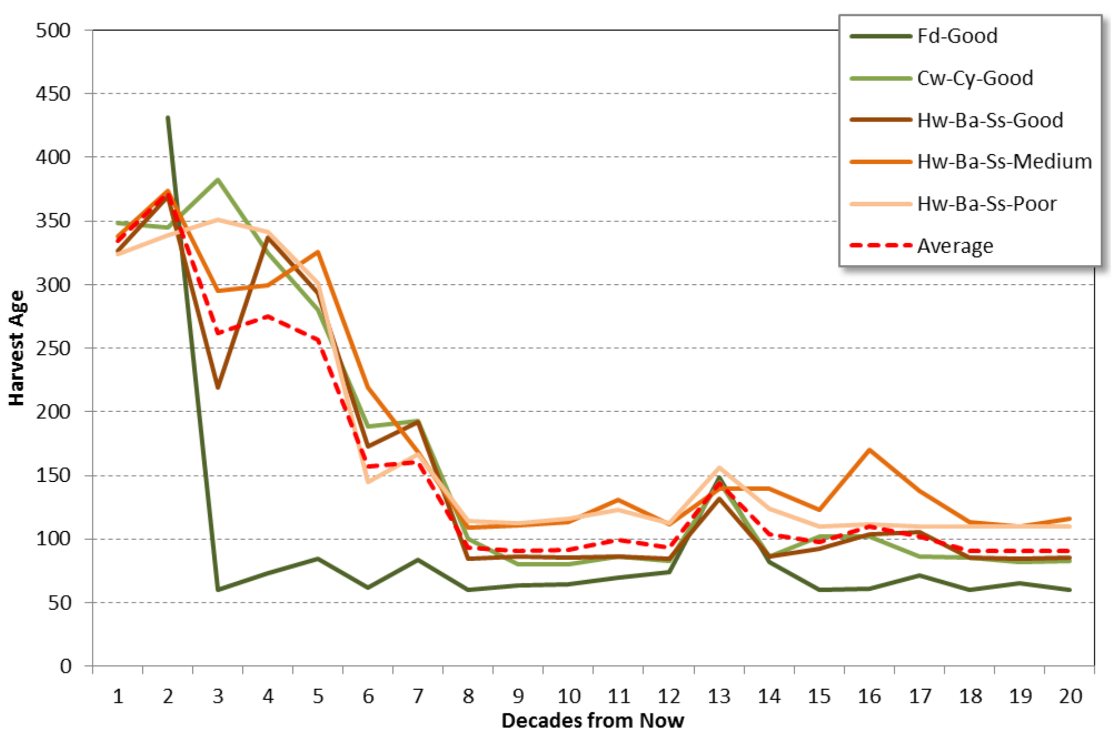

Figure 8 Average harvest age by analysis unit over time – Base Case

The average age of stands harvested over the last 100 years of the planning horizon is consistent with the target rotation ages (see Table 2).

Table 2 Average harvest age by analysis unit between decades 10 and 20 – Base Case

	Analysis Unit Description				
Description	**Fd Good**	**Cw-Cy Good**	**Hw-Ba-Ss Good**	**Hw-Ba-Ss Medium**	**Hw-Ba-Ss Poor**
Average Harvest Age (last 100 years)	74	93	94	128	118
Target Rotation age	68	89	93	116	119

3.2.3 Age Class Distribution

Figure 9 provides a forecast of the age class distribution in 50 year increments for the TFL showing both the THLB and non-THLB areas. However, the way harvesting was represented in the model is not accurately conveyed in these graphs; the model technically "harvested" total harvest planning areas that produced the age classes shown but only 60% of these areas were actually harvested. For example, 40% of each dark green bar less than 50 years old should still be considered old seral since it was not harvested. Despite this misrepresentation, these graphs still reflect the age class structure expected for the effective THLB from harvesting even amounts of area in each age class.

Modeling in 5-year increments results in only half of the 0-10 age class ever being shown in the 50, 100, 150, and 200 year age class graphs.

Natural disturbance modelled on the forested non-THLB ensured that constraints applied to the CFLB do not artificially become irrelevant in the long-term.

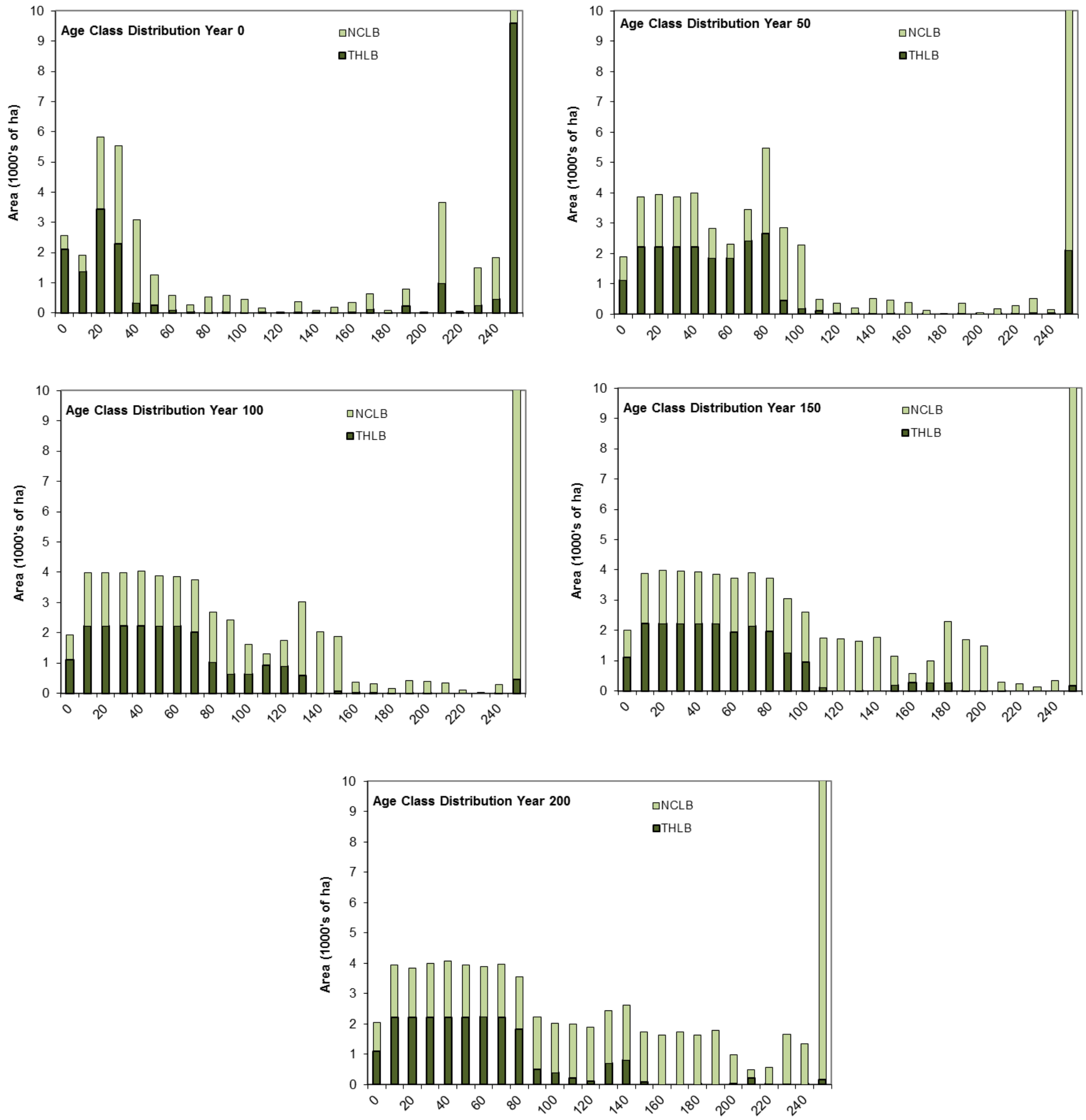

Figure 9 Age class distribution at 50 year intervals – Base Case

3.3 Base Case Constraints

One of the main reasons why timber supply modeling was recommended in exploring potential harvest levels for TFL 57 was to ensure that the harvest level was able to be achieved without violating non-timber management constraints imposed on the land base. Because the model utilizes the total harvest planning area (i.e., does not recognize 40% variable retention), targets presented in the information package were either prorated up for maximum disturbance constraints (maximum rate of harvests and scenic areas) or down for minimum seral retention (Mature+Old Seral retention). This was necessary to recognize that the level of in-block retention (40%) contributes to the targets.

All targets levels shown in the following sections reflect the targets presented in the information package. The model was configured to prevent violations of constraint thresholds for individual units throughout the planning horizon.

3.3.1 Watershed Rate of Cut

Figure 10 shows the overall analysis area disturbed relative to the maximum disturbed thresholds imposed in the model to reflect watershed rate of cut constraints (5% per 5 years and 10% per 10 years). This shows all watersheds combined where targets were applied at individual watershed levels. The area considered disturbed fluctuates over time as this constraint was only applied where the Clayoquot LUO watershed rate of cut limits are established.

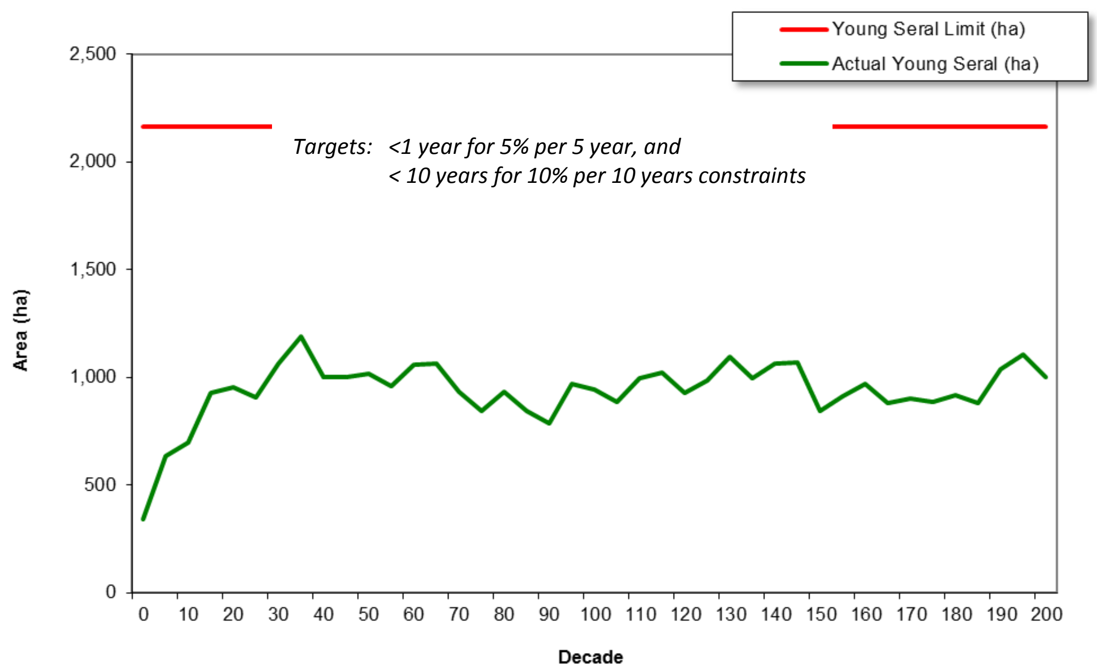

Figure 10 Watershed rate of cut limits relative to disturbed area – Base Case

3.3.2 Scenic Areas

Figure 11 shows the combined area under the visual-effective green-up (VEG) condition relative to maximum disturbance thresholds over time for these polygons. Given the high proportion of non-harvested contributing forest, visual thresholds – applied to the entire contributing forest – do not constrain harvest levels over the planning horizon. However, constraints applied in some of the individual polygons may be reducing harvest availability.

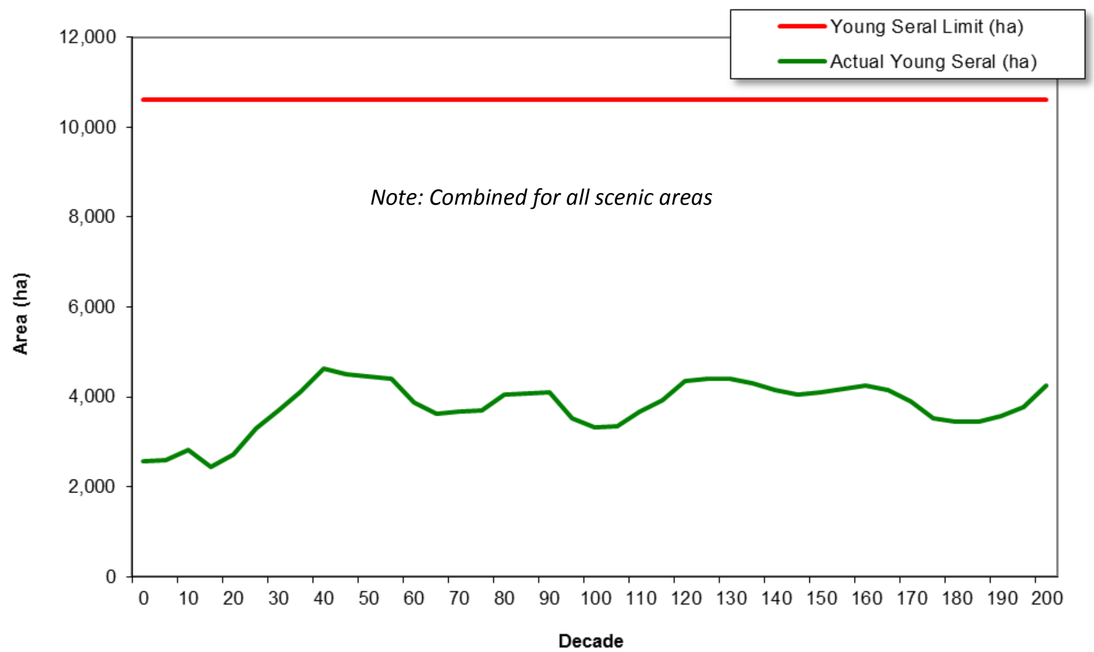

Figure 11 Scenic areas conditions relative to maximum disturbance thresholds – Base Case

3.3.1 Mature+Old Seral Stage

Figure 12 shows the overall minimum target threshold and the amount of old (>140 year) forest over time. This harvest constraint was applied to all individual watersheds and in some cases limited harvest availability.

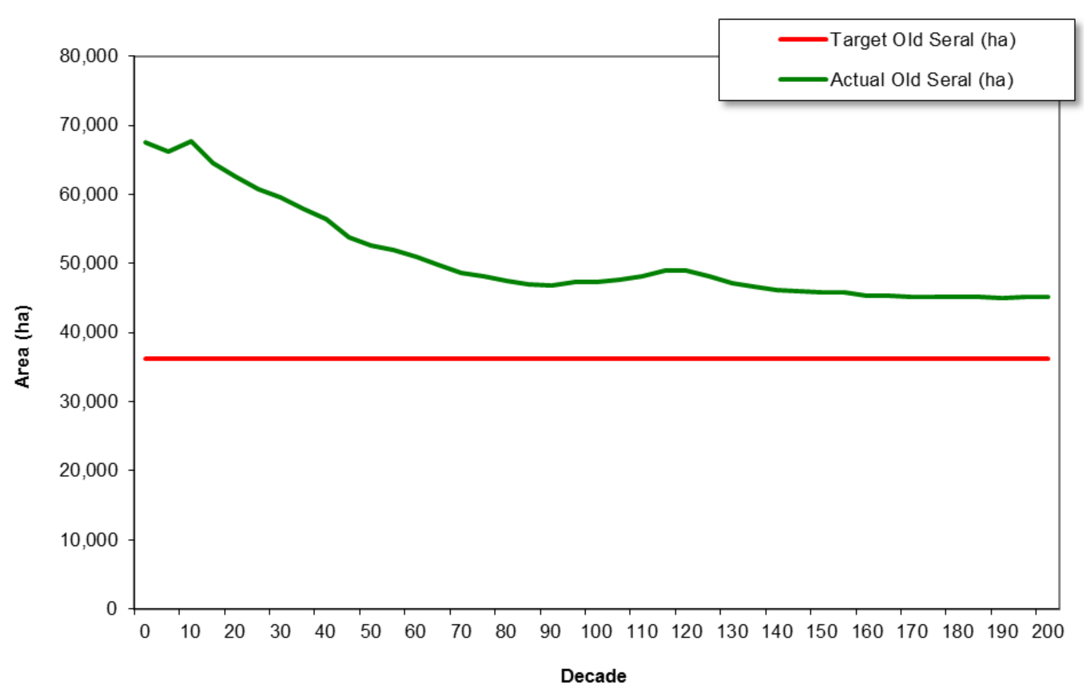

Figure 12 Target and actual old seral within all watersheds combined – Base Case

4 Alternative Harvest Forecasts

The flat-line even-flow harvest forecast presented as the base case makes it difficult to determine the underlying timber supply dynamics involved in defining the harvest forecast. To explore this further, several alternative harvest forecasts were modeled; each with a 400-years planning horizon to ensure the harvest levels were sustainable well past the 200 year planning horizon presented.

A great number of alternative harvest forecasts are possible. Key factors that influence the harvest forecast include: the initial harvest rate, the rate of decline (i.e., transition from short to long term) and the amount of merchantable timber available throughout the planning horizon (i.e., lowest level identifies where "pinch points" exist).

Figure 6 compares two harvest forecasts that begin with greater initial harvest rates than the highest even-flow harvest forecast (i.e., base case). The highest initial harvest level of 299 ha/year was limited by the maximum rate of decline set (i.e., 10% per decade). Lowering the initial harvest rate to 258 ha/year reduced the mid-term trough. Both alternatives produced higher long-term harvest rates than the highest even-flow.

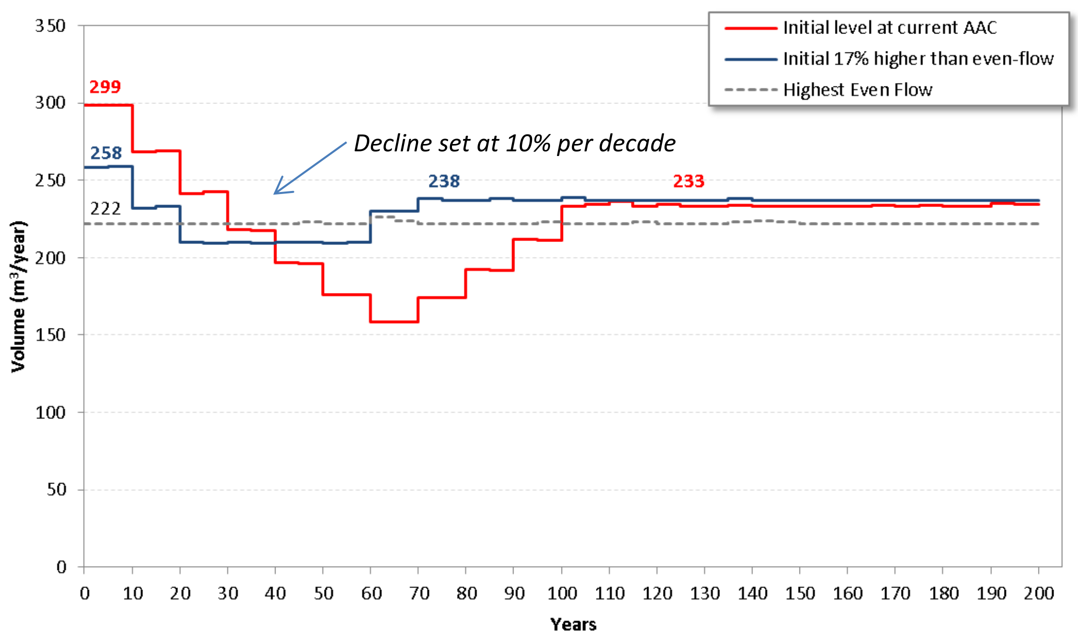

Figure 13 Highest even-flow forecast compared to harvest forecasts with higher initial levels

Figure 14 shows the highest possible non-declining harvest forecast with a step up to the long-term harvest level. The step-up suggests that while the productivity of the land base can sustain a higher harvest rate, the initial harvest rate is limited by the amount timber available for harvest.

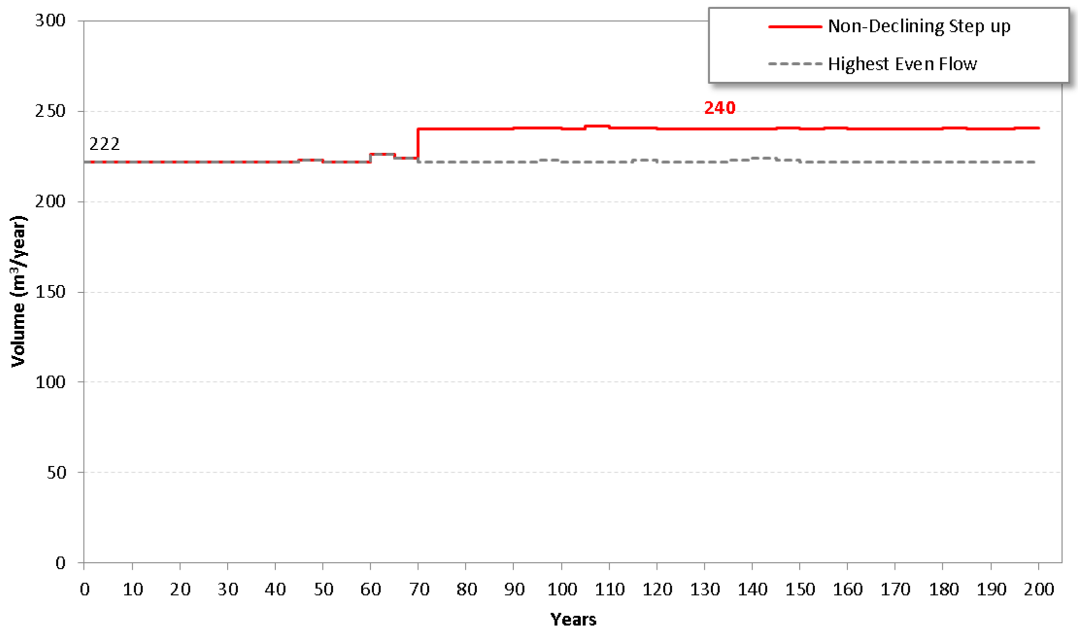

Figure 14 Highest even-flow forecast compared to a non-declining harvest forecast

This is further supported in Figure 15 that shows the non-declining step-up harvest forecast relative to the timber available. In each period, the total amount of available timber is assessed for subsequent planning periods. The availability line identifies two "pinch points" that limit the harvest forecast over the planning horizon: one 65 years from now and another one 175 years from now.

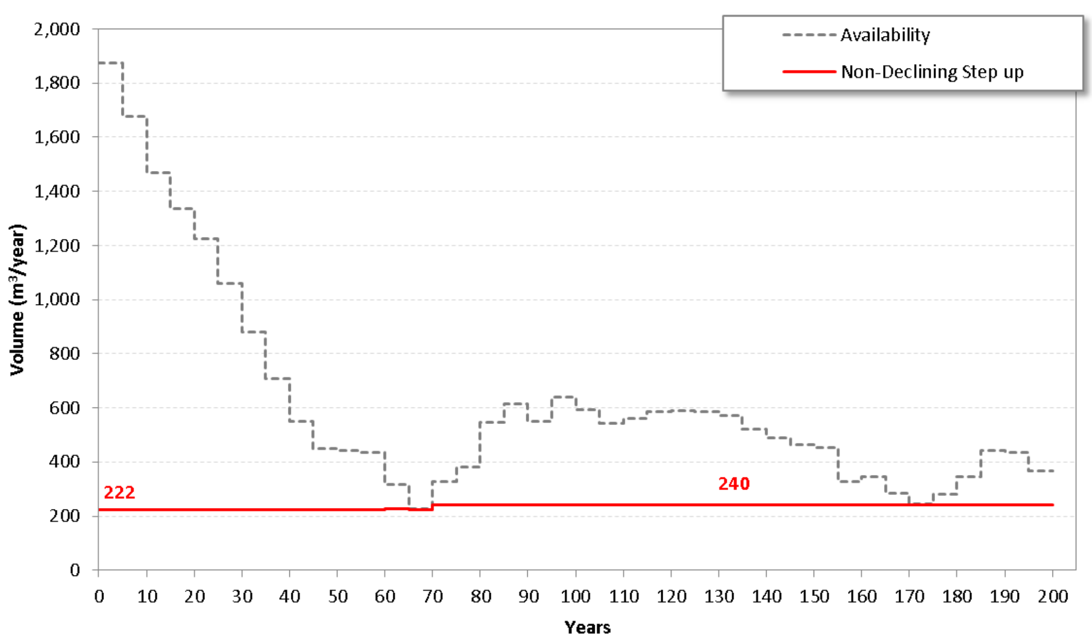

Figure 15 Timber availability for the non-declining harvest forecast

5 Sensitivity Analyses

The data and management assumptions used in any timber supply analysis are subject to some uncertainty. Sensitivity analyses are commonly performed to provide a better perspective on the impact of changing modeled assumptions. Typically only one variable (data or assumption) is changed to explore the sensitivity of that variable.

Table 3 shows the changes in THLB area and harvest rate (ha/yr) resulting from various sensitivity analyses performed for this analysis.

Table 3 Sensitivity modeling results

Sensitivity	Gross THLB (ha)	Effective THLB (ha)	Percent THLB Change from Base Case	Resulting Even Flow Harvest (ha/yr)	Percent Harvest Rate Change from Base Case
Rotation Age -10	21,797	13,078	0%	155	17%
Rotation Age +10	21,797	13,078	0%	117	-12%
Economic Operability @ -$10/m³ and exclude previously harvested stands	18,601	11,160	-15%	122	-8%
Economic Operability @ -$15/m³	23,470	14,082	7%	144	8%
Economic Operability @ -$20/m³	25,497	15,298	17%	157	18%
Economic Operability @ -$25/m³	26,978	16,187	24%	168	26%

5.1.1 Rotation Age Sensitivities

Target rotation ages for the Base Case were based on 10 years prior to the age at which culmination of mean annual increment (CMAI) is expected to occur. Shortening target rotation ages by 10 years resulted in a harvest rate increase of 17%. Conversely, the opposite occurred with increasing target rotation ages. This suggests that the harvest rate is very sensitive to rotation age and must be carefully considered as this can ultimately affect the harvested products expected (i.e., m³/ha, m³/tree, log quality, log products, etc.).

5.1.2 Harvestable Area Sensitivities

The economic operability dataset was a key driver to determining the THLB. The base case applied an economic threshold of $-10/m³ and regardless of the stand's net value, included previously harvested stands within the THLB. Turning off the previously harvested condition reduced the THLB by 15% which resulted in an 8% reduction in harvest forecast. Further reductions in the economic threshold, while including previously harvested stands, generally increased harvest area and harvest rates.

5.1.3 Harvest Priority Sensitivities

Volume-based harvest forecasts can sometimes be impacted by the sequence of stands harvested in the model, particularly where stands are harvested prior to their minimum harvest age. All harvest forecasts presented above were set to harvest stands with the greatest age past their designated rotation harvest age (i.e., relative oldest first).

In these sensitivities, stands were sorted using harvest priorities set to: oldest first and random (i.e., some younger stands first). While it is clear that the volume harvested can change, none of the revised harvest priorities showed a discernable effect on area-based harvest forecasts. The target rotation ages identified for each analysis unit define the extent of timber available for the model to harvest. As discussed in section 5.1.1, reducing the target rotation age simply makes more timber available.

6 Summary and Recommendations

The assumptions developed for the Base Case scenario reflect the current management and desired future products and conditions. The analysis presented here demonstrates that Base Case harvest level complies with the management intent for individual watershed plans established under the Clayoquot Land Use Order. Accordingly, Iisaak recommends application of the harvest rate resulting from the Base Case scenario:

- 222 ha/yr of **total** harvest planning area.