IISAAK FOREST RESOURCES LTD.

TREE FARM LICENSE 57

Timber Supply Analysis Report

MANAGEMENT PLAN 1

DECEMBER 30, 2002

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EXECUTIVE SUMMARY

The Timber Supply Analysis Report is an appendix to Management Plan 1 for Tree Farm License 57. This report presents a base case timber supply and then examines the sensitivity of this long-term timber supply forecast to changes in a number of assumptions. The purpose of the Timber Supply Analysis Report is to provide information on the long-term timber supply to the Chief Forester of the Ministry of Forests, Iisaak Forest Resources Ltd. (Iisaak) shareholders and employees, and other interested parties. This information is then used by the Chief Forester, along with other social and economic information to determine an allowable annual cut (AAC) for TFL 57 for the period of Management Plan 1.

Iisaak recommends an Allowable Annual Cut of 84,150 m3/year for MP 1. The timber supply analysis indicates that much higher short-term harvests could be justified. The base case level of 84,150 M3/year is in keeping with Forest Stewardship Council (FSC) requirements for a non declining harvest flow. It is a conservative approach to harvest levels in the short term that could provide some flexibility during a time when watershed planning is being completed and experience in managing according to Clayoquot Sound Scientific Panel recommendations is developing.

It is anticipated that the 20-year plan will verify the spatial feasibility of the base case harvest forecast.

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1.0 Introduction

An analysis of timber supply has been completed as a component of Management Plan (MP) No. 1 for Iisaak Forest Resources Ltd. (Iissak) Tree Farm Licence (TFL) 57. The analysis evaluates how current management, including allowance for management of non-timber resources, affects the supply of harvestable timber over a 250-year period. The analytical methodology employs a forest level simulation model (Forest Service Simulator or FSSIM), which is used to forecast the long-term development of the forest given:

- A description of the initial forest conditions;
- Expected patterns of stand growth;
- A specified set of rules for harvesting and regenerating the forest;
- A specified set of forest structural characteristics; and
- Management of forest values including bio-diversity, old growth management, watersheds, recreation, visual quality, fisheries as well as others in accordance with Clayoquot Sound Scientific Panel direction.

The process enables forest managers to evaluate timber availability under a range of alternative scenarios. Furthermore, the timber supply analysis provides the technical basis for the Chief Forester of British Columbia to determine an allowable annual cut (AAC) for TFL 57 for the next five years.

Because of the changing nature of resource management objectives, as well as the dynamic nature of forest inventories, the timber supply predictions generated by these analyses are not viewed as static. For this reason, it is necessary to re-evaluate timber supply periodically, incorporating new sources of information and any changes to management objectives. This adaptive management process ensures that harvest strategies remain sustainable in the long term, even in the face of changing circumstances.

2.0 General Description of the Land Base and Tenure

2.1 Description of TFL 57

TFL 57 is located in the South Island Forest District on the west coast of Vancouver Island in Clayoquot Sound. It is bordered to the north by Strathcona Provincial Park. Pacific Rim National Park and the communities of Tofino and Ucluelet are located to the south and west of the TFL. TFL 57 is about 87,000 ha and includes approximately 32% of the total area of Clayoquot Sound. The remainder of Clayoquot Sound is comprised of Provincial and National Parks and Protected Areas (33%), TFL 54 (21%, held by International Forest Products Ltd.), the Arrowsmith Timber Supply Area, and a variety of smaller tenures, private land, and Indian Reserves. The license area consists of twenty-one separate geographical blocks that are interspersed with the Parks, Protected Areas and TFL 54.

Clayoquot Sound is divided into fourteen Watershed Planning Units that are similar to Landscape Units elsewhere in the province. TFL 57 includes all or part of eleven Watershed Planning Units (Bedingfield, Bedwell/Ursus/Bulson, Clayoquot River, Cypre, Flores Island, Fortune Channel, Hesquiat, Kennedy Lake, Meares Island, Sydney/Pretty Girl, Tofino/Tranquil, and Upper Kennedy).

The TFL is located within the traditional territory of the Nuu-Chah-Nulth Central Region First Nations (Ahousaht, Hesquiaht, Tla-o-qui-aht, Toquaht, Ucluelet Bands). The First Nation villages of Ahousaht, Hot Springs Cove, Opitsaht, Esowista, and Port Albion are located near to the TFL.

The TFL includes several variants of the Coastal Western Hemlock Biogeoclimatic Zone (CWHvh1, CWHvm1, CWHvm2), the Mountain Hemlock Zone (MHmm1), and small areas of the Alpine Tundra Zone. TFL 57 consists of stands comprised mainly of western hemlock, amabilis fir (balsam), and western red cedar with smaller amounts of Douglas fir, cypress, sitka spruce, and pine. TFL 57 includes parts of the two distinct physiographic regions that comprise Clayoquot Sound: the Estevan Coastal Plain and the Vancouver Island Mountains. The Estevan Coastal Plain consists of gently undulating or almost flat land that is subdivided into numerous islands and peninsulas by inlets, channels, and Kennedy Lake. The Vancouver Island Mountains are steep and highly dissected with ridge-tops rising to over 1000 m and peaks attaining heights of more than 1300 m.

2.2 History

TFL 57 was created on October 27, 1999 by subdividing TFL 44, (held by Weyerhaeuser and previously by MacMillan Bloedel), into two portions, the "Clayoquot portion" and the "remainder portion". The Clayoquot portion consisted of the entire Clayoquot working circle except for the upper Kennedy Valley. Following the subdivision of TFL 44 the Clayoquot portion was transferred to Iisaak. The following additional changes were also made at that time:

- 24 parcels of MacMillan Bloedel's private land holdings in Clayoquot Sound were removed from TFL 44 (ownership retained by MacMillan Bloedel);
- 15 Timber Licenses inside TFL 44 were transferred to Iisaak (these now comprise the Schedule "A" component of TFL 57); and
- 6 Timber Licenses outside TFL 44 were transferred to Iisaak.

Prior to the subdivisions and transfer to Iisaak, the area had been managed as part of TFL 44 for forty-five years. A significant amount of harvesting has taken place in the area that is now TFL 57 during these years. Minor amounts of harvesting also occurred prior to the establishment of TFL 44, mostly smaller areas along the shoreline. There are presently about 18,000 ha of second growth forest in the TFL, most of this is less than 40 years old. It is mostly of harvest origin with small amounts from natural disturbances. Most of the areas of past harvesting are located in the Kennedy Lake, Cypre, Bedingfield, Fortune Channel, and Tofino-Tranquil watershed planning units.

The southwestern part of the TFL (up to and including the south side of Tofino Inlet and Tofino Creek) is accessible by road from the Provincial Highway system. The other developed areas are accessible by road systems that end at the various log dumps located throughout TFL 57 and TFL 54 including Hecate Bay (Cypre), Bedingfield Bay, Rankin Cove (Tranquil), and Steamer Cove (Flores Island).

Upon agreeing to the transfer of TFL 57 to Iisaak it was decided by the Ministry of Forests that Iisaak could operate under the previously approved Management Plan No. 3 (MP No. 3) for TFL 44 until June, 2002. This has subsequently been extended until December 31, 2002.

TFL 57 has a maximum allowable annual cut of 123,800 cubic metres, of which 8,265 cubic metres are allocated to the Ministry of Forests Small Business Forest Enterprise Program (SBFEP).

The total area of 87,393 ha in TFL 57 consists of 18,161 ha of Schedule A lands and 69,232 ha of Schedule B lands.
MP No.1 takes direction from the *Clayoquot Sound Land Use Decision* (CSLUD, 1993), the *Clayoquot Sound Scientific Panel Report 5, Sustainable Ecosystem Management in Clayoquot Sound: Planning and Practices* (CSSP, 1995), the *Clayoquot Sound Interim Measures Extension Agreement* (IMEA, 2000), and the *Forest Practices Code Act of British Columbia* (FPC Act).

3.1 Timber Flow Objectives

Iisaak Forest Resources Ltd. has a timber flow objective of maintaining a non declining harvest flow from the present to the long-term harvest level for TFL 57. TFL 57 is presently certified under the Forest Stewardship Council. This harvest flow objective is in accordance with indicator 5.6 of the Forest Stewardship Council (FSC) Regional certification Standards for British Columbia (The rate of harvest of forest products shall not exceed levels that can be permanently sustained).

In the base case analysis, the choice(s) of harvest flow considers the following criteria:

- Maintain a non declining harvest flow;
- Achieve a long term sustainable harvest level; and
- Address all defined sustainable resource management values.

3.2 Forest Information

A wide variety of information is required for timber supply analysis. This includes information on the land base inventory, timber growth and yield, and management practices. Inventory information used for this analysis included:

- Vegetation Resource Inventory (VRI) forest cover;
- Clayoquot Sound Scenic Corridors inventory;
- Terrestrial Ecosystem Mapping (TEM);
- Clayoquot Sound Hydroriparian Inventory;
- Watershed Plan Reserves where available;
- Physical and economic operability mapping (previously done by MacMillan Bloedel);
- Marbled murrelet reserve mapping;
- Watershed planning unit and individual watershed boundaries; and
- Terrain mapping.

3.3 Growth and Yield

This section briefly describes the Growth and Yield methodology and includes background on:

1. Existing mature stand volumes - The timber volume in existing mature stands was determined for each analysis unit by using Variable Density Yield Prediction (VDYP) and the area weighted site index (from the forest cover inventory) for these stands.

2. Natural stand yield tables (NSYTs) – The timber volumes in existing immature unmanaged stands was determined for each analysis unit by using VDYP and the area weighted site index for these stands.

3. Managed stand yield tables (MSYTs) – Yield tables for both existing and future managed stands were developed using the Table Interpolation Program for Stand Yields (TIPSY).

4. Site index estimates – Site index estimates for all stands were calculated from forest cover attributes (stand height and age) by staff from the Ministry of Sustainable Resource Management (MSRM).

5. Improved estimates of potential site index (PSI) – Improved site index estimates were developed for existing mature stands using the results of old growth site index adjustment (OGSI) projects for the area. These Old Growth Site Index (OGSI) values were applied to the regenerating managed stands on sites presently occupied by existing mature stands for the purposes of sensitivity analysis. Terrestrial ecosystem mapping (TEM) has recently been completed for the area and although it was not complete in time to use in this analysis it does have the potential to be used in the future as a component of a SIBEC approach to improving site productivity estimates.

Additional details are provided in the Information Package.

3.4 Land Base Classification

Land is classified based on four broad criteria:

1. It is unproductive for forest management purposes;

2. It is or will become inoperable under the assumptions of the analysis;

3. It is unavailable for harvest for sustained resource management values (e.g. Watershed Plan Reserves including hydroriparian, terrain, sensitive soils, recreation reserves, rare ecosystems, ecosystem representation); or

4. It is available for integrated use (including harvesting).

Table 1 provides a graphic representation of the land base reductions for TFL 57. The timber harvesting land-base is defined by removing categories of the land base as shown below:

Table 1 Timber harvesting land base determination

Category	Area (hectares)			Volume (m3)		
	Schedule A	Schedule B	Total	Schedule A	Schedule B	Total
Total area (incl. fresh water)	18,161	69232	87393	5785327	24068495	29853822
Meares Island exclusion	3555	0	3555	1835433	0	1835433
Non-forest	615	2791	3406	0	0	0
Non-productive	621	5385	6006	8106	194509	202615
Total productive forest	13396	61057	74426	3941788	23873986	27815774
Less:						
Low site and non - commercial	210	5351	5561	9648	691454	701102
Inoperable	211	6860	7070	99997	2850886	2950883
Uneconomic	227	3682	3910	89384	1408001	1497384
Hydroriparian	2823	7336	10159	852352	3182375	4034727
Terrain and soils	435	5232	5667	169144	2152350	2321494
Watershed plan ecosystem reserves	1349	3415	4764	470896	1489453	1960349
Other ESA's (Ep)	0	112	112	0	62159	62159
Non-merchantable	191	314	505	51123	93001	144124
Wildlife tree permanent retention	1320	6886	8206	382115	2844820	3226935
Existing roads	492	1095	1587	97441	374754	472196
Total current reductions	12049	48459	60508	4065639	15343762	19409401
Initial timber harvesting land base	6112	20773	26885	1719688	8724733	10444421
Less:						
Future roads, trails, and landings	127	866	993	66592	427797	494389
Long-term land base	5984	19907	25891	1653096	8296937	9950032

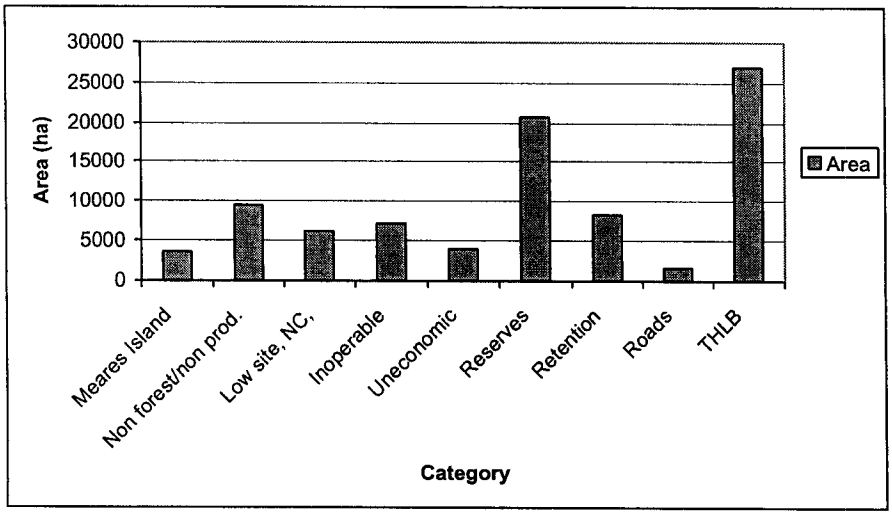


Figure 1 Land-base Distribution 1

The distribution by category of the area deducted from the total area of TFL 57 to determine the timber harvesting land-base is shown in Figure #1 above.

3.5 Inventory Aggregation and Analysis Units

Stands with similar biological, management and silviculture regimes are grouped to reduce complexity. To capture these attributes, the inventory has been assembled and aggregated into analysis units on the basis of:

- Site productivity
- Species composition
- Age
- Silviculture regimes

The inventory was aggregated as shown in Table 2 below for analysis purposes:

Table 2 Analysis Units

Analysis unit #	Analysis unit name	Species/type groups	Site index range	Age range
99*	Deciduous			
11	Fir/Pine-G	1-8, 27-31	>24	1-40
12	Fir/Pine-M	1-8, 27-31	>=20<=24	1-40
13	Fir/Pine-P	1-8, 27-31	<20	1-40
14	Fir-G	1-8	>24	41+
15	Fir-M	1-8	>=20<=24	41+
16	Fir-P	1-8	<20	41+
21	Cedar-Cypress-G	9-11	>24	1-40
22	Cedar-Cypress-M	9-11	>=20<=24	1-40
23	Cedar-Cypress-P	9-11	<20	1-40
24	Cedar-Cypress-G	9-11	>24	41+
25	Cedar-Cypress-M	9-11	>=20<=24	41+
26	Cedar-Cypress-P	9-11	<20	41+
31	Hemlock/Balsam/Spruce-G	12-26	>24	1-40
32	Hemlock/Balsam/Spruce-M	12-26	>=20<=24	1-40
33	Hemlock/Balsam/Spruce-P	12-26	<20	1-40
34	Hemlock/Balsam/Spruce-G	12-26	>=25	41+
35	Hemlock/Balsam/Spruce-M	12-26	>=20<=24	41+
36	Hemlock/Balsam/Spruce-P	12-26	<=19	41+

3.6 Landscape units

In Clayoquot Sound Watershed Planning Units are used instead of Landscape Units. Table 3 summarizes the distribution of productive area by Watershed Planning Unit.

Table 3 Distribution of productive area by watershed planning unit

Watershed Planning Unit	Productive forest area (ha)
Bedingfield	2210.27
Bedwell/Ursus/Bulson	15443.08
Clayoquot River	4533.4
Cypre	15520.19
Flores Island	10097.73
Fortune Channel	4868.11
Hesquiat	179.46
Kennedy Lake	8471.83
Megin	14.44
Moyeha	11.56
Sydney/Pretty Girl	1973.45
Tofino/Tranquil	9599.63
Upper Kennedy	1499.37
Total	74422.78

3.7 Zones

- Current forest management practices are modeled using forest cover requirements. The timber supply model (FSSIM) allows the breaking up of the land base into zones in order to apply forest cover requirements to specific parts of the land base. The following zones were used to model integrated resource management:
- Watershed planning units – These are the units used by the Clayoquot Sound Technical Planning Committee as the basis for completing Watershed Plans as directed by the Clayoquot Sound Scientific Panel. In the timber supply analysis they are used as zones to ensure that at least 40% of the forest within each watershed planning unit is always in an old growth state (>140 years). (See table 3 above for areas)
- Individual watersheds – Individual watershed boundaries have been defined for Clayoquot Sound (Chapman, 1997) according to the recommendations of the Clayoquot Sound Scientific Panel (CSSP) in order to provide a basis for implementing rate of cut recommendations. In the timber supply analysis the watershed boundaries are used as zones to apply a forest cover requirement that ensures that each watershed is harvested at a rate recommended by the CSSP (either a maximum of 5% in 5 years, or 10% in 10 years depending on watershed size). The individual watersheds are much smaller than the watershed planning units with most of them ranging between 200 ha and 1000 ha in area.
- Scenic corridors – In Clayoquot Sound a unique system of visual resource inventory and management has been developed according to CSSP recommendations (Catherine Berris and Associates, 1999). This consists of three scenic corridor classes (Natural Appearing, Minimal Alteration, Small Scale Alteration) with associated forest management objectives and guidelines. Each scenic corridor class within each Watershed Planning Unit is modeled as a separate zone.

- Recreation management zone – In Clayoquot Sound recreation management zones are designated as a 300m band along marine shores (extending 150m or 200m beyond the marine shore reserve) and around some of the larger lakes. This area is treated as a separate zone within each Watershed Planning Unit and forest cover requirements are applied on this basis.

3.8 Timber Supply Analysis Methods

The forest estate model Forest Service Simulator (FSSIM) was used for this timber supply analysis. It is a sequential inventory projection model. FSSIM accommodates multi-layer forest cover requirements. This allows the use of simultaneous overlapping constraints to model biodiversity, watershed rate of cut, and visual management.

4.0 Base Case and Options

The base case harvest forecast has a non-declining harvest flow in order to meet FSC certification criteria. This results in a significantly lower short term harvest level than could be achieved using other approaches to harvest flow.

The options listed below are intended to quantify the impacts on timber supply of pursuing management directions that are different than current management. At the present time Iisaak informally considers part of the TFL to be eehmiis areas (areas that are very precious and presently are managed to emphasize non timber values). The eemhiis areas are mostly located in areas presently classed as "undeveloped watershed planning units" where harvesting cannot take place until final watershed plans are completed and therefore there has been no development proposed by Iisaak in these areas. The eehmiis do not have any official status (they are not protected areas) and are included within the integrated or special management zones of the Clayoquot Sound Land Use Decision.

The marbled murrelet reserves are included in the base case because their status was uncertain when the initial land base net-down assumptions were formulated. At present there is a three year provision that no blocks be approved in these areas.

Table 4 Description of Options

Option	Description
Base Case	Entire THLB included, non declining harvest flow.
Option A (Alternative harvest flow)	Entire THLB included, 10% decline per decade to long term harvest level.
Option B	Eehmiis excluded, non-declining harvest flow.
Option C	Flores Island included as part of THLB, other eehmiis areas excluded from the THLB, non-declining harvest flow.
Option D	Marbled murrelet reserves excluded from the THLB, non-declining harvest flow.

4.1 Base Case

The timber flow and associated inventory characteristics for the base case harvest forecast for the 250 year time horizon are shown in Figures 2-7.

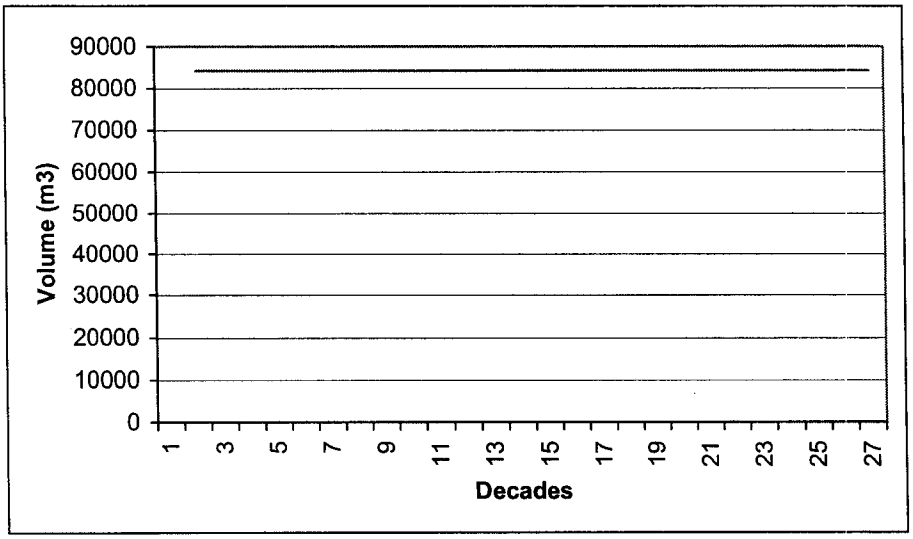


Figure 2 Base Case Harvest Forecast
A non-declining harvest of 84,150 m3 can be supported on the THLB.

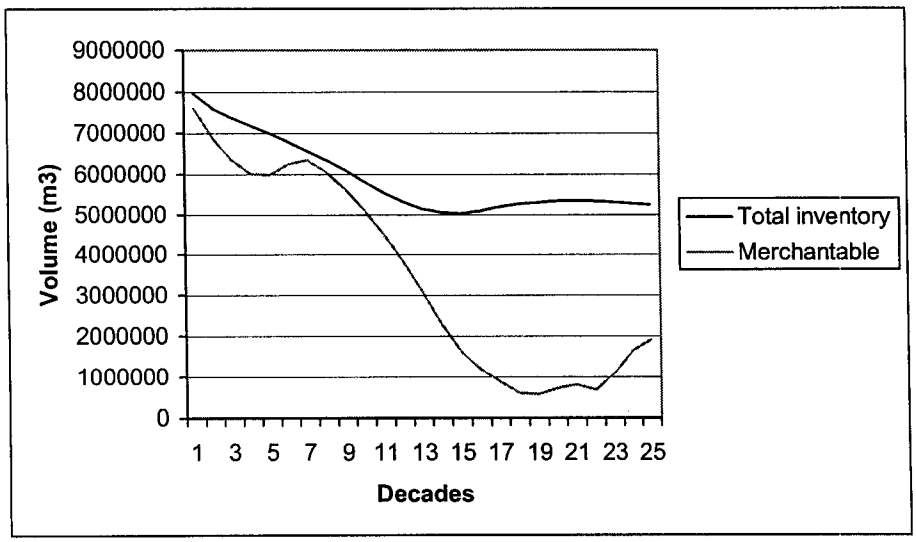


Figure 3 Base Case Growing Stock Profile
Total inventory includes all of the softwood volume supported on the timber harvesting land base (THLB). Merchantable volume is the proportion of the total volume above minimum harvest age. The total inventory gradually declines over the first twelve decades to reach a reasonably steady level for the last half of the analysis time horizon. The merchantable growing stock declines to a low point between decades 17 and 22 where most stands will be harvested at or slightly above minimum harvest ages.

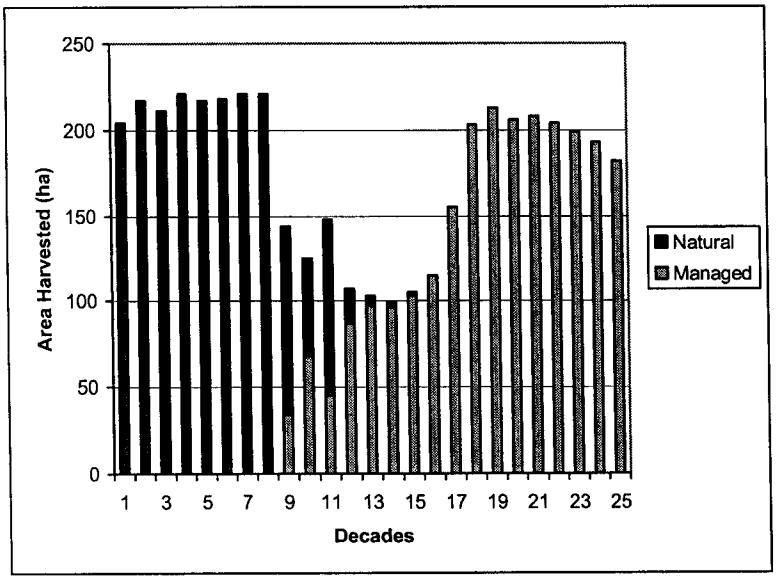


Figure 4 Base Case Timber Supply Sources

Figure 4 shows the sources (existing natural stands or existing or future managed stands) of timber supply. Harvesting is completely in existing natural stands for the first 8 decades and then shifts over 4 decades to a situation where it is almost exclusively in managed stands. The managed stands include those stands presently less than 40 years of age as well as stands to be established in the future.

Figures 5 through 7 show average harvested age, volume per hectare and area harvested per year.

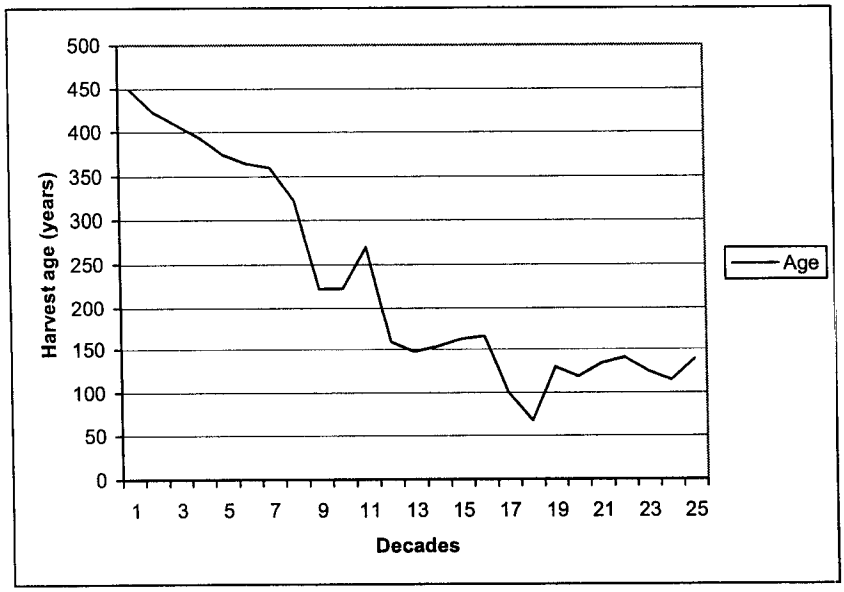


Figure 5 Base Case Average Harvest Age

Figure 5 shows the average harvest age steadily dropping over the first 150 years of the time horizon as the transition from harvesting existing older stands to managed second growth stands is completed. There is one point (decade 17-18) where the average harvest age drops very close to the specified minimum harvest age. This is the time when the merchantable inventory (the proportion above minimum harvest age) is quite low (see Figure 3).

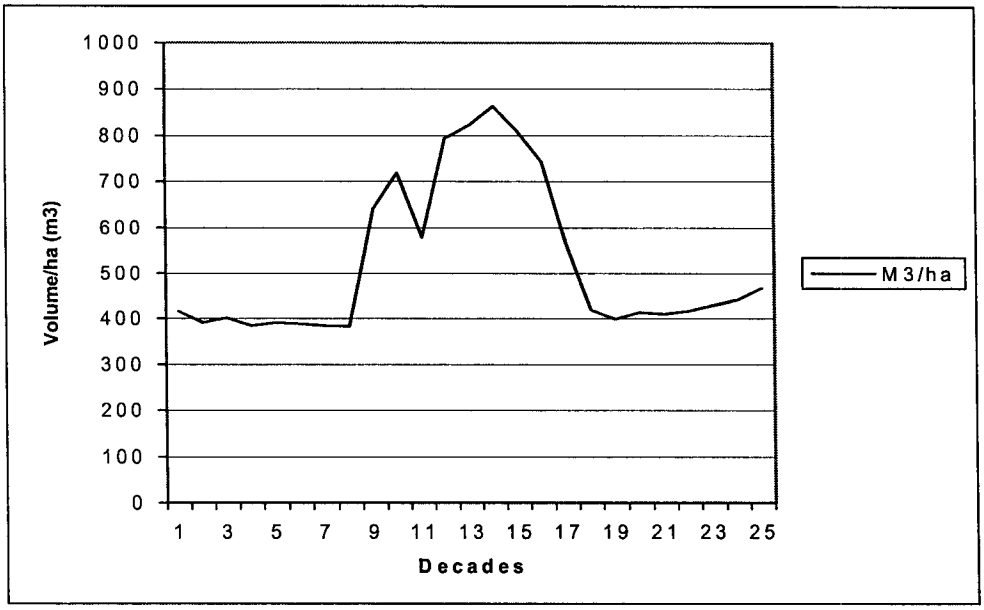


Figure 6 Base Case Average Volume Per Hectare

Figure 6 shows the harvest initially being focused on existing stands mostly situated on less productive sites. In the period between decades 9 and 17 harvesting shifts to managed stands on more productive sites with higher volumes per hectare. In the last few decades of the time horizon harvesting is focused on managed stands on less productive sites with a lower average volume per hectare.

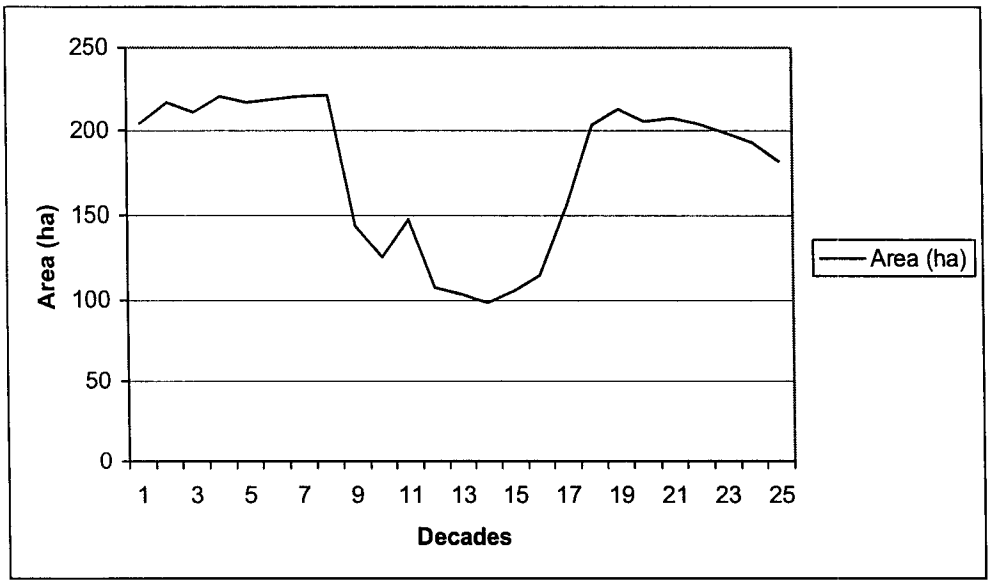


Figure 7 Base Case Average Area Harvested

Figure 7 shows the average area harvested per year. It reflects the same trend described in Figure 6 above where average area harvested is highest at the start and end of the time horizon when lower productivity (and consequently lower volume) sites are being harvested.

Figures 8-13 show the changes in forest structure over time.
Each figure indicates the residual structure of the forest on the timber harvesting land base. The age class structure of the entire forested area in TFL 57 would be much different (with a large amount of old forest at all times) since there is no harvesting in the non THLB area.

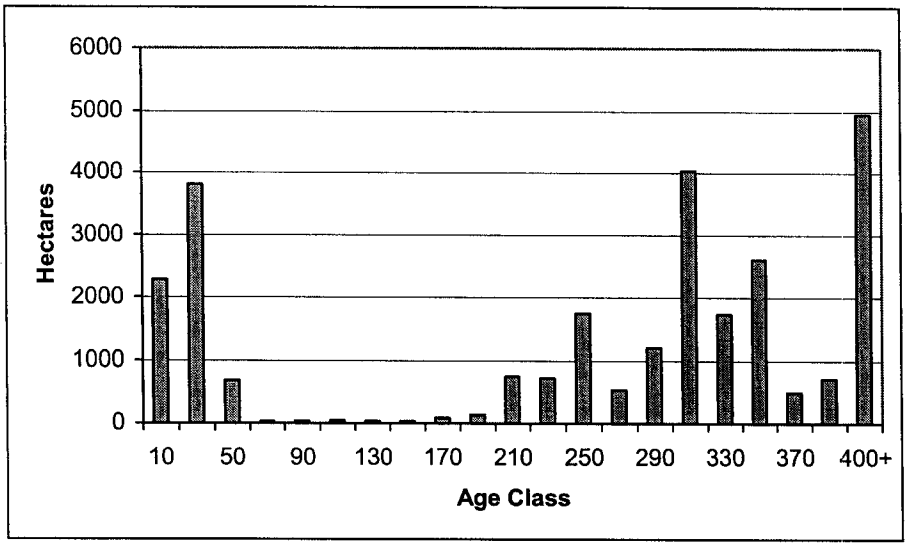


Figure 8 Age Class Distribution on the THLB - current

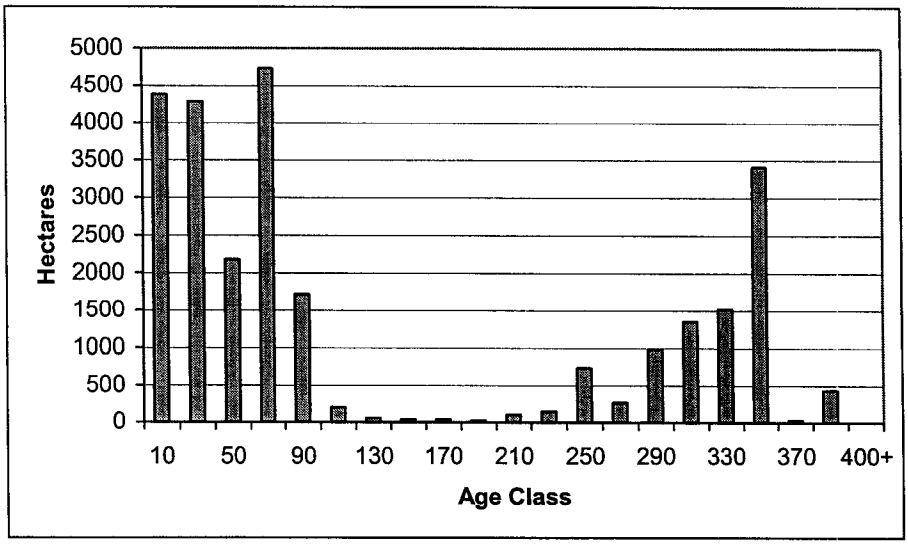


Figure 9 Age Class Distribution on the THLB – 50 years

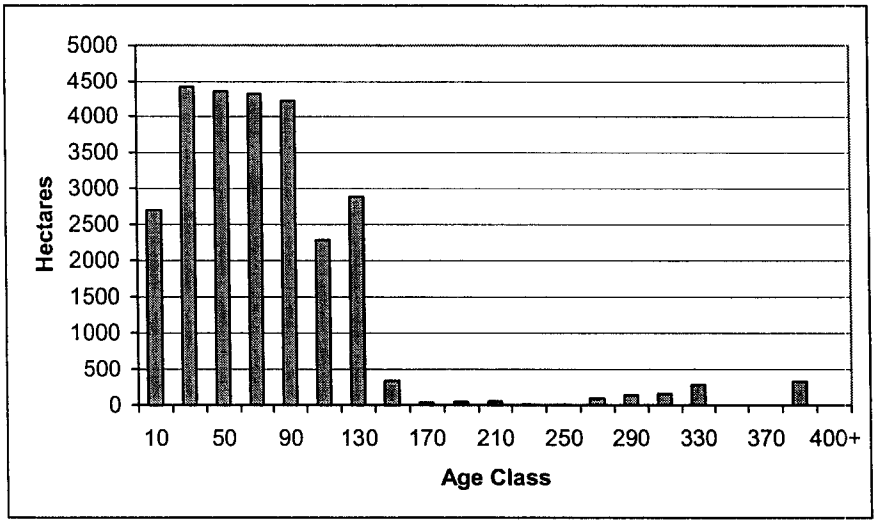


Figure 10 Age Class Distribution on the THLB – 100 years

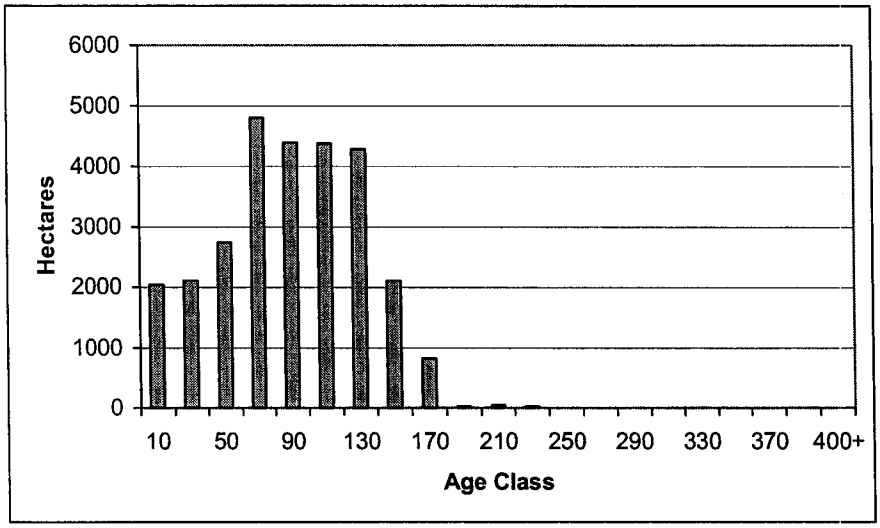


Figure 11 Age Class Distribution on the THLB – 150 years

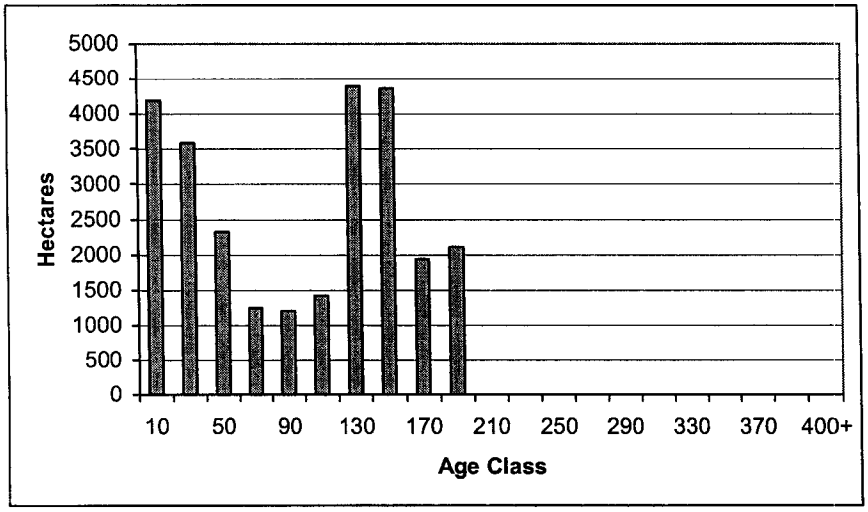


Figure 12 Age Class Distribution on the THLB – 200 years

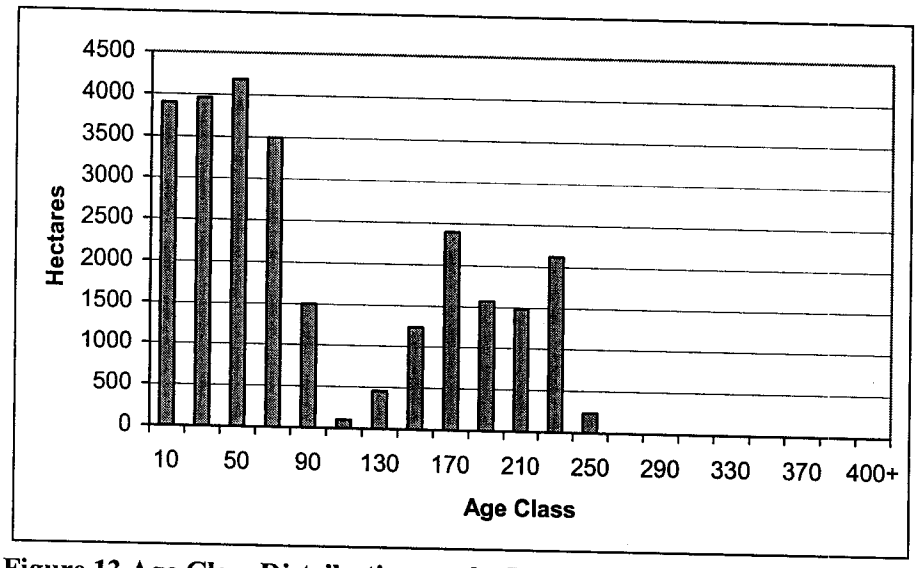


Figure 13 Age Class Distribution on the THLB – 250 years

The age class distribution on the THLB at the present time shows considerable area in stands less than 50 years of age, large areas in stands greater than 200 years of age, and very little area between 50 and 200 years. A much more balanced age class distribution is achieved on the THLB after 100 years. Later in the planning horizon (between 200 and 250 years) substantial areas of younger stands (approximately 100 years old) are harvested, leaving relatively little area in that age class.

A summary of the results of the Base Case and the options is presented in Table 5. More details are included in the following sections.

Table 5 Net harvest levels for base case and options

Annual Harvest Level (m3/year)					
Decade	**Base Case**	**Option A**	**Option B**	**Option C**	**Option D**
1	84150	105000	65340	71500	80500
2	84150	94500	65340	71500	80500
3	84150	85000	65340	71500	80500
4-25	84150	84150	65340	71500	80500

The following is a summary of the Base Case harvest scenario.

Table 6 Natural and Managed Forest LRSYs

Description	Area/volume
Current THLB	26885 ha
- future roads	991 ha
Long term THLB	25891 ha
x mai	
LRSY	99172 M3
NRL	992 M3
NET LRSY	98180 M3
LTHL	84150 M3
% of LRSY	84.8%

4.2 Option A – Alternative Harvest Flow

Option A – 10% decline per decade – This option examines an alternative approach to harvest flow that is commonly used in many other management units in British Columbia.

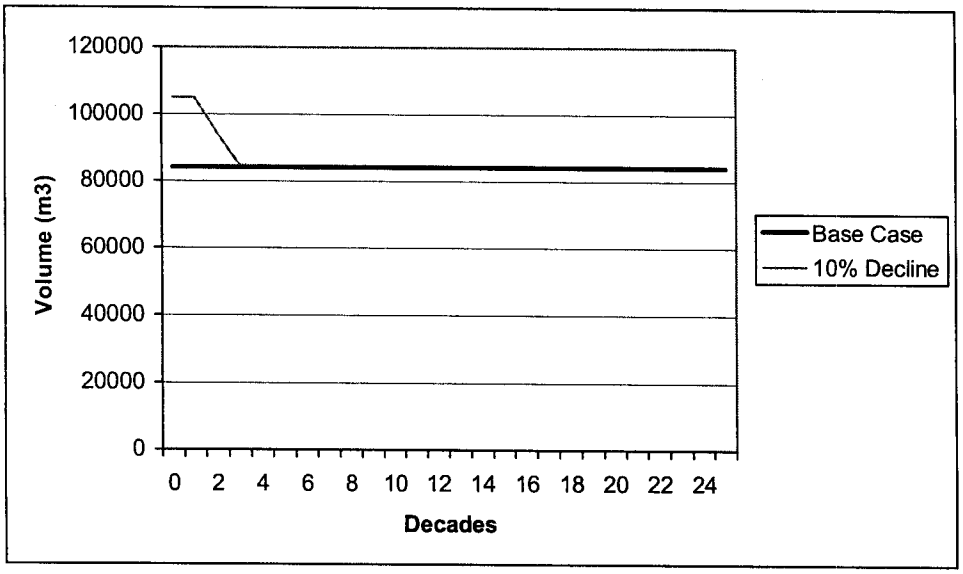


Figure 14 Alternative Harvest Flow

Figure 14 shows that it is possible to maintain an initial harvest level of 105,000 m3 per year for 1 decade before declining to the long term harvest level of 84,150 m3 per year. Higher initial harvest levels result in a temporary decline below the long term harvest level.

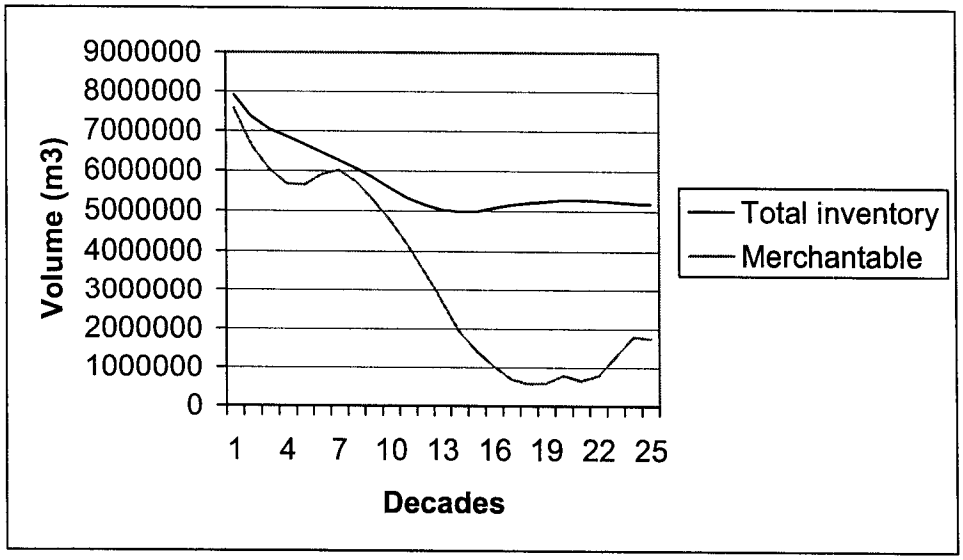


Figure 15 Option A (Alternative Harvest Flow) Growing Stock Profile

The total inventory gradually declines over the first twelve decades to reach a reasonably steady level for the last half of the analysis time horizon. As for the base case, the merchantable growing stock declines to a low point between decades 17 and 22 where most stands will be harvested at or slightly above minimum harvest ages.

4.3 Option B – Eehmiis excluded

This option examines the impact of excluding all of the eehmiis areas from the timber harvesting land base.

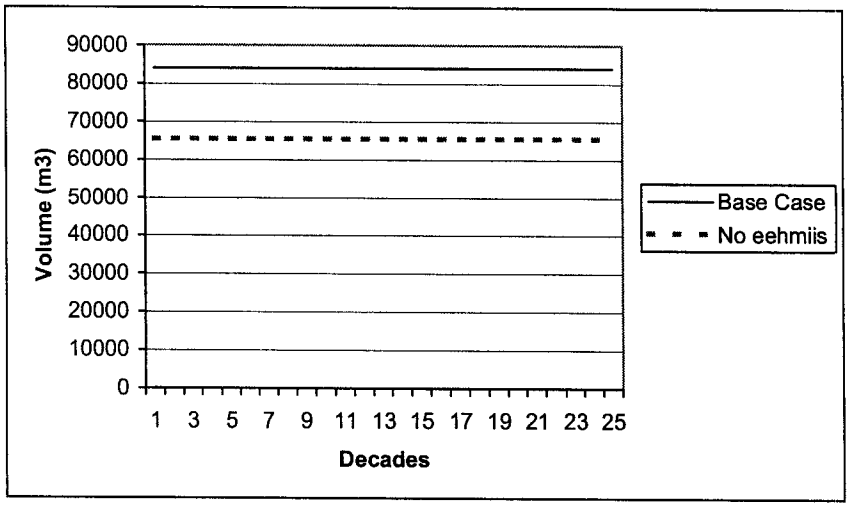


Figure 16 Option B Harvest Forecast – Eehmiis Excluded

Excluding the eehmiis areas results in a non declining harvest level of 65,340 m3 per year or 22.3% less than the base case. This is a smaller percentage reduction than the reduction in THLB area from removing the eehmiis (37%). The use of the non declining harvest flow approach for the base case (and therefore as the benchmark of comparison for the options and sensitivity analysis) results in the harvest forecasts being largely controlled by timber availability at one point in time horizon. This point occurs around the 15th decade. Given that the harvest forecast is largely governed by one point on the time horizon it is reasonable to expect that harvest level impacts may be different in percentage terms than changes in the THLB. Site productivity is also likely to vary across the land base which can affect the relationship between area and harvest level impacts.

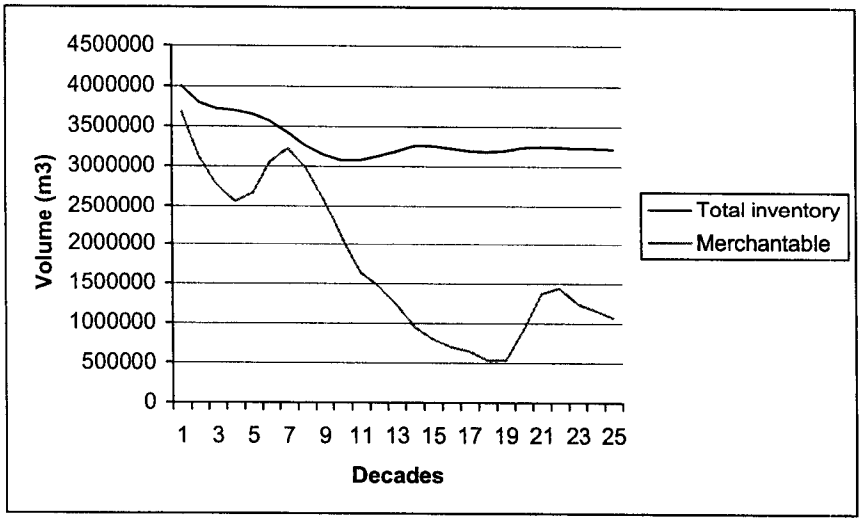


Figure 17 Option B Eehmiis Excluded Growing Stock Profile

The total inventory gradually declines over the first nine decades to reach a reasonably steady level for the last half of the analysis time horizon. The merchantable growing stock declines to a low point between decades 17 and 19 where most stands will be harvested at or slightly above minimum harvest ages.

4.4 Option C – Flores included

This option examines the impact of including Flores Island in the timber harvesting land base but excluding the other eehmiis areas from the timber harvesting land base.

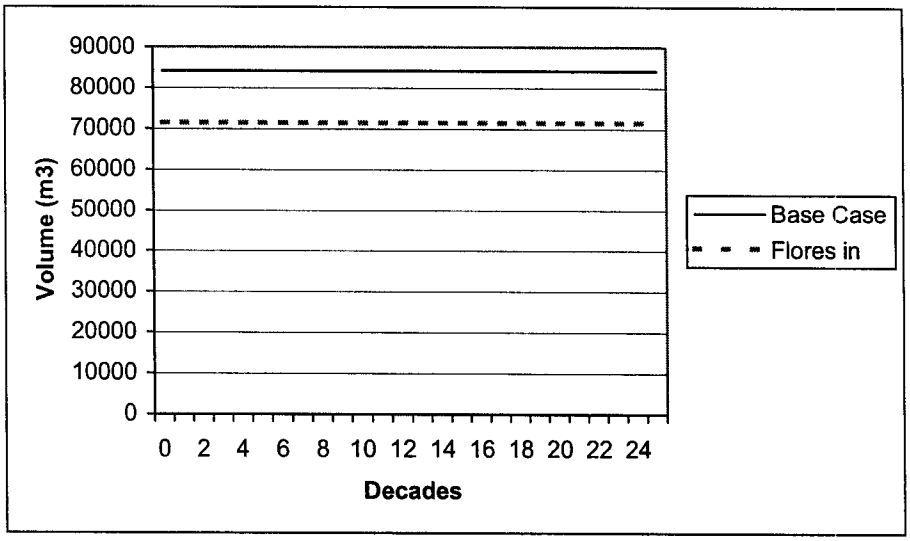


Figure 18 Flores Included – Harvest Forecast

Including Flores Island while excluding the other eehmiis areas results in a non declining harvest level of 71,500 m3 per year or 15% less than the base case. This compares to an area reduction in the THLB of 12.0 %.

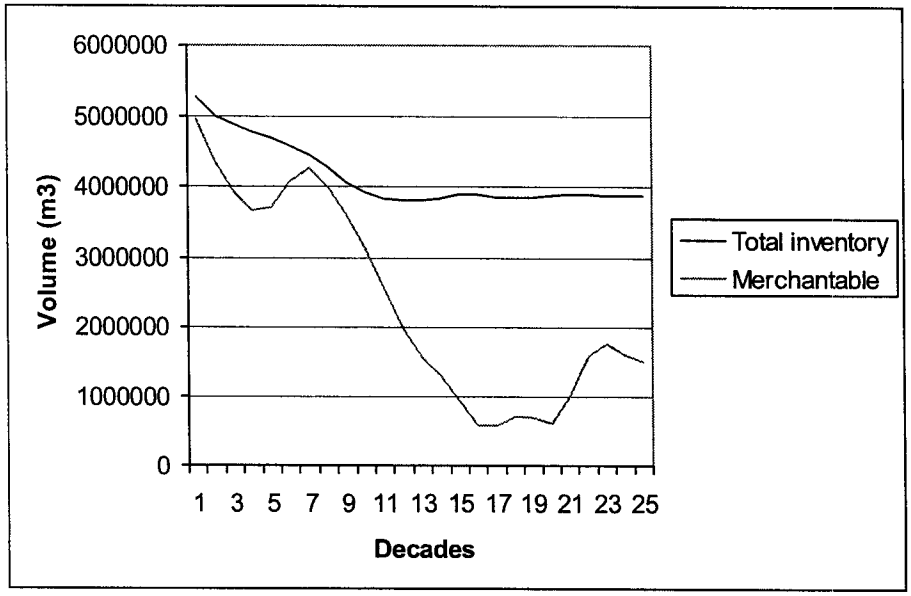


Figure 19 Option C Flores Included – Growing Stock Profile

The total inventory gradually declines over the first ten decades to reach a reasonably steady level for the last half of the analysis time horizon. The merchantable growing stock declines to a low point between decades 15 and 20 where most stands will be harvested at or slightly above minimum harvest ages.

4.5 Option D Marbled Murrelet Areas

This option examines the impact of excluding the marbled murrelet habitat areas from the timber harvesting land base.

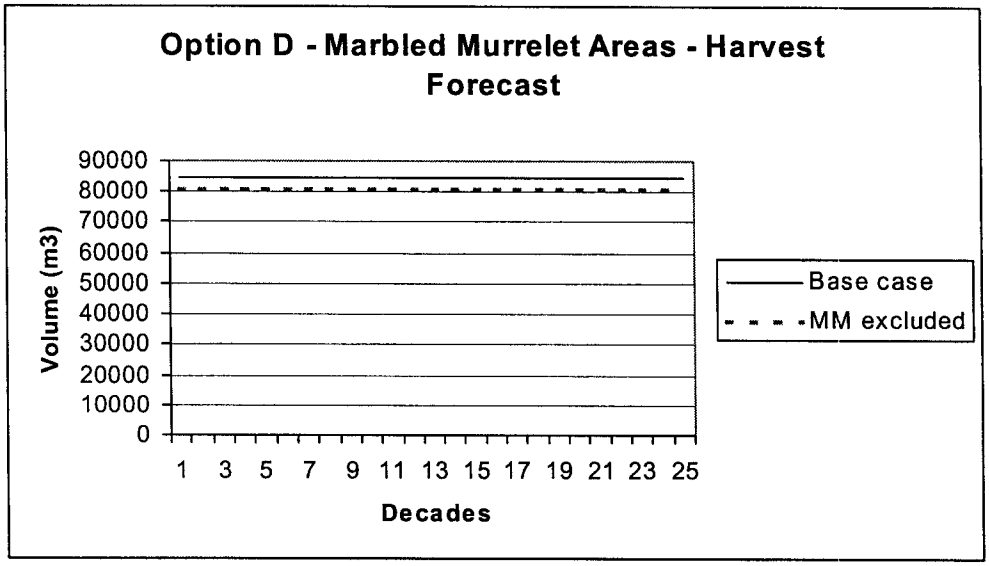


Figure 20 – Option D – Marbled Murrelet Areas – Harvest Forecast

Excluding the marbled murrelet habitat areas from the timber harvesting land base results in a non declining harvest level of 80,500 m3 per year or 4.3% less than the base case. The land base reduction from these areas amounts to 4.7% of the THLB.

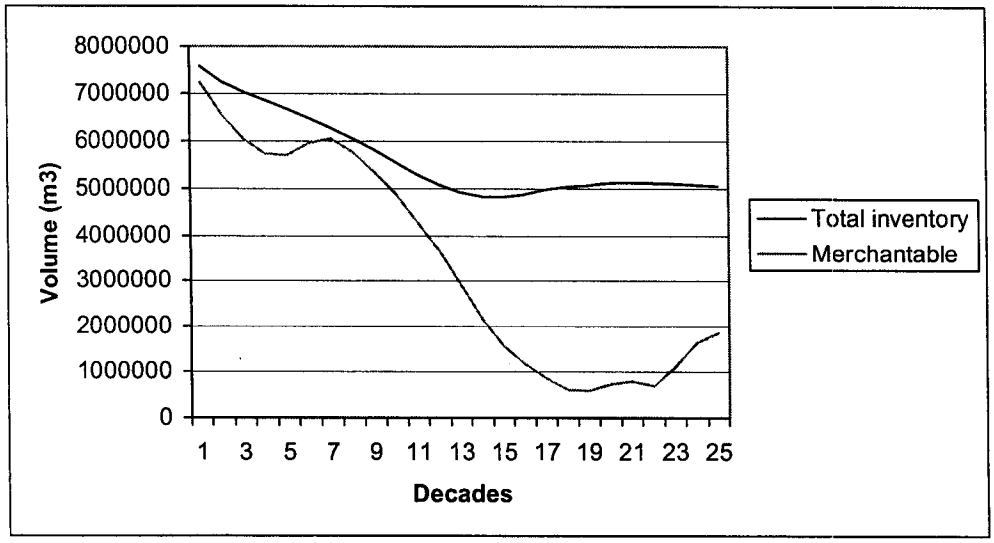


Figure 21 Option D Marbled Murrelet Areas Growing Stock Profile

The total inventory gradually declines over the first thirteen decades to reach a reasonably steady level for the last half of the analysis time horizon. The merchantable growing stock declines to a low point between decades 17 and 22 where most stands will be harvested at or slightly above minimum harvest ages.

5.0 Sensitivity Analysis

- 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.
- The magnitude of the change in the sensitivity variable(s) reflects the degree of uncertainty surrounding the assumption associated with that variable.
- By testing a number of sensitivity issues, it is possible to determine which variables most affect results.
- This facilitates the management decisions that must be made in the face of uncertainty.

The sensitivity analyses are all based on the non-declining harvest flow used for the base case in order to satisfy Forest Stewardship Council certification criteria.
The sensitivity analyses are listed Table 7. The timber supply impacts are illustrated in Sections 5.1 through 5.6.

Table 7 Current management sensitivity analyses

Issue	Sensitivity Levels to be Tested	Section
Land base	adjust timber harvesting land base by +/- 10%	5.1
	remove marginally economic areas from the THLB	5.1
Site productivity	apply OGSI adjustment to existing mature stands	5.2
Growth and yield	adjust existing (VDYP) stand yields by +/- 10%	5.3
	adjust future (TIPSY) managed stand yields by +/- 10%	5.4
	adjust managed minimum harvest ages by +/- 10 years	5.5
Forest cover	alter forest cover requirements for visual management	5.6
	apply watershed rate of cut to the THLB rather than total	5.7
Summary	summary of sensitivity issues / impacts	5.8

5.1 Sensitivity to Changes in Land-Base – adjust the THLB by +-10%

In order to assess the sensitivity of the timber supply to changes in the harvestable land base, the THLB is adjusted by +/-10% .

Table 8 Net harvest levels – adjust timber harvesting land base

Decade	Annual Harvest Level (m^3 / year)		
	THLB-10%	Base Case	THLB +10%
1-25	75500	84150	93000

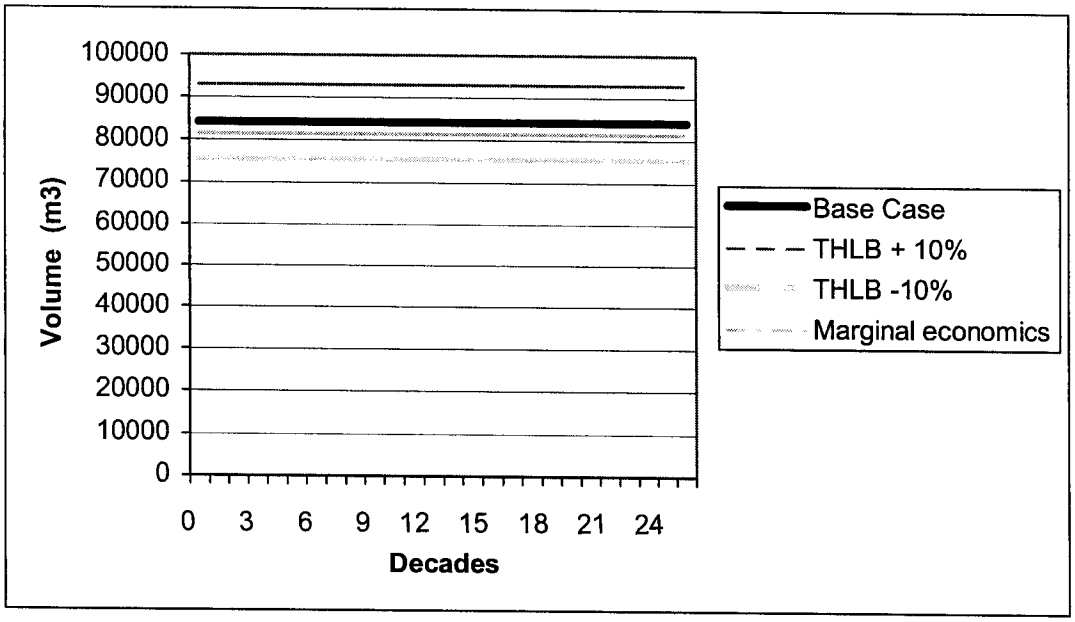


Figure 22 Land-base Sensitivity Harvest Forecasts

The land base sensitivity analysis indicated a significant sensitivity to both increasing and decreasing the size of the timber harvesting land base. The percentage increases and decreases in the non declining long term harvest forecast were similar to the percentage increases and decreases to the THLB. The removal of the marginally economic areas from the timber harvesting land base resulted in a non declining long term harvest level of 81,500 M3 per year. This is a 3% decrease from the base case, the removal of these areas resulted in a 4.7% decrease in the size of the timber harvesting land base.

5.2 Sensitivity to Changes in Site Productivity

Based on field observations it is commonly thought that site productivity estimates for sites currently occupied by existing mature and old stands are conservative. In order to assess sensitivity to changes in site productivity Old Growth Site Index (OGSI) equations were used to adjust the site index for the areas of the timber harvesting land base presently occupied by mature stands. These adjusted site index values were then used to generate a new set of TIPSY yield tables for use in the sensitivity analysis.

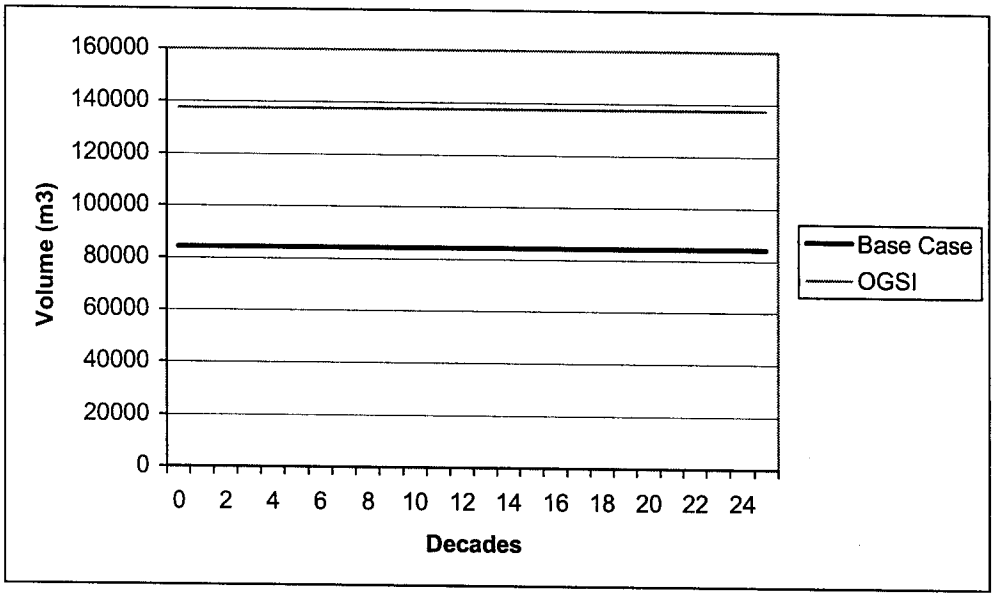


Figure 23 Site Productivity Sensitivity Harvest Forecast

The OGSI adjusted site index values result in a non declining long term harvest level of 137,500 M3 per year, a 63% increase over the base case. This large increase provides an indication of the importance of accurate site productivity estimation to the harvest forecast in the highly productive forest ecosystems of TFL 57.

Site index adjustments are applied only to regenerating stands and as such, aside from faster greenup, the impact on timber supply is generally in the long-term. In this case, the use of the non-declining harvest flow approach for the base case results in a large increase in the harvest forecast in the short term as well as in the longer term. The constraining point in the base case is sufficiently far out in the time horizon that the application of site index adjustments affects it significantly.

5.3 Sensitivity to changes in existing (VDYP) stand yields

Table 9 Net harvest levels – adjust existing stand yields

Decade	Non Declining Harvest Level (m^3 / year)		
	NSYT –10%	Base Case	NSYT +10%
1-25	81500	84150	87125

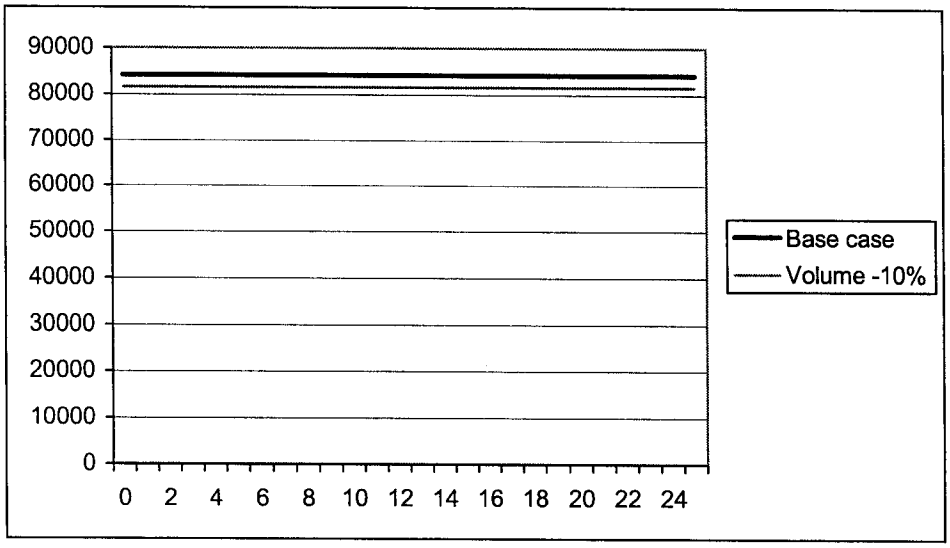


Figure 24 Existing Stand Yield Sensitivity Harvest Forecast

Decreasing existing stand volumes by 10% resulted in a non declining long term harvest forecast of 81,500 M3/year, a decrease of 3.1%. Increasing existing stand volumes by 10% (not shown on the graph) resulted in a short term increase in the harvest level to 87,125 M3 per year. This could not be maintained in a non declining fashion without a declining long term inventory since the yields of the regenerated stands were not increased. This sensitivity analysis would be more relevant with a base case that featured a declining harvest flow.

5.4 Sensitivity to changes in volumes of future managed (TIPSY) stands.

Table 10 Net harvest levels – adjust future stand yields

Decade	Non Declining Harvest Level (m^3 / year)		
	MSYT –10%	Base Case	MSYT +10%
1-25	77000	84150	89500

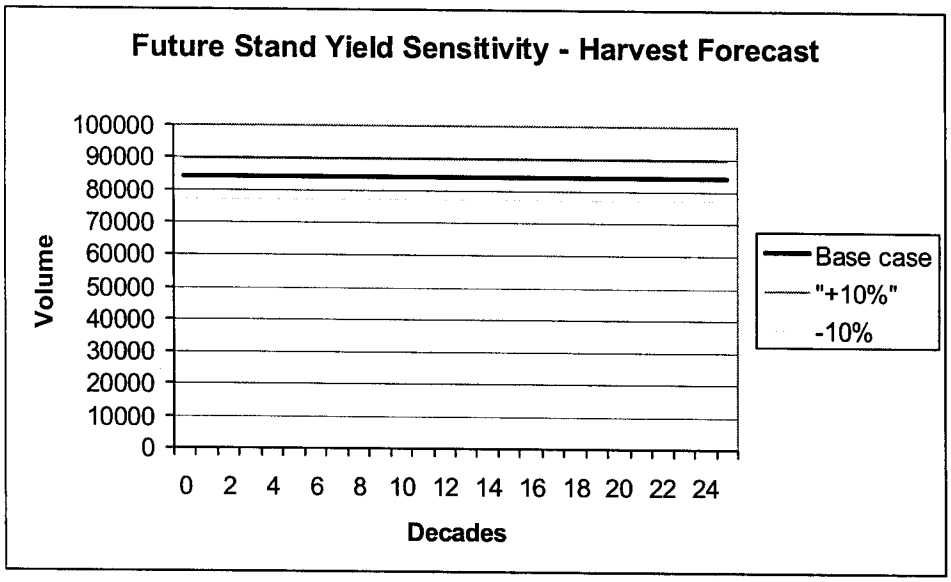


Figure 25 Future Stand Yield Sensitivity Harvest Forecast

Decreasing future stand volumes by 10% resulted in a non declining long term harvest forecast of 77,000 M3/year, a decrease of 8.5%. Increasing existing stand volumes by 10% resulted in a short term increase in the harvest level to 89,500 M3 per year, an increase of 6.4%.

5.5 Sensitivity to changes in Minimum Harvest Ages

Minimum harvest ages for future managed stands were based on the greater of the following two criteria:

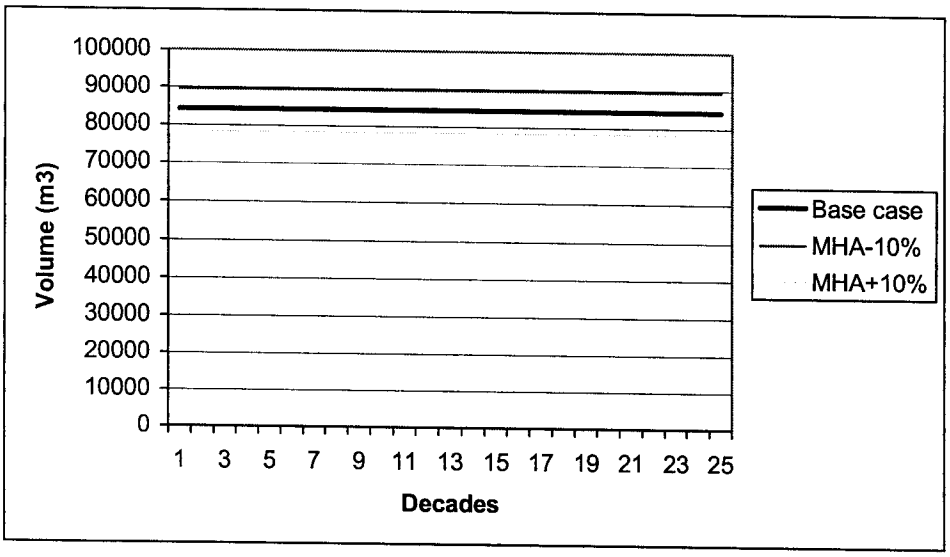
- The age at which the stand achieves 90% of maximum annual increment.
- The age at which the stand reaches a volume of 300 cubic meters per hectare.

This is an arbitrary approach, representing a conservative estimate of this age; *i.e.* in some cases it is reasonable to expect to harvest stands at an earlier age. The sensitivity to this assumption was tested by arbitrarily adjusting minimum harvest ages by +/- 10 %.

Table 11 Net harvest levels – adjust minimum harvest ages

Decade	Non Declining Harvest Level (m^3 / year)		
	MHA –10 %	Base Case	MHA +10 %
1-25	89595	84150	78210

Figure 26 Minimum Harvest Age Sensitivity Harvest Forecast



The base case harvest level is quite sensitive to changes in minimum harvest ages with a decrease of 10% in minimum harvest ages showing an increase of 6.5% in the harvest level. This increase is achieved at the expense of a significant decline in the inventory in the last few decades of the forecast period. Nonetheless it is significant since without changing the minimum harvest ages it is not possible to increase the base case harvest forecast.

5.6 Sensitivity to changes in forest cover requirements for visual management

In TFL 57, as in most management units, visual resource management is modeled through the use of forest cover requirements. TFL 57 does use a somewhat different visual management approach than elsewhere in B.C. however. In TFL 57 visual management is directed by the Clayoquot Sound Scenic Corridors project. The three zones in the scenic corridors (Natural Appearing, Minimal Alteration, and Small Scale Alteration) have operational guidelines for amount of visual disturbance and heights for visually effective greenup associated with them. Current practices in TFL 57 in areas subject to the Scenic Corridors direction consist primarily of small patches, narrow strips, and individual tree removal. These practices were considered to be represented more realistically by partial cutting approaches to visual management (e.g. Table 4 in the Visual Impact Assessment Guidebook) than traditional clear cut approaches to setting forest cover requirements. The forest cover requirements used in the base case (25%, 30%, 35% maximum denudation for natural appearing, minimal alteration, and small scale alteration respectively) are based on this approach. In order to test the sensitivity to this approach forest cover requirements were reduced (e.g. tightened) by first 10% (to 15%, 20%, 25% respectively), and then by 20% (to 15%, 10%, 5% respectively). They were then increased (loosened) by 10% (to 45%, 40%, 35% respectively).

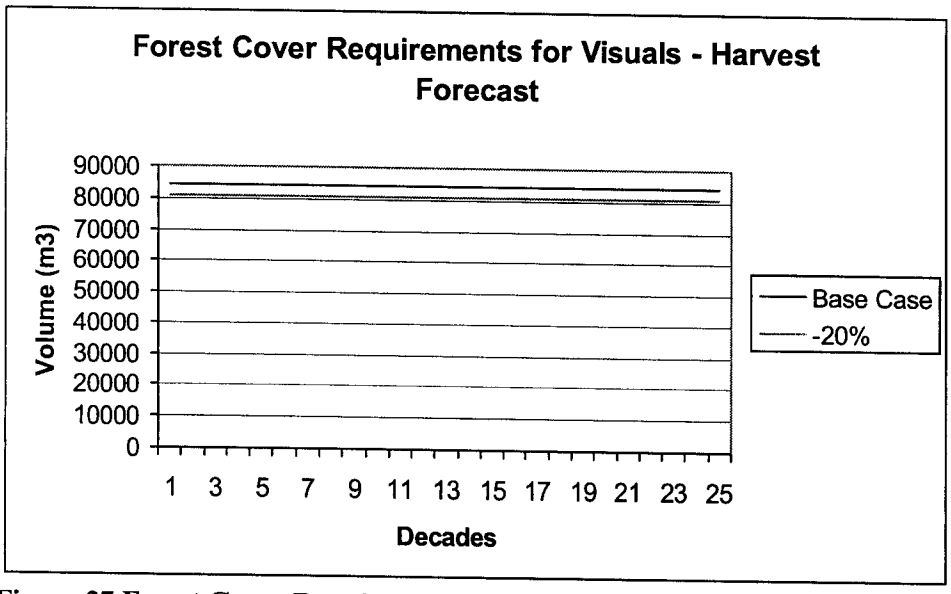


Figure 27 Forest Cover Requirements for Visuals – Harvest Forecast

Reducing or increasing the forest cover requirements for visuals by 10% had no effect on the harvest forecast (and therefore are not shown in Figure 27). As Figure 27 shows reducing the forest cover requirements by 20% did result in a decrease in the non declining harvest level to 80,625 M3 per year, a reduction of 4.2%.

5.7 Sensitivity to how watershed rate of cut is applied to the land-base

The Clayoquot Sound Scientific Panel recommends applying a rate of cut limit based on the entire area of the watershed. In the last AAC determination rate of cut was applied to the timber harvesting land base. Some of the watersheds are located entirely in TFL 57 and others are shared with TFL 54. FSSIM deals with the productive forested land base and the timber harvesting land base.
In the base case rate of cut was assigned as either 5% in 5 years or 10% in 10 years based on the total area of the watershed (inside and outside of TFL 57). The rate of cut was applied to the total watershed area within TFL 57 by adjusting the percentages to account for the difference between total watershed area and total forested area within the timber supply model.
In order to determine sensitivity to how rate of cut is applied the following alternative approaches were tested:

- Apply to the timber harvesting land base within each watershed.
- Apply and maximum rate of cut of 1% in 5 years, 2% in 10 years to the productive forest area. These are purely arbitrary levels to test a response, they have no management significance.

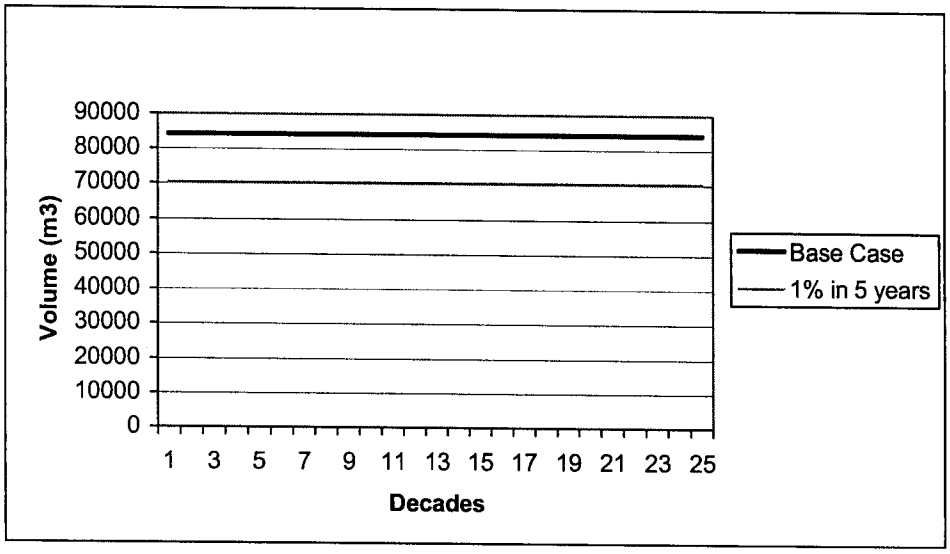


Figure 28 Watershed Rate of Cut Sensitivity Harvest Forecast

Applying the watershed rate of cut to the timber harvesting land base, on average tightened the rate of cut forest cover requirements significantly as compared to the base case, but still had no effect on the base case harvest forecast. This is reasonable in that applying rate of cut to the timber harvesting land base will still allow the entire THLB in a watershed to be cut every 100 years. The watershed rate of cut was further constrained to a level of 1% in five years (and 2% in 10 years where applicable) based on the productive forest area. This was an arbitrary level, simply chosen to reach a level where an impact was noticeable (16.5% reduction).
This analysis has shown that the base case harvest forecast is not particularly sensitive to changes in the way in which the rate of cut recommendations are applied.

5.8 Summary of Sensitivity Issues

Table 10 provides a summary of the impacts of the sensitivity issues explored in this section. Impacts, shown as percentages, are only listed where the results differ from the base case by more than 0.5%. Impacts shown represent aggregate differences over the periods indicated.

Table 12 Sensitivity analyses – summary of percentage impacts

		Annual Harvest
		1-25
Base Case Net Harvest (total cubic meters) =		21,037,500
Issue Tested	**Sensitivity**	**Impact**
Adjust THLB +10%	+10%	+10.5%
Adjust THLB –10%	-10%	-10.3%
Marginal economic areas	Remove	-3.1%
Apply OGSI adjustments		+63.4%
Existing VDYP	+10%	+3.5%
Existing VDYP	-10%	-3.1%
Future TIPSY yields	+10%	+6.4%
Future TIPSY yields	-10%	-8.5%
Min. harvest ages	+10%	-7.1%
Min. harvest ages	-10%	+6.5%
VQO disturbance	-20%	-4.2%
Rate of cut	1%/5 years	-16.5%

6.0 Discussion

The base case harvest forecast features a non declining flow of 84,150 M3/year. This level is determined largely by available timber at approximately 150 years from the present. The non declining flow approach, in addition to meeting Forest Stewardship Council (FSC) certification criteria, provides a conservative approach to short term harvest levels. It does require that harvest options and sensitivity analyses be interpreted carefully so that the timing of the impact of the item being examined is not obscured by the base case harvest flow.

This harvest level is most sensitive to land base changes and uncertainties in site productivity estimation. A number of possibilities with respect to land base changes are examined in the options as well as in the sensitivity analysis. The harvest forecast is also quite sensitive to changes in minimum harvest age.

In the short term it is possible to achieve a significantly higher harvest level (105,000 m3/year) if a declining (10% per decade to the long term harvest level) harvest flow is used. This approach to harvest flow was not chosen for the base case but it does provide an indication of the degree to which the short term harvest level is conservative. This is particularly so since the point at which availability controls timber supply is so far out on the time horizon (150 years). This is important at this point given that there is some uncertainty in terms of both land base and management practices given that watershed planning has not yet been completed for the TFL.

The land base options showing the impacts of excluding all or part of the eehmiis areas from the THLB show the importance of further work on refining the management emphasis for these areas. The timber supply impact of excluding the eehmiis varies somewhat from their land base impact. It is possible that short-term impacts of excluding these areas could be somewhat different (potentially greater) from the long-term impacts shown here.
Excluding the marbled murrelet habitat areas from the THLB results in an impact on the harvest forecast that in percentage terms (4.3%) is approximately similar to the area reduction.

The removal of the marginally economic areas from the timber harvesting land-base resulted in a 3% decrease in the harvest forecast level. This operability classification was completed prior to the implementation of the Clayoquot Sound Scientific Panel recommendations. Harvest methods and silvicultural systems have evolved considerably since these areas were identified. These management changes can cause some previously economic stands to become uneconomic and can also result in previously uneconomic stands becoming economic. The overall effect is difficult to estimate.

The very large response to the OGSI site index adjustments suggest that further work to clarify this may be appropriate. The large short-term response is primarily due to the use of a base case with a non declining harvest flow). TEM mapping has recently been completed for the entire TFL and could be used as the basis for a SIBEC site index adjustment approach (where relationships between ecosystems and site index for various tree species are quantified).

The base case harvest forecast shows a significant sensitivity to decreased future stand volumes (8.5% decrease in response to a 10% decrease in volumes). This emphasizes the importance of a monitoring program and an adaptive management approach to implementing the variable retention harvest system so that the growth and yield implications of different levels and distribution of retention are understood.

The base case harvest forecast is quite sensitive to changes in minimum harvest age (a 10% decrease in minimum harvest ages results in a 6.5% increase in the harvest level). Minimum harvest age is assigned according to the greater of the age at which the stand achieves 90% of maximum mean annual increment or the age at which the stand reaches a volume a 300 cubic metres per hectare. This results in minimum harvest ages which are quite high for some of the poor site analysis units (160 years for AU 26 – cedar poor for TIPSY tables with unadjusted site index) due to high culmination ages). Harvesting some of these stands somewhat earlier could be a reasonable management option.

The base case harvest forecast is not sensitive to changing forest cover requirements for visual management unless they are tightened to a level typically used for standard clear cut approach to visual management. This tightening the forest cover requirements to this degree) is not representative of current management and therefore indicates that while there may be some uncertainty associated with the approach used to model visuals in the base case the risk to the timber supply forecast is relatively low.

In the base case watershed rate of cut was applied to the total area of each watershed. This is in accordance with the Clayoquot Sound Scientific Panel recommendations and is the way it is done operationally. The watershed rate of cut was applied to the THLB as a sensitivity analysis, in part because this was the approach that was used in the previous AAC determination. This had no effect on harvest levels.

Iisaak recommends an Allowable Annual Cut of 84,150 m3/year for MP 1. This harvest level is consistent with Forest Stewardship Council (FSC) requirements for a non-declining harvest flow and provides a conservative approach to harvest levels in the short term.