TIMBER SUPPLY ANALYSIS
FOR TREE FARM LICENSE 8

Pope & Talbot Ltd.

Boundary Timber Division

Management Plan No. 10

Prepared by:

Timberline Forest Inventory Consultants Ltd.

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EXECUTIVE SUMMARY

This report documents the analysis of timber supply that has been completed as a component of Management Plan (MP) No. 10 for Pope and Talbot Limited (P&T) Tree Farm Licence (TFL) 8. The analysis evaluates how current management, including management of non-timber resources, affects the supply of harvestable timber over a 250-year period. An analysis of the spatial feasibility of the base case harvest level over a 20-year period was also conducted, and is reported under separate cover (included as Appendix IV to MP No. 10).

The analytical methodology employs a forest level simulation model, 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
- Consideration of non-timber values.

The timber supply analysis provides the technical basis for the Chief Forester of British Columbia, or his designate, to determine an allowable annual cut (AAC) for TFL 8 for the next five years.

The AAC is currently set at 144,720 cubic meters per year, as per Instrument No. 20 for TFL 8.

The base case harvest flow was developed in consideration of the following objectives:

- Maintain, or increase, the initial harvest level as long as possible;
- Limit any reductions in the periodic harvest rate to less than 10% of the level prior to the reduction; and
- Achieve a stable even-flow long-term supply and growing stock over a 250-year time horizon.

The forest cover inventory was updated for disturbance to the year 2000 prior to inclusion in this analysis. An inventory audit completed on the TFL concluded that both the mature and immature components of the inventory are statistically acceptable. A Terrestrial Ecosystem Mapping project undertaken on the TFL, and approved in March 2000, provided a revised ecosystem inventory that in turn provided the basis for silviculture regimes and potential site index adjustments that were applied to the development of growth and future yield predictions for managed stands. All analyses conducted in support of Management Plan No. 10 made use of growth and yield estimates developed by J.S. Thrower and Associates. Reports documenting their work are included as appendices to this timber supply analysis report.

Of the 73,406 hectares of productive forest in the TFL, 65,919 hectares (90%) were classified as harvestable. The remaining 10% of the productive forest was excluded from the timber harvesting landbase due to considerations such as environmental sensitivity, terrain instability, poor site productivity, non-merchantable forest types and riparian reserves.

The base case harvest forecast consists of a short-term harvest level of 163,535 cubic metres per year for six decades, followed by an increase in decade 7 to a long term harvest level (LTHL) of 208,100 cubic metres per year. The short-term harvest level represents a 13 % increase over the current AAC, and is 96% of the theoretical long run sustained yield (LRSY) for natural stands. The LTHL is 81% of the theoretical LRSY for managed stands. Further increases in the LTHL were attempted but were found to result in declining growing stock profiles, making any such increase in the LTHL unsustainable.

A comprehensive series of sensitivity analyses were performed to assess the stability of the base case timber supply forecast in light of uncertainties around model assumptions, inputs and parameters. In the short-term, the base case harvest forecast was found to be insensitive to uncertainties in any of the model assumptions and parameters that were tested. In the long term, the base case harvest level was found to be sensitive only to overestimations of managed stand yields or of the timber harvesting landbase. The results of the sensitivity analyses indicate that the ability of the TFL 8 landbase to sustain the base case harvest forecast throughout the planning horizon is overwhelmingly a result of the new TEM inventory and the corresponding potential site index estimates (JST 2001b) used to develop the growth and yield forecasts for managed stands.

Based on the results of the analyses reported herein, and on the spatial feasibility analysis (Appendix IV of Management Plan No. 10), it is proposed that the AAC for TFL 8 be increased to 163,535 cubic metres per year for the five year period covered by Management Plan No. 10.

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1. INTRODUCTION

This report documents the analysis of timber supply that has been completed as a component of Management Plan (MP) No. 10 for Pope and Talbot Limited (P&T) Tree Farm Licence (TFL) 8. The analysis evaluates how current management, including management of non-timber resources, affects the supply of harvestable timber over a 250-year period. The analysis also quantifies the sensitivity of the results to uncertainty associated with modelling inputs. An analysis of the spatial feasibility of the base case harvest level over a 20-year period was also conducted (included as Appendix IV to MP No. 10).

The analytical methodology employs a forest level simulation model, 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
- Consideration of non-timber values.

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, or his designate, to determine an allowable annual cut (AAC) for TFL 8 for the next five (5) 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 iterative process ensures that harvest strategies remain sustainable in the long term, even in the face of changing circumstances.

Two options were developed for this analysis: the "base case" option, reflecting P&T's current management practices on TFL 8; and a maximum even flow option which is presented for comparison. On the strength of the base case analysis, the accompanying sensitivity analyses and the spatial feasibility analysis, a harvest level was selected for submission to the Chief Forester for acceptance as the new AAC.

2. DESCRIPTION OF THE LICENCE AREA

TFL 8, held by P&T Boundary Timber Division, consists of two (2) distinct units; Block 1 in the Boundary Creek area, north of Greenwood, and Block 2 in the Trapping Creek and Carmi Creek drainages, north of Beaverdell. Communities in the vicinity of TFL 8 include Grand Forks, Greenwood, Midway, Rock Creek, Westbridge and Beaverdell. These towns are located along Highway 3 and Highway 33 which connect Rock Creek with Kelowna. An overview of the TFL is shown in Figure 2.1.

Historically, TFL 8 originally consisted only of Block 1, which was granted to Boundary Sawmills Ltd. in 1951. Block 2, formerly known as TFL 11 and managed by the Olinger Lumber Company, was reassigned to Boundary Sawmills Ltd. as part of TFL 8 in 1968. In 1969 Pope & Talbot Inc. of Portland Oregon purchased Boundary Forest Products, which itself was a consolidation of Boundary Sawmills Ltd. and several other operations based in Grand Forks. The company was renamed Pope & Talbot Ltd. and remains a subsidiary of the parent company.

The current TFL 8 is located within the Nelson Forest Region, and is administered from the Boundary Forest District office. The total area of TFL 8 is approximately 77,456 hectares (excluding non-crown land), of which 5% is non-productive or non-forested. All of TFL 8 is Schedule B (crown) land. Approximately 35% of the net timber harvesting land base (THLB) is Douglas-fir leading forest over 60 years of age. Another 24% of the THLB is lodgepole pine leading forest, also over 60 years of age.

The AAC is currently set at 144,720 cubic meters per year[1] (m^3/yr).

[1] The current AAC is defined by Instrument No. 20 for TFL 8.

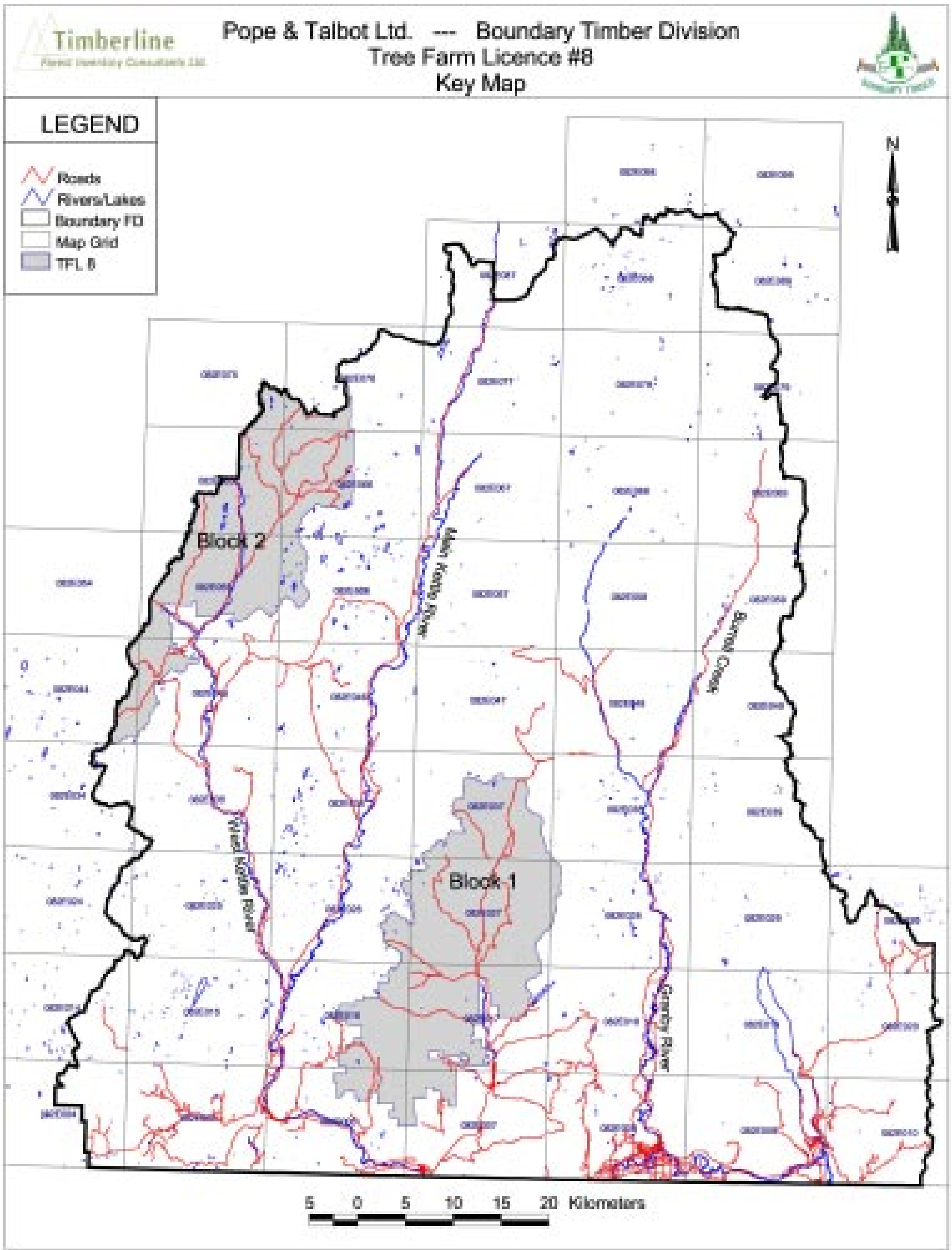

Figure 2.1 Key Map

3. TIMBER FLOW OBJECTIVES

Forest cover objectives and the biological capacity of the net timber harvesting land base (THLB) ultimately dictate the harvest level. However, a number of alternative harvest flows are possible. In this analysis, the initial objectives considered in developing a proposed harvest flow were the following:

- Maintain, or increase, the initial harvest level as long as possible;
- Limit any reductions in the periodic harvest rate to less than 10% of the level prior to the reduction; and
- Achieve a stable even-flow long-term supply and growing stock over a 250-year time horizon.

The base case harvest flow presented in this report did not require any reductions in harvest level, so the second objective listed above proved to be non-binding.

4. FOREST INFORMATION

A complete description of the information used in P&T's TFL 8 MP No. 10 timber supply analysis is contained in the document Timber Supply Analysis Information Package for Tree Farm License 8, dated January 22, 2002. This document is included as an appendix to this report, which is itself is included as Appendix III of the TFL 8 MP No. 10 submission, for review and acceptance by Ministry of Forests (MoF) staff.

4.1 Landbase Classification

Land is classified into one of the following four broad categories:

1. Unproductive for forest management purposes;
2. Inoperable, either currently or in the future, under the assumptions of the analysis;
3. Unavailable for harvest for other reasons (e.g. wildlife habitat or preservation of visual quality); or
4. Available for integrated use (including harvesting).

The classification of the TFL 8 landbase area is summarized in the following figures. Figure 4.1 illustrates the distribution of the total TFL area (excluding non-crown areas within the TFL boundary) between productive and non-productive or non-forested areas. Figure 4.2 illustrates the process by which the productive landbase of 73,406 hectares is classified in terms of its contribution to timber and non-timber uses. The THLB area of 65,919 hectares includes 2,698 hectares of NSR (not sufficiently restocked) area that is scheduled for full restocking within the first 5 years of the planning horizon.

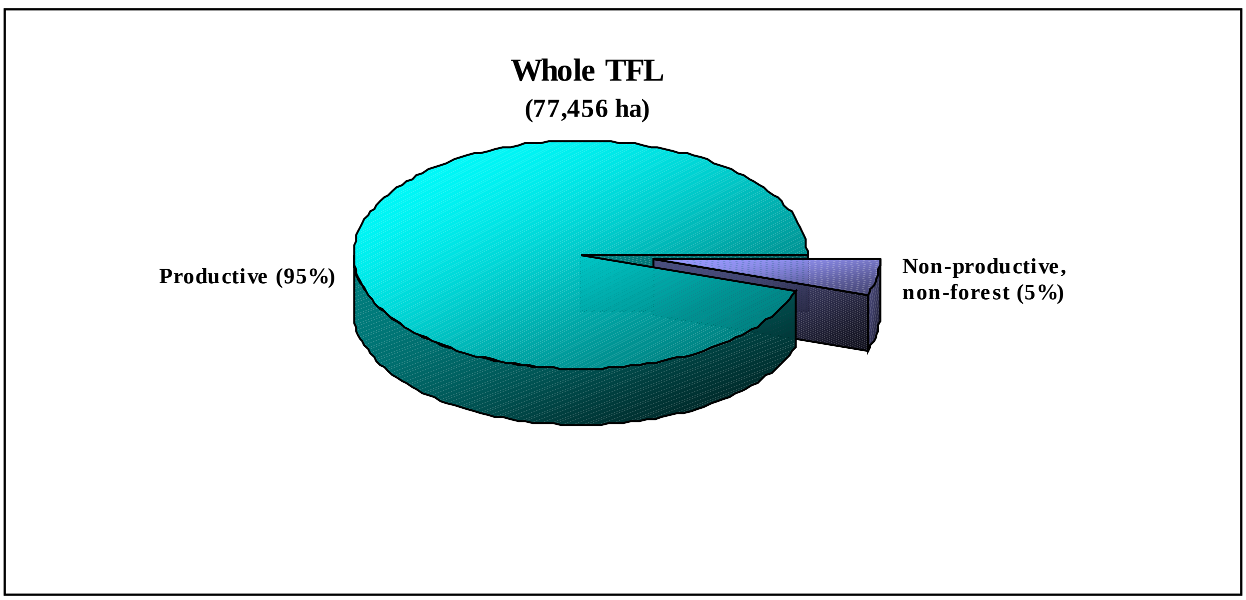

Figure 4.1 Distribution of total TFL Area

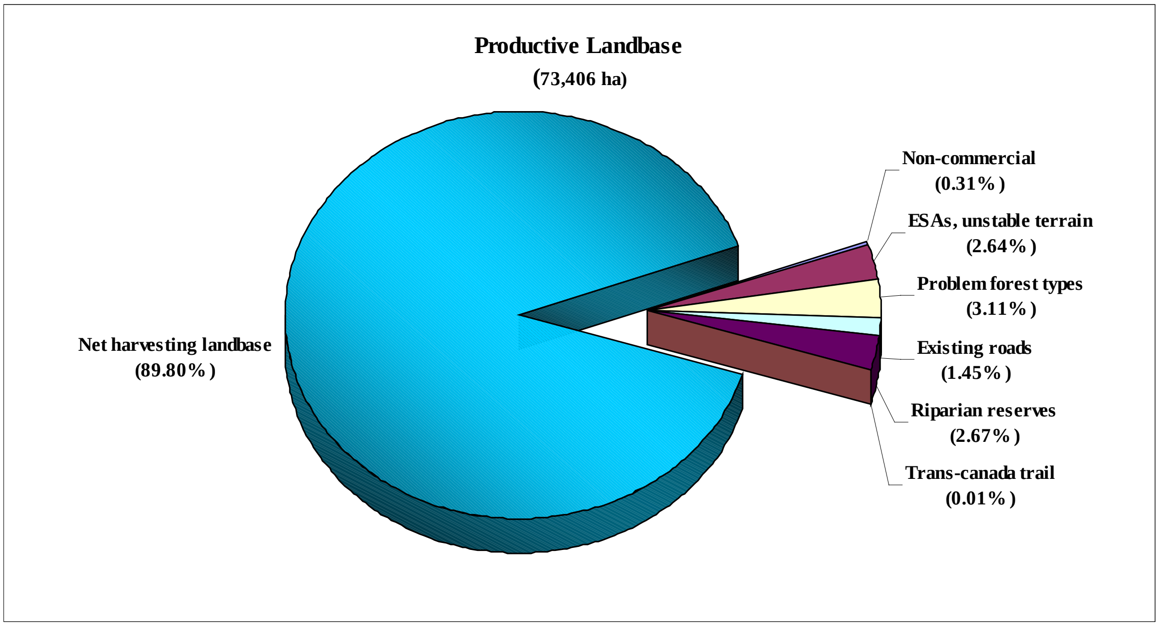

Figure 4.2 Classification of productive landbase

4.2 Forest Inventory

The TFL 8 forest cover inventory has been updated for disturbance and projected to the year 2000 by Forsite Consultants Ltd. Furthermore, a statistical adjustment of inventory attributes was applied to dense lodgepole pine stands, following the results of a study undertaken for Pope & Talbot by J.S. Thrower & Associates (JST, 1999). Figure 4.3 provides a visual summary of the standing forest inventory on the THLB. The figure shows the distribution of net landbase area by leading age (the oldest age in each 10-year age class), and by the rank1 leading species within each age class. The figure shows a significant gap in the age class inventory in the 31 to 60 year age range, which will tend to limit the rate at which a uniform distribution of area within each age class can be established.

4.3 Growth and Yield

J. S. Thrower and Associates undertook the development of growth and yield relationships for the analysis of TFL 8. A report documenting this work and the results is included as an appendix to the TFL 8 MP No. 10 report (JST 2001a). The following is a brief summary of the contents of that report.

4.3.1 Natural Stands

Natural stands were defined as all stands in the current forest cover inventory with age greater than 25 years. Natural stand yield tables (NSYTs) for the timber supply analysis were developed using the batch version of the Ministry of Forests (MoF) program BatchVDYP (version 6.6d).

4.3.2 Managed Stands

Existing managed stands were defined as all stands in the current forest cover inventory with age less than 26 years. These stands have been managed since establishment and include both natural and artificially regenerated sites.

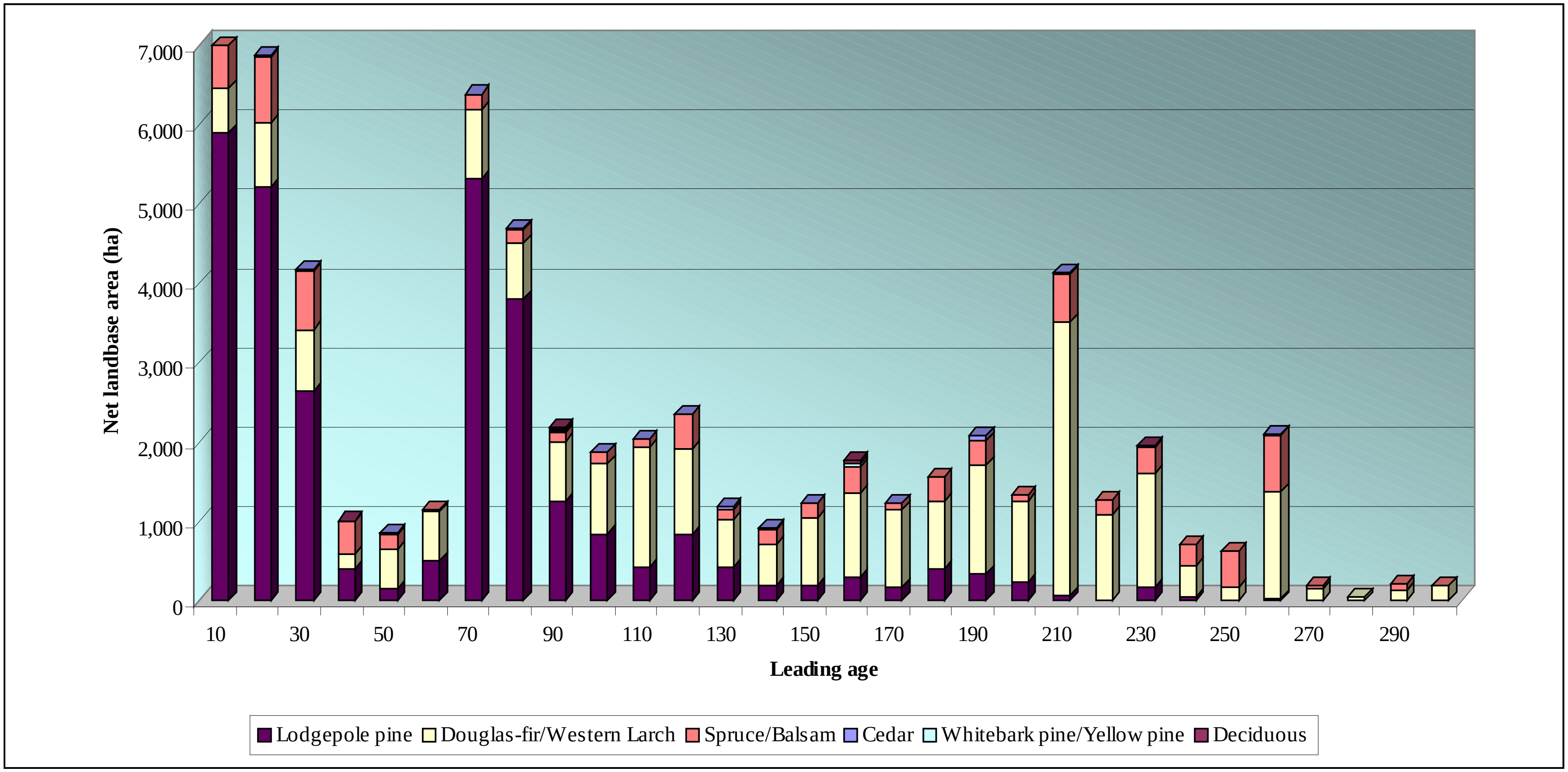

Figure 4.3 Distribution of net landbase by age and leading species

P&T regularly prescribe a combination of clearcut (CC), patchcut (PC) and single tree selection (STS) silvicultural systems within mule deer winter range areas, depending on ecological site series and the Kootenay-Boundary Land Use Plan Implementation Strategy (KBLUP-IS) guidelines. Managed stand yield tables (MSYTs) incorporating improved estimates of potential site index[2] were developed using *BatchTIPSY (version 3.0a)* for CC and PC systems. These MSYTs also incorporate future genetic gain expectations based on information provided by the Tree Improvement Branch. MSYTs for the STS regimes were based on a system of custom equations derived from permanent sample plot data and Prognosis^{BC} model analysis (JST, 2001a).

4.3.3 Theoretical Productivity Estimates

Table 4.1 provides average theoretical productivity estimates for the TFL 8 landbase, derived from both natural and managed stand yield tables. The actual long-term harvest level (LTHL) will always be slightly below the theoretical long run sustained yield (LRSY), which is attainable only if all stands are harvested at the age of maximum mean annual increment (MAI). This is due to the imposition of minimum harvest ages and forest cover requirements, which alter time of harvest.

Table 4.1 Theoretical long-term productivity estimates

Description	Natural	Managed
THLB, including NSR (ha)	65,918	65,918
- Future roads (ha)	0	2,091
= Long term THLB (ha)	65,918	63,827
* Average MAI at culmination (m^3/ha)	2.71	4.22
= Theoretical gross LRSY (m^3/yr)	178,639	269,184
- Wildlife tree patch retention (m^3/yr)	7,146	10,767
- Non-recoverable losses (m^3/yr)	900	900
= Theoretical net LRSY (m^3/yr)	170,593	257,517

4.3.4 Analysis Units

In order to reduce the complexity of the forest description for the purposes of timber supply simulation, considerable aggregation of individual stands is necessary. However, it is critical that these aggregations obscure neither biological differences in forest productivity, nor differences in management objectives and prescriptions. Aggregation based on similarities in forest productivity and management prescriptions results in the assignment of each individual stand to a particular analysis unit as described below.

The basic modelling units used to derive natural stand yield estimates for the present analysis were the individual forest cover inventory polygons. The fundamental modelling units used to derive managed stand yield estimates for CC and PC regimes were the eco-polygons formed by the spatial intersection of the forest cover inventory polygons and the TEM polygons. This procedure resulted in a total of 8,927 NSYTs and 9,647 MSYTs. This number of yield tables is generally intractable for timber supply analysis, so they were aggregated to form analysis units (also known as clusters). Clusters were defined as groups of similar curves based on treatment stratum (CC or PC), leading species, site index class, presence or absence of genetically improved

[2] - Improved potential site index estimates were based on the site index adjustment work of J.S.Thrower and Associates (JST 2001b)

stock, proportion of conifer volume and model type (VDYP or TIPSY). The clustering process resulted in a total of 437 analysis units, each with a natural and managed stand yield table. In addition, 22 analysis units were defined for STS regimes based on potential site index and pre-harvest standing volume classes.

4.4 Inventory Aggregation

Stands are also grouped into landscape units (LUs) and resource emphasis areas (REAs) to recognize similarities in management focus.

4.4.1 Landscape Units

TFL 8 intersects portions of three of the LUs (LUs B1, B7 and B8 – see Figure 8 in MP No. 10) designated by the Kootenay-Boundary Higher Level Plan Order (KBHLPO). In the timber supply analysis, most forest cover requirements must be met within the spatial units defined by the intersection of these LUs with the biogeoclimatic ecosystem classification (BEC) variant. Figure 4.4 summarizes the distribution of productive and net area by LU – BEC variant – BEO.

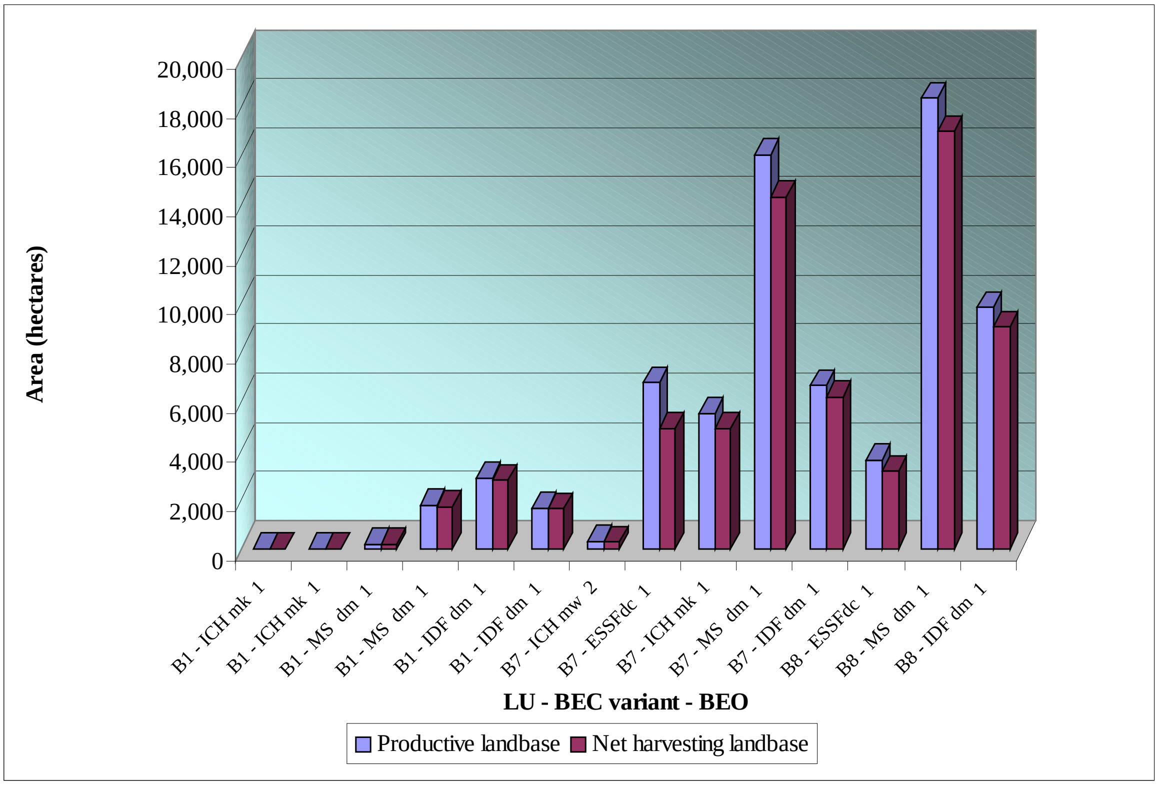

Figure 4.4 Distribution of landbase area by LU-BEC variant-BEO

4.4.2 Resource Emphasis Areas

The landbase has been divided into REAs to facilitate the application of forest cover constraints. These include:

- Mule deer winter range (DWR) areas;
- Forest connectivity corridors (FCC);

- Known scenic areas for which draft visual quality classes (VQCs) have been identified; and
- Integrated resource management (IRM) areas.

The distribution of productive landbase area among the REAs is shown in Figure 4.5.

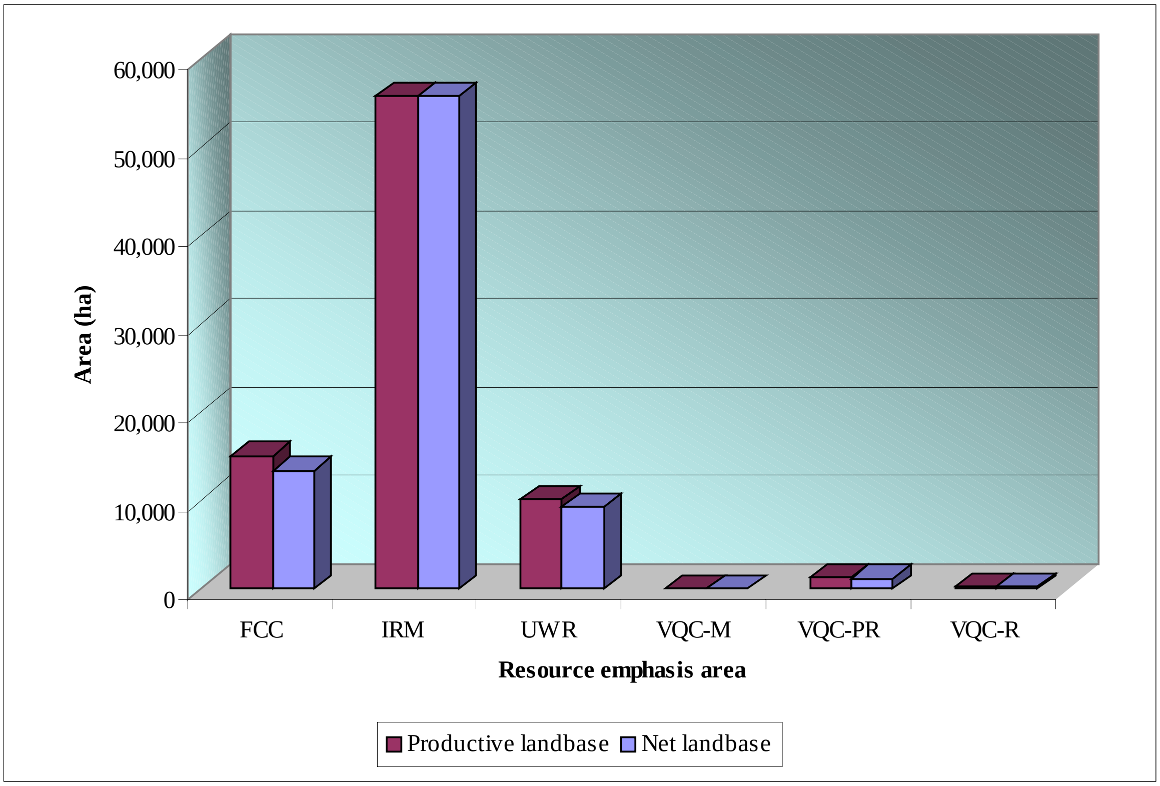

Figure 4.5 Resource emphasis areas

5. ANALYSIS METHODS

Timberline's proprietary simulation model CASH6 (**C**ritical **A**nalysis by **S**imulation of **H**arvesting, version 6.2j) was used to develop all harvest schedules and growing stock profiles included in the TFL 8 timber supply analysis.

This model uses either an aspatial or spatial geographic approach to land base and inventory definition in order to adhere as closely as possible to the intent of forest cover requirements on harvesting. CASH6 can simulate the imposition of overlapping forest cover objectives on timber harvesting and resultant forest development. These objectives are addressed by placing restrictions on the distribution of age classes, defining maximum or minimum limits on the amount of area in young and old age classes found in specified components of the forest. For the purposes of this analysis, objectives are of the following two types:

1. **Disturbance (green-up)**

   The disturbance category is defined as the total area below a specified green-up height or age. This disturbed area is to be maintained below a specified maximum percent. The effect is to ensure that at no time will harvesting cause the disturbed area to exceed this maximum percent. This category is typically used to model adjacency, visual, wildlife or hydrological green-up requirements in resource emphasis areas, and early seral stage requirements at the landscape unit level; and

2. **Retention (old growth)**

   The retention category is defined as the total area above a specified age. This retention area is to be maintained above a specified minimum percent. The effect is to ensure that at no time will harvesting cause the retention area to drop below this minimum percent. This category is typically used to model thermal cover and/or old growth requirements in wildlife management resource emphasis areas, and mature and old growth seral stage requirements at the landscape unit level.

The model projects the development of a forest, allowing the analyst to impose different harvesting/silviculture strategies on its development, in order to determine the impact of each strategy on long-term resource management objectives. CASH6 was used to determine harvest schedules that incorporate all integrated resource management considerations including spatial feasibility factors, for example, silviculture block green-up.

In these analyses, timber availability is forecast in decadal time steps (periods). The main output from each analysis is a projection of the amount of future growing stock, given a set of growth and yield assumptions, and planned levels of harvest and silviculture activities. Growing stock is characterized in terms of total growing stock (total volume on the timber harvesting land base), operable growing stock (volume in stands at or above minimum harvest age), and available growing stock (maximum operable volume that can be harvested in any given decade without violating forest cover constraints).

A 250-year time horizon was employed in these analyses, to ensure that short and medium term harvest targets do not compromise long-term growing stock stability. Also, modelled harvest levels included allowances for non-recoverable losses. Harvest figures reported here exclude this amount unless otherwise stated.

6. BASE CASE ANALYSIS

The base case analysis reflects current management performance as of the date of commencement for the preparation of MP No. 10. This analysis incorporates the following factors:

- Forest cover inventory, updated for disturbance to January 1, 2000;
- Statistical adjustment of dense lodgepole pine inventory attributes;
- Current management regimes;
- Updated mapping of existing roads;
- Current Forest Development Plan approved cut-blocks;
- Updated draft visual quality classes (VQC) for the known scenic areas defined by the Kootenay-Boundary Higher Level Plan Order (KBHLPO);
- Updated landscape units, as defined by the KBHLPO;
- Definition of landscape-level biodiversity requirements in accordance with the KBHLPO;
- Definition of stand-level biodiversity requirements in accordance with the Landscape Unit Planning Guide (LUPG);
- Updated riparian classifications;
- Definition of riparian buffers consistent with Pope & Talbot's operational practice regarding riparian reserve and management zones;
- Updated mule deer winter range (DWR) zone;
- New connectivity corridors (KBHLPO);
- Expanded Slope Stability Mapping for areas previously unmapped and unclassified;
- New Terrestrial Ecosystem Mapping (TEM) of Pope & Talbot's Tree Farm Licence 8;
- New Potential Site Index Estimates for the Main Commercial Species on TFL 8;
- Genetic gain estimates;
- Uneven-aged management regimes within the DWR zones; and
- Updated estimates of non-recoverable losses (NRLs).

6.1 Analysis Results

6.1.1 Harvest Forecasts

Table 6.1 presents harvest flow levels for the two options developed in this analysis: the base case option and the maximum even flow option. The maximum even flow option was developed as a means of providing an upper bound on harvest levels in the context of the forest cover requirements being modeled, and is presented here for comparison only. Two harvest levels are shown for the maximum even flow option: one in which old growth retention targets were reduced to 1/3 of the full value in low biodiversity emphasis areas, and one in which full old growth retention targets were applied throughout the entire planning horizon. Figure 6.1 shows the harvest forecasts for both options graphically, and also depicts the current AAC for convenient reference.

Table 6.1 Harvest levels, base case and maximum even flow

Decade	**Net Harvest**	**Max even flow** (m^3/yr)	
	m^3/yr	1/3 old growth	full old growth
1-6	163,535	205,600	186,600
7-25	208,100	205,600	186,600

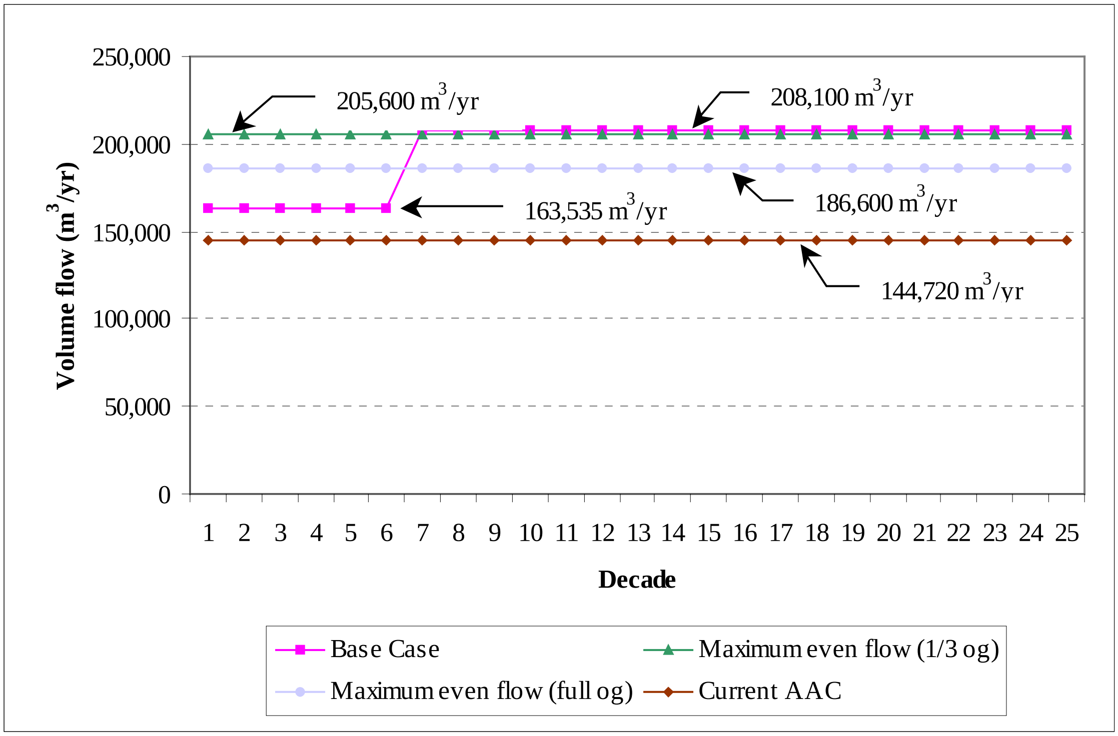

Figure 6.1 Harvest flows, base case, maximum even flow and current AAC

The base case harvest level was initially set at 163,535 m3/yr for the first 60 years of the planning horizon, and then increased by 27% to 208,100 m3/yr for the remainder of the 250 year planning horizon. The initial base case harvest level represents a 13 % increase over current AAC, and is 96% of the theoretical LRSY for natural stands (see Table 4.1)3. The base case long-term harvest level (LTHL) is 81% of the theoretical LRSY for managed stands.

The growing stock characteristics associated with the base case harvest flow are shown in Figure 6.2. Total and operable growing stocks both decline initially, but rise again quickly and by decade 7 have settled into very stable long term patterns that persist throughout the remainder of the planning horizon. This indicates a healthy and stable long-term timber supply. Available growing stock also shows a modest decrease in the short-term, specifically in decades 2 through 5, but then rises again and also establishes a very stable pattern in the long term. There are no significant points of limited timber supply anywhere in the forecast. Further increases in the LTHL were attempted in the analysis, but were found to result in declining growing stock profiles, making any such increase in the LTHL unsustainable.

Figure 6.3 depicts the sources of harvest volume over the entire planning horizon. The majority of timber volume comes from existing mature stands for the first 90 years. The transition to second growth forests begins in decade 7, and by decade 10 these stands constitute the primary source of harvested volume. Natural stands continue to make a very minor contribution to the harvest in later decades as a few stands which were previously bound up by the action of forest cover constraints become available for harvest. By design, a small but constant volume is harvested in each decade from the single tree selection stands within the deer winter range areas. The distribution of harvested volume by silvicultural system is shown in Figure 6.4.

[3] Several factors were considered in selecting the short-term harvest level for the base case option. These factors are discussed in detail in Chapter 8.

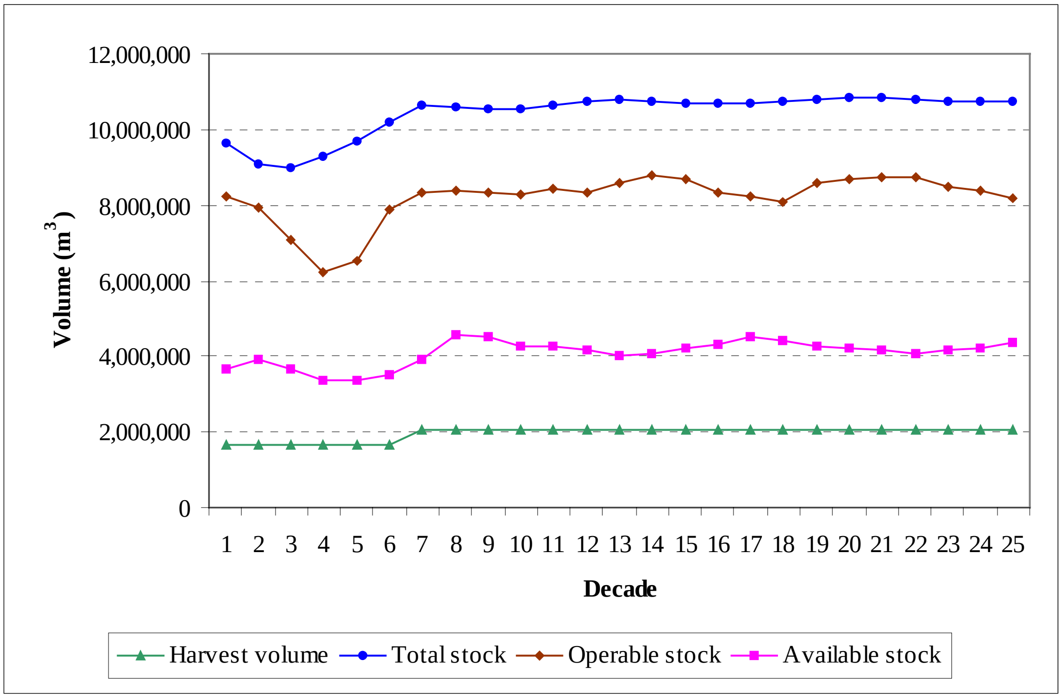

Figure 6.2 Base case growing stock profiles

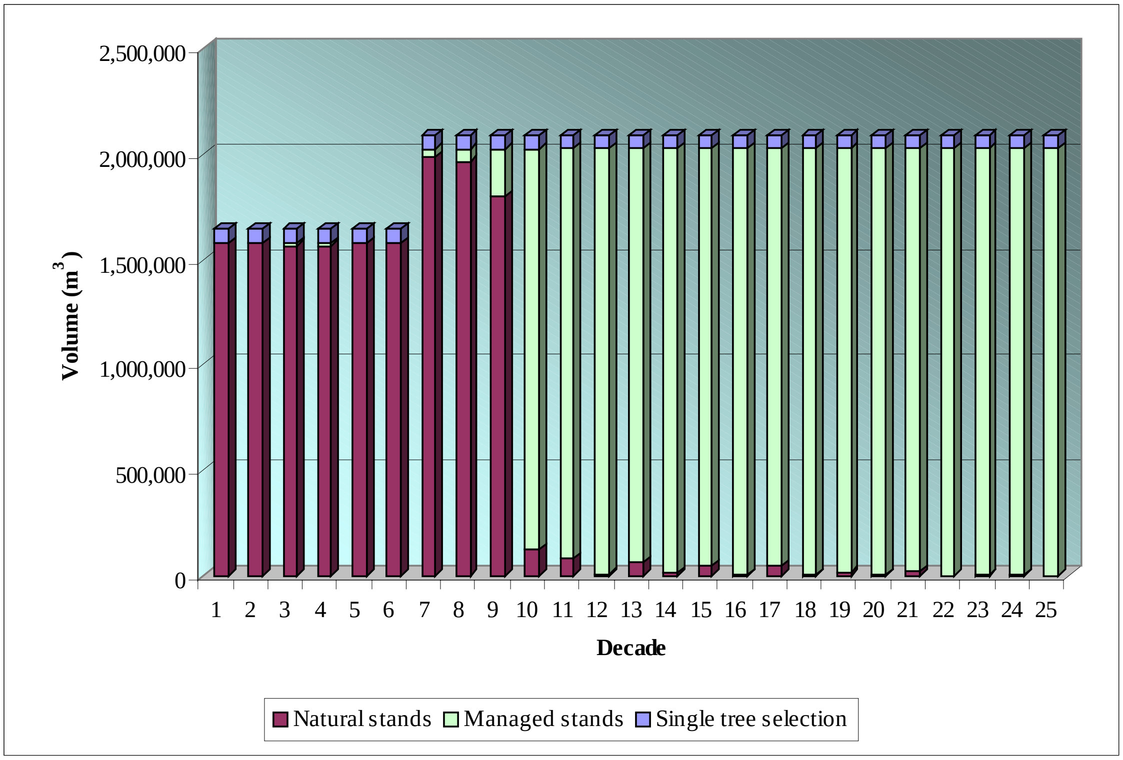

Figure 6.3 Harvest volume by natural, existing and future managed stand types

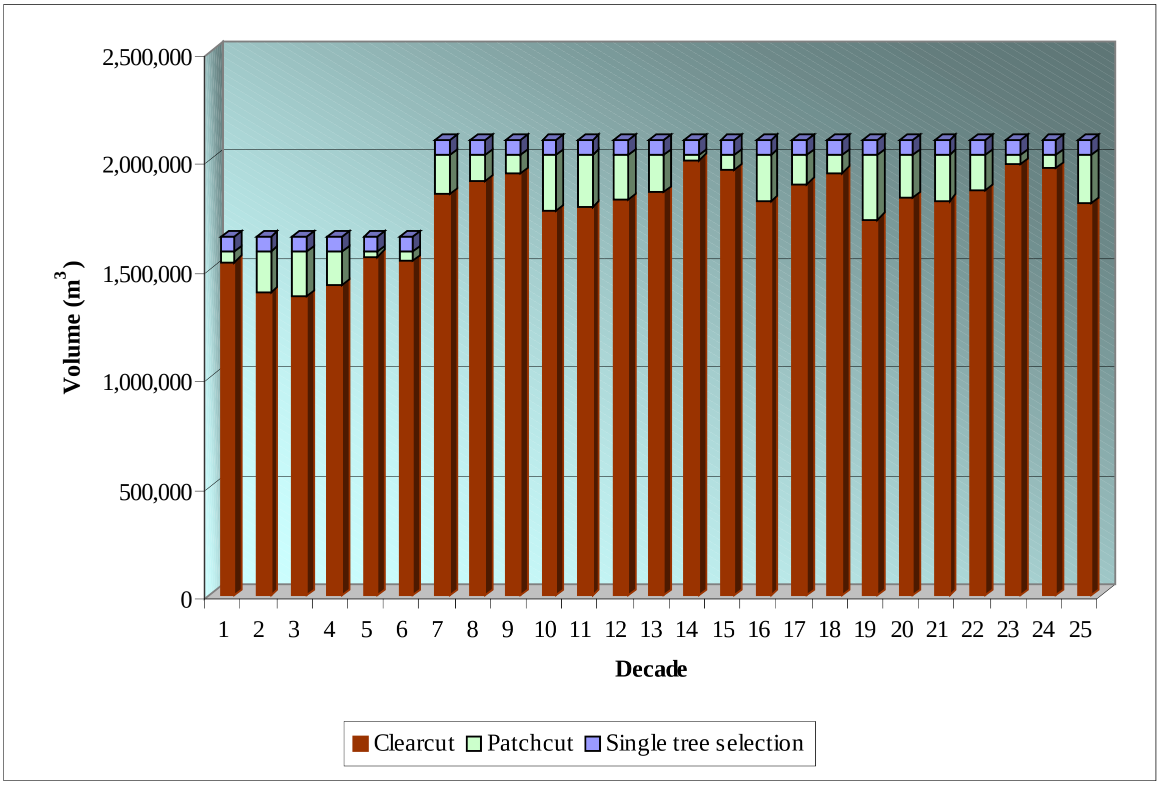

Figure 6.4 Harvest volume by silvicultural system

Figure 6.5 shows the area-weighted average age and volume per hectare of stands harvested in each decade of the forecast. Average harvest age declines quickly in the short-term as the older component of the initial inventory is harvested first (a result of the oldest first harvest rule applied throughout the analysis). Once the harvest shifts to managed stands, the average harvest age remains constant at about 84 years for the remainder of the planning horizon. Average volume per hectare also declines over the first 60 years for the same reason, but then increases again and ultimately fluctuates around a long term average of approximately 310 m^3/ha. The increase in decades 7 and 8 coincides with the increase in available growing stock, which in turn is a consequence of the prior recruitment of older stands to satisfy mature seral retention requirements. It can be seen by reviewing the results of the sensitivity analyses presented in the next chapter that the shape of the availability curve in this region of the forecast is strongly sensitive to the mature-plus-old seral retention target (Figure 7.20). Thus, in the initial decades of the forecast the model recruits (that is, reserves from harvest) enough area of the oldest stands that are younger than the minimum ages defining mature seral conditions to satisfy the mature-plus-old seral retention requirements. As these stands age into true mature seral condition the need for further recruitment is diminished, freeing up some older natural stands for harvesting.

The dynamics of mature-plus-old seral recruitment are also apparent in Figure 6.6 which shows that the average area harvested in each decade climbs sharply in decades 1 through 7 since the harvest comes from progressively younger stands with less standing volume per hectare. Once the harvest has shifted to managed stands in the long term, the average harvested area fluctuates around a value of approximately 6,800 hectares per decade.

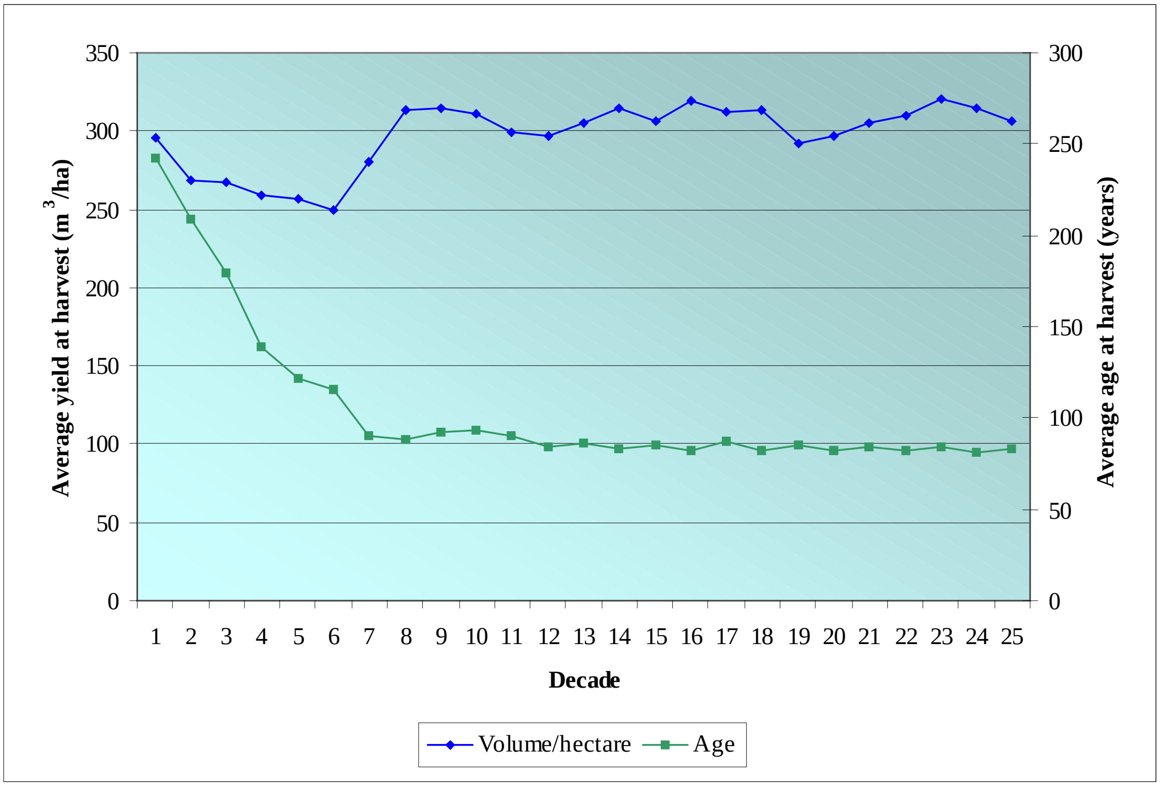

Figure 6.5 Average volume per hectare and age at harvest

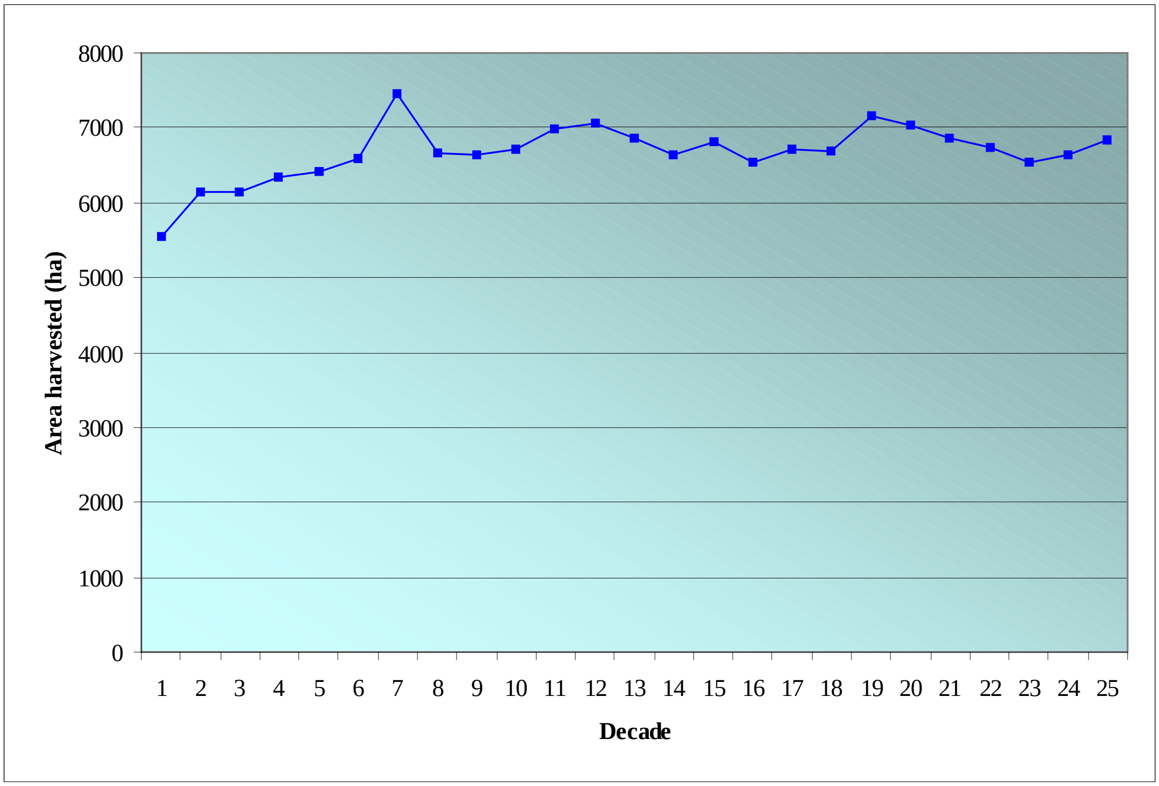

Figure 6.6 Area harvested by decade

6.1.2 Age class distributions

Figure 6.7 shows the dynamic behaviour of the residual forest age class structure over the 250 year planning horizon. Referring back to the initial age class distribution shown in Figure 4.3, there is a significant gap in the age class inventory in the 31 to 60 year age range. This gap in the age class distribution limits the rate at which a uniform age class distribution can be established within the THLB. However, the base case harvest flow forecast does not suffer from any shortfalls in available inventory, so the age gap in the initial inventory imposed no real limitation on the forecast results. It can be seen in Figure 6.7 that the residual forest is already approaching a uniform age class distribution in year 100, where the majority of the THLB is in stands less than 101 years old.

Figure 6.7 also shows that, although the harvestable old growth inevitably declines in the future, the total productive area greater than age 250 increases steadily over time, reaching approximately 14,482 hectares by the end of decade 25. In other words, 20% of the productive landbase is above age 250 by the end of the planning horizon and 50 % of this area comes from the noncontributing portion of the productive forest. This has very positive implications with respect to retention objectives on the TFL. It should be noted that, since 90 % of the productive landbase area is also harvestable, 7,226 ha of harvestable area older than 250 years remains at the end of the simulation as a result of recruitment to meet forest cover requirements.

6.1.3 Seral stage objectives

Landscape level biodiversity objectives have been addressed in the analysis through the imposition of minimum retention requirements for both mature and old seral stand structures within each LU – BEC variant combination occurring on the TFL productive landbase. In areas that have been assigned a low biodiversity emphasis, current policy allows for an initial reduction of old growth retention requirements to 1/3 of the full requirement specified in the KBHLPO, with the proviso that the full target must be met by the end of the third rotation. The CASH6 timber supply model does not permit the explicit modelling of an increasing retention target over time. Consequently the approach taken in this analysis was to establish a preliminary harvest flow using the reduced old seral targets throughout the planning horizon, and then to test for compliance with full old growth requirements by performing a second simulation in which full old seral targets were applied throughout the planning horizon. Note that the analysis using full old seral targets is a more stringent test of compliance than is actually required, since it forces full compliance to happen as early as possible, rather than just by the end of the third rotation. In the present analysis, a review of outputs from the reduced old seral targets simulation run showed that full old growth requirements were met by the end of the third rotation anyway in all but three of the seral zones[4]. Consequently, the second analysis run was required in order to force compliance within these three zones. Figure 6.8 illustrates the results for both scenarios. The total, operable and available stock curves labeled as “1/3 old” in the figure are identical to those shown previously in Figure 6.2. The same quantities are also shown for the scenario in which full old growth requirements were applied throughout (labelled as “full og” in the figure). It is apparent that, even at full old growth retention levels, availability of harvestable timber is not limited at the base case harvest level.

[4] The zones of non-compliance were the IDFdm1 portions of LUs B7 and B8, and the ESSFdc1 in LU B8.

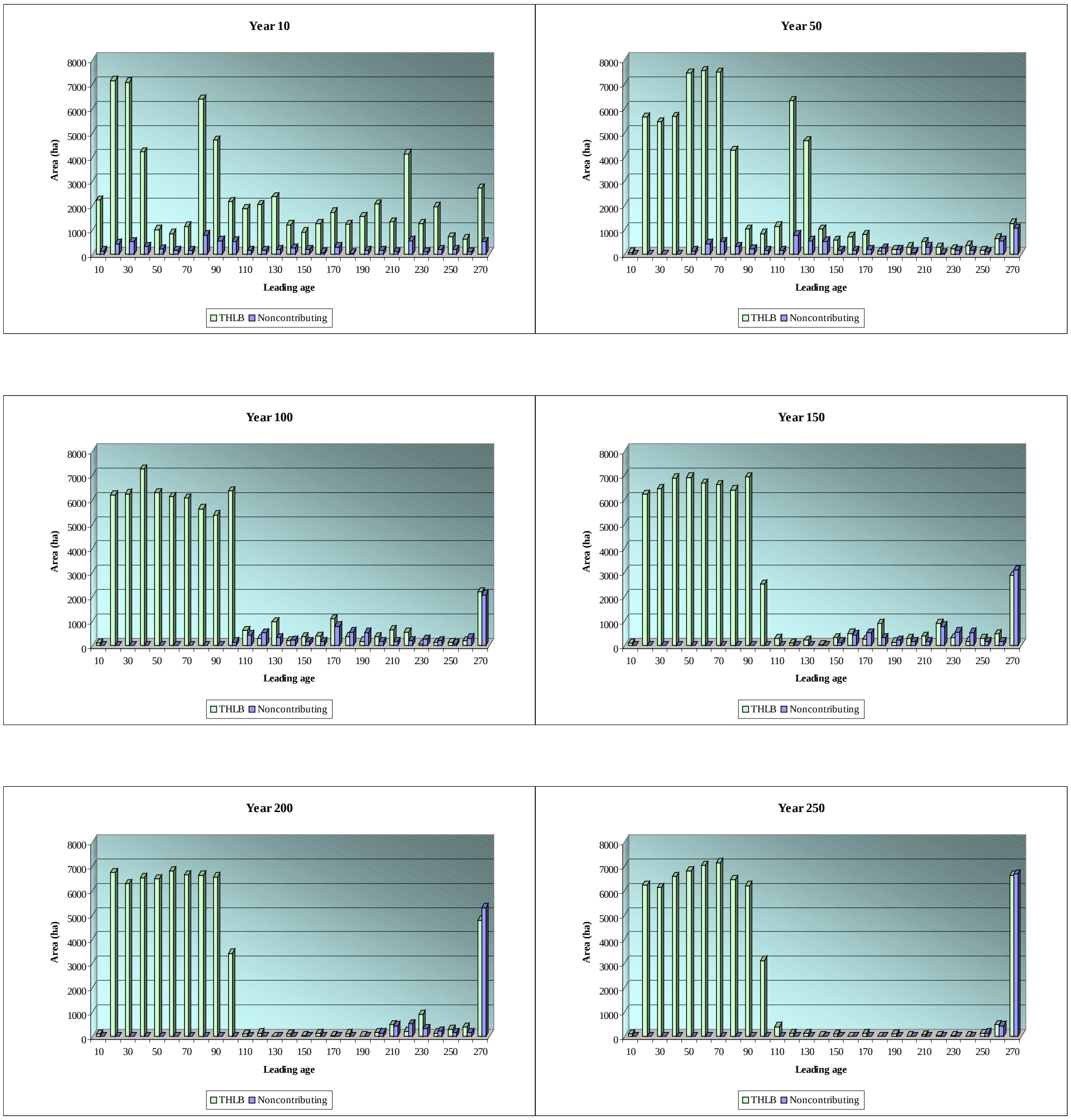

Figure 6.7 Forest age structure through time

Compliance with full old seral retention targets is demonstrated by Table 6.2. Both the target and achieved retention percentages shown reflect the full old seral requirements. Clearly, all old seral retention objectives are met by year 100 of this simulation run.

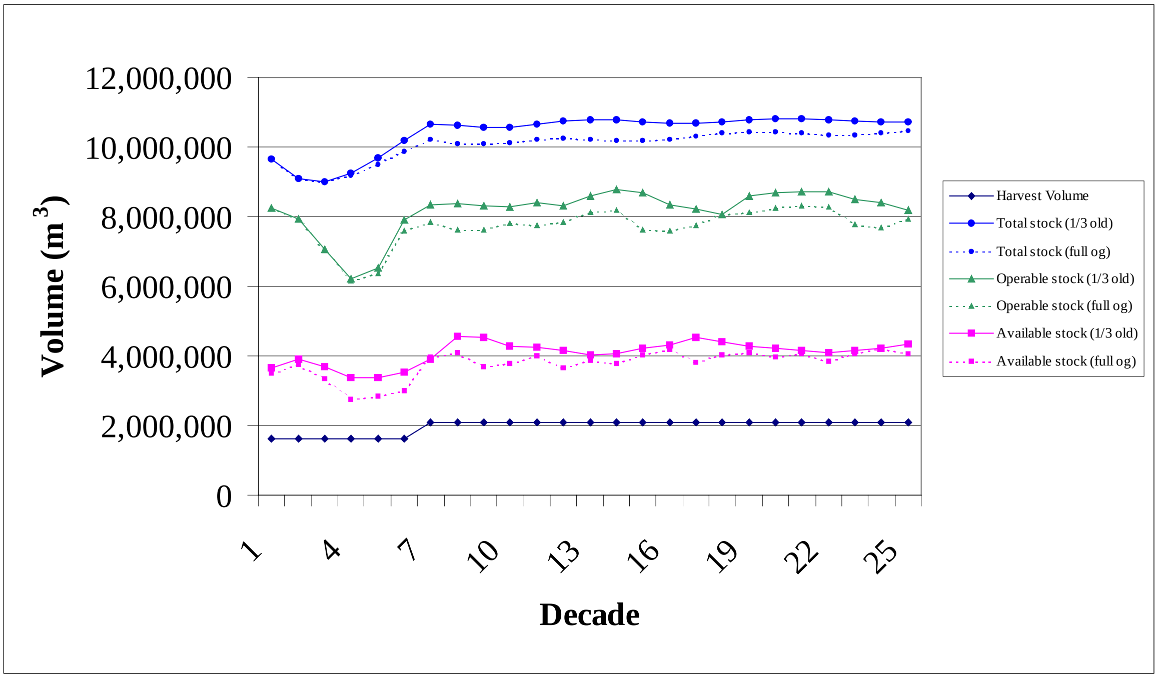

Figure 6.8 Growing stock profiles with and without drawdown of old targets

Table 6.2 Dynamics of old seral retention

Landscape unit	**BEC variant**	**NDT**	**BEO**	**Base area** ha	**Old** (% > age)	**Achieved % (Old)** Year 0	Year 50	Year 100	Year 150	Year 200	Year 250
B1	ICH mk 1	3	I	2	14 > 140	89	22	22	22	22	14
	IDF dm 1	4	H	2,870	19 > 250	4[1]	19	37	46	50	50
	IDF dm 1	4	I	1,630	13 > 250	0	13	19	26	34	34
	MS dm 1	3	H	165	21 > 140	36	32	33	34	34	34
	MS dm 1	3	I	1,754	14 > 140	42	22	25	26	26	26
B7	ESSFdc 1	3	L	6,724	14 > 140	47	21	26	28	27	27
	ICH mk 1	3	L	5,450	14 > 140	30	14	14	15	15	14
	ICH mw 2	2	L	307	9 > 250	4	8	9	9	9	14
	IDF dm 1	4	L	6,598	13 > 250	3	13	13	13	13	14
	MS dm 1	3	L	16,021	14 > 140	28	14	14	18	18	18
B8	ESSFdc 1	3	L	3,602	14 > 140	44	15	19	20	20	20
	IDF dm 1	4	L	9,789	13 > 250	1	11	13	13	13	15
	MS dm 1	3	L	18,264	14 > 140	15	14	14	20	20	19

[1]-Shaded cells identify zones of initial non-compliance.

7. SENSITIVITY ANALYSIS

Timber supply analysis generally integrates a large number of measured or estimated inputs, model parameters and simplifying assumptions, all of which are subject to varying degrees of uncertainty and imprecision. Sensitivity analysis is intended to assess the stability of a given timber supply forecast in light of these uncertainties by evaluating the response to systematic perturbations of model assumptions and input parameters. 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.

Each sensitivity analysis tests the impact of changes to a single variable or specific assumption while holding all other factors constant. The magnitude of the perturbation reflects the degree of uncertainty associated with that particular assumption or input quantity. In each of the following sections, the impact of a particular parameter adjustment on available growing stock volume was assessed first by imposing the parameter adjustment and calculating available volume at the base case harvest level. Available growing stock was determined for a given decade by setting an infinite harvest target in that period while imposing the base case level for all other periods. Based on the changes in availability, a new harvest level was then established where required.

7.1 Landbase Definition

7.1.1 Adjust timber harvesting landbase by ± 10%

To test the sensitivity of the base case forecast to uncertainty in the landbase classification assumptions, the size of the THLB was alternately increased and decreased by 10%. The change in landbase classification was accomplished by shifting the appropriate number of hectares between the net and noncontributing components of the landbase.

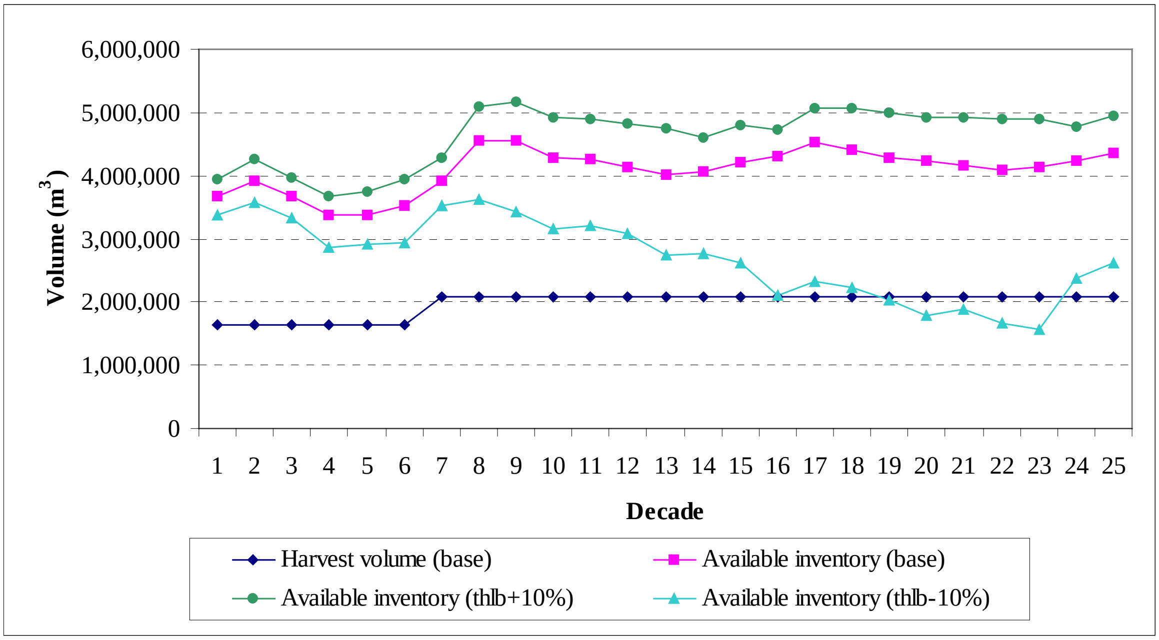

Figure 7.1 Timber harvesting landbase ± 10%

The resulting changes in available inventory are shown in Figure 7.1. Increasing the THLB by 10% caused an average upward shift in the available growing stock of 9% in the short-term and 15% in the long term. Decreasing the THLB by 10% resulted in a downward shift of about 12% in the short-term, but initiated a decline in available inventory over the long term resulting in a true shortfall in decades 19 through 23.

As shown in Figure 7.2, a 5% reduction in the LTHL to 198,100 m^3/yr was required to overcome the shortfall and reestablish stable long term growing stocks. Therefore it can be concluded that the LTHL is sensitive to overestimations of the THLB in the order of 10%.

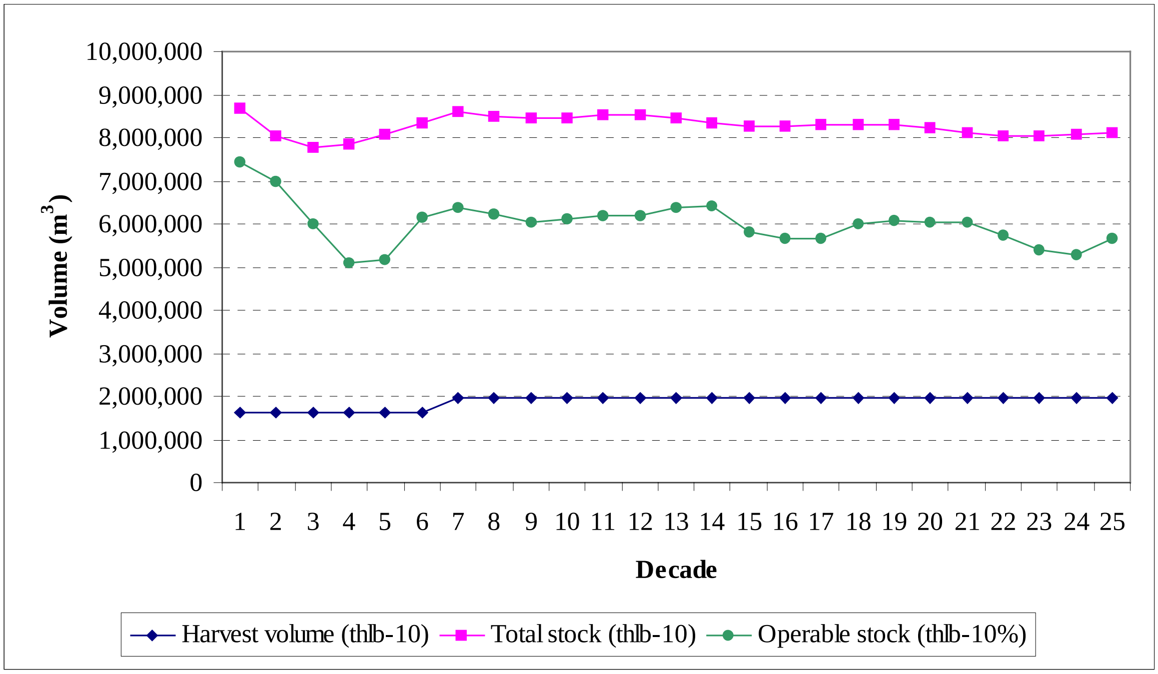

Figure 7.2 Revised harvest forecast, timber harvesting landbase – 10%

7.2 Growth and Yield Assumptions

7.2.1 Adjust natural stand yields by ± 10%

The sensitivity of the base case forecast to uncertainties in natural stand yield estimates was tested by alternately increasing and decreasing all CC and PC VDYP yield curves by 10%.

The impact of these input modifications on available growing stock is presented in Figure 7.3. Increasing the NSYTs by 10% resulted in an average increase in available volume of 14% between decades 1 and 7 inclusive, while the magnitude of the increase generally becomes progressively smaller beyond decade 9, and approaches zero by the end of the planning horizon. Decreasing NSYTs by 10% produced a more significant downward response in the available inventory volume. An average decrease of about 15% occurred over the short-term era, then reached a maximum of 26% in decade 9 after which the available growing stock slowly returns toward the base case level. The impact of decreasing natural stand yields extends so far into the long term because a greater proportion of managed stands must be harvested to satisfy the increased harvest level in decades 7 and 8, thus altering the dynamics of the transition from natural to managed stands and reducing the availability of managed stands early in the long term.

The base case harvest level was found to be insensitive to uncertainties in natural stand yields of this magnitude, because there is ample inventory available for harvesting throughout the entire planning horizon.

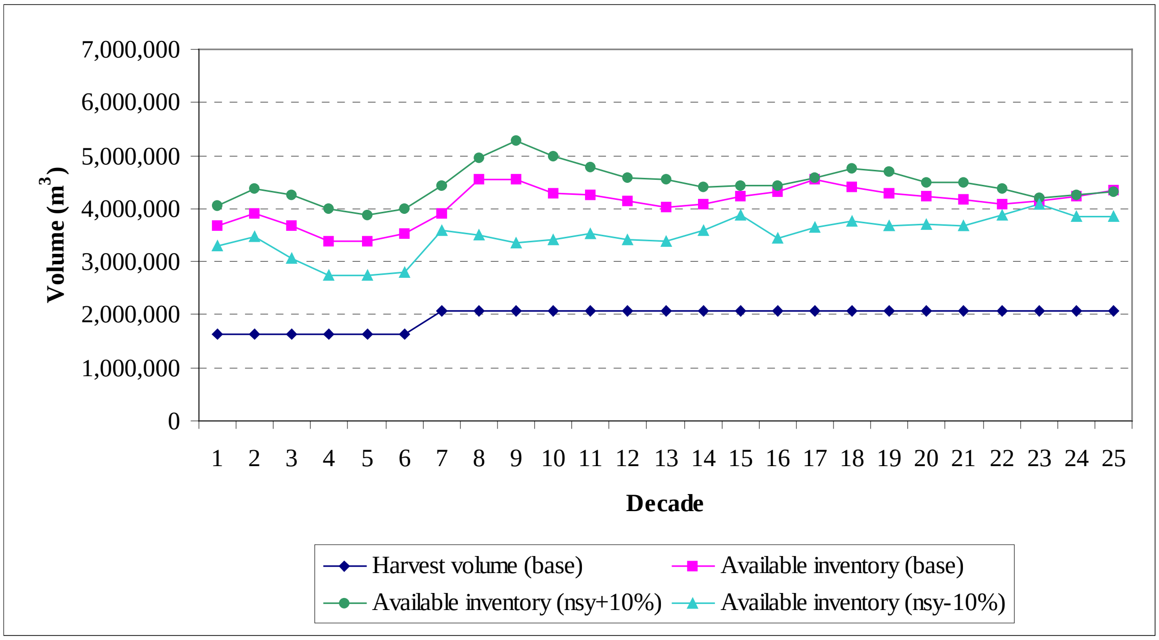

Figure 7.3 Natural stand yields ± 10 %

7.2.2 Adjust managed stand yields by ± 10%

TIPSY yield curves for CC and PC silvicultural systems were alternately increased and then decreased by 10% to evaluate the sensitivity of the base case forecast to uncertainties in the estimates of managed stand yields.

The impact on available growing stock is presented in Figure 7.4. Increasing future stand yields resulted in an increase in available growing stock from decade 8 onward, the magnitude of which grows slowly throughout the planning horizon. Decreasing future stand yield estimates initiates a decline in available growing stock in the mid and long term eras which culminates in a true shortfall in decades 22 through 24.

It was necessary to reduce the LTHL by slightly more than 10% to 186,600 m^3/yr in order to overcome the shortfalls in available inventory and restore a stable long term growing stock. The modified harvest forecast is depicted in Figure 7.5.

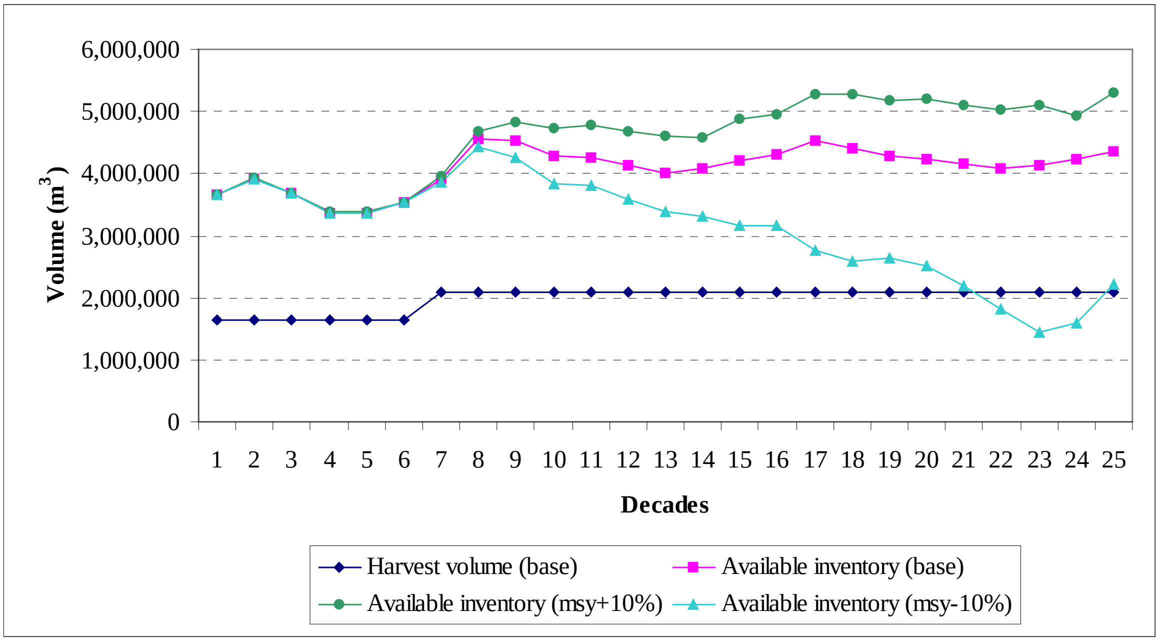

Figure 7.4 Managed stand yields ± 10 %

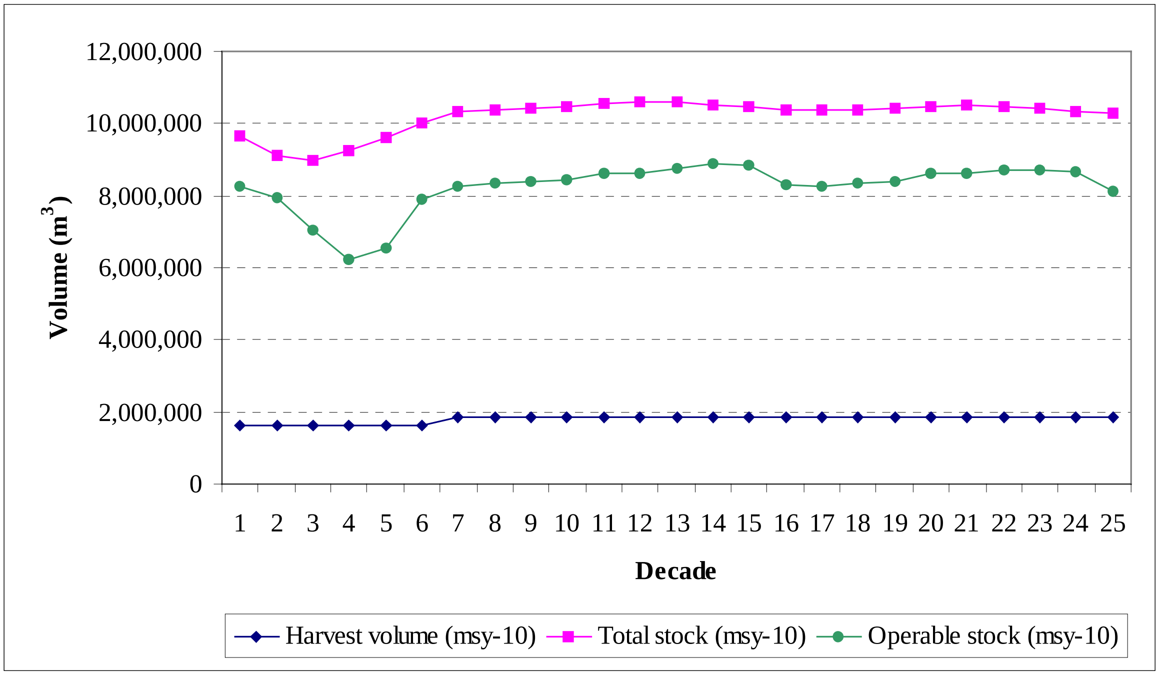

Figure 7.5 Revised harvest forecast, managed stand yields – 10%

7.2.3 Adjust managed stand minimum harvest ages ± 10 years

To assess the sensitivity of the base case forecast to uncertainties in assumptions about merchantability criteria, minimum harvest ages (MHAs) for all CC and PC MSYTs were alternately increased and decreased by 10 years.

The impact of the modified assumptions on available growing stock is presented in Figure 7.6. Neither change had any impact in decades 1 through 6 since managed stands are an insignificant component of the overall harvest in those decades. From decade 9 onward, decreasing the MHA had no significant impact on available growing stock, indicating that in most decades throughout the long term the availability of harvestable stands is not limited by MHAs. The increase in MHAs resulted in an average decrease in available inventory volume of 8.5% from decade 7 onward, although the gap closes noticeably in decades 12, 14, 17 and 22 indicating that there are sufficient alternate harvest candidates to replace those which get disqualified as a result of older MHAs.

Neither adjustment of MHAs had any impact on the base case harvest level.

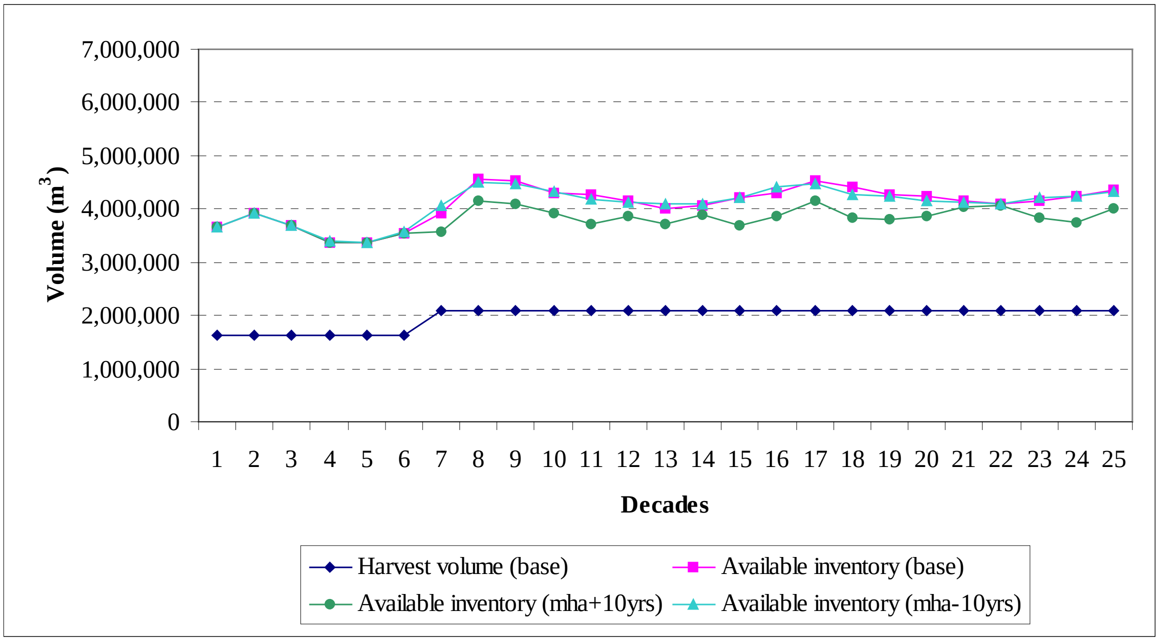

Figure 7.6 Minimum harvest ages ± 10 years

7.2.4 Alter minimum harvest ages to age at 90% and 100% of culmination MAI

Two alternate rules for assigning MHAs were also explored as sensitivity issues. MHAs for all CC and PC analysis units were determined as the age at which MAI reaches 90% of it's maximum value, and then as the age at which MAI culminates.

Figure 7.7 illustrates the impact of each alternate set of MHAs on the base case forecast. As with the previous sensitivity analysis of minimum harvest ages, reducing the MHA had a negligible impact on available inventory volume. Increasing MHAs to the age at culmination of MAI had some minor impact on available volume in decade 2 and during the transition from natural to managed stands. However, neither modification of MHAs had any impact on the base case harvest level.

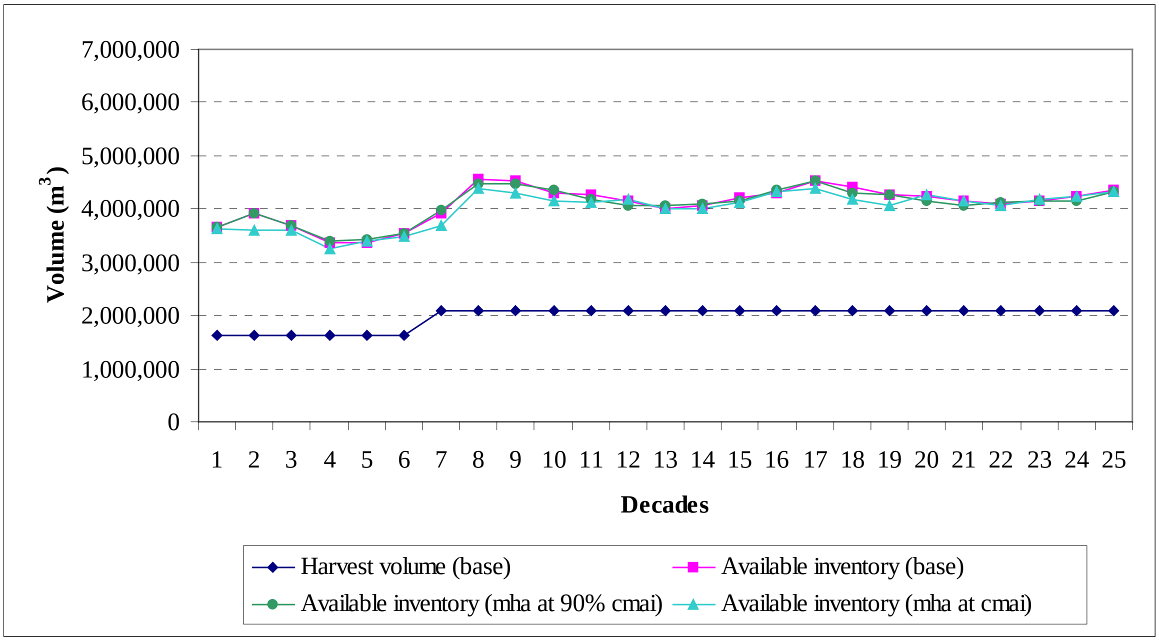

Figure 7.7 Minimum harvest age at 90% and 100% of culmination MAI

7.2.5 Adjust regeneration delay by ± 1 year

Regeneration delays for all CC and PC analysis units were alternately increased and decreased by 1 year to measure the timber supply impact of uncertainties in these parameters. Figure 7.8 shows that increasing regeneration delays by 1 year caused an average decrease in available inventory over the long term of 2 %, while a 1 year decrease in regeneration delays produced an average 3% increase in long term available volume. However, uncertainties in regeneration delay estimates of this magnitude have no significant implications for long term timber supply.

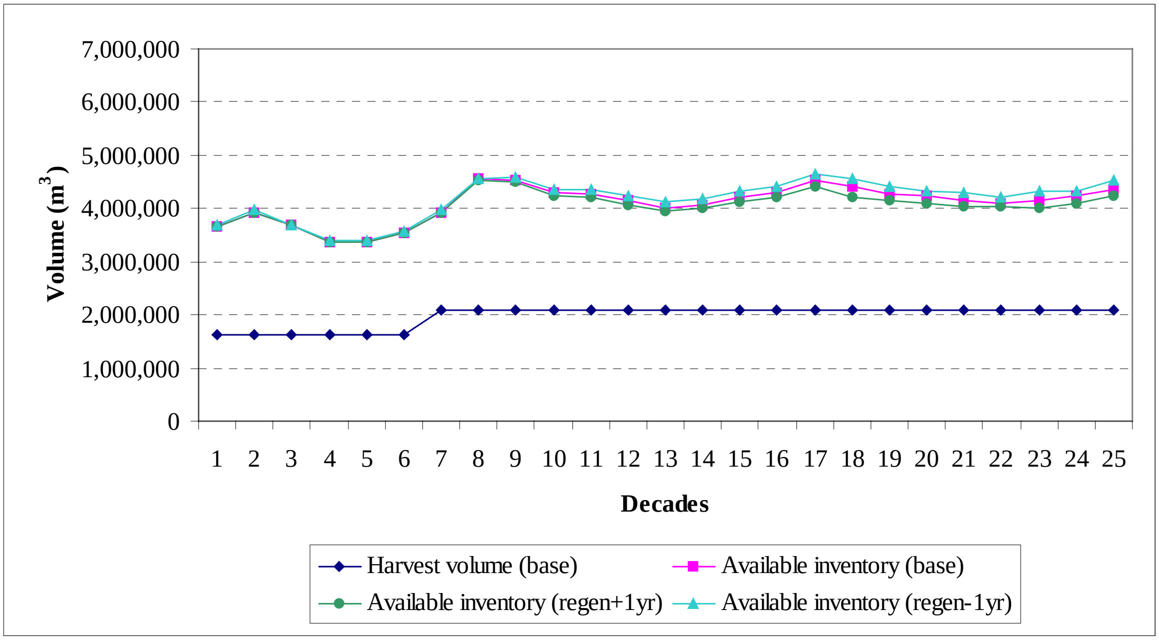

Figure 7.8 Regeneration delay ± 1 year

7.2.6 Apply FIP site index to MSYTs in ESSF

Estimates of managed stand yields within the ESSF incorporated site index adjustments based on an empirically derived elevation model (JST 2001b). To evaluate the sensitivity of the base case forecast to this elevation model, alternate MSYTs were derived for all CC and PC analysis units within the ESSF using unadjusted inventory site index values.

The impact of using the modified set of MSYTs is shown in Figure 7.9. Reductions in available growing stock relative to the base case begin in decade 5 and true shortfalls ultimately occur in decades 16 through 18 and, following a brief recovery, in decades 24 and 25.

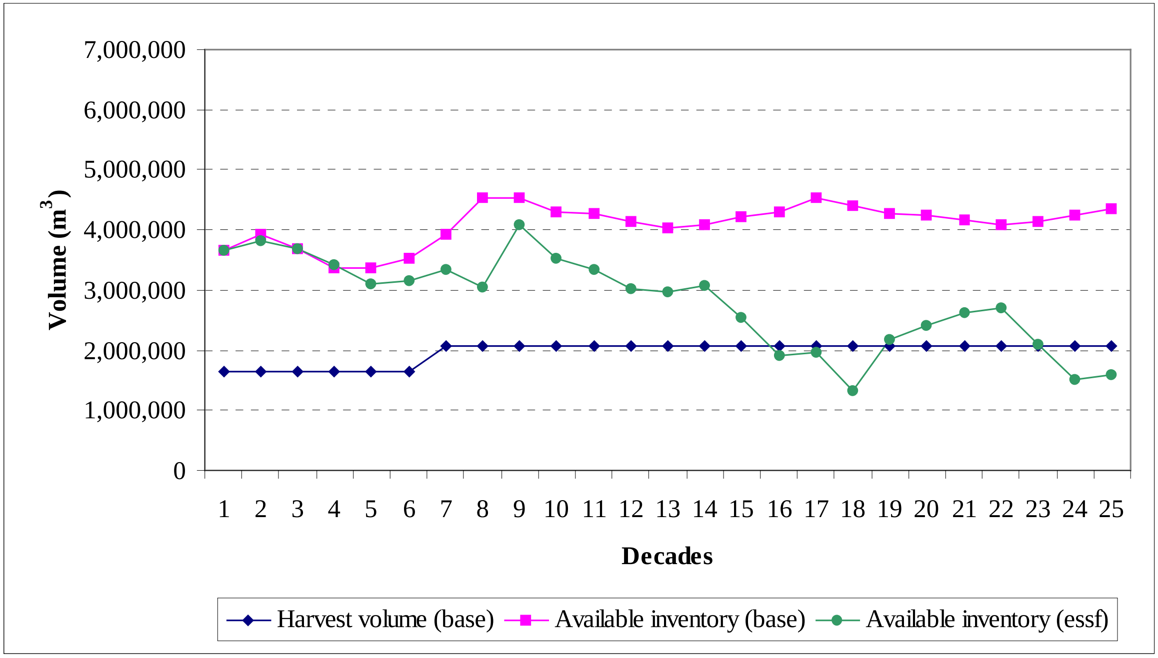

Figure 7.9 Apply inventory site index to MSYTs in ESSF

Figure 7.10 illustrates that in order to reestablish sustainable long term growing stock conditions, it was necessary to reduce the LTHL to 194,100 m^3/yr. This represents a reduction to the base case LTHL of 6.7%.

7.2.7 Apply FIP site index to all MSYTs

A more comprehensive test of the sensitivity of the base case to uncertainties in the potential site index estimates inherent in the managed stand yield predictions was also undertaken. An alternate set of TIPSY yield curves was developed for *all* CC and PC analysis units using unadjusted inventory site index values.

The available growing stock volume determined using the modified set of MSYTs is shown in Figure 7.11. With the exception of a minor recovery in decade 8, available growing stock declines steadily from decade 2 onward, and is in deficit from decade 10 onward.

The base case LTHL was reduced by 40% to 145,100 m^3/yr before stable long-term growing stock conditions were restored. The revised harvest forecast is shown in Figure 7.12.

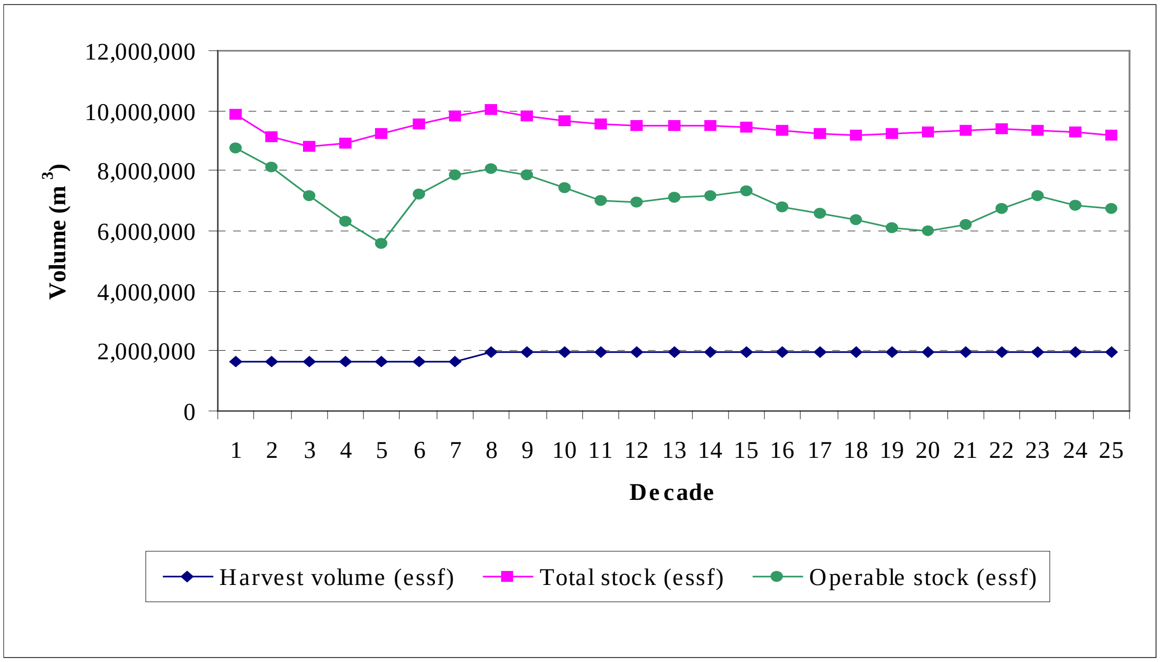

Figure 7.10 Revised harvest forecast, inventory SI applied in ESSF

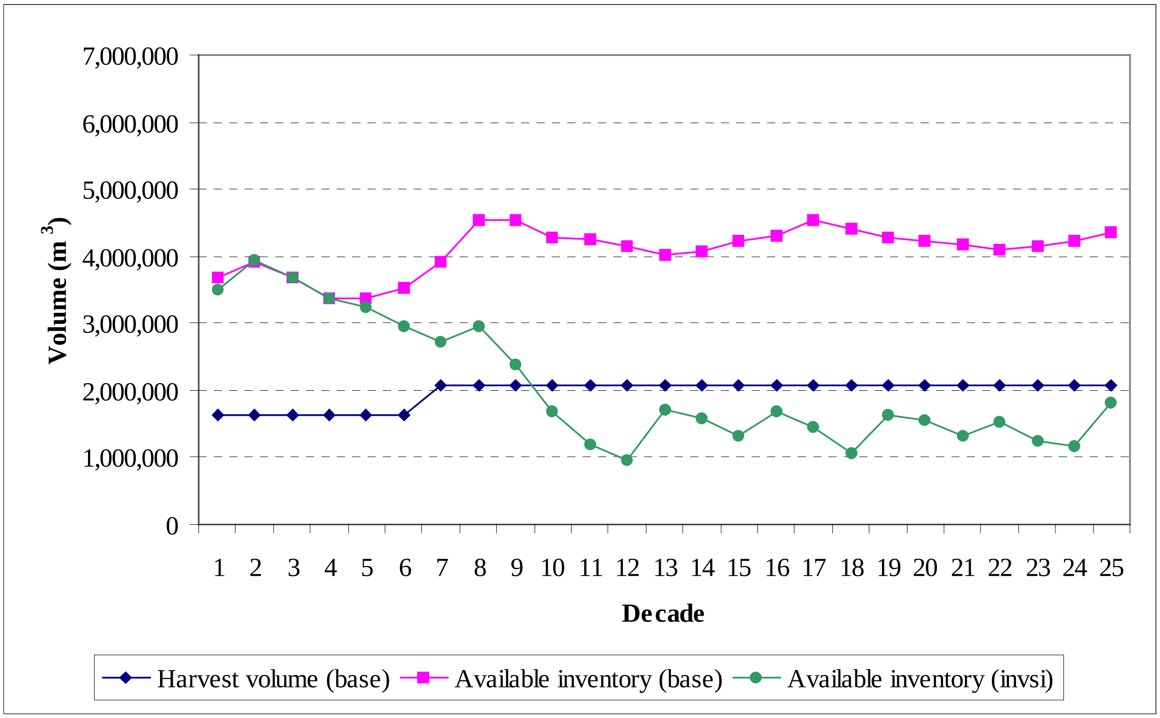

Figure 7.11 Available growing stock, inventory SI applied to all MSYTs

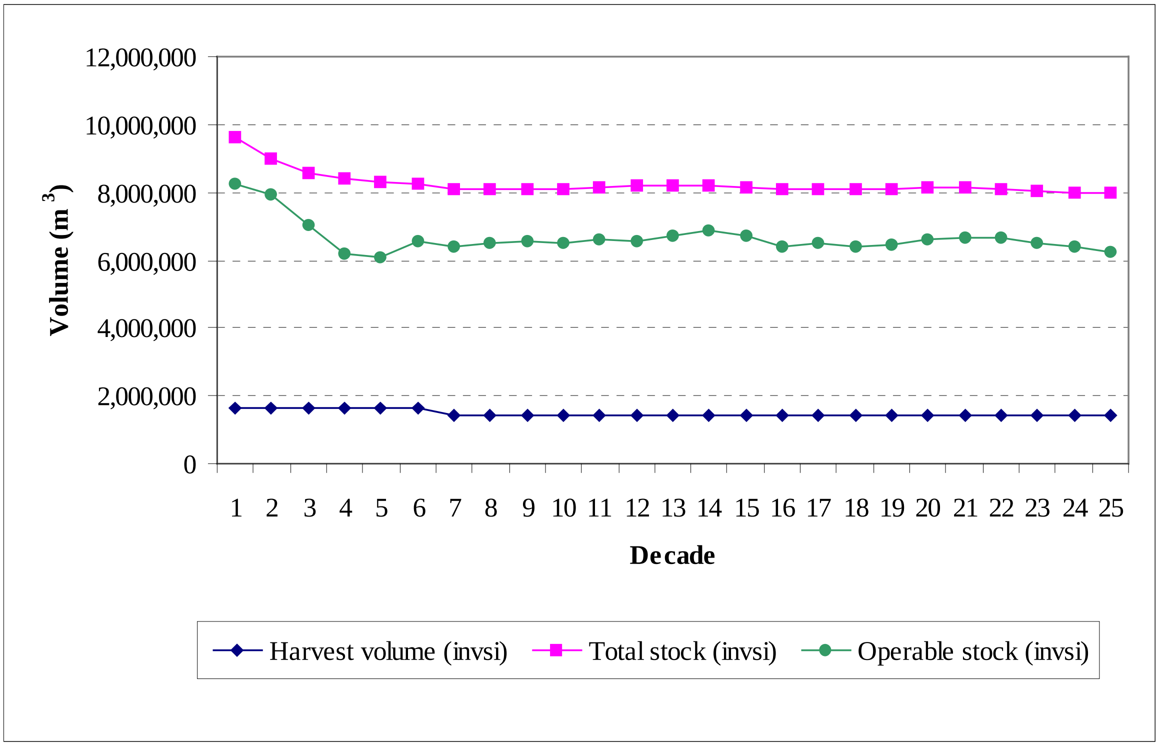

Figure 7.12 Revised harvest forecast, inventory SI applied to all MSYTs

7.3 Resource Emphasis Assumptions

7.3.1 Adjust green-up heights by ± 1 metre

Green-up height estimates were alternately increased and decreased by 1 metre to test the sensitivity of the base case to these parameters. The impact of these parameter modifications on available growing stock is presented in Figure 7.13.

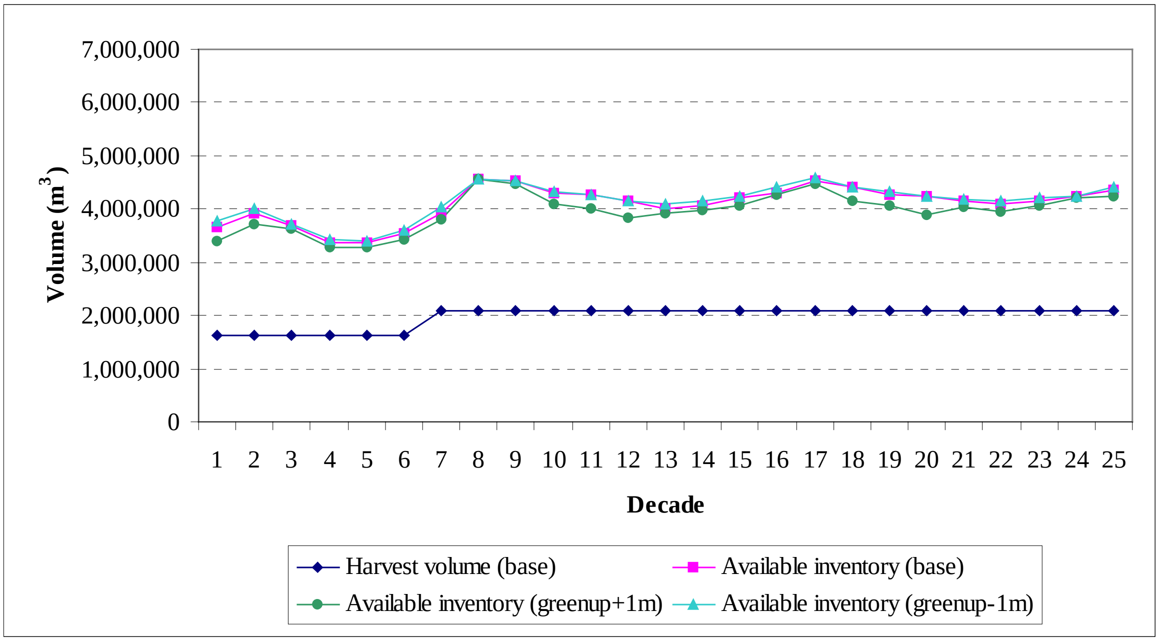

Figure 7.13 Greenup height ± 1 metre

Decreasing the green-up heights had no significant impact on available inventory, while increasing green-up heights caused minor reductions in availability in most decades, with the exception of decades 8, 16 and 24 where green-up requirements are clearly not limiting availability. The average reduction over the entire planning horizon was 3%.

The adjusted green-up heights had no impact on the base case harvest level.

7.3.2 Alter IRM maximum disturbance limits by ± 5 %

The sensitivity of the base case harvest flow to changes in disturbance limits in the IRM zone was tested by alternately increasing and decreasing the maximum disturbance limit by 5%. The impact of these changes to model parameters is presented in Figure 7.14. Increasing the limit on disturbed area by 5% caused an average upward shift in available growing stock of 13%, while decreasing the allowable proportion of disturbed area by 5% caused a downward shift of 17%. Neither modification of IRM disturbance limits warranted any alteration of the base case harvest level.

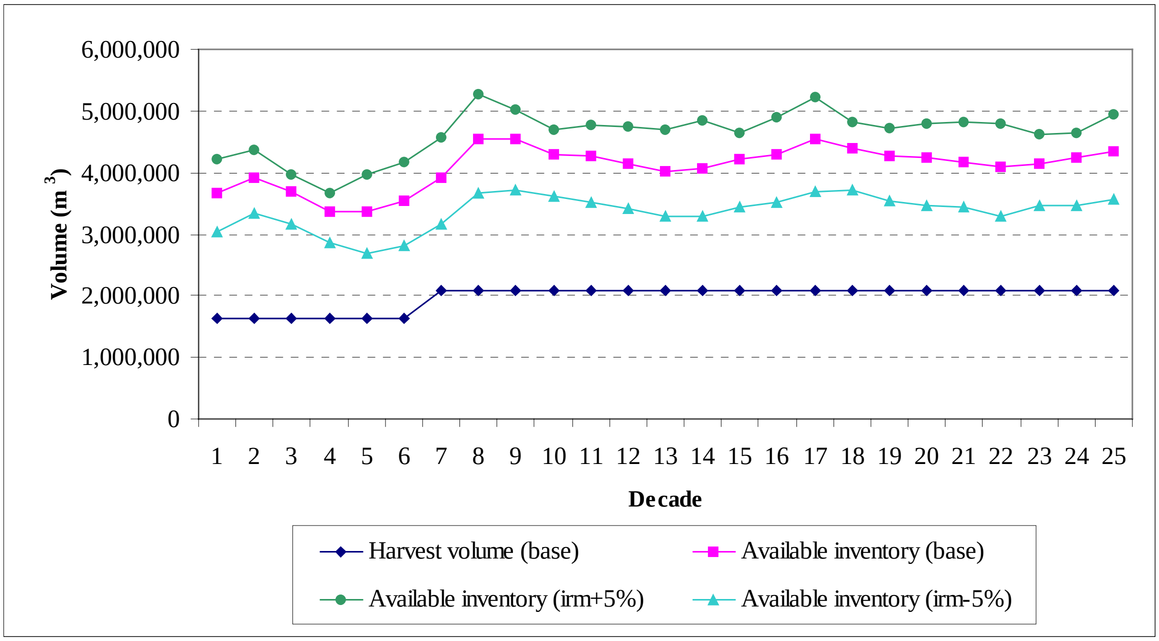

Figure 7.14 IRM disturbance limits ± 5 %

7.3.3 Alter VQC maximum disturbance limits by ± 5 %

VQC disturbance percentages were altered by ± 5% to evaluate the sensitivity of the base case forecast to these model parameters. Figure 7.15 shows that neither the available growing stock nor the harvest level were significantly impacted by this perturbation of model parameters.

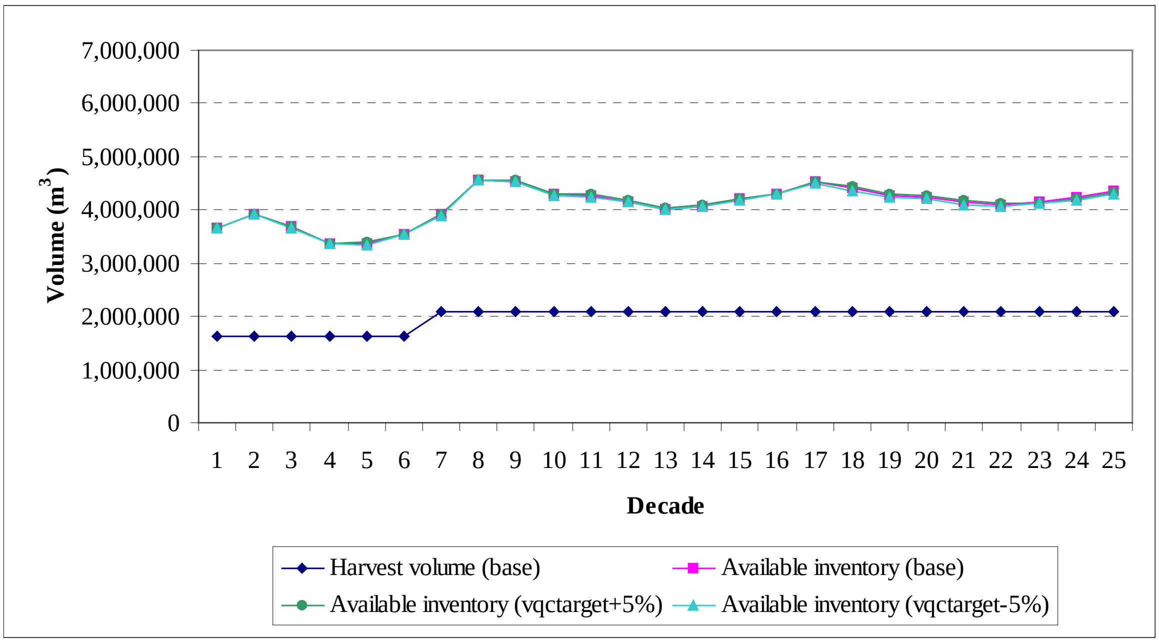

Figure 7.15 VQC disturbance limits ± 5 %

7.3.4 Alter DWR maximum disturbance limits by ± 5 %

Maximum disturbance limits in the mule deer winter range zone were altered by ± 5%. The resulting impact on available inventory is depicted in Figure 7.16. Modifications to the DWR disturbance limits had no significant impact on availability, and therefore required no alteration of the base case harvest level.

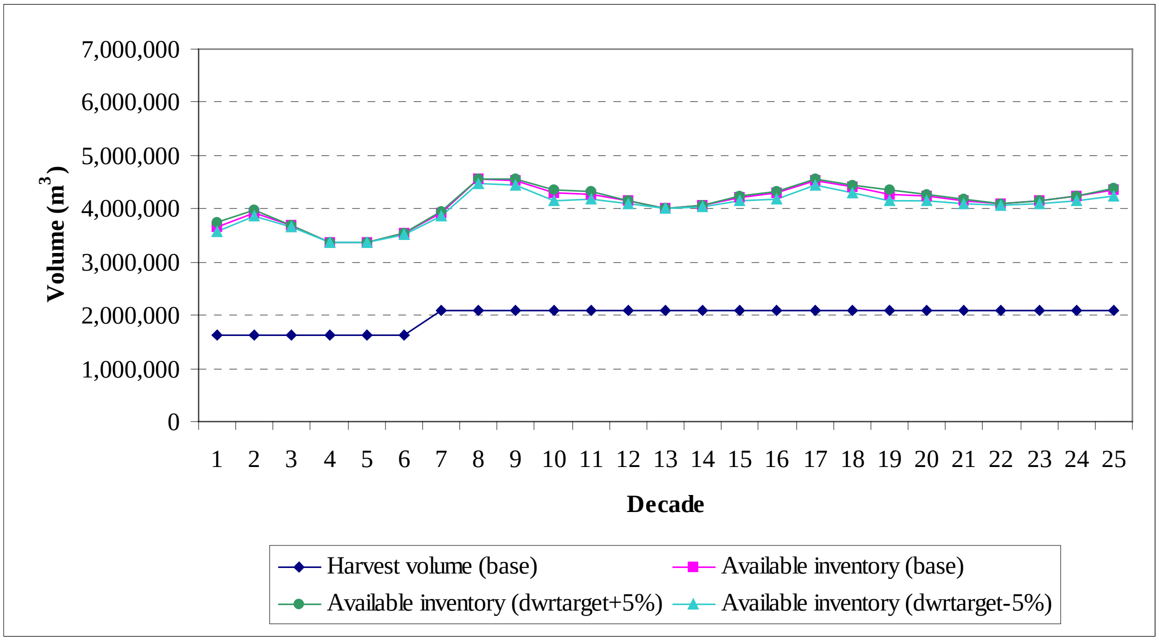

Figure 7.16 DWR disturbance limits ± 5 %

7.3.5 Apply mature thermal cover retention requirements in DWR

Following the Kootenay-Boundary Land Use Plan Implementation Strategy guidelines for mule deer winter range as closely as possible in an aspatial forest level analysis context, mature forest cover requirements as shown in Table 7.1 were applied at the LU-BEC variant level to evaluate the impact on the base case harvest forecast. Figure 7.17 demonstrates that the resulting impacts on available inventory and the base case harvest level were negligible.

Table 7.1 Mule deer winter range mature forest retention requirements

Mule deer winter range type	**Min age (yrs)**	**Min %**
IDF dm 1, slopes < 50%	101	25
IDF dm 1, slopes > 50%, southern aspects	101	15
ICH mk 1	121	35
MS dm 1	121	35

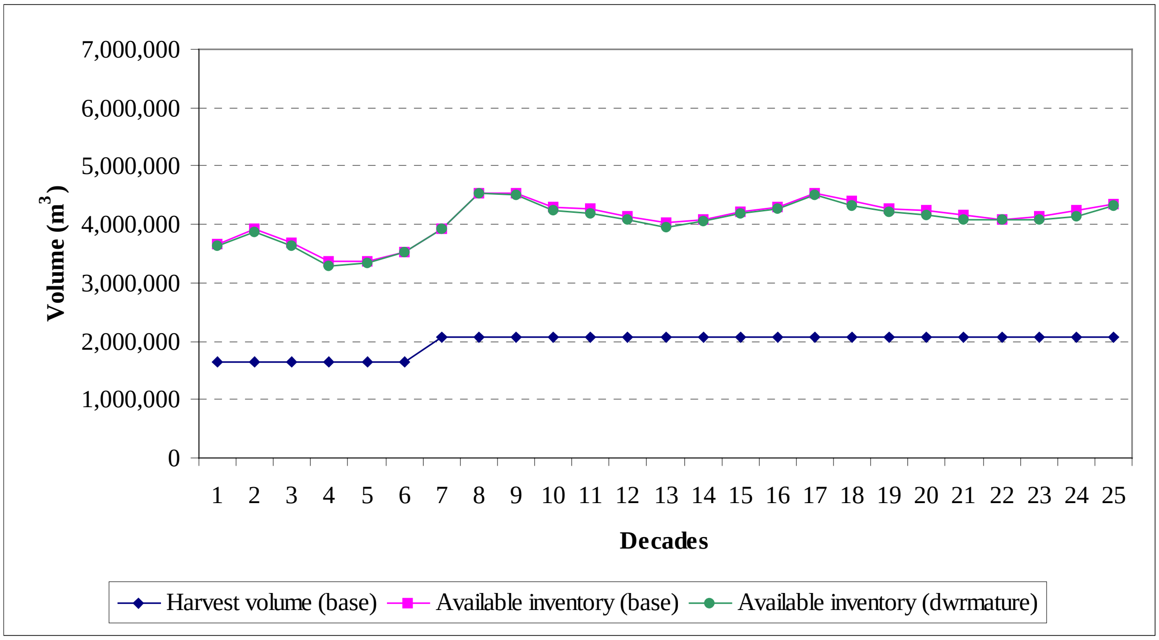

Figure 7.17 Apply thermal cover requirements in DWR

7.3.6 Reduce yields in NDT4 open forest types

The impact of converting, and maintaining, selected NDT4 areas to open forest was simulated using a reduction of stand yields in the selected areas. Selection criteria for the candidate areas, developed by the Nelson Forest Region Ministry of Forests, resulted in the identification of 493 hectares of NDT4 open forest within the net harvesting landbase.

J.S. Thrower and Associates conducted a comparison of TASS (Tree and Stand Simulator) simulation results at 1500 trees/ha (representative of fully stocked condition) and at 100 trees/ha (representative of open forest regime). It was concluded that stands maintained in an open forest condition would result, on average, in an 80% reduction in yield compared to a fully stocked stand (see Appendix IV). The initial conversion to open forest condition was simulated by reducing stand yields on first entry to 80% of the yield table value. Maintenance of open forest condition was simulated by reducing yields in all subsequent stand entries to 20% of the yield table value.

Figure 7.18 demonstrates that this modified management regime had no significant impact on the base case forecast.

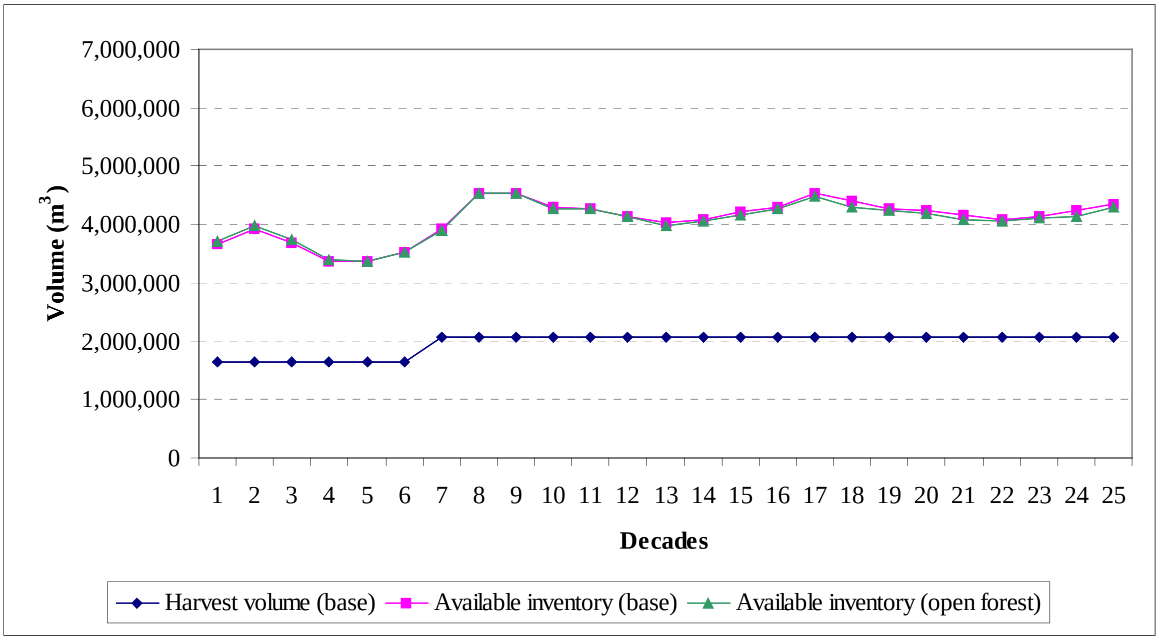

Figure 7.18 Selected NDT4 areas managed for open forest condition

7.4 Biodiversity Assumptions

7.4.1 Adjust minimum age for mature seral condition by ± 10 years

The minimum ages defining the onset of mature seral stand structures were alternately increased and decreased by 10 years to assess the sensitivity of timber availability and supply to these model parameters. The resulting impact on available growing stock is shown in Figure 7.19.

Decreasing the minimum age of mature seral cover had no significant impact on available volumes. Increasing the minimum age of mature seral cover by 10 years resulted in a temporary reduction of available growing stock in decade 4, although full recovery occurs in the subsequent decade. The temporary reduction in available volume is further evidence of the short-term mature seral recruitment dynamics already discussed in Section 6.1.1. Altering the minimum mature seral age definitions had no impact on the base case harvest level.

7.4.2 Adjust mature-plus-old seral retention target ± 5 %

The minimum retention targets for mature-plus-old seral habitat were altered by ± 5 % to assess the impact on timber availability and supply. Appropriate adjustments were made to account for the presence of single tree selection areas and forest connectivity corridors within each LU/BEC variant (further details may be found in the *Timber Supply Information Package for Tree Farm License 8*, included as an appendix to this report). The resulting impact on available growing stock is shown in Figure 7.20.

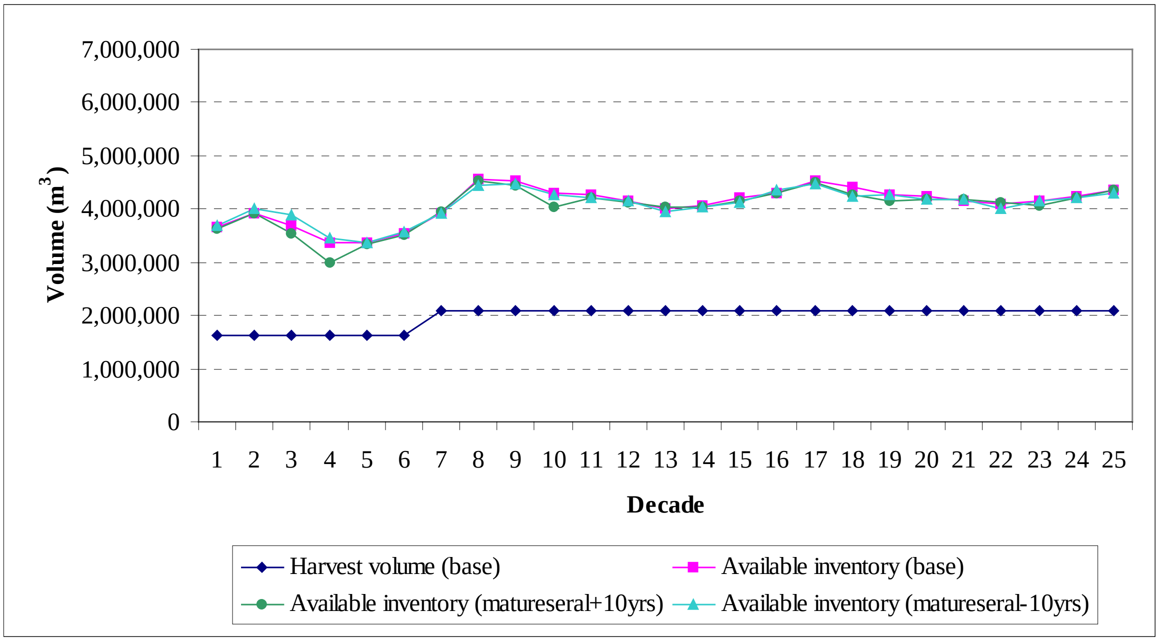

Figure 7.19 Mature seral minimum age ± 10 years

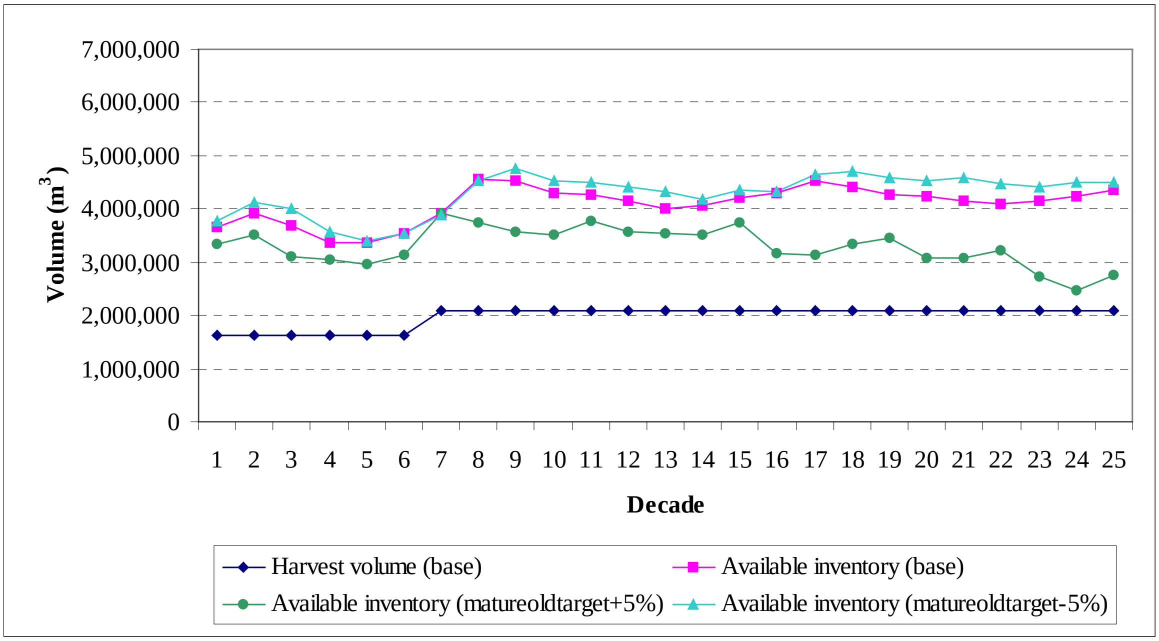

Figure 7.20 Mature-plus-old seral retention target ± 5 %

It is clear from Figure 7.20 that increasing the retention target for mature-plus-old seral stands has a significant impact on the available growing stock throughout the entire planning horizon (with the exception of decade 7 where growing stocks are most significantly influenced by the increase in harvest level). Decreasing the retention target also impacted available growing stock, but to a much less significant degree. However, since the base case harvest level has been set well below any points of potential shortfall in availability, no modification to the harvest level was required.

7.4.3 Adjust minimum age for old seral condition by ± 10 years

The minimum ages defining the onset of old seral stand structures were alternately increased and decreased by 10 years to assess the impact of these model assumptions on timber availability and supply. Figure 7.21 demonstrates that uncertainties of this magnitude in the assumed age of development of old-growth stand structures have no significant impact on either available growing stock or the base case harvest level.

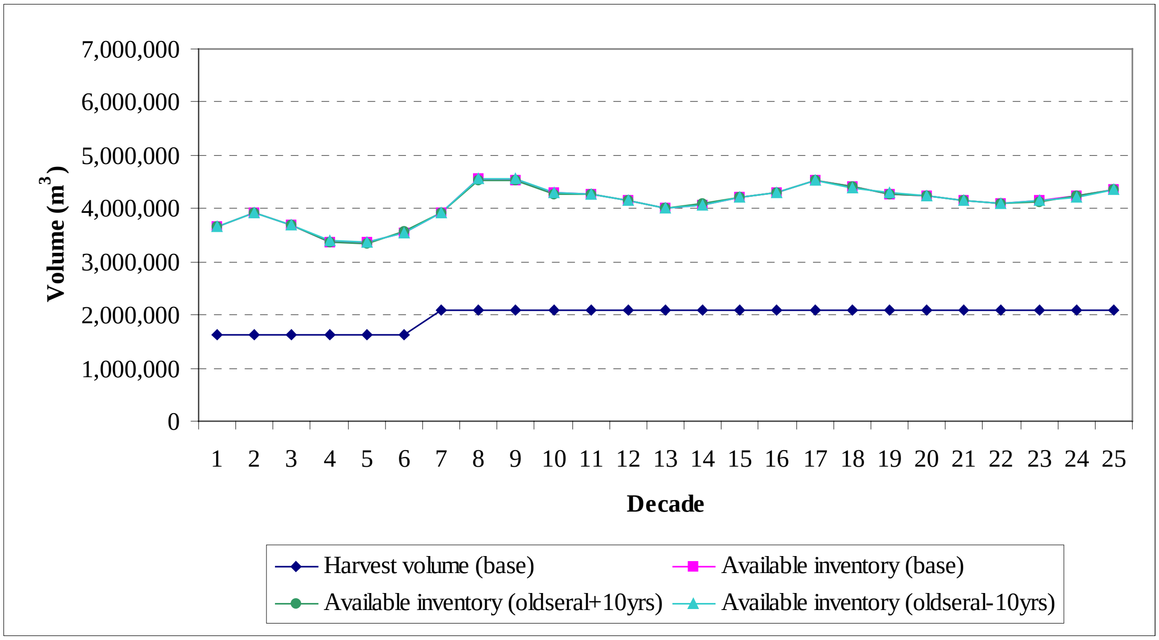

Figure 7.21 Old seral minimum age ± 10 years

7.4.4 Adjust old seral retention target ± 2 %

The minimum retention targets for old seral habitat were adjusted by ± 2 % to assess the impact on timber availability and supply. Appropriate adjustments were made to account for the presence of single tree selection areas and forest connectivity corridors within each LU/BEC variant. Changes of this magnitude in old seral retention targets were found to have no significant impact on the base case forecast.

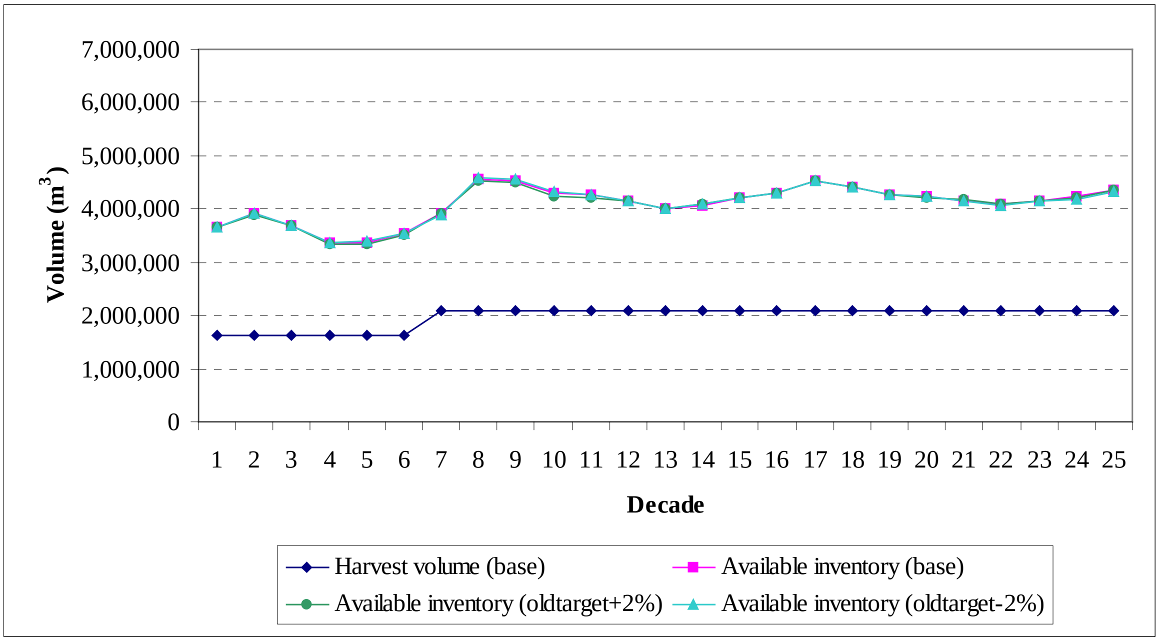

Figure 7.22 Old seral retention target ± 2 %

7.5 Summary

In the short-term, the base case harvest forecast was found to be insensitive to uncertainties in any of the model assumptions and parameters that were tested. In the long term, the base case harvest level was found to be sensitive only to overestimations of managed stand yields or of the timber harvesting landbase.

The results of the analyses presented in this chapter demonstrate that the ability of the TFL 8 landbase to sustain the base case harvest forecast throughout the planning horizon is overwhelmingly a result of the new TEM inventory and the corresponding potential site index estimates (JST 2001b) used to develop the growth and yield forecasts for managed stands.

8. RECOMMENDATIONS

The base case analysis developed in Sections 6 and 7 assumed a short-term harvest level of 163,535 cubic metres per year, sustainable for six decades before increasing to a long term harvest level of 208,100 cubic metres per year. The results of the maximum even flow option presented in Figure 6.1 indicate the potential for setting a higher short-term harvest level somewhere between 186,600 and 205,600 m3/yr. Taking the lower of these two numbers as a conservative point of reference, a number of additional potential downward pressures on timber supply were considered in arriving at the final choice of short-term harvest level for the base case option.

1. The reference maximum even flow forecast of 186,600 m^3/yr, which is 129% of the current AAC, dropped to 114.9% of the current AAC when patches of timber 3 ha and less were removed from the spatial feasibility analysis (*Twenty Year Spatial Feasibility Analysis for Tree Farm License 8*, included as Appendix IV of Management Plan 10). Operationally, harvesting is typically limited in these types because the total volume is small and the administration and development costs to permit them is high. It is likely many of these areas will be harvested when surrounding timber is merchantable. Therefore the indicated AAC impact of 14.1 % was reduced by 50% and estimated to be a 7% downward pressure.
2. The Identified Wildlife Management Strategy is assumed to represent a downward pressure of 1%.
3. The timber supply analysis modelled seral targets for old and mature-plus-old on the TFL landbase only, although the LUs within the TFL also include area on the adjacent TSA. This method effectively applies a proportionate rule for allocating seral targets within the TFL and the adjacent TSA. If the Ministry of Sustainable Resource Management (MSRM) chooses instead to allocate based on best stand attributes, then it is estimated that an impact of 1% will result.
4. The timber supply analysis made no attempt to model disturbance within non-contributing areas, thus these areas make a significant contribution to meeting seral retention requirements in the mid and long term. It is estimated that natural disturbances within the noncontributing landbase will result in a downward pressure of between 1 and 2 %.
5. The harvest level increase is primarily due to the TEM and corresponding site index adjustment on managed stands. There is some uncertainty that second growth stands will perform as predicted (due to factors such as forest health, productivity, operational adjustment factors). A downward impact of 2% has been estimated.
6. Additional area has been brought into the THLB for this timber supply review due to the inclusion of dense lodgepole pine stands. There are concerns that some of the stands that are now included are marginally merchantable and will not be consistently harvested due to economic variability. In addition, the dense pine inventory project (JST, 1999) only addressed stands previously identified as problem forest types and where appropriate brought those stands into the THLB. As noted in the project report, there may be other stands that were not previously identified as problem forest types, which under similar scrutiny might be removed from the THLB. A downward pressure of 2% has been estimated.
7. Equivalent clearcut areas were modelled using a surrogate method. There is some uncertainty with this therefore an impact of 0.5% was assumed.
8. Additional operational factors such as unmapped operability or terrain limitation, operability in other unmapped sensitive areas, de facto visually constrained areas (i.e. Big

White, Jewel Lake, and Carmi), and other local interest pressures, have an estimated 1.5% downward pressure.

9. Amabilis Fir (Species code "BA") is found in the inventory for TFL 8 even though Amabilis Fir actually does not occur on the TFL (see Appendix II and III for further information). BA is the leading species in approximately 1483 ha, corresponding to 2.2% of the THLB. This corresponds to a 1.32% overestimate of the volume on the THLB.

The total of these impacts is approximately 16%. Thus the potential 29% increase over the existing AAC was reduced by 16% to arrive at a short-term harvest level that is 13% above the existing AAC, or 163,535 cubic metres per year. In addition to providing a margin of safety against these downward pressures on timber supply, the chosen short-term harvest level permitted a transition to the LTHL sooner than would have been possible with a larger short-term harvest level. Therefore, based on the results of the analyses reported herein, and on the spatial feasibility analysis (Appendix IV of Management Plan 10), it is proposed that the AAC for TFL 8 be increased to 163,535 cubic metres per year for the five year period covered by Management Plan 10.

9. REFERENCES

J.S. Thrower & Associates (JST), 1999. Statistical Adjustment of Dense Lodgepole Pine Polygons in the Boundary Forest District. Contract Rep. To Pope & Talbot. March 16, 1999. 12 pp.

J.S. Thrower & Associates (JST), 2001a. Yield Tables for Natural and Managed Stands: Management Plan 10 on TFL8. November 15, 2001. 42 pp.

J.S. Thrower & Associates (JST), 2001b. Potential Site Index Estimates for Major Commercial Tree Species on TFL 8. Contract Rep. To Pope & Talbot. March 30, 2001. 17 pp.

APPENDIX I- Information Package

APPENDIX II- Response to MWALP comments on modelled WTP retention levels

APPENDIX III- Inventory species codes

At a very late stage in the analysis process it was noticed that the forest cover inventory for TFL 8 includes a component of Amabilis fir (species code BA) leading stands[5]. Since Amabilis fir does not actually occur on the TFL, this was deemed to be an error in the inventory database. This inventory error has potential implications for the estimates of natural stand yields developed for this analysis, although there is no impact on managed stand yields since all fir was assumed to be subalpine fir (species code BL) in managed stand silviculture regimes.

J.S Thrower and Associates undertook an evaluation the potential magnitude of error in natural stand yields resulting from the miscoding of fir stands, and the results of their investigations are reported in a memo, which is included in a subsequent appendix of this report. Assuming that all instances of species code BA in the inventory should in fact be species code BL, they concluded that the overestimation of natural stand volumes would be on the order of 1.32% of the total THLB volume.

Although an overestimate of this magnitude is well within the bounds of the base case sensitivity to natural stand yield errors as established in Section 7.2.1, we chose to address this issue directly in a further sensitivity analysis run. Therefore, all natural stand yield curves were reduced by a factor of 1.32 %, applied in addition to the 4% reduction for retention of wildlife trees. The resulting impact on available inventory volume was found to be negligible, as shown in Figure III.1

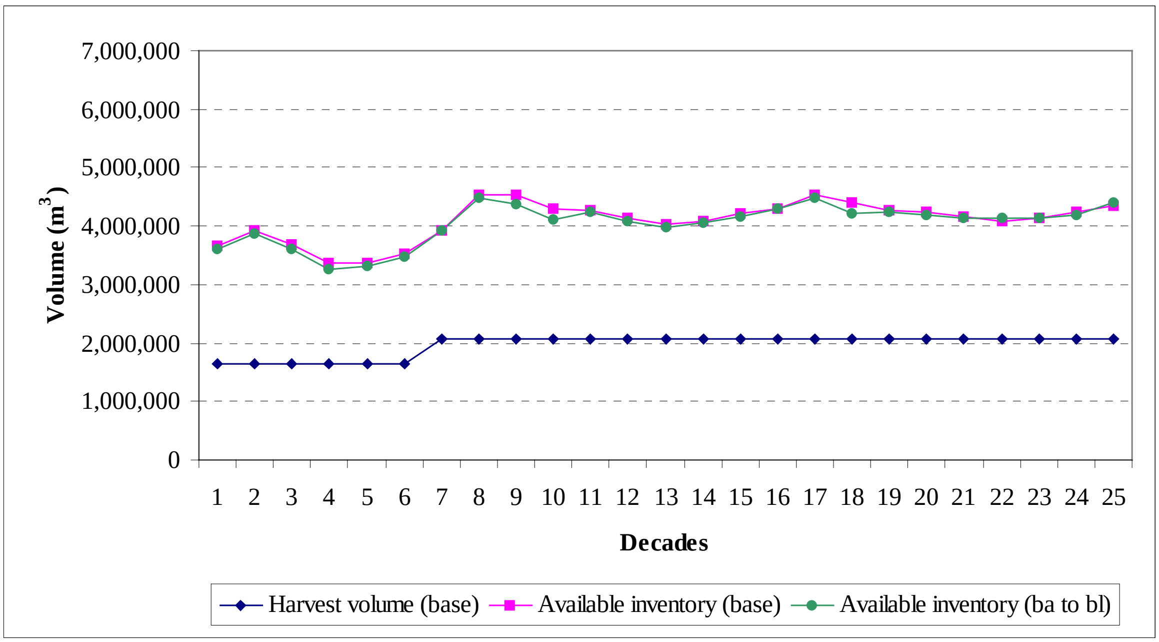

Figure III.1 NSYT yields reduced to reflect subalpine fir yields in natural stands

5 Amabilis fir was also found to be recorded as a minor component of many stands in the inventory file.

APPENDIX IV- Volume impact from inventory species error

APPENDIX V- Volume impact of NDT4 open forest management

APPENDIX VI- Yield Tables for Natural and Managed Stands: Management Plan 10 on TFL 8

APPENDIX VII- Potential Site Index Estimates for the Major Commercial Tree Species on TFL 8

APPENDIX VIII- Statistical Adjustment of Dense Lodgepole Pine Polygons in the Boundary Forest District