TIMBER SUPPLY ANALYSIS

TREE FARM LICENSE 8
TSR 3

Pope & Talbot Ltd.
Boundary Timber Division

Prepared by:
Timberline Forest Inventory Consultants Ltd.
Kelowna, B.C.

Reference:7061911
June 2007

Timberline
Natural Resource Group

July, 2007

File: 7061911

Pope & Talbot Ltd.

Attention: Doug Lang

Reference: Tree Farm License 8 Timber Supply Review 3

Please find enclosed the Timber Supply Analysis (TSR 3) for Tree Farm License 8. Do not hesitate to call if you have any questions or comments related to the document or any other aspect of the analysis.

Yours truly,

TIMBERLINE FOREST INVENTORY CONSULTANTS LTD.

Kelly Sherman, R.P.F. and

Krysta Giles-Hansen, F.I.T.

Resource Analysts

214 - 1884 SPALL ROAD, KELOWNA, BC V1Y 4R1
TEL: (250) 762-3191 ▪ FAX: (250) 762-3192
WWW.TIMBERLINE.CA

DOCUMENT HISTORY

Revision Number	Description	Submitted Date	Submitted by:
1	Analysis Report	July 2007	Kelly Sherman

EXECUTIVE SUMMARY

This report documents the timber supply analysis that has been completed as a component of TSR 3 for Pope and Talbot Limited (P&T) Tree Farm License (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 uncertainty associated with modeling inputs is quantified through sensitivity analyses.

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; 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.

The current practice with endemic MPB is considered representative of current management practice and includes information updates from both the MP 10 base case (2002). Improvements from the MP 10 base case are:

- Spatial analysis, which includes:
    - Blocking layer;
    - Adjacency for 20 years;
- Added mule deer winter range and moose winter range modeling (in place of MP 10 ungulate winter range);
- Updating Visual zones;
- Direct 35% of the harvest level into MPB affected stands;
- SIA in ESSF (JST, 2006);
- Incorporating natural disturbances in the non-THLB; and
- MPB modeling.

Figure 1 below shows the TSR 3 current practice with endemic MPB scenario (base case) harvest level against the current AAC of 175,000m^3/year. The current practice scenario has a harvest level of 186,000m^3/year until year 100 where it can increase to 209,000m^3/year.

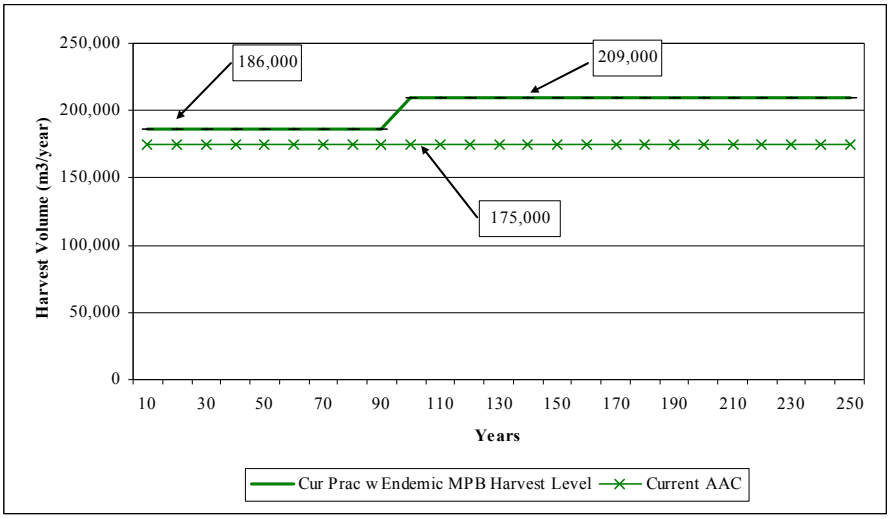

Figure 1 Harvest Level- Current Practice with Endemic MPB Against the Current AAC

Sensitivity analysis is conducted to assess the stability of a timber supply forecast in light of uncertainties by evaluating the response to systematic alterations of model assumptions and input parameters. Table 1 shows the results of the sensitivities carried out on the current practice with endemic MPB (base case) scenario.

Table 1 Sensitivity Analysis Results Summary

Description	Short/Mid Term	Long Term
Current Practice with Endemic MPB	186,000	209,000
THLB - 5%	172,000	200,000
Natural Stand Yields + 10%	188,000	203,000
Natural Stand Yields - 10%	169,000	212,000
Managed Stand Yields + 10%	189,000	232,000
Managed Stand Yields - 10%	170,000	183,000
Minimum Harvest Age + 10%	175,000	210,000
Minimum Harvest Age - 10%	187,000	206,000
Site Index + 1m	189,000	200,000
Site Index - 1m	186,000	208,000
Site Index + 2m	192,000	245,000
Site Index - 2m	164,000	164,000
No Genetic Gains	170,000	183,000
Increase Planted Stocking to 1400 st/ha	191,000	233,000
Bring NSR into the THLB	189,000	217,000
Green up Height + 1m	186,000	209,000
Green up Height - 1m	186,000	209,000
IRM on and Spatial Adjacency Off	185,000	209,000
No Moose REA	189,000	209,000
No Disturbances in the non-THLB	186,000	209,000
Harvest Rule Maximum Volume	181,000	208,000
Harvest Rule Relative Oldest	186,000	209,000
Spatial OGMAs used	183,000	209,000
Maximum 10 year harvest with mid term above Natural LRSY	316,000/129,000	211,000
FAB Scenario	186,000	237,000

In light of the provincial MPB epidemic it was considered prudent to take into account a potential MPB epidemic in TFL 8. Currently TFL 8 and the Arrow/Boundary Forest District are experiencing endemic MPB populations that are on the decline. However, it is projected that on TFL 8 7,300 ha of THLB will be severely affected by MPB by 2011 and an additional 2,100 ha by 2016 (Eng et.al., 2006). Figure 2 shows the current practice with epidemic MPB against the current practice with endemic MPB scenario. The MPB epidemic has been modeled using the MoFR MPB Projections and following assumptions:

- Pine leading MPB affected stands are prioritized for harvest and available from the time they are over 50% affected until their shelf life expires. For these stands:
    - Spatial adjacency is not enforced;
    - Visuals and IRM are not enforced; and
    - Stands have increased retention of 13% to account for the 20% retention recommended in the large scale salvage areas (MoFR, 2004);
    - Minimum harvest age is reduced to age 40 to ensure no MPB-attacked stands are tied up inadvertently.
- MPB affected stands harvested prior to the expiration of their shelf life are grow on managed stand yield curves;
- Pine leading MPB stands unable to be harvested prior to the expiration of their shelf life (mortality) lose 100% of their volume and grow back on natural stand yield curves with a 15 year regeneration delay; and
- Non-pine leading MPB affected stands that are not harvested have a volume reduction according to the levels of infestation (severe- 40%, moderate - 20% and low - 5%).

The current practice with epidemic MPB scenario assumes an initial harvest level of 186,000m^3/year for 10 years, a 5 year shelf life and with 35% of the harvest targeted towards MPB-attacked stands. With epidemic MPB, the mid term harvest level drops to 159,000m^3/year.

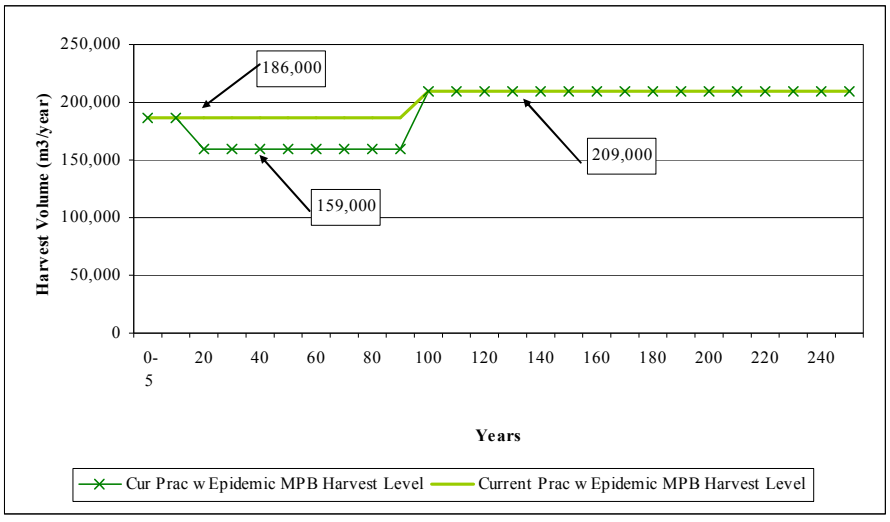

Figure 2 Harvest Level- Current Practice with Endemic and Epidemic MPB

Sensitivity analyses were conducted around the central MPB assumptions of shelf life and the percentage of MPB-attack targeted for harvest. The current practice with epidemic MPB scenario assumes a 5 year shelf life and 35% MPB harvest target and is shown as scenario 1b* in Table 2 below. In the sensitivity analyses, shelf life was altered from 5 years to 2 or 7 years and the percentage MPB targeted was altered from 35% to 10%, 50% and 70%. Table 2 summarizes the results from these MPB sensitivity analyses.

Table 2 MPB Sensitivity Analysis Results Summary

Description	Short Term	Mid Term	Long Term
1a-shelf life 2yrs -35%MPB target	186,000	155,000	210,000
1b*-shelf life 5yrs -35%MPB target	186,000	159,000	209,000
1c-shelf life 7yrs -35%MPB target	186,000	160,000	203,000
2-shelf life 5yrs -10%MPB target	186,000	143,000	207,000
3a-shelf life 2yrs -50%MPB target	186,000	165,000	210,000
3b-shelf life 5yrs -50%MPB target	186,000	166,000	206,000
3c-shelf life 7yrs -50%MPB target	186,000	171,000	203,000
4a-shelf life 2yrs -70%MPB target	186,000	175,000	208,000
4b-shelf life 5yrs -70%MPB target	186,000	183,000	209,000
5a-shelf life 2yrs -50%MPB target- all MPB	259,000	145,000	216,000
5b-shelf life 5yrs -50%MPB target- all MPB	259,000	152,000	215,000
5c-shelf life 7yrs -50%MPB target- all MPB	259,000	154,000	216,000
Faster MPB Spread	186,000	154,000	209,000

If the MPB epidemic is to occur as predicted by the MOF then there will be a need to harvest a large portion of the affected pine to mitigate a mid-term dip in the timber supply. However, TFL 8 currently has endemic and declining MPB population. The analysis has tried to capture this contrast by modelling the current practice with endemic MPB as the traditional 'basecase' and sensitivities along with many MPB epidemic scenarios.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION

This report documents the timber supply analysis that has been completed as a component of TSR 3 for Pope and Talbot Limited (P&T) Tree Farm License (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 uncertainty associated with modeling inputs is quantified through sensitivity analyses.

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; 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.

2. GENERAL DESCRIPTION OF LAND BASE & TENURE

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, P&T. 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 P&T. Ltd. and remains a subsidiary of the parent company.

The current TFL 8 is located within the Southern Interior Forest Region, and is administered from the Arrow Boundary Forest District office. The total area of TFL 8 is approximately 77,727 ha, of which 72,393 ha is classed as productive land. The AAC is currently set at 175,000 (m^3/yr).

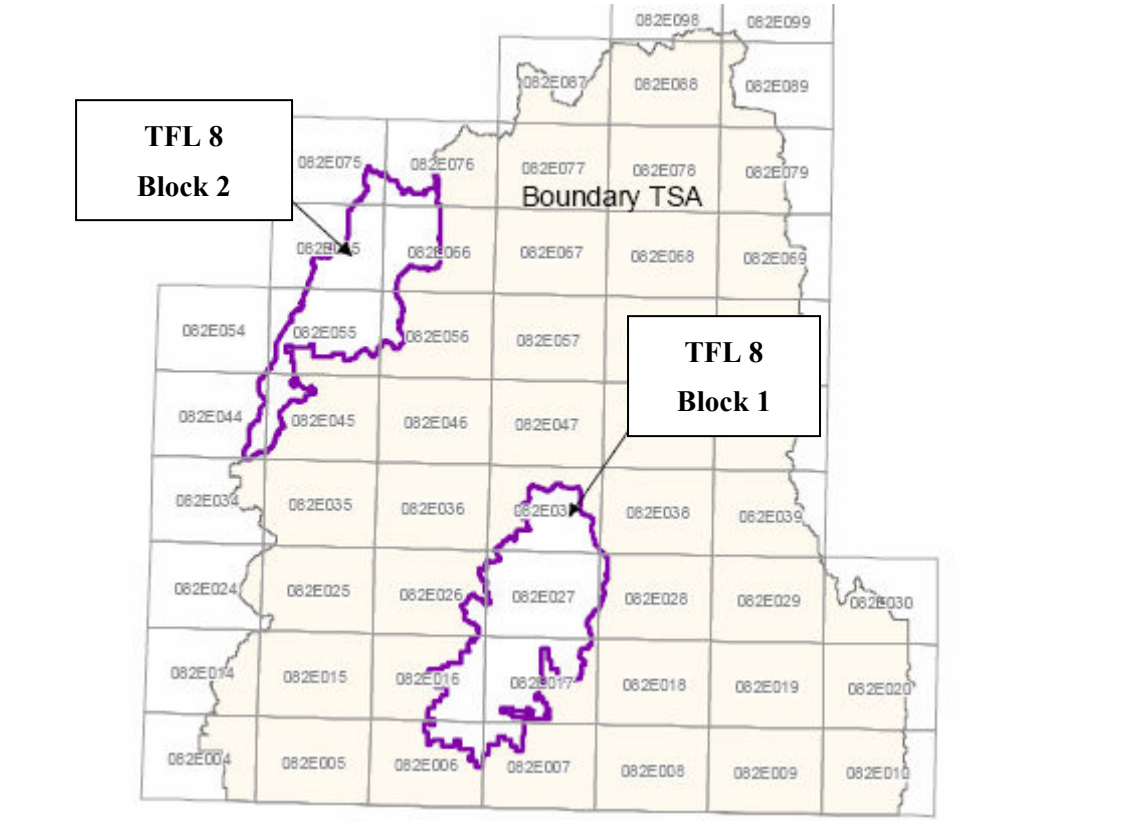

Figure 2.1 Key Map

3. TIMBER FLOW OBJECTIVES

3.1.1 No-MPB Epidemic

Forest cover constraints and biological capacity of the net operable landbase will dictate timber availability and harvest level options that are available. With the assumption that there is no MPB epidemic, the choice of harvest flow will reflect the following objectives:

- Maintain a non-declining yield harvest forecast; and
- Achieve a stable long-term harvest level over a 250 year planning horizon.

3.1.2 MPB Epidemic

If the MPB Epidemic hits TFL 8 as projected there will be shortage of timber during the natural to managed transition. This shortage of timber makes it practical to abandon the non-declining harvest forecast and create a mid-term trough. The initial harvest level will be the non-MPB non-declining yield harvest level. After MPB mortality occurs, there will be a drop in harvest level down to the post-MPB mid term harvest level. This level will be determined by the dynamics of the MPB epidemic (i.e. amount and distribution of MPB mortality). After the timber availability recovers from this MPB mortality sufficiently, the long term harvest level will be increased to a stable level.

4. FOREST INFORMATION

A complete description of the information used in P&T's TFL 8 TSR 3 timber supply analysis is contained in the document Timber Supply Analysis Information Package, Tree Farm License 8, TSR 3 (2006).

4.1 Land base 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 land base area is summarized in the following two figures. Figure 4.1 illustrates the distribution of the total TFL area. Area that is unsuitable for forest management is classed as non crown, non forest and non productive area within the TFL boundary (5,334 ha). The productive area is classed as non-THLB (7,789 ha) or THLB (64,604 ha).

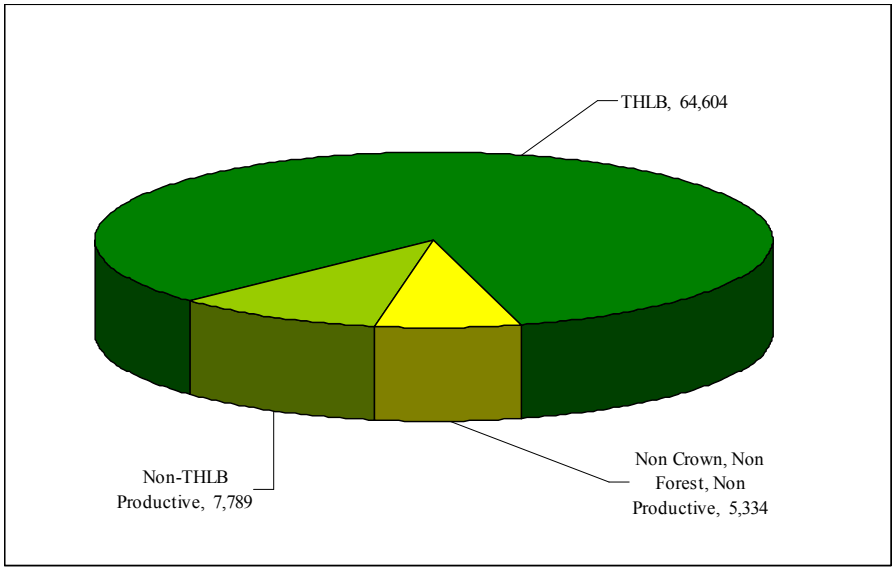

Figure 4.1 Distribution of total TFL Area

Figure 4.2 illustrates the process by which the productive land base of 72,393 hectares is classified in terms of its contribution to timber and non-timber uses. The non-THLB productive area is broken down by netdown classification e.g. non-commercial, ESA, low site. For more detail on the netdown, refer to the I*nformation Package* (Timberline, 2007).

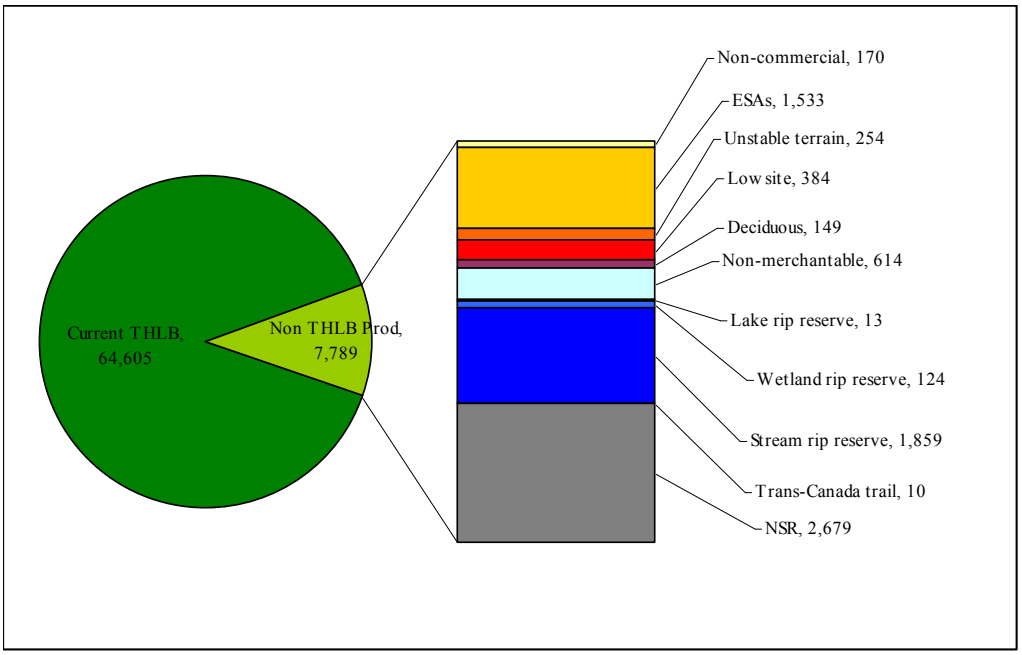

Figure 4.2 Classification of productive land base

4.2 Forest Inventory

The TFL 8 forest cover inventory has been updated for disturbance to Dec 31, 2005 and projected to 2006. Figure 4.3 provides a visual summary of the standing forest inventory on the THLB. The figure shows the distribution of net land base area by leading age (the oldest age in each 10-year age class). The figure shows a significant gap in the age class inventory in the 41 to 70 year age range. Figure 4.4 shows the THLB and non-THLB area by leading species.

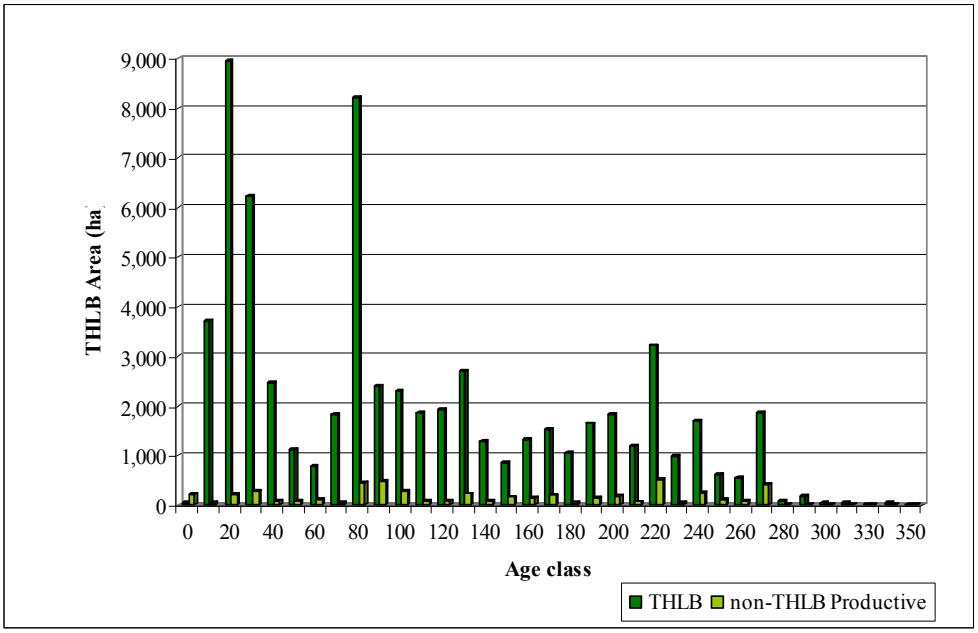

Figure 4.3 Distribution of TFL 8 by Ageclass

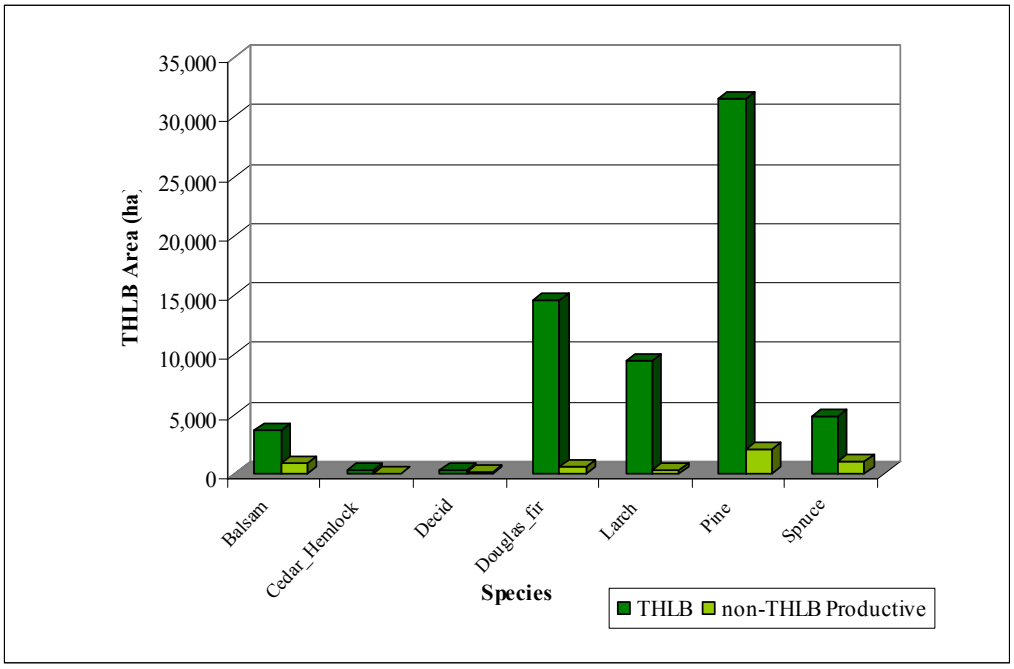

Figure 4.4 Distribution of TFL 8 by Leading species

4.3 Growth and Yield

4.3.1 Natural Stands

Natural stands were defined as all stands in the current forest cover inventory with age greater than 30 years. Natural stand yield tables (NSYTs) for the timber supply analysis were developed using the batch version of the Ministry of Forests (MoFR) program *Batch*VDYP (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 31 years. Managed stand yield tables (MSYTs) incorporating improved estimates of potential site index[1] were developed using *Batch*TIPSY *(version 3.0a)* for clearcut systems. These MSYTs also incorporate future genetic gain expectations based on information provided by P&T. For more details, refer to the *Information Package* (Timberline, 2007).

4.3.3 Theoretical Productivity Estimates

Table 4.1 provides average theoretical productivity estimates for the TFL 8 land base, derived from both natural and managed stand yield tables. The actual long-term harvest level 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.

[1] - Improved potential site index estimates were based on the site index adjustment (SIA) work of J.S.Thrower and Associates (JST 2001b) and subsequent SIA project in the ESSF (JST 2006)

Table 4.1 Theoretical long-term productivity estimates

THLB Area (ha)			CMAI		LRSY	
Natural	Managed	Total	Natural	Managed	Natural	Managed
45,798	18,900	64,698	1.97	4.00	127,703	258,983

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.

Ecosystem based aggregation was used in this analysis- AUs are BEC-leading site series-leading species combinations. There are 73 natural AUs and 73 corresponding managed AUs. Please see the *Information Package* for more information and details.

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 (B1, B7 and B8) 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 BEC variant. Table 4.2 summarizes the distribution of productive and net area by "LU – BEC variant – BEO". Note that in this table, B7-MSdm1a-L was combined with B7-MSdm1-L.

Table 4.2 Distribution of land base area by LU-BEC variant-BEO

LU	KBHLPO-BEC	NDT	BEO	Area (ha)		
				THLB	non-THLB Productive	Total Productive
B1	**IDFdm1**	**4**	**H**	4,065	380	4,446
B1	**MSdm1**	**3**	**I**	1,714	189	1,903
B7	**ESSFdc1**	**3**	**L**	5,024	1,691	6,715
B7	**ICHmk1**	**3**	**L**	4,929	471	5,400
B7	**ICHmw2**	**2**	**L**	251	45	296
B7	**IDFdm1**	**4**	**L**	5,722	825	6,547
B7	**MSdm1**	**3**	**L**	13,874	1,889	15,763
B8	**ESSFdc1**	**3**	**L**	3,204	350	3,553
B8	**IDFdm1**	**4**	**L**	8,838	871	9,709
B8	**MSdm1**	**3**	**L**	16,982	1,068	18,050
Total				**64,602**	**7,781**	**72,383**

4.4.2 Resource Emphasis Areas

The land base has been divided into REAs to facilitate the application of forest cover requirements. REAs in TFL 8 can be summarized as:

- Visual Quality Objectives (VQOs);
- Forest connectivity corridors (FCC) (managed for old seral forest retention);
- Seral Stage Distribution (managed for old seral forest retention);
- Moose winter range (MWR); and
- Mule deer winter range (MDWR).

The distribution of productive land base area among the REAs is shown in Figure 4.5. For more information on modeling assumptions, please see the *Information Package*.

Figure 4.5 Resource emphasis areas

REA Summary	Area (ha)		
	THLB	non-THLB Productive	Total
MDWR	4,637	772	5,408
MWR	2,870	587	3,458
VQO	6,132	504	6,636
Seral	64,689	7,687	72,376
FCC	13,157	1,738	14,894
Disturbing the non-THLB	0	6,737	6,737

5. ANALYSIS METHODS

5.1 Forest Harvest Modelling

Timberline's proprietary simulation model CASH6 (Critical Analysis by Simulation of Harvesting, version 6.2l) 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, modeled harvest

levels included allowances for non-recoverable losses (NRLs). Harvest figures reported here exclude this amount unless otherwise stated.

5.2 Interpreting Timber Availability

Traditionally harvest flow has been the primary indicator used to evaluate the timber supply impacts of various management scenarios. However the harvest flow for a given scenario does not necessarily reveal the complete timber supply picture. Another useful indicator is timber availability, which is the total volume of merchantable timber that could be harvested in any given period without violating any forest cover requirements. The profile of timber availability provides valuable insights into the timber supply dynamics of a given scenario. In general, the periods with the least amount of timber available control the resulting harvest flow. Standard TSR harvest flows are generally controlled by 'pinch points', which are periods in which there is virtually no surplus timber available beyond the forecast harvest level.

5.3 Comparing Management Scenarios

Although a stand-alone timber availability profile can provide valuable information, they have greater utility when comparing management scenarios. When comparing different management scenarios using timber availability profiles, it is critical to use the same harvest request in both scenarios. In doing so the differences in the timber availability profiles can be entirely attributed to differences in the management scenarios. In every case when two timber availability profiles are displayed on the same graph, the profiles are created using the same harvest flow. Generally the harvest flow requested is the basecase harvest flow unless otherwise specified. Figure 5.1 shows an example that compares the timber availability profiles of an alternative management scenario to the basecase. The difference between the two availability profiles (slashed region) can be entirely attributed the differences between the management scenario and the basecase.

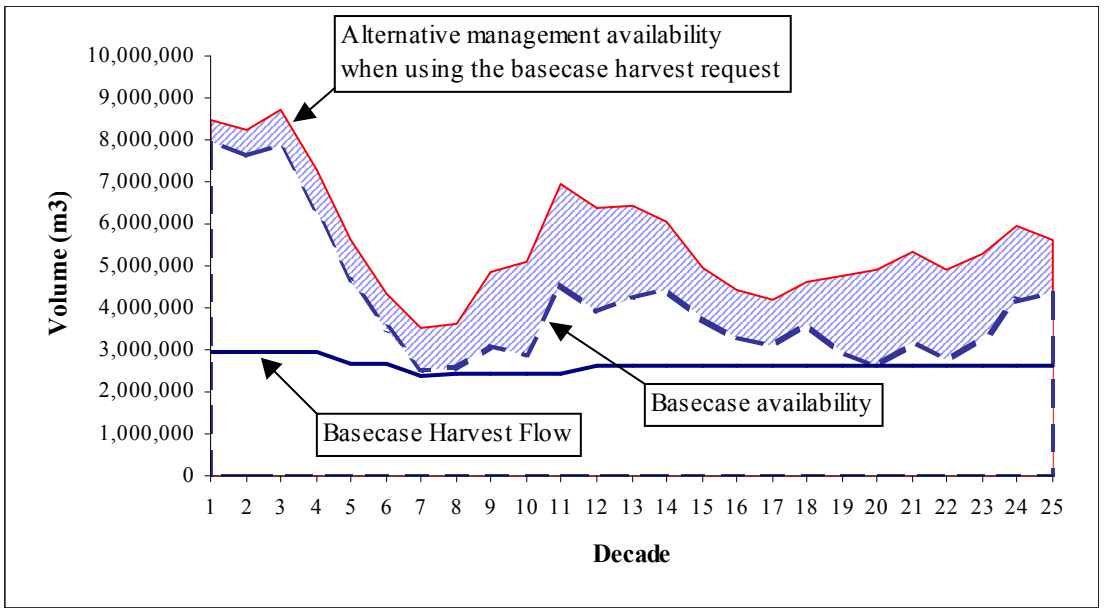

Figure 5.1 Comparing management scenarios using availabilities

6. TSR 3 CURRENT PRACTICE WITH ENDEMIC MPB

The TSR 3 current practice with endemic MPB analysis reflects current management performance as of the date of commencement for the preparation of TSR 3. This analysis incorporates the following factors:

The current practice with endemic MPB is considered representative of current management practice and includes information updates from both the MP 10 base case (2002). Improvements from the MP 10 base case are:

- Spatial analysis, which includes:
    - Blocking layer;
    - Adjacency for 20 years;
- Added mule deer winter range and moose winter range modeling (in place of MP 10 ungulate winter range);
- Updating Visual zones;
- Direct 35% of the harvest level into MPB-affected stands;
- SIA in ESSF (JST, 2006); and
- Incorporating natural disturbances in the non-THLB.

6.1 Analysis Results

6.1.1 Harvest Forecasts

Table 6.1 and Figure 6.1 present the harvest flow levels for the current practice with endemic MPB scenario. The current AAC of 175,000m^3/year is shown for comparison.

Table 6.1 Harvest level- Current practice with endemic MPB

Year	Harvest Level (m^3/year)
2006-2115	186,000
2116-2255	209,000

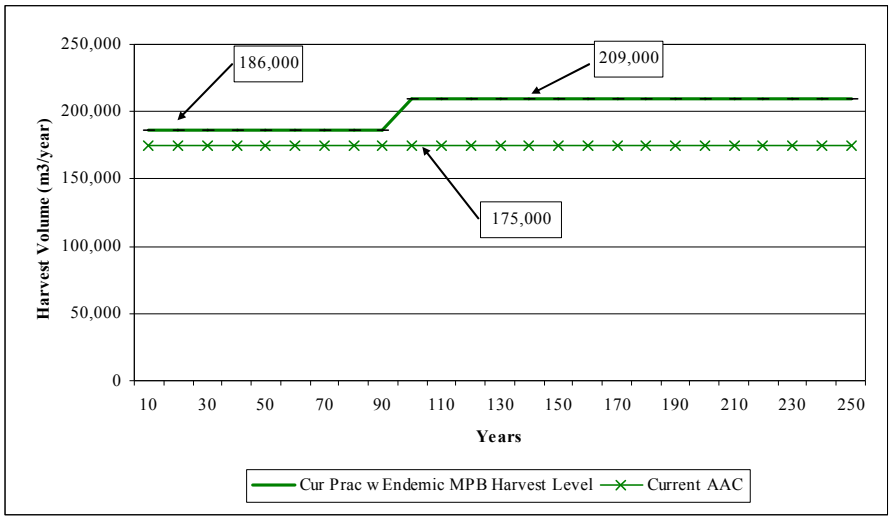

Figure 6.1 Harvest Level- Current practice with endemic MPB

Figure 6.2. shows the total stock, operable stock and available timber for the TFL 8 current practice with endemic MPB scenario. Total stock is initially at ~937,000 m^3 and declines slightly in the mid term before peaking around year 120 and then settling into a stable long term level. Operable stock (that which is able to be harvested), is significantly lower that total stock but follows a similar pattern of dipping and peaking before finding a relatively stable long term level. The available timber stock drops sharply in the first four decades, reaching a pinch point in decade 4, 6 and 9. These pinch points control the harvest level in the first 100 years (mid term). Following the trend of total and operable stock, available stock peaks around year 120 before settling into a stable long term level. The peak at year 230 is a smaller echo of the 120 year peak.

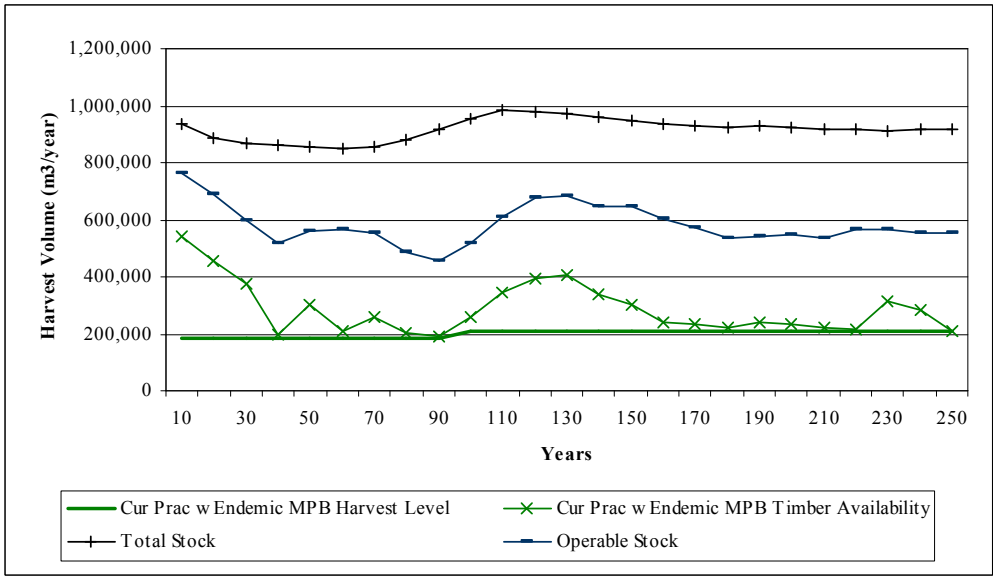

Figure 6.2 Current practice with endemic MPB growing stock profiles

Figure 6.3 shows the natural to managed conversion of harvested wood over time. The switch from natural stands to managed occurs between decade 4 and 6, with decade 5 sourcing 54% of the harvested volume from natural stands.

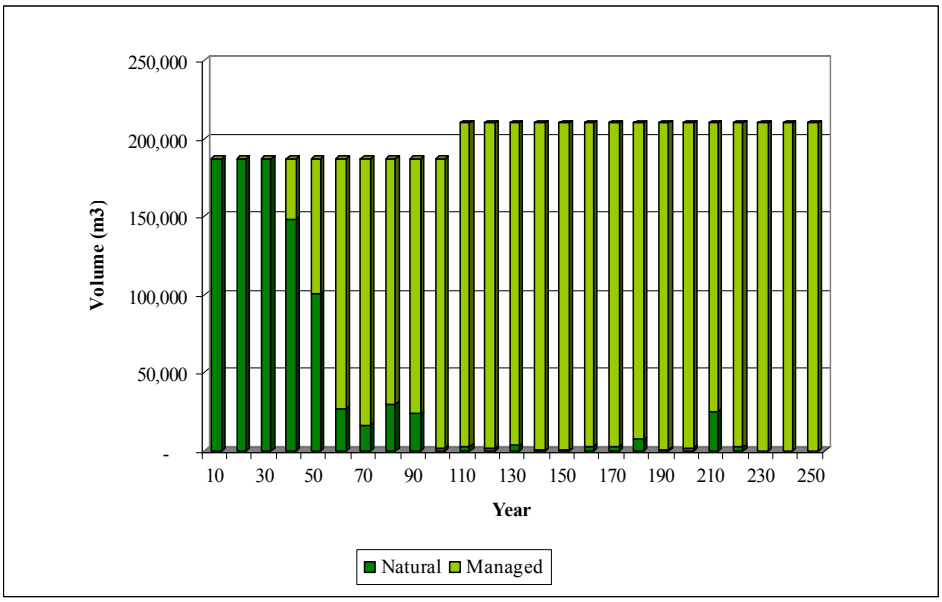

Figure 6.3 Harvest volume by natural and managed stand types

Figure 6.4 shows selected statistics for harvested stands by decade- the average DBH, average volume per hectare, average age and average area harvested. The average DBH is initially at 40 cm before dropping sharply to 25 cm in decade 4. The DBH then reaches a stable and slightly increasing level of 30-33cm for the rest of the planning horizon. The volume harvested by decade initially starts at 300 m^3/ha and decreases to a low of 225m^3/year in decade 4 before increasing across the rest of the planning horizon. The area harvested follows a mirrored pattern to that of the average volume/ha, increasing from an initial value of 600 ha/year to 800 ha/year in decade 4 and steadily decreasing after for the rest of the planning horizon. The average harvested age drops from the initial 230 years to around 100 years by decade 6 as the conversion from natural to managed stands occurs.

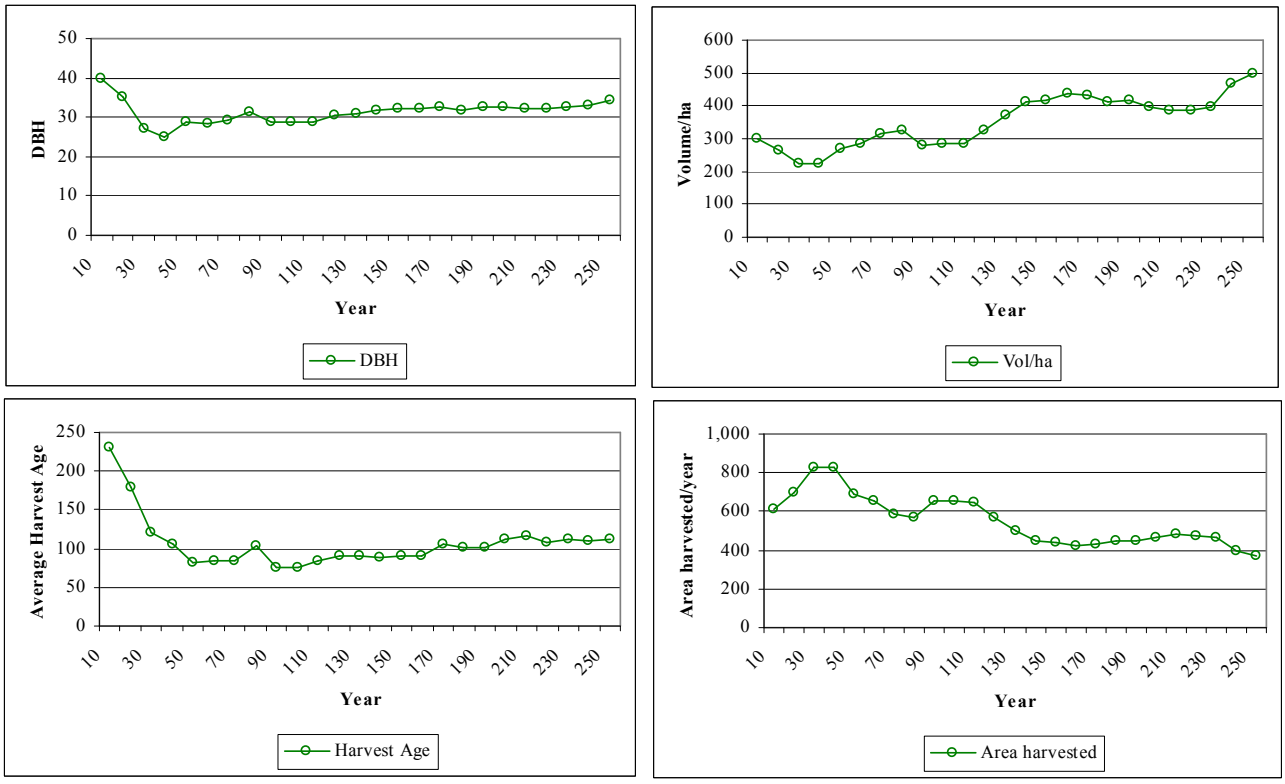

Figure 6.4 Average DBH, volume/ha, age at harvest and area harvested

6.1.2 Age class distributions

Figure 6.5 shows the dynamic behaviour of the residual forest age class structure over the 250 year planning horizon. Looking at the initial age class distribution, there is a significant gap in the age class inventory in the 41 to 70 year age range. It can be seen that the residual forest is reaching a uniform age class distribution by decade 10 where the bulk of stands are less than 90 years old. In all cases, there is significant area retained in stands greater than 250 years old. This steadily increases from ~4,000 ha initially, to ~8,000 ha in 250 years.

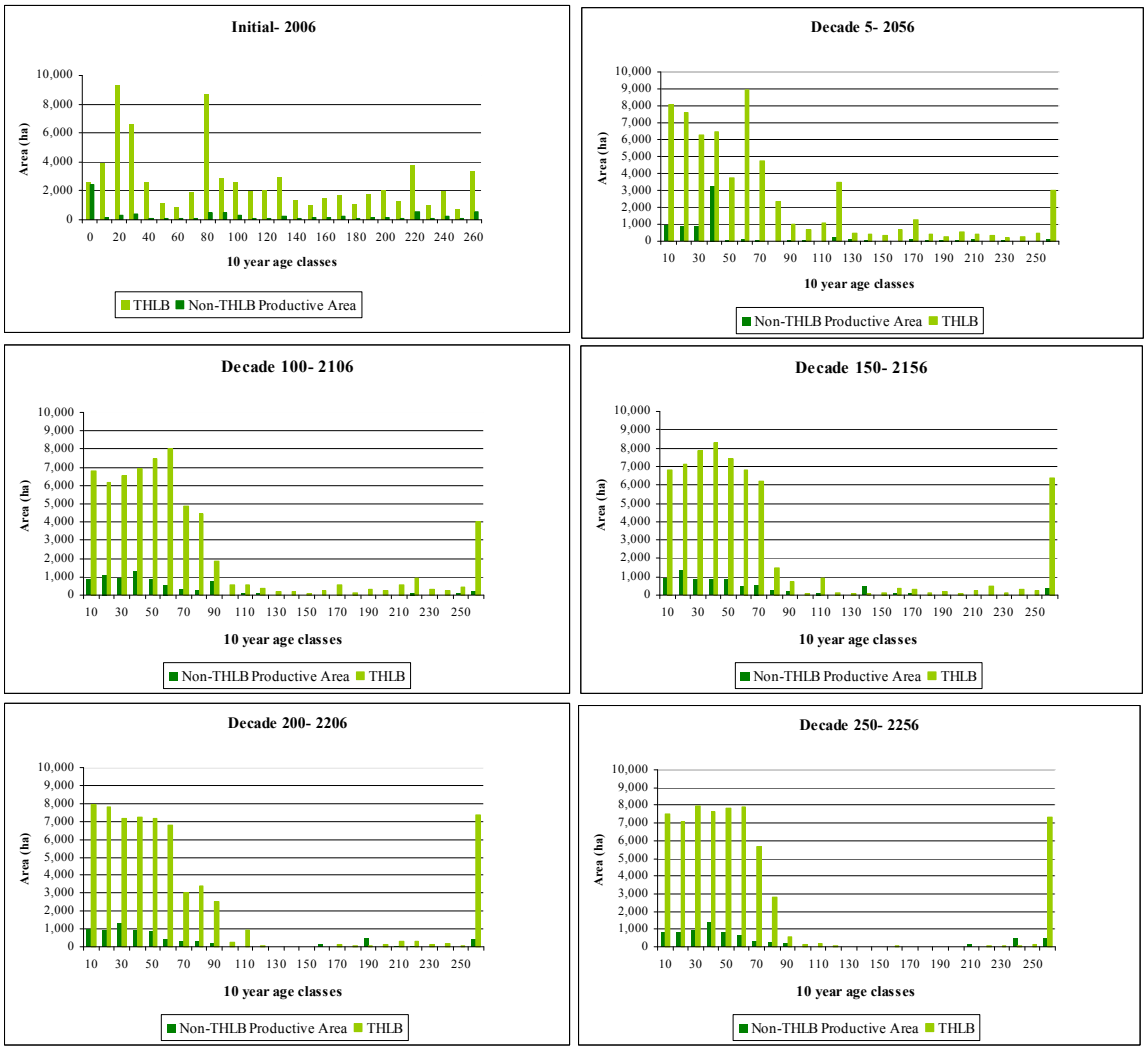

Figure 6.5 Forest age structure through time

7. SENSITIVITY ANALYSES

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 alterations 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 impact of this change is measured by looking at the area and volume impacted (if applicable) along with the harvest level and timber availability implications. Each sensitivity will be compared against the current management with endemic MPB scenario. A summary of the following sensitivities are shown below in Table 7.1.

Table 7.1 Summary of Sensitivities

	Sensitivity
THLB definition	- 10% THLB Bring NSR into THLB
Growth and yield	+/- 10% Natural stand yields +/- 10% Managed stand yields +/- 10% Minimum harvest ages +/- 1meter Site index +/- 2meter Site index No Genetic Gains Increase Planted Stocking Change merchantability definition
REA assumptions	+/- 1meter Green up heights Turn off adjacency and turn on IRM Add Williamson Sapsucker WHA Turn off the Moose Winter Range
Biodiversity Assumptions	Model spatial OGMAs Turn off Disturbances in the non-THLB
Alternate Harvest Conventions	Relative oldest harvest rule Maximum volume harvested Maximum non declining harvest level Maximum 10 year harvest with mid term at natural LRSY
MPB	See table below

7.1 Land base Definition

7.1.1 Adjust timber harvesting land base by – 5%

To test the sensitivity to uncertainty in the land base classification assumptions, the size of the THLB was decreased by 5%. The change in land base classification was accomplished by shifting the appropriate number of hectares between the THLB and non-THLB Productive areas of the land base. Table 7.2 shows that the THLB is reduced by 3,230 ha, the non-THLB productive area is increased by this amount and the total area remains constant at 72,393 ha.

Table 7.2 Area Change- THLB -5%

	Current Practice with Endemic MPB	THLB -5 %
THLB	64,604	61,374
Non-THLB Productive	7,789	11,019
Total Productive	72,393	72,393

Table 7.3 and Figure 7.1 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 7.5% from 186,000m^3/year to 172,000m^3/year and the long term harvest level is decreased by 4.3% from 209,000m^3/year to 200,000m^3/year. In the mid term, this is a slightly higher than proportional harvest level impact.

Table 7.3 Harvest Level- THLB – 5%

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	THLB -5 %
2006-2115	186,000	172,000
2116-2255	209,000	200,000

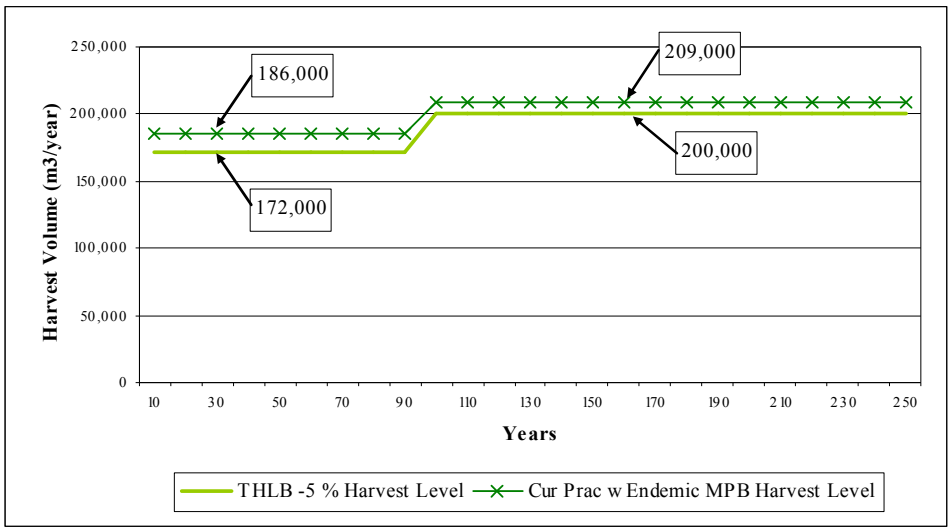

Figure 7.1 Harvest Level- THLB – 5%

The resulting changes in timber availability are shown in Figure 7.2. The available timber starts 5% lower in the THLB -5% sensitivity but creates a strong pinch point in the mid term which forces the harvest level down slightly more than proportional by 7.5%.

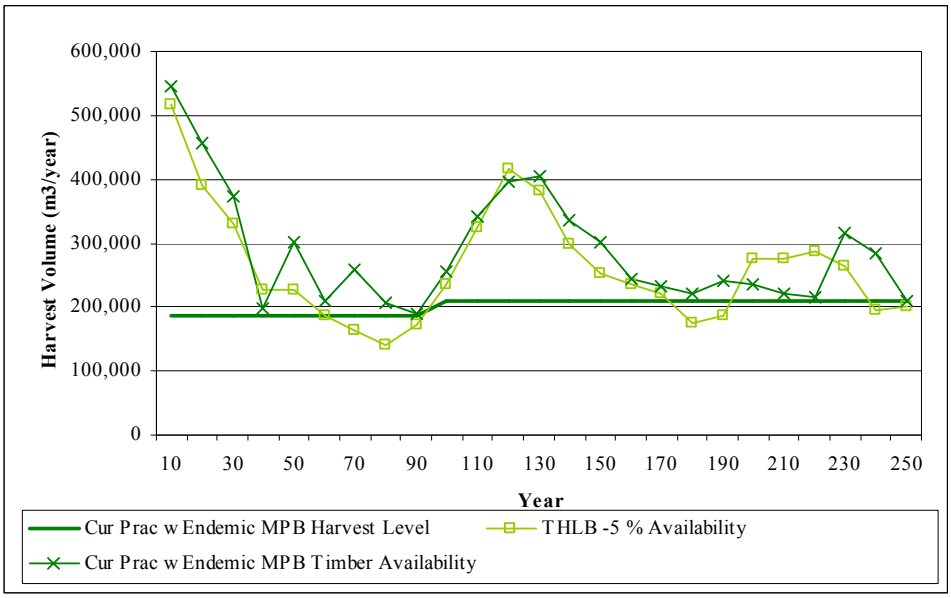

Figure 7.2 Timber Availability- THLB – 5%

7.1.2 Bring NSR into the THLB

In the basecase, 2,678 ha of NSR was netted out of the THLB. This sensitivity tests the timber supply impact of bringing this NSR area back into the THLB. The assumption was made that the full area was regenerated from age 0.

Table 7.4 and Figure 7.3 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is increased by 2% from 186,000m^3/year to 189,000m^3/year and the long term harvest level is increased by 4% from 209,000m^3/year to 217,000m^3/year. In the mid term, this is a slightly higher than proportional harvest level impact.

Table 7.4 Harvest Level- NSR in THLB

Year	Harvest Level (m3/year)	
	Cur Prac w Endemic MPB	Bring NSR into THLB
2006-2115	186,000	189,000
2116-2255	209,000	217,000

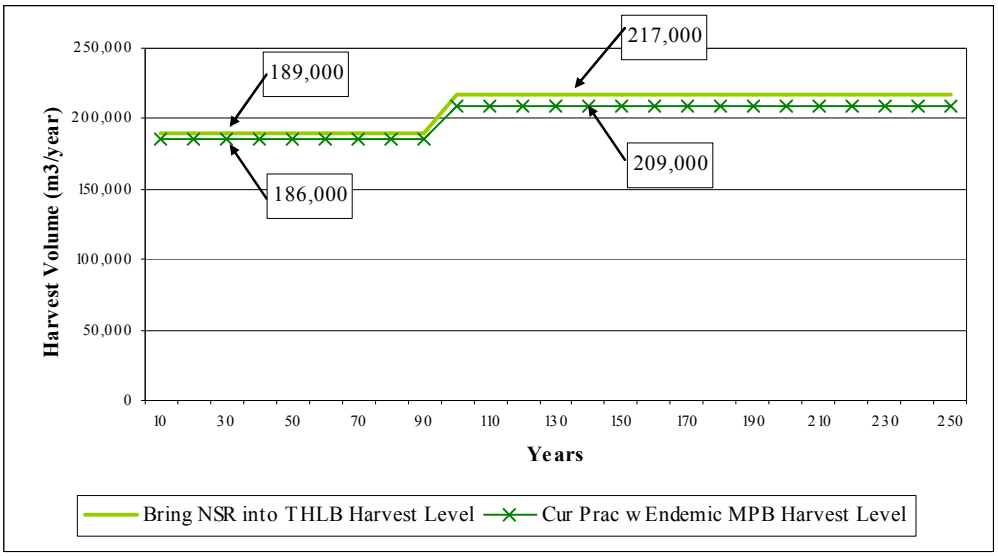

Figure 7.3 Harvest Level- NSR in THLB

The resulting changes in timber availability are shown in Figure 7.4.

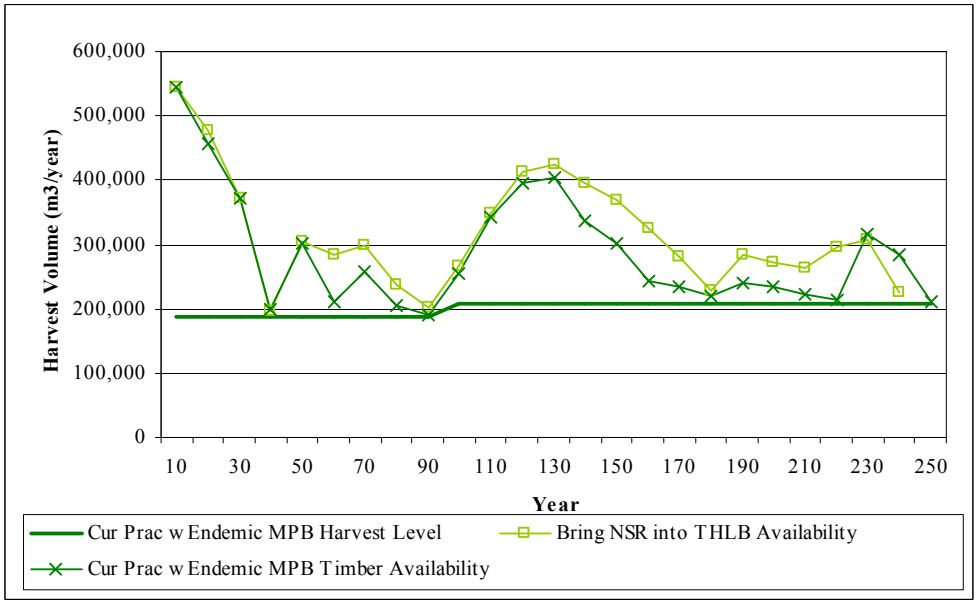

Figure 7.4 Timber Availability- NSR in THLB

7.2 Growth and Yield Assumptions

7.2.1 Adjust natural stand yields by ± 10%

The sensitivity to uncertainties in natural stand yield estimates was tested by alternately increasing and decreasing all the VDYP yield curves by 10%. Table 7.5 shows the harvest level for the current practice with endemic MPB scenario and these sensitivities. If natural stand yields are increased by 10%, the mid term harvest level is increased by 1% from 186,000m^3/year to

188,000m^3/year. In this case, because of the increased harvest in the mid term, the long term is decreased slightly by 3% from 209,000m^3/year to 203,000 m^3/year.

If natural stand yields are decreased by 10%, the mid term harvest level is decreased by 9% from 186,000m^3/year to 169,000m^3/year. In this sensitivity, because the mid term harvest is decreased, the long term is increased by 1% to 212,000m^3/year.

Table 7.5 Harvest Level- Natural Stand Yield ± 10%

Year	Harvest Level (m^3/year)		
	Cur Prac w Endemic MPB	Natural Stand Yields +10%	Natural Stand Yields -10%
2006-2115	186,000	188,000	169,000
2116-2255	209,000	203,000	212,000

Figure 7.5 shows the harvest levels of the current practice with endemic MPB scenario and these sensitivities.

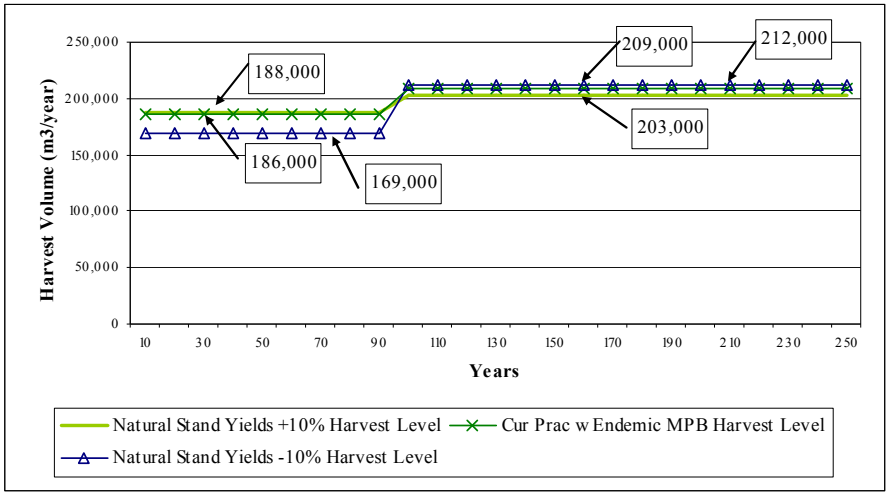

Figure 7.5 Harvest Level- Natural stand yields ± 10 %

The impact of these input modifications on timber availability is presented in Figure 7.6. The initial volume of timber available was ± 11% for the two sensitivities. There is a big difference in mid term availability between the three sensitivities but in the long term (when dependent on managed stand yields), there is a relatively small difference in available timber.

The natural stand yield +10% timber availability has alleviated the pinch points in decade 4, 6 and 8 but is still pinching in decade 9 (where most of the harvest is dependent upon managed stands). This is why the mid term harvest only increases by 1% when natural stand yields are increase by 10%.

The natural stand yield -10% timber availability is very reduced in the mid term during the critical natural to managed conversion which pushes the harvest level down by 9%.

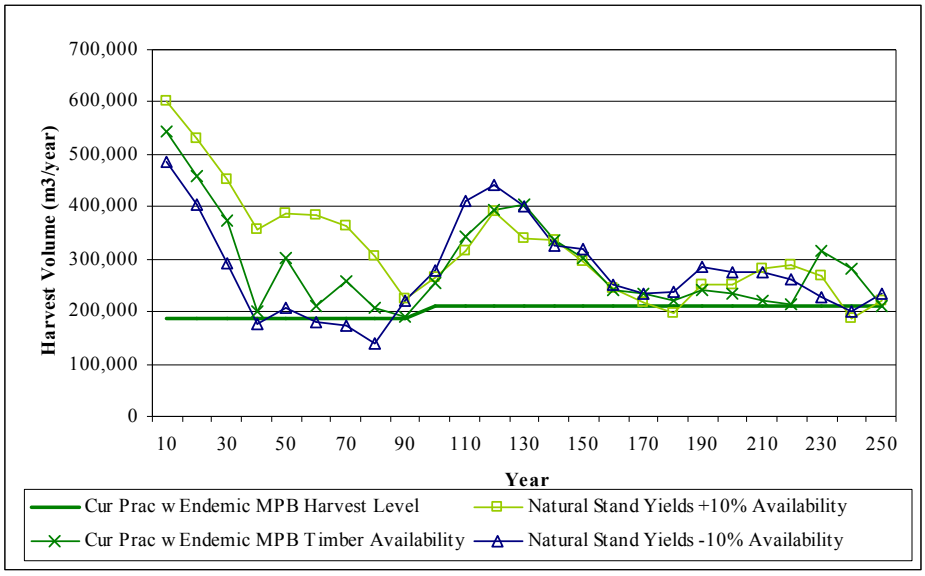

Figure 7.6 Timber Availability- Natural stand yields ± 10 %

7.2.2 Adjust managed stand yields by ± 10%

TIPSY yield curves for were alternately increased and decreased by 10% to evaluate the sensitivity of the current practice with endemic MPB forecast to uncertainties in the estimates of managed stand yields.

Table 7.6 and Figure 7.7 show the harvest level for the current practice with endemic MPB scenario and these sensitivities. If managed stand yields are increased by 10%, the mid term harvest level is increased by 2% from 186,000m^3/year to 189,000m^3/year. In the long term, which is dependent on managed stand yields, the harvest level is increased by 11% from 209,000m^3/year to 232,000 m^3/year.

If managed stand yields are decreased by 10%, the mid term harvest level is decreased by 9% from 186,000m^3/year to 170,000m^3/year. In the long term, the harvest level is decreased by 12% to 183,000m^3/year.

Table 7.6 Harvest Level- Managed stand yields ± 10 %

Year	Harvest Level (m^3/year)		
	Cur Prac w Endemic MPB	**Managed Stand Yields +10%**	**Managed Stand Yields -10%**
2006-2115	186,000	189,000	170,000
2116-2255	209,000	232,000	183,000

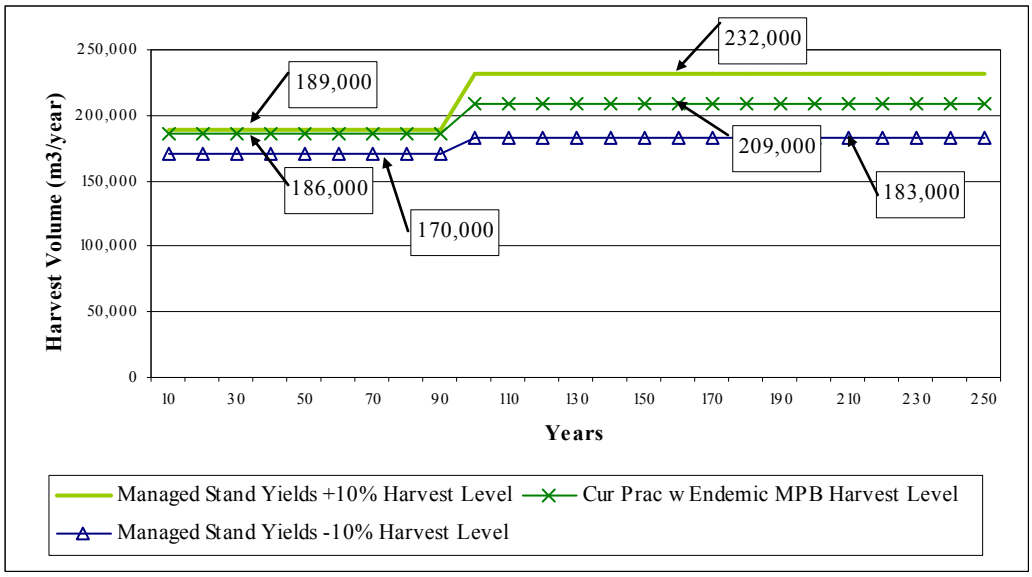

Figure 7.7 Harvest Level- Managed stand yields ± 10 %

Figure 7.8 shows the timber availability for the current practice with endemic MPB scenario and these sensitivities. There is a large divergence in timber availability in the long term which reflects the fact that it is the managed stand yield curves that are being altered in this sensitivity.

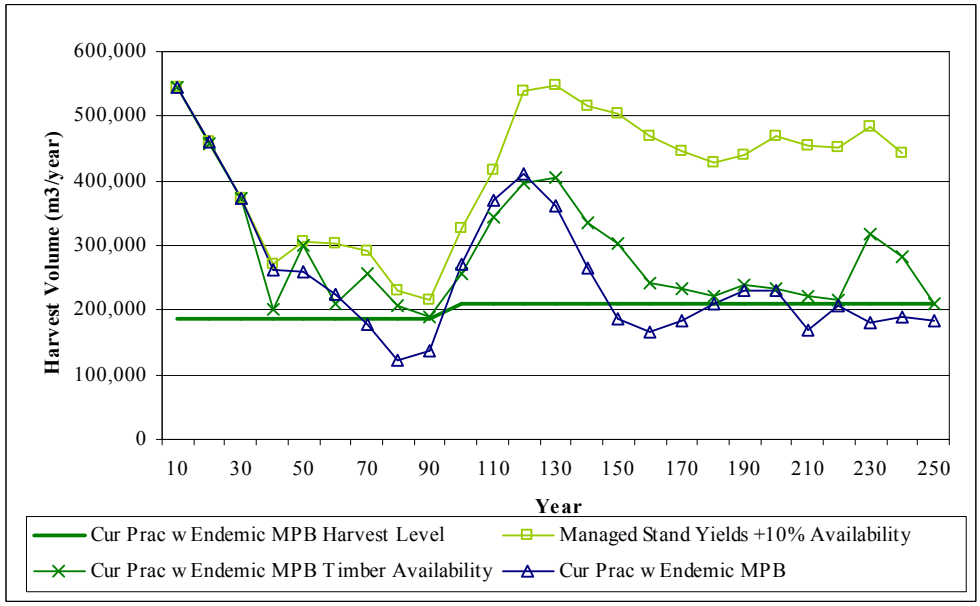

Figure 7.8 Timber Availability- Managed stand yields ± 10 %

7.2.3 Adjust managed stand minimum harvest ages ± 10 %

To assess the sensitivity of the current practice with endemic MPB forecast to uncertainties in assumptions about merchantability criteria, minimum harvest ages (MHAs) for all yield tables were alternately increased and decreased by 10%.

Table 7.7 and Figure 7.9 show the harvest level for the current practice with endemic MPB scenario and these sensitivities. If MHAs are increased by 10%, the mid term harvest level is decreased by 6% from 186,000m^3/year to 175,000m^3/year. In the long term, the harvest level is increased slightly from 209,000m^3/year to 210,000 m^3/year.

If MHAs are decreased by 10%, the mid term harvest level is increased by 1% from 186,000m^3/year to 187,000m^3/year. In the long term, the harvest level is decreased by 1% to 206,000m^3/year. The long term harvest level is lower than the current practice with endemic MPB long term harvest level because lowering the MHA allows harvesting to occur below the maximum mean annual increment (MAI) age where growth is maximized.

Table 7.7 Harvest Level- MHA ± 10 %

Year	Harvest Level (m^3/year)		
	Cur Prac w Endemic MPB	MHA +10%	MHA -10%
2006-2115	186,000	175,000	187,000
2116-2255	209,000	210,000	206,000

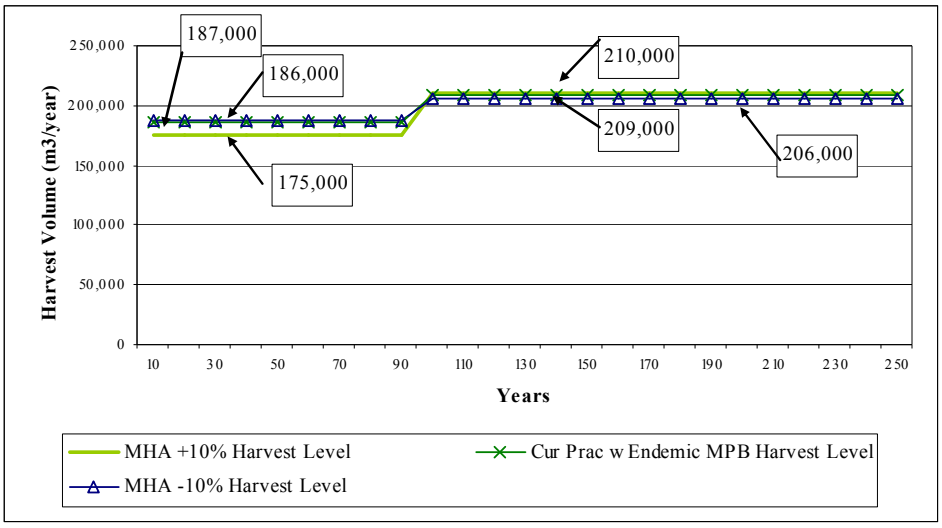

Figure 7.9 Harvest Level- MHA ± 10%

Figure 7.10 shows the timber availability of the current practice with endemic MPB and the two MHA sensitivities.

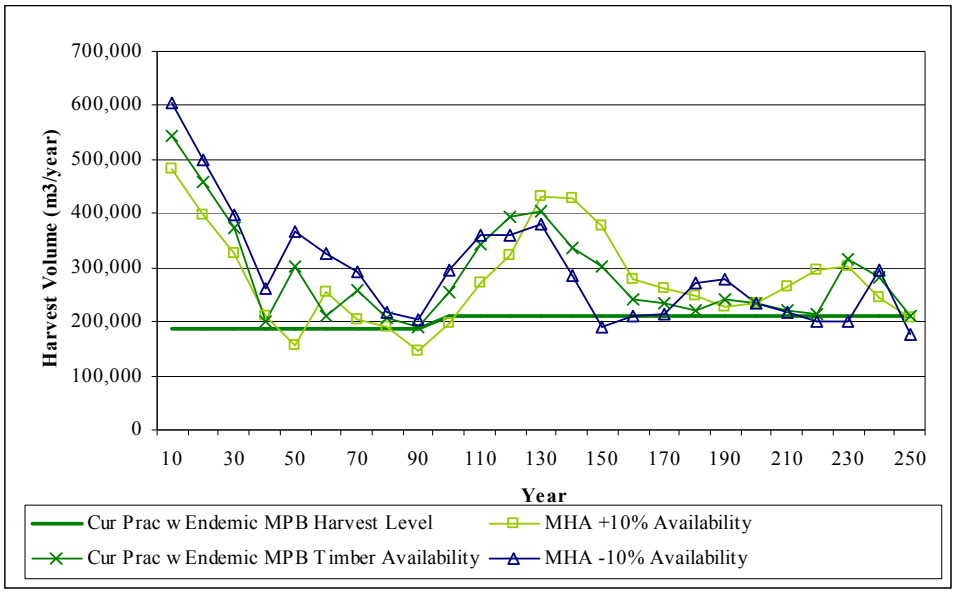

Figure 7.10 Timber Availability- MHA ± 10%

7.2.4 Adjust Managed Stand Site Index by ± 1 meter

Managed stand site index (SI) estimates were increased and decreased by 1 meter to test the sensitivity to these parameters. Table 7.8 and Figure 7.11 show the harvest level for the current practice with endemic MPB scenario and these sensitivities. If managed SI is increased by 1m, the mid term harvest level is increased by 2% from 186,000m^3/year to 189,000m^3/year. In the long term, the harvest level is decreased slightly from 209,000m^3/year to 200,000 m^3/year.

If managed SI is decreased by 1m, the mid term harvest level is does not change and in the long term, the harvest level is decreased very slightly to 208,000m^3/year.

Table 7.8 Harvest Level- SI ± 1m

Year	Harvest Level (m^3/year)		
	Cur Prac w Endemic MPB	Managed Site Index +1m	Managed Site Index -1m
2006-2115	186,000	189,000	186,000
2116-2255	209,000	200,000	208,000

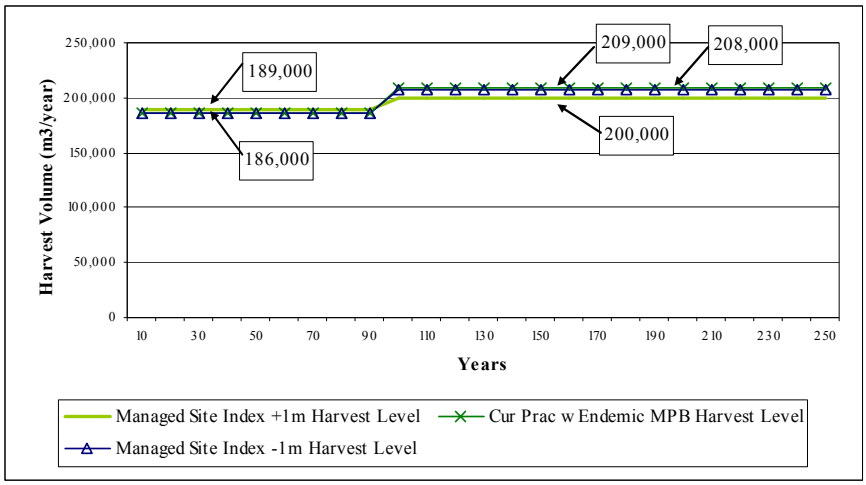

Figure 7.11 Harvest Level- SI ± 1m

Figure 7.22 shows the timber availability of the current practice with endemic MPB and the two managed SI sensitivities.

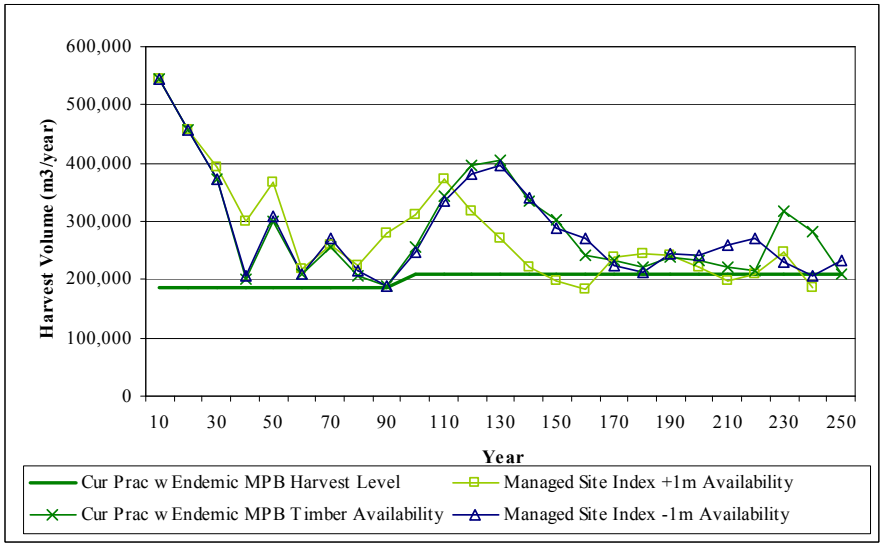

Figure 7.12 Timber Availability- SI ± 1m

7.2.5 Managed Stand Site Index ± 2m

This sensitivity tests the timber supply impact of changing the managed stand site index ±2m. Table 7.9 and Figure 7.13 show the harvest level for the current practice with endemic MPB scenario and these sensitivities. If the managed stand site index is increased by 2m, the mid term harvest level is increased by 3% from 186,000m^3/year to 192,000m^3/year. In the long term, the harvest level is increased by 17% to 245,000m^3/year. If the managed stand site index is decreased by 2m, the mid term harvest level is decreased by 12% from 186,000m^3/year to 164,000m^3/year. In the long term, the harvest level is decreased by 22% to 164,000m^3/year.

Table 7.9 Harvest Level- Managed Stand Site Index ±2m

Year	Harvest Level (m^3/year)		
	Cur Prac w Endemic MPB	Managed Site Index +2m	Managed Site Index -2m
2006-2115	186,000	192,000	164,000
2116-2255	209,000	245,000	164,000

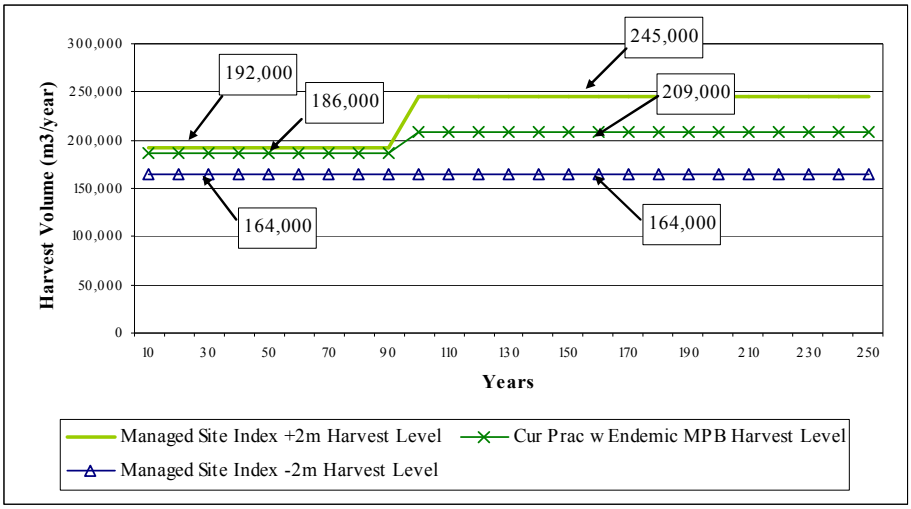

Figure 7.13 Harvest Level- Managed Stand Site Index ±2m

Figure 7.14 shows the timber availability of the current practice with endemic MPB and these sensitivities.

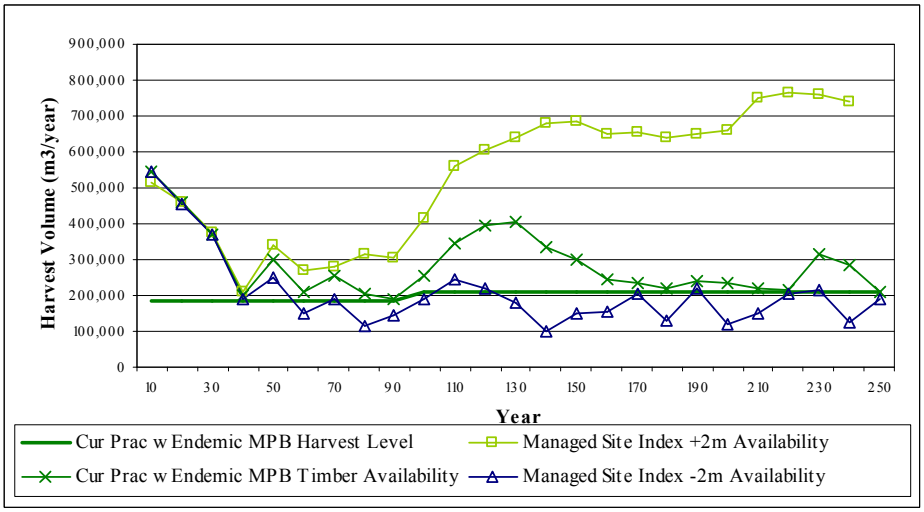

Figure 7.14 Timber Availability- Managed Stand Site Index ±2m

7.2.6 No Genetic Gains

This sensitivity tests the timber supply impact of assuming no genetic gains for managed stands. The full managed stand assumptions including genetic gains that are used in the current practice with endemic MPB scenario are found in the *Information Package* (Timberline, 2007).

Table 7.10 and Figure 7.15 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 8.6% from 186,000m^3/year to 170,000m^3/year. In the long term, the harvest level is reduced by 12.4% from 209,000m^3/year to 183,000m^3/year.

Table 7.10 Harvest Level- No Genetic Gains

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	No Genetic Gains
2006-2115	186,000	170,000
2116-2255	209,000	183,000

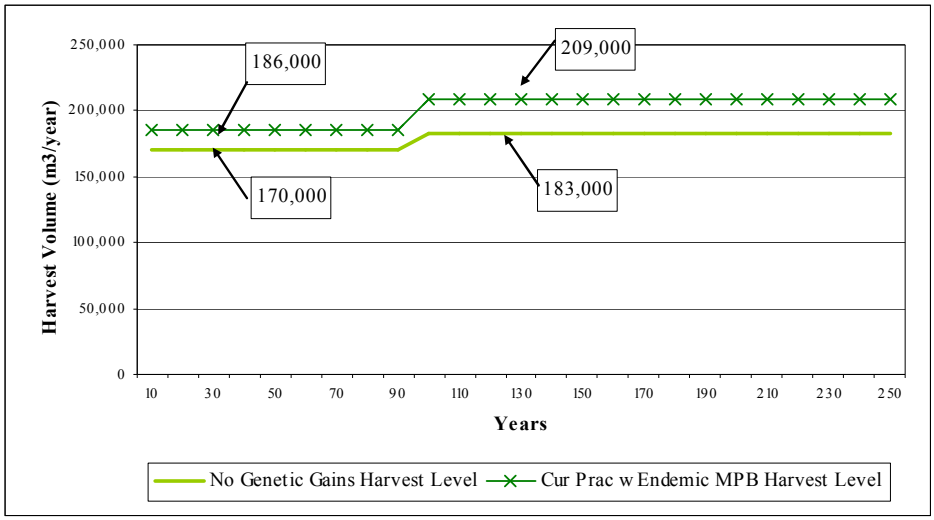

Figure 7.15 Harvest Level- No Genetic Gains

Figure 7.16 shows the timber availability of the current practice with endemic MPB and this sensitivity.

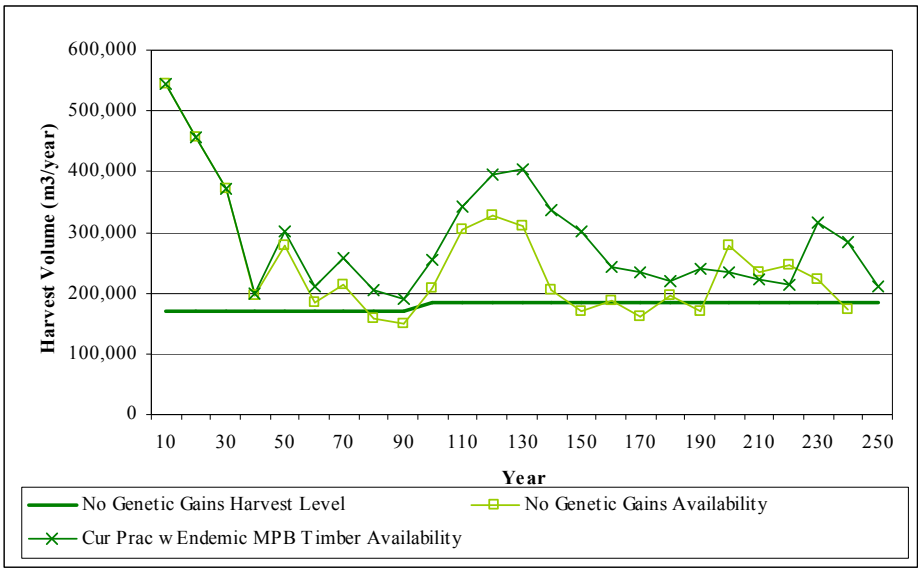

Figure 7.16 Timber Availability- No Genetic Gains

7.2.7 Increase Planted Stocking

This sensitivity tests the timber supply impact of increasing the managed stand stocking to 1,400 stems/ha across the board. All other managed stand assumptions are unchanged and can be found in the *Information Package* (Timberline, 2007).

Table 7.11 and Figure 7.17 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is increased by 3% from 186,000m^3/year to 191,000m^3/year. In the long term, the harvest level is increased by 11% from 209,000m^3/year to 233,000m^3/year.

Table 7.11 Harvest Level- Increase Planted Stocking

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	**Increase Planting Stocking**
2006-2115	186,000	191,000
2116-2255	209,000	233,000

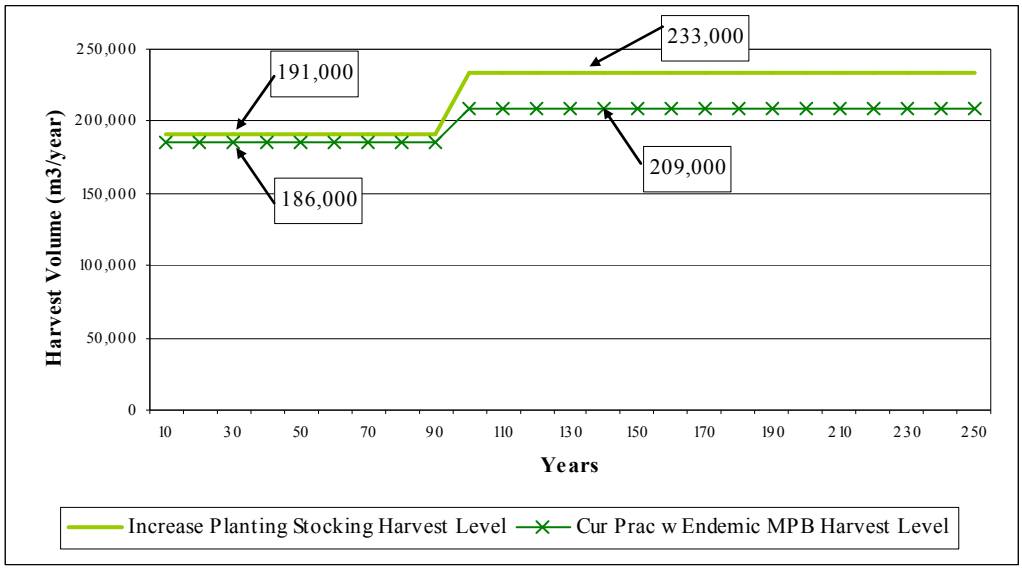

Figure 7.17 Harvest Level- Increase Planted Stocking

Figure 7.18 shows the timber availability of the current practice with endemic MPB and this sensitivity.

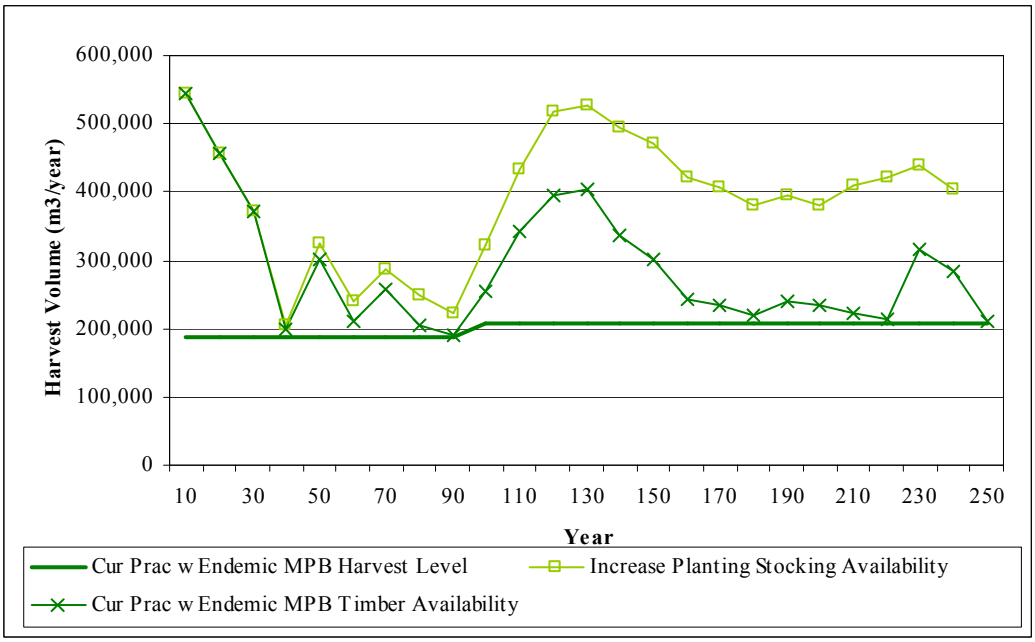

Figure 7.18 Timber Availability- Increase Planted Stocking

7.2.8 5 Inch Top Utilization Level

Volume conversion equations were developed and applied to the natural stand yield curves based on DBH. The volume conversion equation used in this sensitivity is shown below in Figure 7.19.

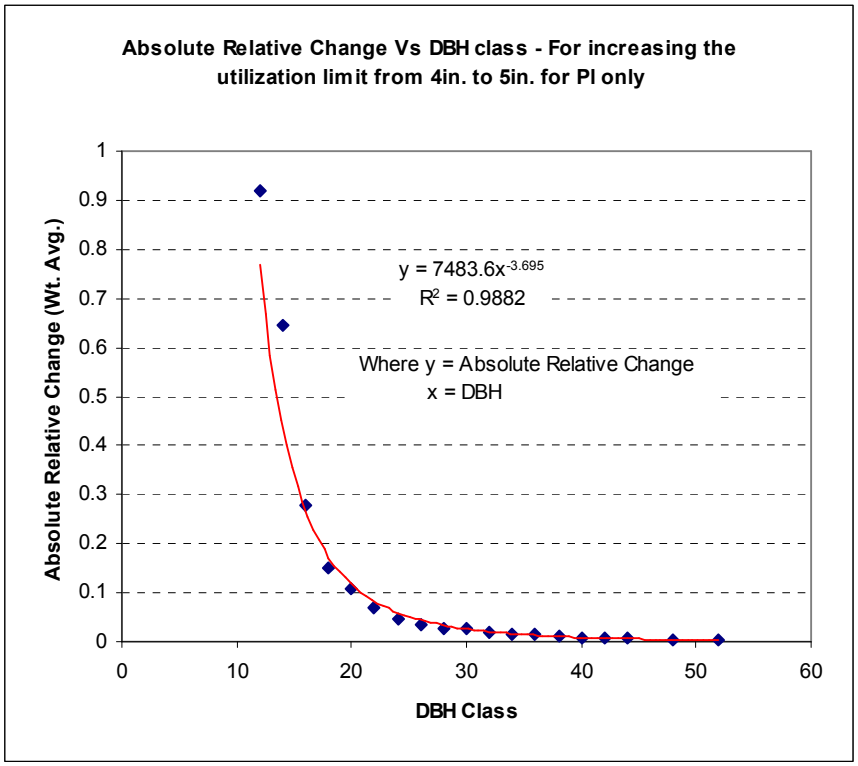

Figure 7.19 Volume Conversion Equation for converting from a 4" to 5" top

Table 7.12 and Figure 7.20 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 2% from 186,000m^3/year to 183,000m^3/year. In the long term, the harvest level is reduced slightly to 208,000m^3/year.

Table 7.12 Harvest Level- Maximum Volume

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	5 Inch Top Utilization Level
2006-2115	186,000	183,000
2116-2255	209,000	208,000

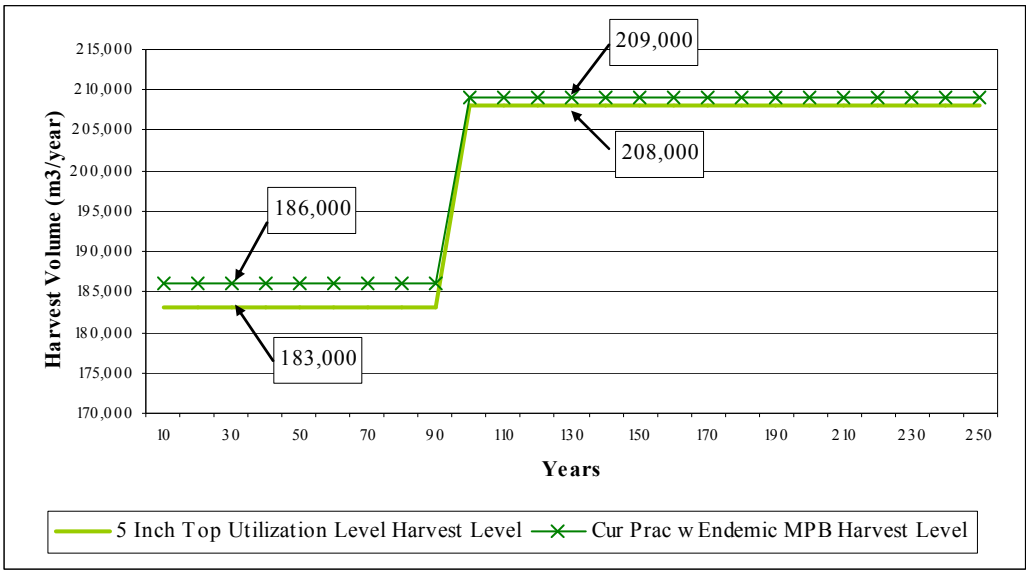

Figure 7.20 Harvest Level- Maximum Volume

Figure 7.21 shows the timber availability of the current practice with endemic MPB and this sensitivity.

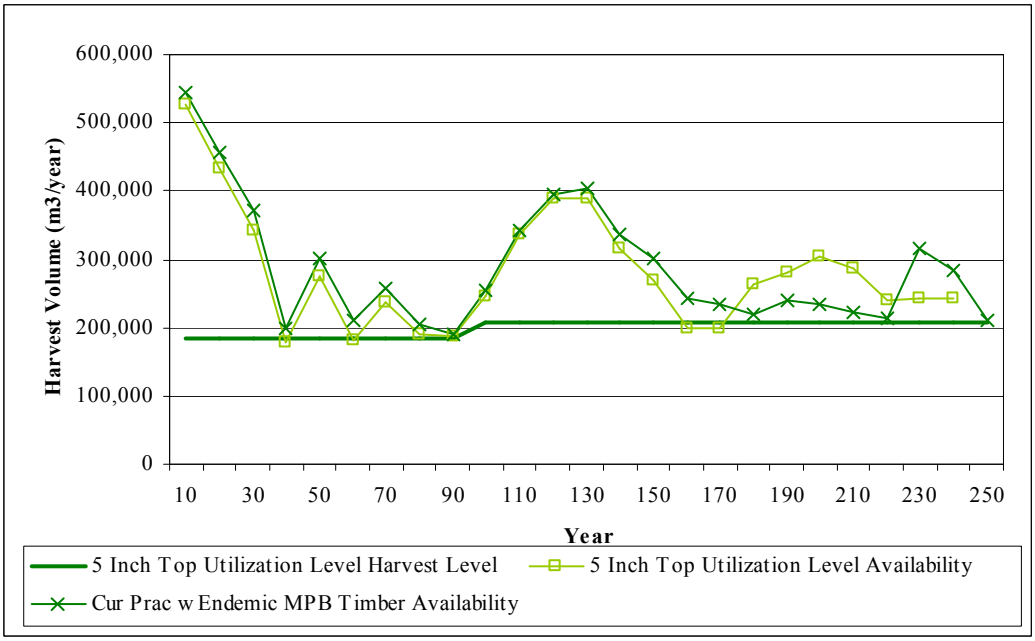

Figure 7.21 Timber Availability- Maximum Volume

7.3 Resource Emphasis Assumptions

7.3.1 Adjust green-up heights by ± 1 meter

Spatial adjacency has been modeled for 20 years in the current practice with endemic MPB scenario. Spatial adjacency is a disturbance constraint- the maximum area that can be younger than a specified age or shorter than a specified height. It is intended to model the green-up requirements for cutblock adjacency. In the practice with endemic MPB scenario, the green-up height of 2.5m will be applied across the THLB throughout the full planning horizon.

The green-up height of 2.5m was alternately increased and decreased by 1 meter to test the sensitivity to green-up height. Table 7.13 shows the harvest level for the current practice with endemic MPB scenario and these sensitivities. If green-up heights are increased or decreased by 1m, there is no change in mid or long term harvest level.

Table 7.13 Harvest Level- Green-up Height ± 1m

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	Green Up Height +/- 1 m
2006-2115	186,000	186,000
2116-2255	209,000	209,000

Figure 7.22 shows the timber availability for the current practice with endemic MPB and the two green-up height sensitivities. There is no change in the timber availabilities.

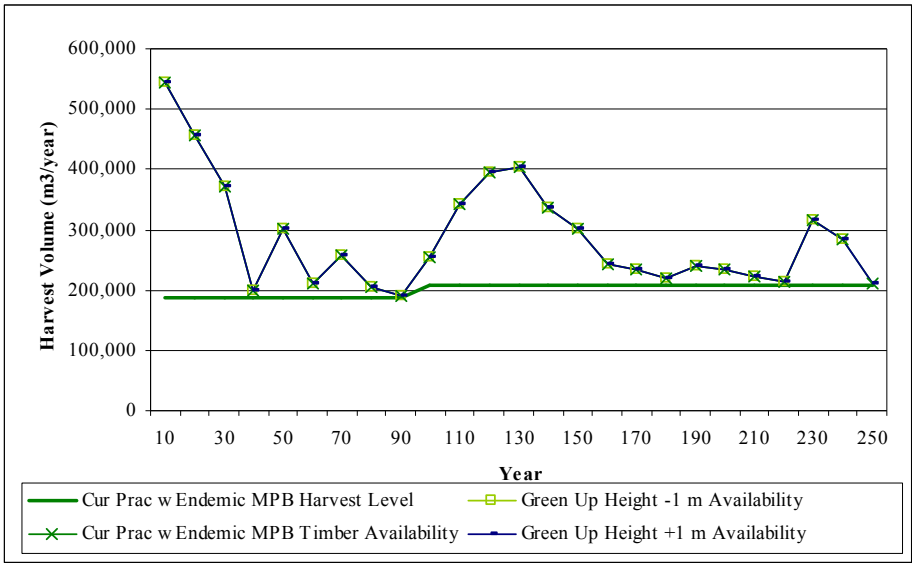

Figure 7.22 Timber Availability- Green-up height ± 1m

7.3.2 No Moose REA

The sensitivity of the TFL 8 timber supply to the Moose resource emphasis area (REA) is tested in this sensitivity by removing the Moose REA constraints completely. Moose REAs had a maximum disturbance constraint of 20% <16m height and a minimum retention constraint of 60% over 30 years. These constraints were met over 2,870 THLB ha and within 8 planning cells (see the *Information Package* 2006 for more detail).

Table 7.14 and Figure 7.23 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is increased by 2% from 186,000m^3/year to 189,000m^3/year. In the long term, the harvest level is unchanged at 209,000m^3/year.

Table 7.14 Harvest Level- no Moose REA

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	No Moose REA
2006-2115	186,000	189,000
2116-2255	209,000	209,000

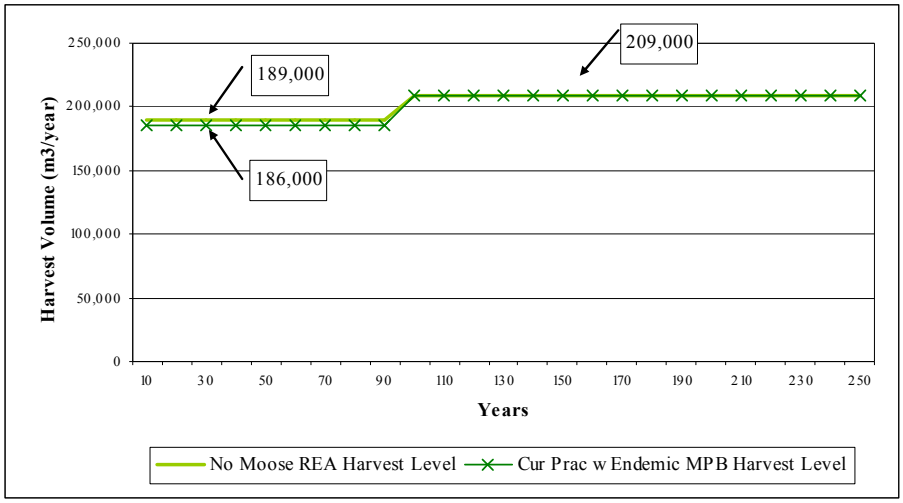

Figure 7.23 Harvest Level- no Moose REA

Figure 7.24 shows the timber availability of the current practice with endemic MPB and this sensitivity.

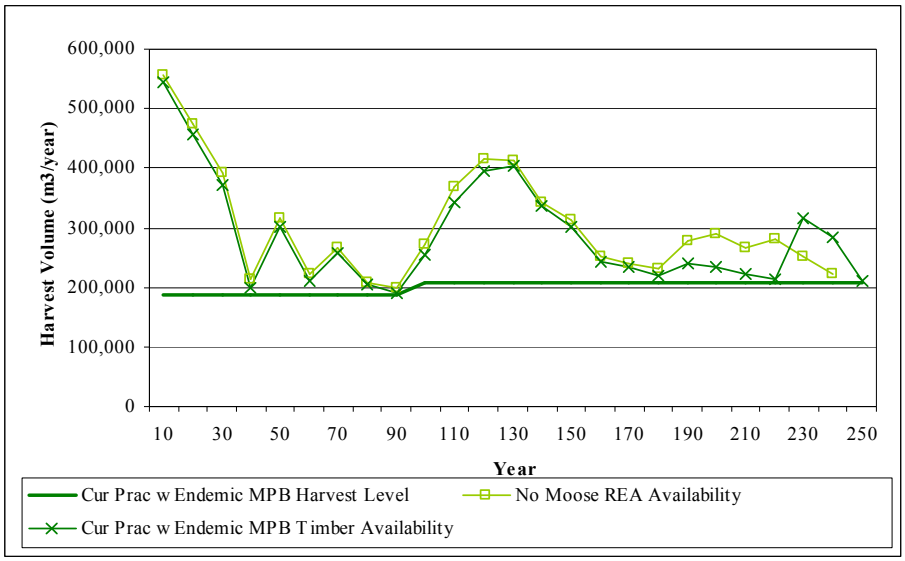

Figure 7.24 Timber Availability- no Moose REA

7.3.3 Williamson Sapsucker WHA

This sensitivity tests the timber supply impact of removing areas identified as Williamson Sapsucker wild life habitat areas from the THLB. These areas are classed as non-THLB productive, and can contribute to forest cover requirements. An area of 338 ha was removed from the THLB. The timber supply impact of this was -1% in the mid term and 0% (no change) in the long term.

7.4 Biodiversity Assumptions

7.4.1 IRM on (No Spatial Adjacency)

In the current practice with endemic MPB scenario, spatial adjacency was controlled for 20 years. Spatial adjacency is a disturbance constraint that is intended to model the green-up requirements for cutblock adjacency. In this sensitivity, spatial adjacency will be turned off and the aspatial substitute will be turned on. The total THLB area is classified by integrated resource management (IRM) zone, which is a combination of LU and BEC. Each IRM zone will be managed by applying a disturbance constraint of 2.5m.Table 7.15 shows the area in each IRM zone.

Table 7.15 IRM Zones

LU-KBHLPO BEC	THLB Area (ha)
B1-IDFdm1	4,065
B1-MSdm1	1,714
B7-ESSFdc1	5,024
B7-ICHmk1	4,929
B7-ICHmw2	251
B7-IDFdm1	5,722
B7-MSdm1	12,946
B7-MSdm1a	928

B8-ESSFdc1	3,204
B8-IDFdm1	8,838
B8-MSdm1	16,982

Table 7.16 and Figure 7.25 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 1% from 186,000m^3/year to 185,000m^3/year. In the long term, the harvest level is unchanged from 209,000m^3/year.

Table 7.16 Harvest Level- IRM on

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	IRM on (no adjacency)
2006-2115	186,000	185,000
2116-2255	209,000	209,000

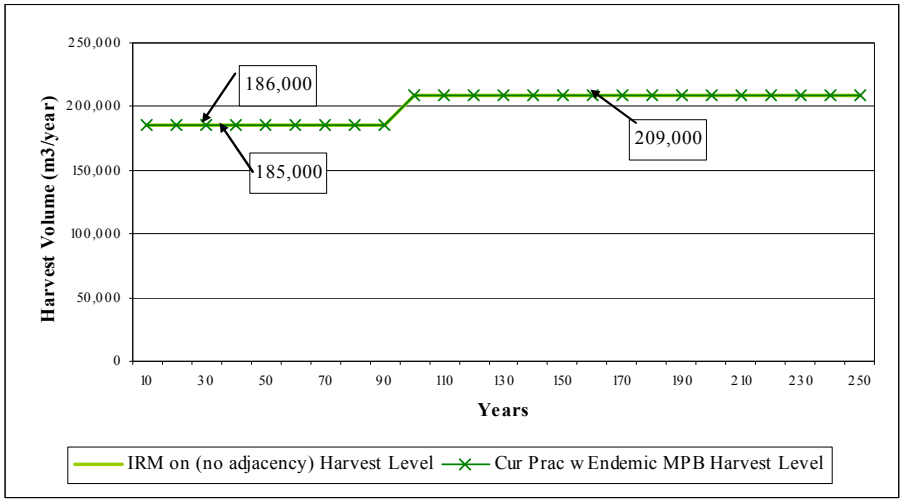

Figure 7.25 Harvest Level- IRM on

Figure 7.26 shows the timber availability of the current practice with endemic MPB and this sensitivity.

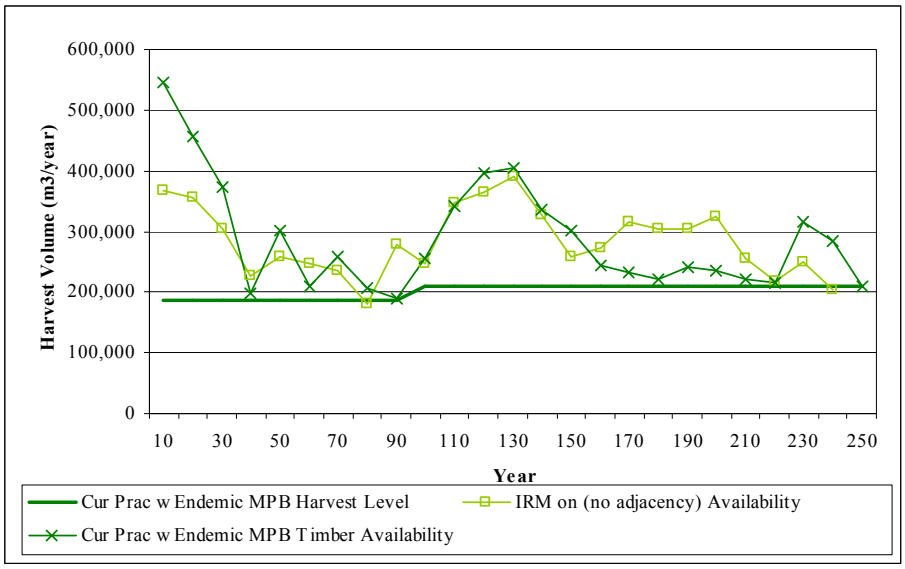

Figure 7.26 Timber Availability- IRM on

7.4.2 No Disturbances in the Non-THLB

In the current practice with endemic MPB scenario, natural death and disturbances in the non-THLB are modeled by imposing disturbance and retention regime (by BEC) based on the natural range of variation (NROV) found in the *Biodiversity Guidebook*. The purpose of this is to address the issue of continuous aging of the non-THLB throughout the planning horizon and therefore unrealistic contribution to fulfilling various land base requirements.

This sensitivity tests the timber supply impact of removing these disturbances in the non-THLB and letting it age continuously. For more information about the disturbance and retention regime imposed, please see the *Information Package.*

Table 7.17 shows the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid and long term harvest level is unchanged. This is reasonable because the non-THLB is only 10% of the total productive area of TFL 8.

Table 7.17 Harvest Level- no Disturbances in the non-THLB

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	**No Disturbances in the Non-THLB**
2006-2115	186,000	186,000
2116-2255	209,000	209,000

7.4.3 Spatial OGMA Netdown

In the current practice with endemic MPB scenario, landscape level biodiversity is managed through seral constraints. See the *Information Package* for more details. As a spatial alternative, this sensitivity tests the timber supply impact of removing the existing proposed old growth management areas (OGMAs) from the THLB land base into the non-THLB productive forest.

Table 7.18 shows the area removed from the THLB as spatial OGMAs is 4,979ha or 8% of the THLB area.

Table 7.18 Spatial OGMA Netdown

Area	Cur Prac w Endemic MPB	Spatial OGMA Netdown
THLB	64,604	59,625
Non-THLB Productive	7,789	12,768
Total Productive	72,393	72,393

Table 7.19 and Figure 7.27 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 2% from 186,000m^3/year to 183,000m^3/year. In the long term, the harvest level is unchanged from 209,000m^3/year.

Table 7.19 Harvest Level- Spatial OGMA Netdown

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	Spatial OGMA Netdown
2006-2115	186,000	183,000
2116-2255	209,000	209,000

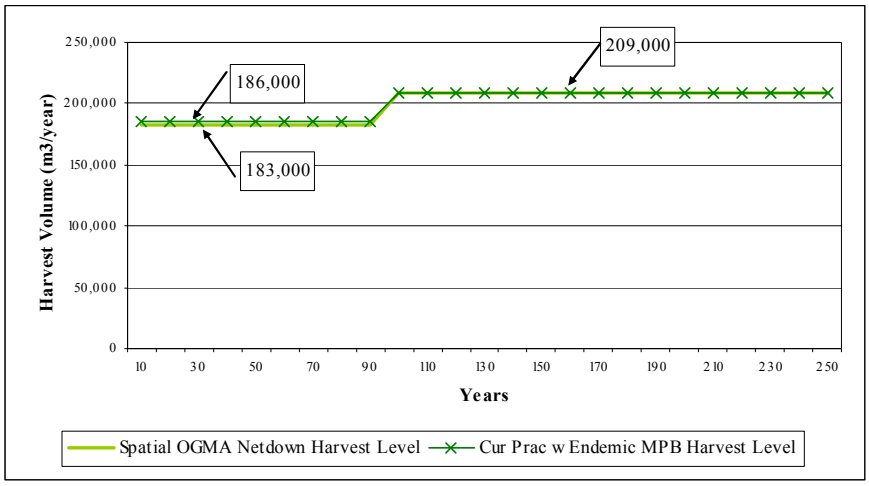

Figure 7.27 Harvest Level- Spatial OGMA Netdown

Figure 7.28 shows the timber availability of the current practice with endemic MPB and this sensitivity.

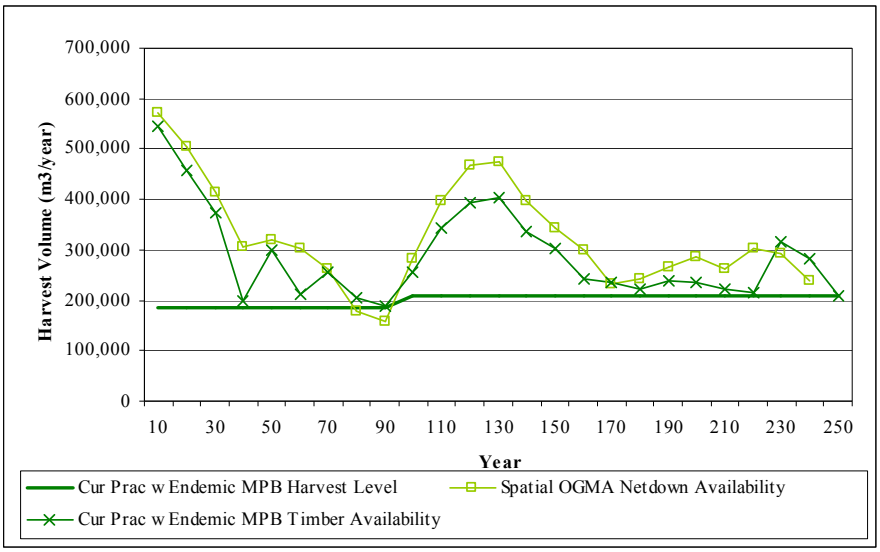

Figure 7.28 Timber Availability- Spatial OGMA Netdown

7.5 Harvest Rules

7.5.1 Maximum Volume Harvest Rule

Table 7.20 and Figure 7.29 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level is decreased by 3% from 186,000m^3/year to 181,000m^3/year. In the long term, the harvest level is unchanged from 209,000m^3/year.

Table 7.20 Harvest Level- Maximum Volume

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	Maximum Volume Harvest Rule
2006-2115	186,000	181,000
2116-2255	209,000	208,000

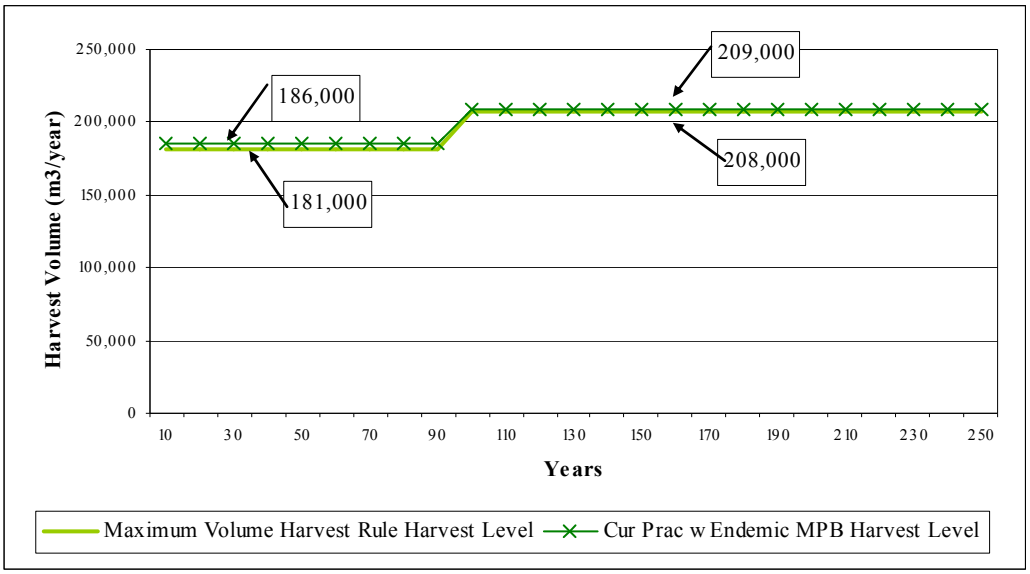

Figure 7.29 Harvest Level- Maximum Volume

Figure 7.30 shows the timber availability of the current practice with endemic MPB and this sensitivity.

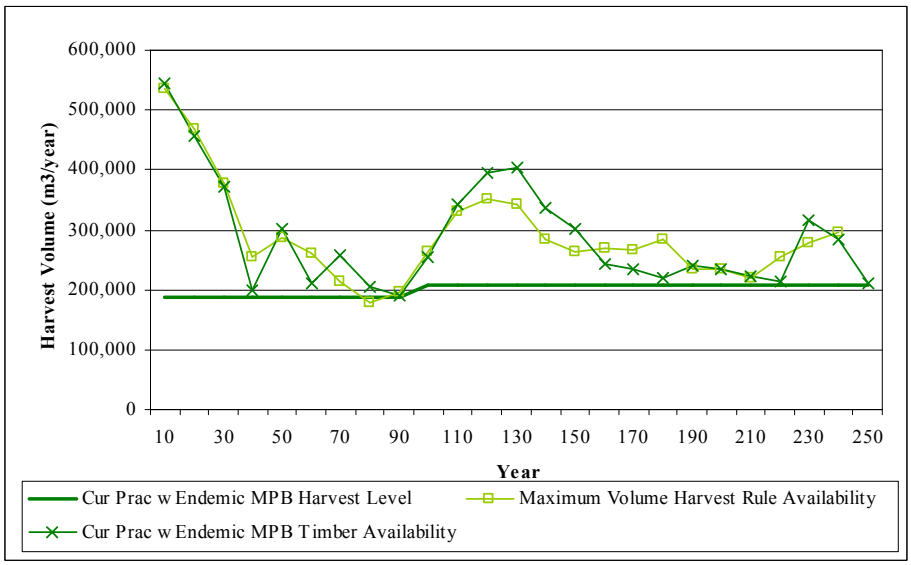

Figure 7.30 Timber Availability- Maximum Volume

7.5.2 Relative Oldest Harvest Rule

Table 7.21 and Figure 7.31 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level remains unchanged at 186,000m^3/year. In the long term, the harvest level is unchanged from 209,000m^3/year.

Table 7.21 Harvest Level- Relative Oldest

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	Relative Oldest Harvest Rule
2006-2115	186,000	186,000
2116-2255	209,000	209,000

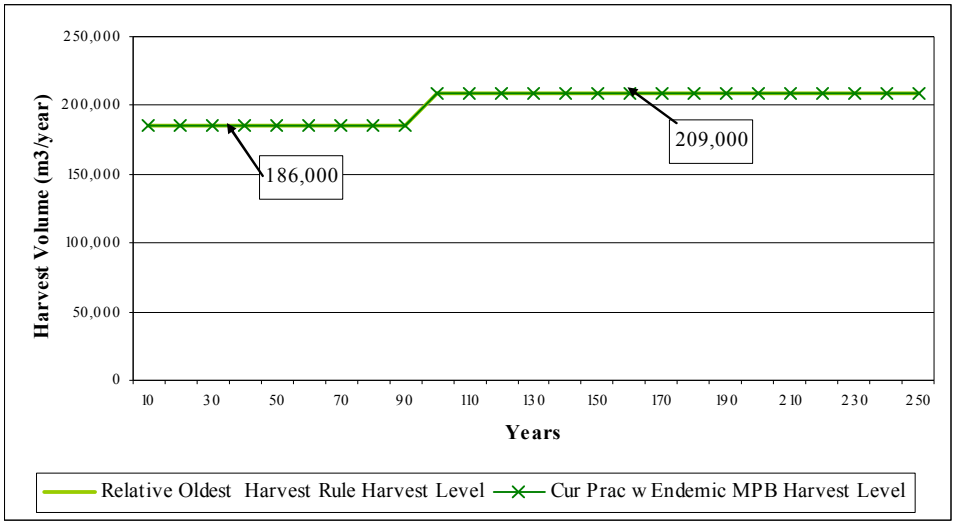

Figure 7.31 Harvest Level- Relative Oldest

Figure 7.32 shows the timber availability of the current practice with endemic MPB and this sensitivity.

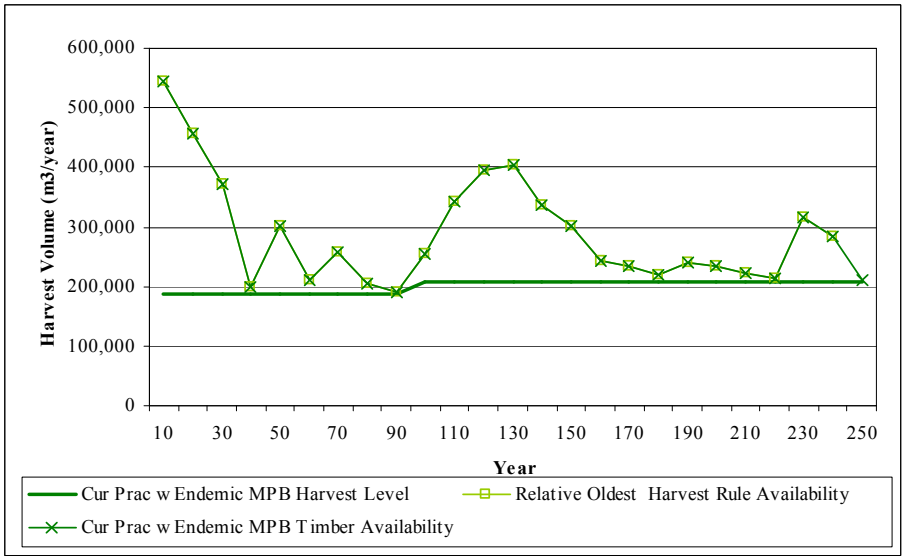

Figure 7.32 Timber Availability- Relative Oldest

7.5.3 10 Year Maximum Harvest

This sensitivity tests the timber supply impact of maximizing the 10 year harvest level while still keeping the mid term harvest level above the natural long run sustainable yield (LRSY) of 128,000m^3/year. Table 7.22 and Figure 7.33 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The 10 year maximum harvest level that is attainable was found to be 316,000m^3/year. The mid term harvest level was set at the natural LRSY of 128,000m^3/year. In the long term, the harvest level is changed from 209,000m^3/year to 211,000m^3/year, an insignificant increase of 1%. The timber availability for this sensitivity is identical to the current practice with endemic MPB because no input assumptions have changed (only harvest level).

Table 7.22 Harvest Level- 10 Year Maximum Harvest

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	10 Yr Max Harvest with midterm above natural LRSY
2006-2015	186,000	316,000
2016-2115	186,000	128,000
2116-2255	209,000	211,000

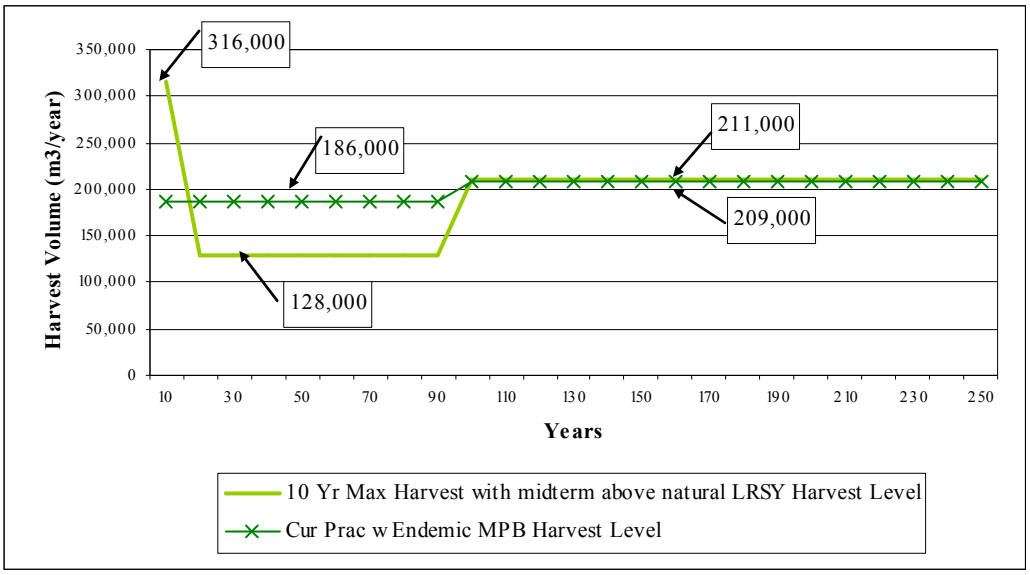

Figure 7.33 Harvest Level- 10 Year Maximum Harvest

7.5.4 Forest Analysis Branch Scenario

After Forest Analysis Branch (FAB) review of the *Information Package* (Timberline, 2007), three main assumptions that affect the timber supply level were identified and altered. These were:

- Low stocking in some managed stand assumptions.
- NSR area not recovered into the THLB; and
- NRLs did not include an allowance for small scale salvage (SSS).

The first two issues were dealt with individually in separate sensitivity analyses and are documented earlier in this report. This scenario looks at all three assumption changes simultaneously, in order to investigate the timber supply impact. The assumptions changed from the basecase in this scenario are:

1. Low Stocking: all managed stands were assumed to be planted at 1,400 stems/ha
2. NSR: All NSR was regenerated on a managed stand yield curve on the THLB from age 0; and
3. SSS: NRLs had an additional 4,000 m^3/year added onto them to account for SSS. This puts the total NRLs in this scenario at 5,000m^3/year[2].

Table 7.23 and Figure 7.34 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. The mid term harvest level remains unchanged at 186,000m^3/year. In the long term, the harvest level is increased from 209,000m^3/year to 237,000m^3/year.

Table 7.23 Harvest Level- FAB Scenario

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	FAB Scenario
2006-2115	186,000	186,000
2116-2255	209,000	237,000

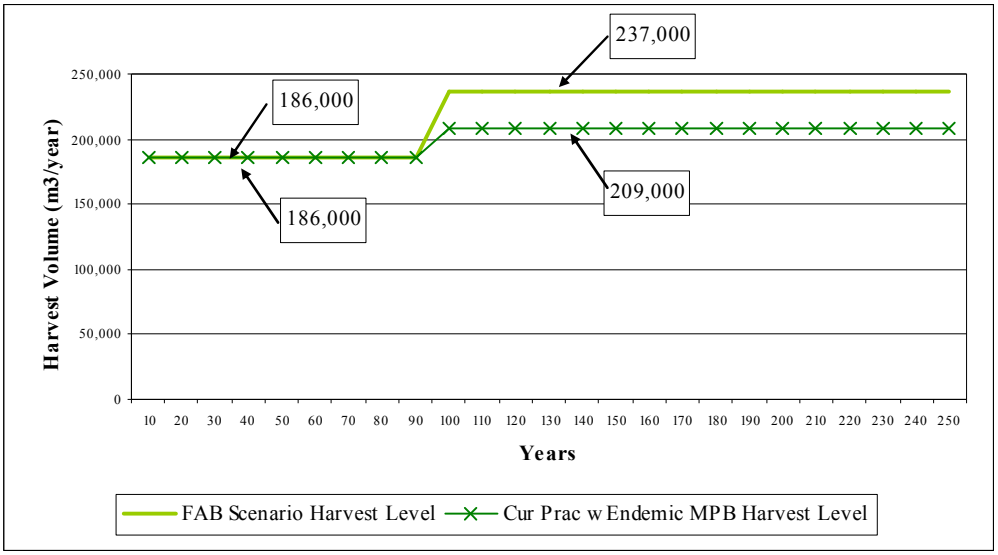

Figure 7.34 Harvest Level- FAB Scenario

Figure 7.35 shows the timber availability of the current practice with endemic MPB and this sensitivity.

2 There was a range in estimates for SSS harvest between 1,500 – 5,100 m^3/year. This scenario used 4,000 m^3/year additional NRLS for SSS because it was a reasonable estimate that conveniently leaves the harvest level unchanged.

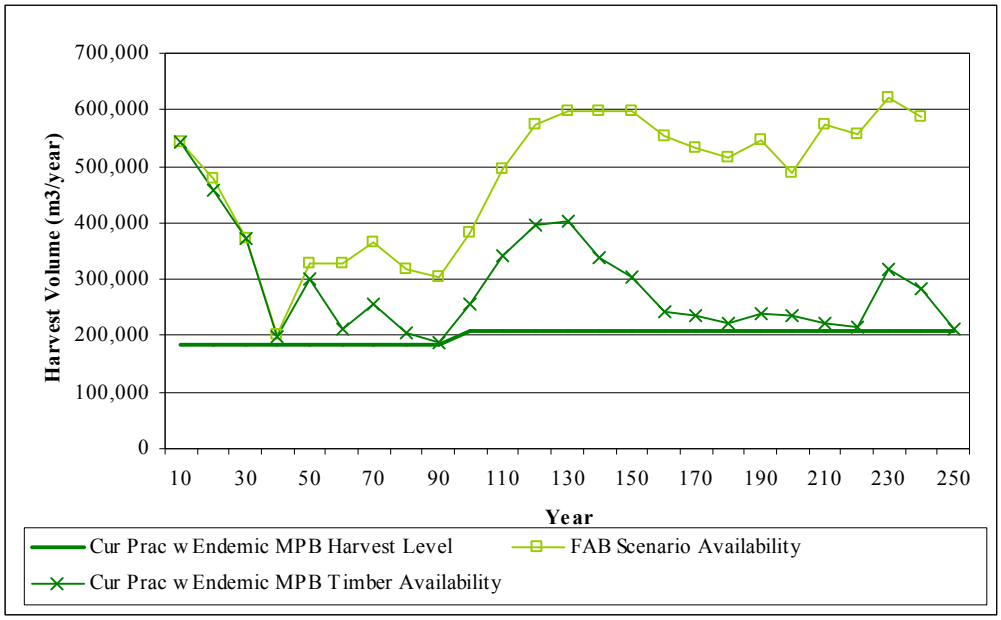

Figure 7.35 Timber Availability- FAB Scenario

7.6 Summary of Non-MPB Sensitivities

Table 7.24 shows a summary of mid and long term harvest levels for the above sensitivities.

Table 7.24 Summary of Non-MPB Sensitivities

Description	Short/Mid Term	Long Term
Current Practice with Endemic MPB	186,000	209,000
THLB - 5%	172,000	200,000
Natural Stand Yields + 10%	188,000	203,000
Natural Stand Yields - 10%	169,000	212,000
Managed Stand Yields + 10%	189,000	232,000
Managed Stand Yields - 10%	170,000	183,000
Minimum Harvest Age + 10%	175,000	210,000
Minimum Harvest Age - 10%	187,000	206,000
Site Index + 1m	189,000	200,000
Site Index - 1m	186,000	208,000
Site Index + 2m	192,000	245,000
Site Index - 2m	164,000	164,000
No Genetic Gains	170,000	183,000
Increase Planted Stocking to 1400 st/ha	191,000	233,000
Bring NSR into the THLB	189,000	217,000
Green up Height + 1m	186,000	209,000
Green up Height - 1m	186,000	209,000
IRM on and Spatial Adjacency Off	185,000	209,000
No Moose REA	189,000	209,000
No Disturbances in the non-THLB	186,000	209,000
Harvest Rule Maximum Volume	181,000	208,000
Harvest Rule Relative Oldest	186,000	209,000
Spatial OGMAs used	183,000	209,000
Maximum 10 year harvest with mid term above Natural LRSY	316,000/129,000	211,000
FAB Scenario	186,000	237,000

8. EPIDEMIC MPB SENSITIVITIES

Currently TFL 8 and the Arrow/Boundary Forest District are experiencing endemic MPB populations that are on the decline (Rick Mazzocchi, 2007). However, it is projected that on TFL 8 7,300 ha of THLB will be severely affected by MPB by 2011 and an additional 2,100 ha by 2016 (Eng et.al., 2006). The current endemic levels and the projected epidemic levels of MPB in TFL 8 introduce complexity to the immediate management decision. To address this complexity a series of analyses has been run to understand the impact of an MPB epidemic.

The MPB epidemic has been modeled using the MoFR MPB Projections assuming the following:

- Pine leading very severe(VS)[3] MPB attacked stands are prioritized for harvest and are available from the time they are over 50% affected until their shelf life[4] expires. For these stands:
    - Spatial adjacency is not enforced;
    - Visuals and IRM are not enforced; and
    - Stands have increased retention of 13% to account for the 20% retention recommended in the large scale salvage areas (MoFR, 2004);
    - Minimum harvest age is reduced to age 40 to ensure no MPB-attacked stands are tied up inadvertently.
- MPB affected stands harvested prior to the expiration of their shelf life grow in managed stand yield curves;
- Pine leading MPB stand unable to be harvested prior to the expiration of their shelf life loose 100% of their volume and grow back on natural stand yield curves with a 15 year regeneration delay[5]; and
- Non-pine leading MPB affected stands not harvested have volume reduction according to the levels of infestation (severe (S) 40%, moderate (M) - 20% and low (L) - 5%).

The full modeling details are in Section 10 of the *Information Package* (Timberline 2007). Table 8.1 outlines the combinations of initial harvest level, shelf life and % MPB targeted used in MPB sensitivities. Scenario 1b* is regarded as the current management with epidemic MPB scenario and will be used to compare other sensitivities against.

[3] Very Severe MPB attack refers to the severity of MPB infestation. Following the MoFR forest health overview classification system, very severe (VS) classification describes a stand that is >50% affected, severe (S) is 30-50% affected, moderate (M) is 10-30% affected, low (L) is 1-10% affected and trace (T) is <1% affected.

[4] Shelf life is defined as the length of time in years a stand is available for conventional sawlog harvesting after being attacked by MPB.

[5] Regeneration delay is the length of time in years a stand is assumed to be unstocked with timber species after shelf life has expired.

Table 8.1 MPB Sensitivities

Scenario	Initial Harvest Level	Shelf life	% MPB Targeted
1a-shelf life 2yrs -35%MPB target	186,000	2	35%
1b*-shelf life 5yrs -35%MPB target	186,000	5	35%
1c-shelf life 7yrs -35%MPB target	186,000	7	35%
2-shelf life 5yrs -10%MPB target	186,000	5	10%
3a-shelf life 2yrs -50%MPB target	186,000	2	50%
3b-shelf life 5yrs -50%MPB target	186,000	5	50%
3c-shelf life 7yrs -50%MPB target	186,000	7	50%
4a-shelf life 2yrs -70%MPB target	186,000	2	70%
4b-shelf life 5yrs -70%MPB target	186,000	5	70%
5a-shelf life 2yrs -50%MPB target	260,000	2	50%
5b-shelf life 5yrs -50%MPB target	260,000	5	50%
5c-shelf life 7yrs -50%MPB target	260,000	7	50%
Faster MPB Spread	180,000	5	35%

This section summarizes the results of various MPB sensitivities.

8.1.1 Current Practice with Epidemic MPB- 35% MPB target and 5 year shelf life

This sensitivity models the impact of introducing MPB projections with the assumptions of 35% MPB-attacked stands being targeted for harvest in the first 15 years and a 5 year shelf life.

Table 8.2 and Figure 8.1 show the harvest level for the current practice with endemic MPB scenario and this sensitivity. In the short term the harvest level is set at the maximum non declining yield level of 186,000m^3/year. After MPB death is modeled, the mid term harvest level drops to 159,000m^3/year. In the long term, the harvest level is unchanged at 209,000m^3/year.

Table 8.2 Harvest Level- 35% MPB and 5 year shelf life

Year	Harvest Level (m^3/year)	
	Cur Prac w Endemic MPB	**Cur Prac w Epidemic MPB**
2006-2020	186,000	186,000
2021-2110	186,000	159,000
2111-2270	209,000	209,000

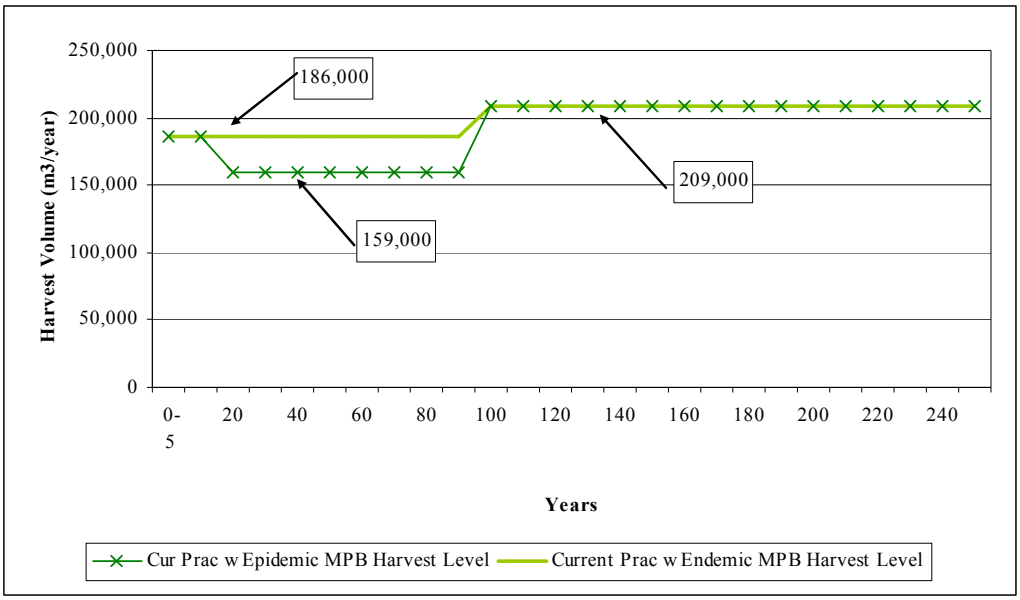

Figure 8.1 Harvest Level- 35% MPB and 5 year shelf life

Figure 8.2 shows the timber availability of this sensitivity.

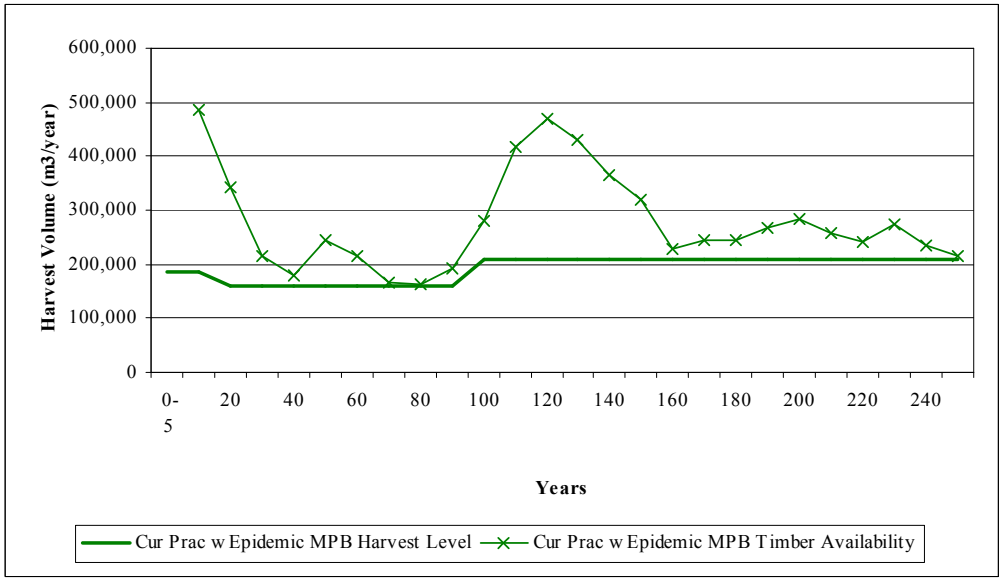

Figure 8.2 Timber Availability- 35% MPB and 5 year shelf life

Table 8.3 presents the volume loss associated with MPB mortality in this sensitivity. Of the total ~9,000 ha very severe MPB attack, 40% was harvested and 60% experienced mortality.

Table 8.3 MPB Loss- 35% MPB and 5 year shelf life

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
VS THLB	9,173	3,625	5,549

8.1.2 Shelf life sensitivity around 35% MPB target

This section shows the timber supply impact of changing the 5 year shelf life from the sensitivity above, to 2 years and 7 years.

Table 8.4 and Figure 8.3 show the harvest level for these sensitivities. In the short term the harvest level is kept constant at 186,000m^3/year. In the mid term, using a two year shelf life decreases the harvest level from 159,000m^3/year to 155,000m^3/year. Using a seven year shelf life increases the harvest level from 159,000m^3/year to 160,000m^3/year.

Table 8.4 Harvest Level- Shelf Life Sensitivity around 35% MPB target

Year	Harvest Level (m^3/year)		
	Cur Prac w Epidemic MPB	**2 yr Shelf Life**	**7 yr Shelf Life**
2006-2020	186,000	186,000	186,000
2021-2110	159,000	155,000	160,000
2111-2270	209,000	210,000	203,000

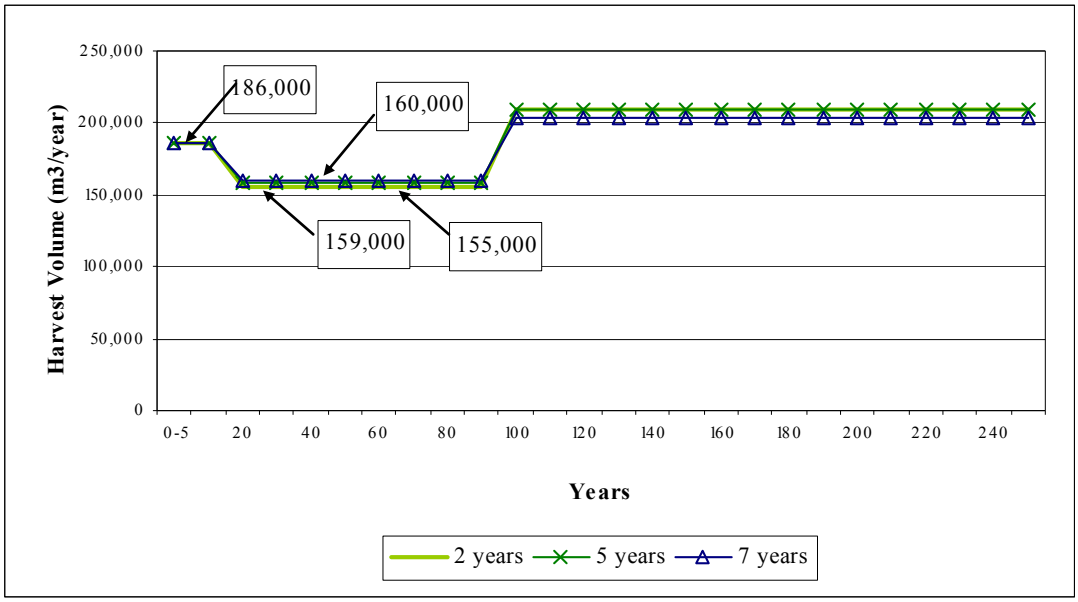

Figure 8.3 Harvest Level- Shelf Life Sensitivity around 35% MPB target

Figure 8.4 shows the timber availability of the current practice with epidemic and the two shelf life sensitivities.

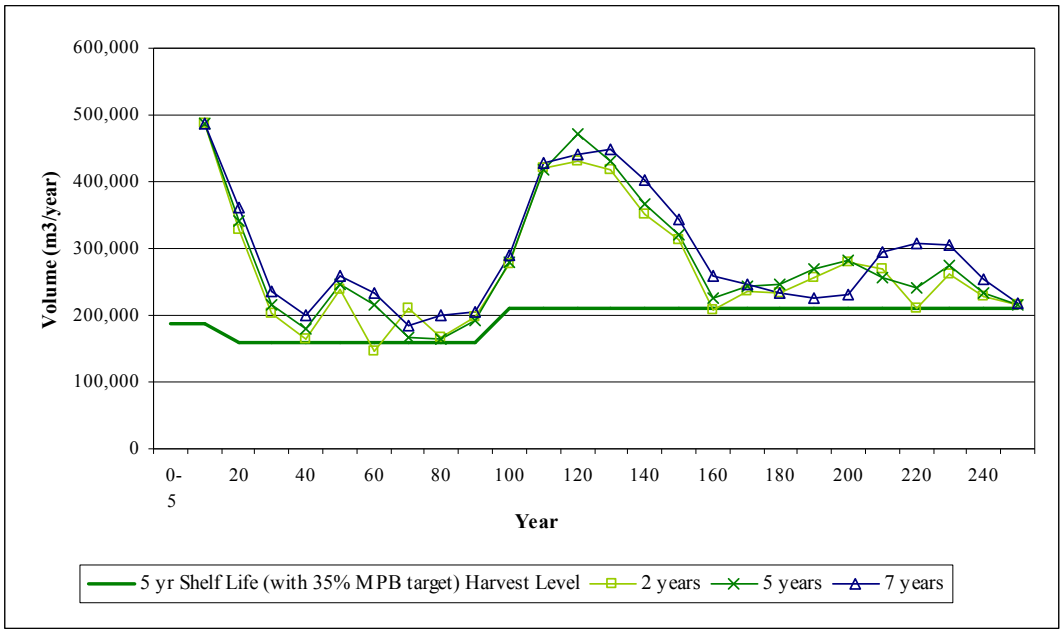

Figure 8.4 Timber Availability- Shelf Life Sensitivity around 35% MPB target

Table 8.5 presents the volume loss associated with MPB mortality in this sensitivity. The 5 year shelf life sensitivity harvested 40% of the total VS MPB attacked stands. With a 2 year shelf life, this is reduced to 32% and with a 7 year shelf life this is increased by 52%.

Table 8.5 MPB Loss- Shelf Life Sensitivity around 35% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
2 Year VS	9,173	2,894	6,280
7 Year VS	9,173	4,775	4,399

8.1.3 10% MPB Target

This sensitivity tests the timber supply impact of changing the percentage of MPB attacked stands from 35% to 10%. The shelf life is kept constant at 5 years.

Table 8.6 and Figure 8.5 show the harvest level for the current practice with epidemic MPB scenario and this sensitivity. In the mid term, the harvest level is decreased from 159,000m^3/year to 143,000m^3/year.

Table 8.6 Harvest Level- 10% MPB target

Year	Harvest Level (m^3/year)	
	Cur Prac w epidemic MPB	**10% MPB target (5yr shelf life)**
2006-2020	186,000	186,000
2021-2110	159,000	143,000
2111-2270	209,000	207,000

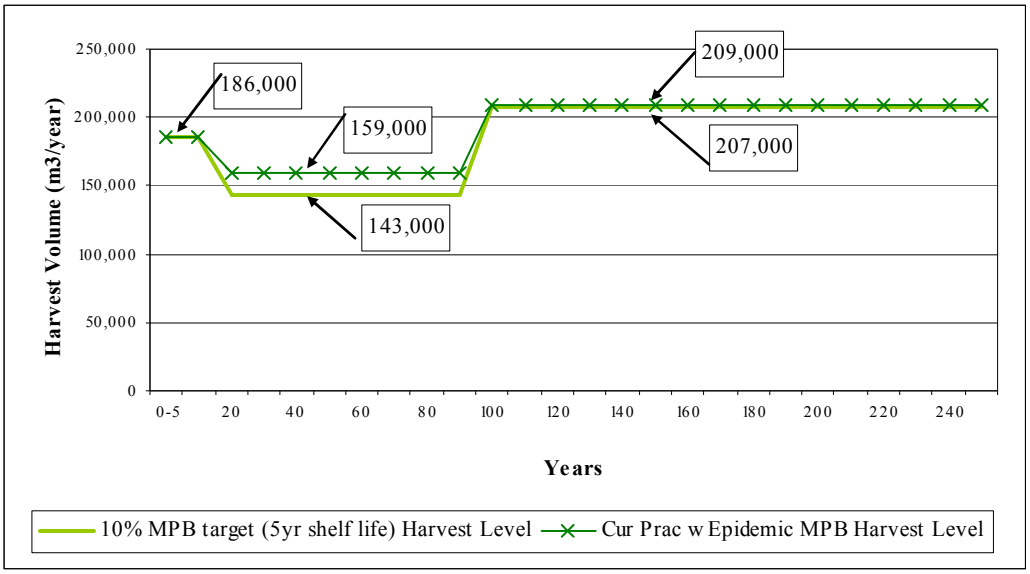

Figure 8.5 Harvest Level- 10% MPB target

Figure 8.6 shows the timber availability of these sensitivities.

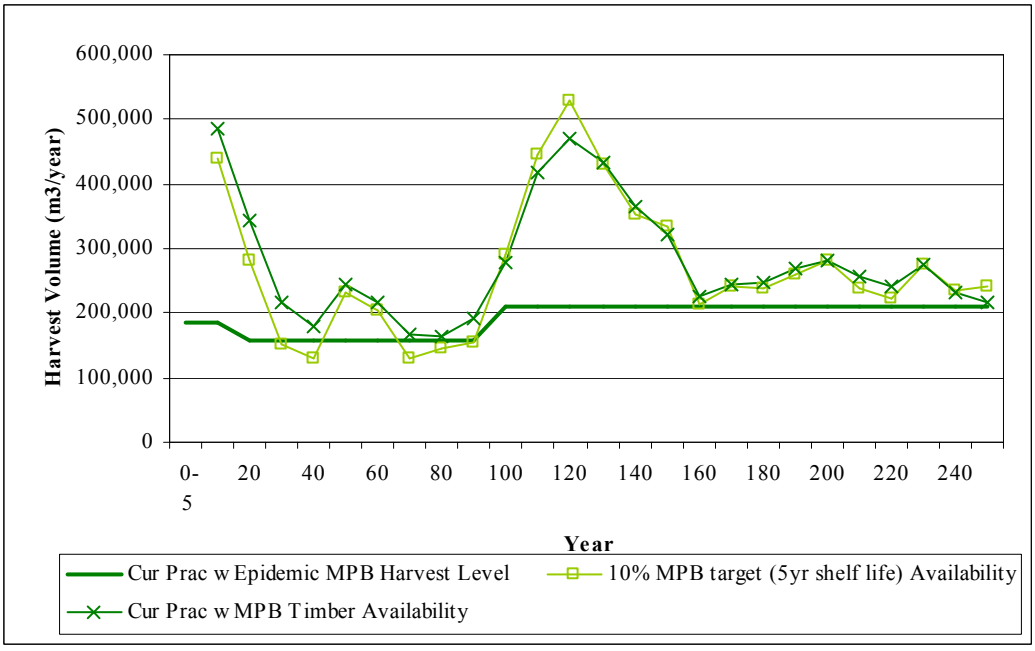

Figure 8.6 Timber Availability- 10% MPB target

Table 8.7 presents the volume loss associated with MPB mortality in this sensitivity. With 35% MPB-attacked stands being targeted, 40% of the total VS MPB attacked stands were harvested. With 10% being targeted, this is reduced to 9%.

Table 8.7 MPB Loss- 10% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
VS THLB	9,173	801	8,372

8.1.4 50% MPB Target

This sensitivity tests the timber supply impact of changing the percentage of MPB attacked stands from 35% to 50%. The shelf life is kept constant at 5 years.

Table 8.8 and Figure 8.7 show the harvest level for the current practice with epidemic MPB scenario and this sensitivity. In the mid term, the harvest level is increased from 159,000m^3/year to 166,000m^3/year.

Table 8.8 Harvest Level- 50% MPB target

Year	Harvest Level (m^3/year)	
	Cur Prac w epidemic MPB	**50% MPB target (5yr shelf life)**
2006-2020	186,000	186,000
2021-2110	159,000	166,000
2111-2270	209,000	206,000

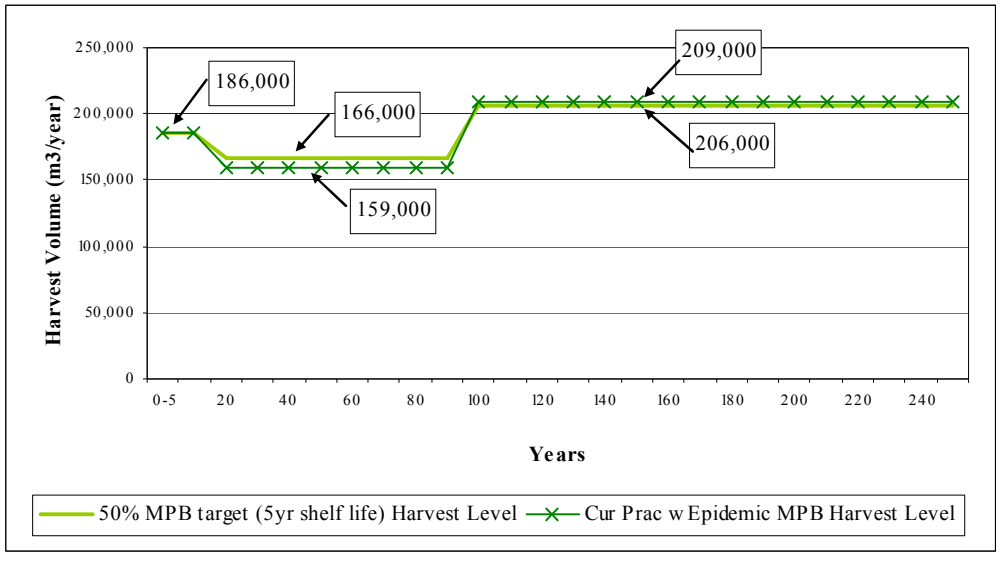

Figure 8.7 Harvest Level- 50% MPB target

Figure 8.8 shows the timber availability for these sensitivities.

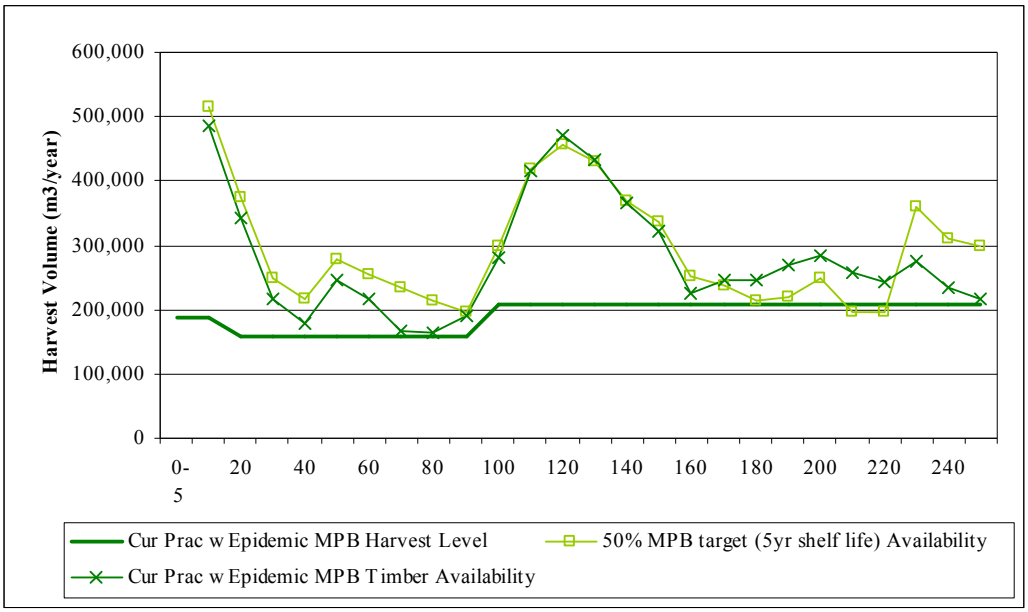

Figure 8.8 Timber Availability- 50% MPB target

Table 8.9 presents the volume loss associated with MPB mortality in this sensitivity. With 35% MPB-attacked stands being targeted in the current practice with epidemic MPB scenario, 40% of the total VS MPB attacked stands were harvested. With 50% being targeted, this is increased to 62%.

Table 8.9 MPB Loss- 50% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
VS THLB	9,173	5,713	3,460

8.1.5 Shelf life sensitivity around 50% MPB target

This section shows the timber supply impact of changing the 5 year shelf life from the sensitivity above to 2 years and 7 years.

Table 8.10 and Figure 8.9 show the harvest level for these sensitivities. In the short term the harvest level is kept constant at 186,000m^3/year. In the mid term, using a two year shelf life decreases the harvest level from 166,000m^3/year to 165,000m^3/year. Using a seven year shelf life increases the harvest level from 166,000m^3/year to 171,000m^3/year.

Table 8.10 Harvest Level- Shelf Life Sensitivity around 50% MPB target

Year	Harvest Level (m3/year)		
	50% MPB target (5yr shelf life)	50% MPB target (2yr shelf life)	50% MPB target (7yr shelf life)
2006-2020	186,000	186,000	186,000
2021-2110	166,000	165,000	171,000
2111-2270	206,000	210,000	203,000

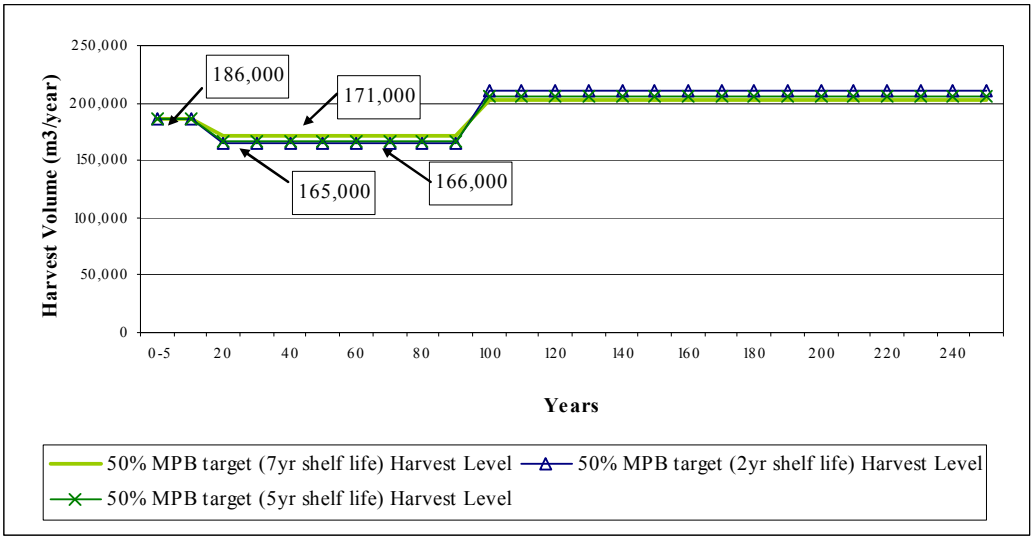

Figure 8.9 Harvest Level- Shelf Life Sensitivity around 50% MPB target

Figure 8.10 shows the timber availability of these sensitivities.

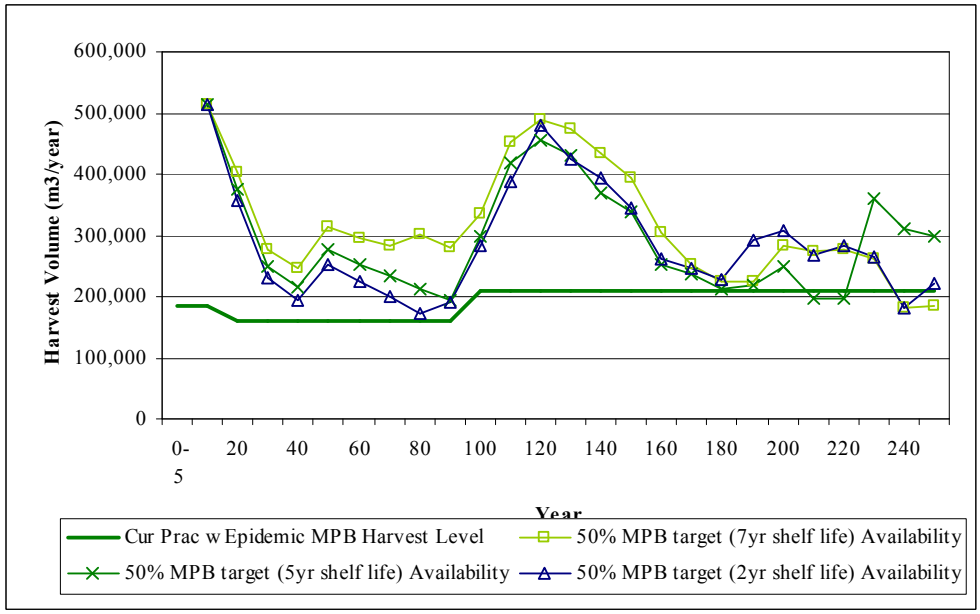

Figure 8.10 Timber Availability- Shelf Life Sensitivity around 50% MPB target

Table 8.11 presents the volume loss associated with MPB mortality in this sensitivity. With a 5 year shelf life, 62% of the total VS MPB attacked stands were harvested. With a 2 year shelf life, this is decreased to 50% and with a 7 year shelf life, this is increased to 81%.

Table 8.11 MPB Loss- Shelf Life Sensitivity around 50% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
5 year VS	9,173	5,713	3,640
2 year VS	9,173	4,585	4,588
7 year VS	9,173	7,450	1,723

8.1.6 70% MPB Target

This sensitivity tests the timber supply impact of changing the percentage of MPB attacked stands from 35% to 70%. The shelf life is kept constant at 5 years.

Table 8.12 and Figure 8.11 show the harvest level for the current practice with epidemic MPB scenario and this sensitivity. In the mid term, the harvest level is increased from 159,000m^3/year to 183,000m^3/year.

Table 8.12 Harvest Level- 70% MPB target

Year	Harvest Level (m^3/year)	
	Cur Prac w epidemic MPB	**70% MPB target (5yr shelf life)**
2006-2020	186,000	186,000
2021-2110	159,000	183,000
2111-2270	209,000	209,000

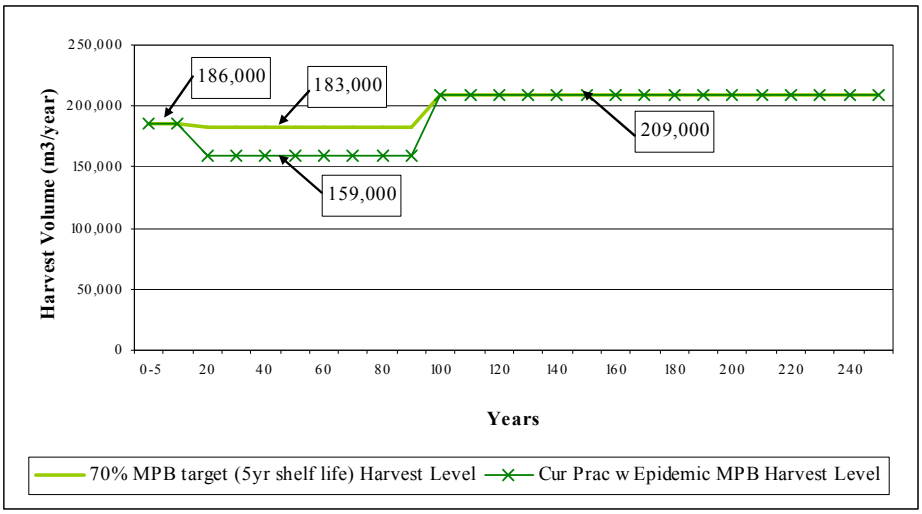

Figure 8.11 Harvest Level- 70% MPB target

Figure 8.12 shows the timber availability of these sensitivities.

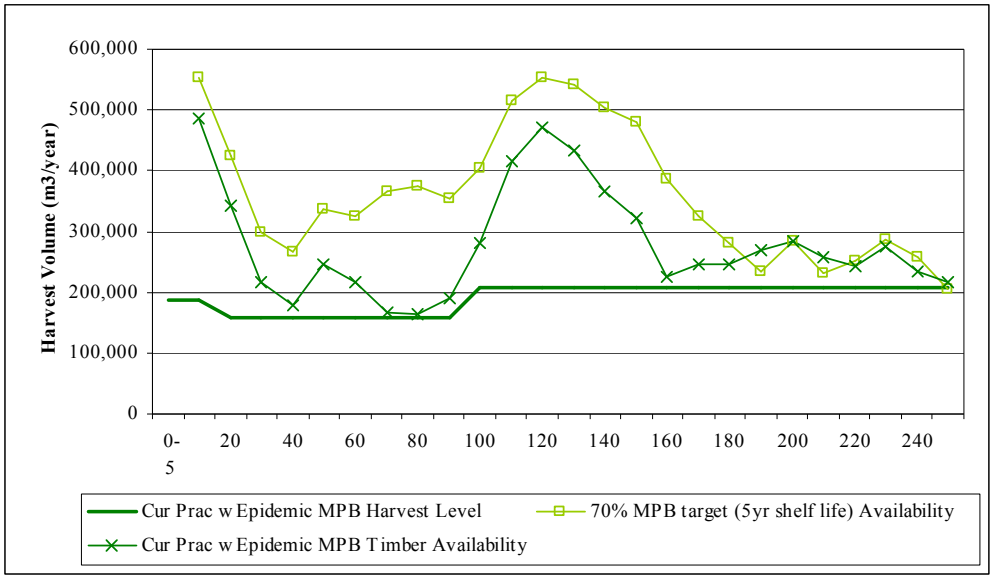

Figure 8.12 Timber Availability- 70% MPB target

Table 8.13 presents the volume loss associated with MPB mortality in this sensitivity. When 35% of the harvest in targeted at MPB-attacked stands, 40% of the total VS MPB attacked stands were harvested. By increasing the target percentage to 70%, this is increased to 98%.

Table 8.13 MPB Loss- 70% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
VS THLB	9,173	8,988	186

8.1.7 Shelf life sensitivity around 70% MPB target

This section shows the timber supply impact of changing the 5 year shelf life from the sensitivity above, to 2 years. A 7 year shelf life was not tested in this case because the 5 year shelf life at 70% MPB targeted was able to harvest 98% of the total VS targeted.

Table 8.14 and Figure 8.13 show the harvest level for these sensitivities. In the mid term, using a two year shelf life decreases the harvest level from 183,000m^3/year to 175,000m^3/year.

Table 8.14 Harvest Level- Shelf Life Sensitivity around 70% MPB target

Year	Harvest Level (m^3/year)	
	70% MPB target (5yr shelf life)	70% MPB target (2yr shelf life)
2006-2020	186,000	186,000
2021-2110	183,000	175,000
2111-2270	209,000	208,000

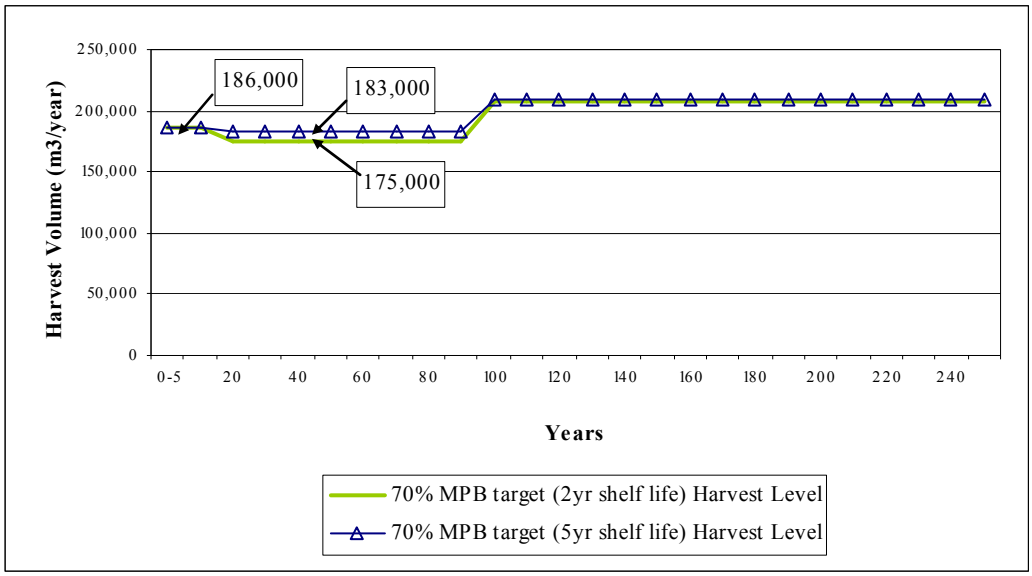

Figure 8.13 Harvest Level- Shelf Life Sensitivity around 70% MPB target

Figure 8.14 shows the timber availability of these sensitivities.

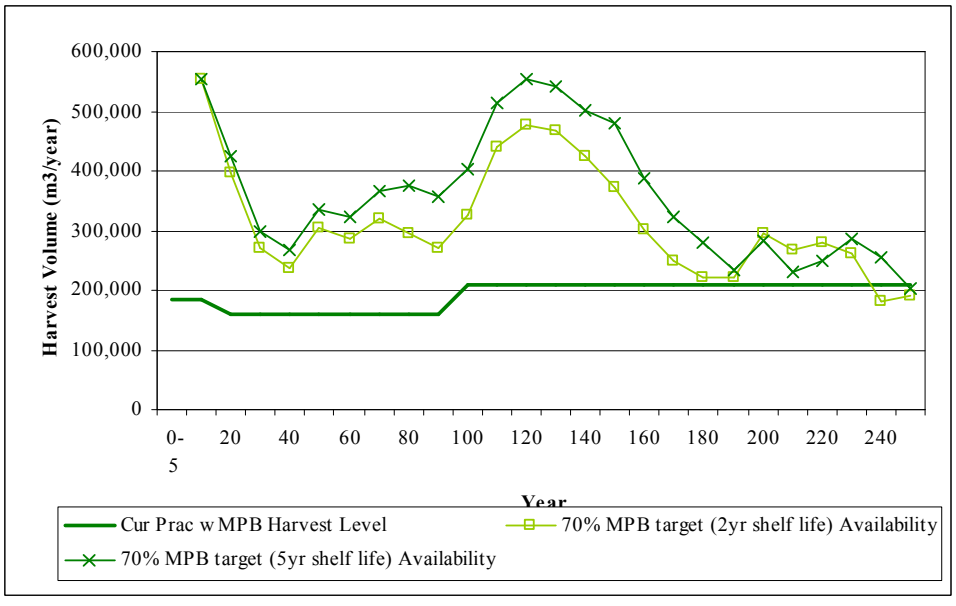

Figure 8.14 Timber Availability- Shelf Life Sensitivity around 70% MPB target

Table 8.15 presents the volume loss associated with MPB mortality in this sensitivity. With a 5 year shelf life, 98% of the total VS MPB attacked stands were harvested. By using a 2 year shelf life, this decreased to 79%.

Table 8.15 MPB Loss- Shelf Life Sensitivity around 70% MPB target

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
5 year VS	9,173	8,988	186
2 year VS	9,173	7,219	1,954

8.1.8 Harvest All MPB in 50% of Cut

This sensitivity tests the timber supply impact of harvesting all predicted VS MPB-attacked stands while keeping these stands at 50% of the total harvest. Table 8.16 and Figure 8.15 show the harvest level for the current practice with epidemic MPB scenario and this sensitivity. The short term harvest level is increased from 186,000m^3/year to 256,000m^3/year in order to capture all the VS MPB-attacked stands in 50% of the harvest. In the mid term, the harvest level is decreased from 159,000m^3/year to 152,000m^3/year. The long term is increased slightly to 215,000m^3/year.

Table 8.16 Harvest Level- Harvest All MPB in 50% of Cut

	Harvest Level (m^3/year)	
Year	**Cur Prac w epidemic MPB**	**50% MPB target getting all MPB (5yr shelf life)**
2006-2020	186,000	259,000
2021-2110	159,000	152,000
2111-2270	209,000	215,000

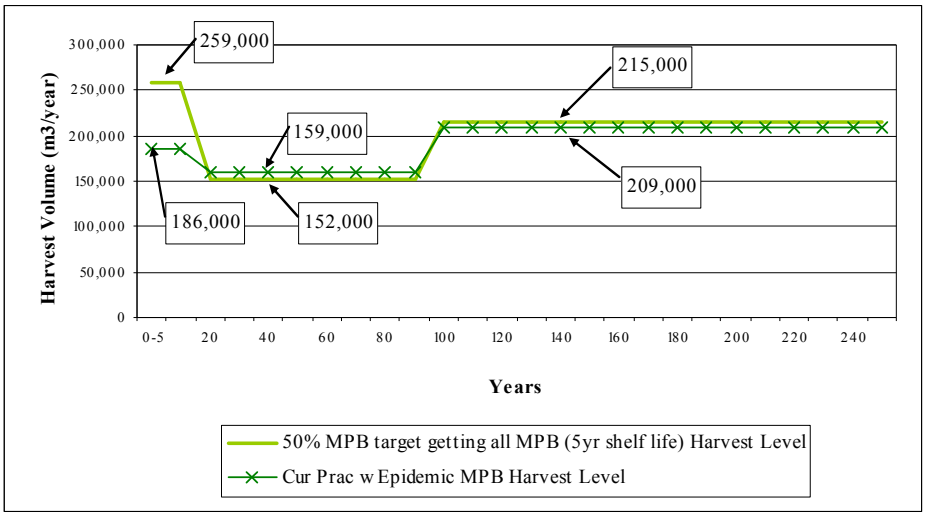

Figure 8.15 Harvest Level- Harvest All MPB in 50% of Cut

Figure 8.16 shows the timber availability of these sensitivities.

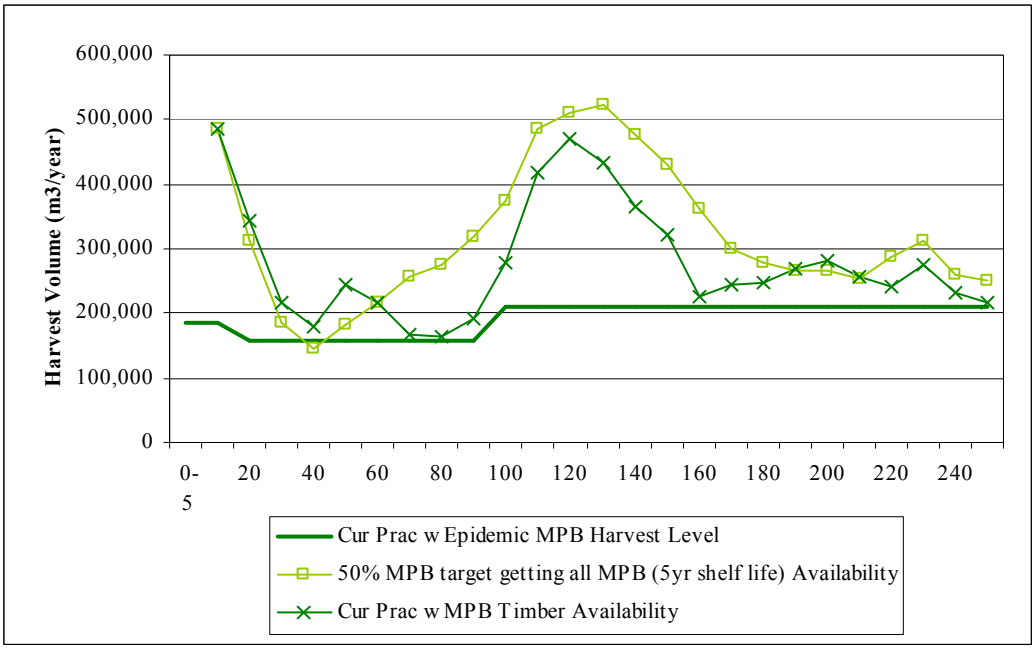

Figure 8.16 Timber Availability- Harvest All MPB in 50% of Cut

Table 8.17 presents the volume loss associated with MPB mortality in this sensitivity. 97% of the total VS MPB attacked stands were harvested.

Table 8.17 MPB Loss- Harvest All MPB in 50% of Cut

	Area THLB (ha)		
	Total	**Harvest**	**MPB Mortality**
VS THLB	9,173	8,897	277

8.1.9 Shelf life sensitivity around Harvest All MPB in 50% of Cut

This section shows the timber supply impact of changing the 5 year shelf life from the sensitivity above, to 2 years. A 7 year shelf life was not tested in this case because the 5 year shelf targeting all the VS MPB-attack was able to harvest 97% of the total VS targeted.

Table 8.18 and Figure 8.17 show the harvest level for these sensitivities. In the mid term, using a two year shelf life decreases the harvest level from 152,000m^3/year to 145,000m^3/year.

Table 8.18 Harvest Level- Shelf Life Sensitivity around harvest all MPB in 50% of Cut

Year	Harvest Level (m^3/year)	
	50% MPB target getting all MPB (5yr shelf life)	50% MPB target getting all MPB (2yr shelf life)
2006-2020	259,000	259,000
2021-2110	152,000	145,000
2111-2270	215,000	216,000

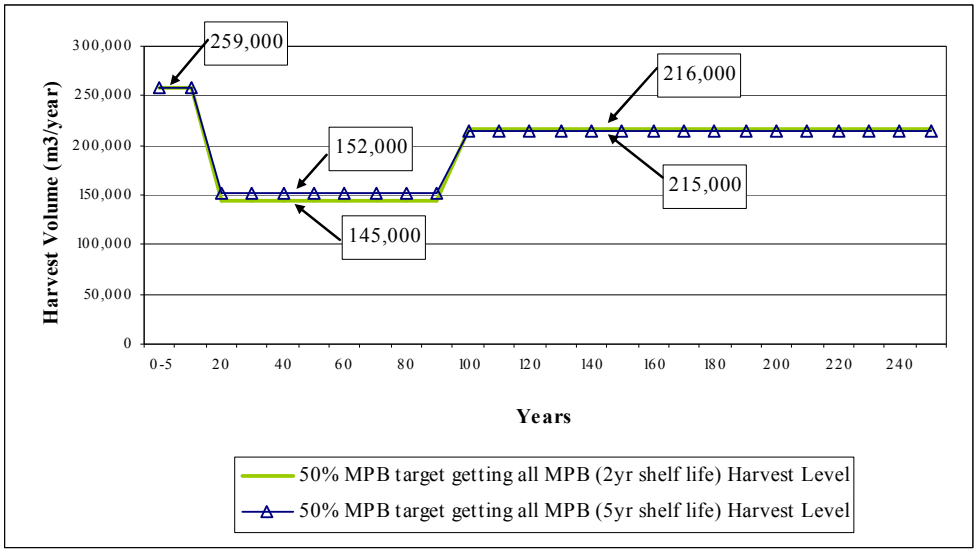

Figure 8.17 Harvest Level- Shelf Life Sensitivity around harvest all MPB in 50% of Cut

Figure 8.18 shows the timber availability of the two sensitivities.

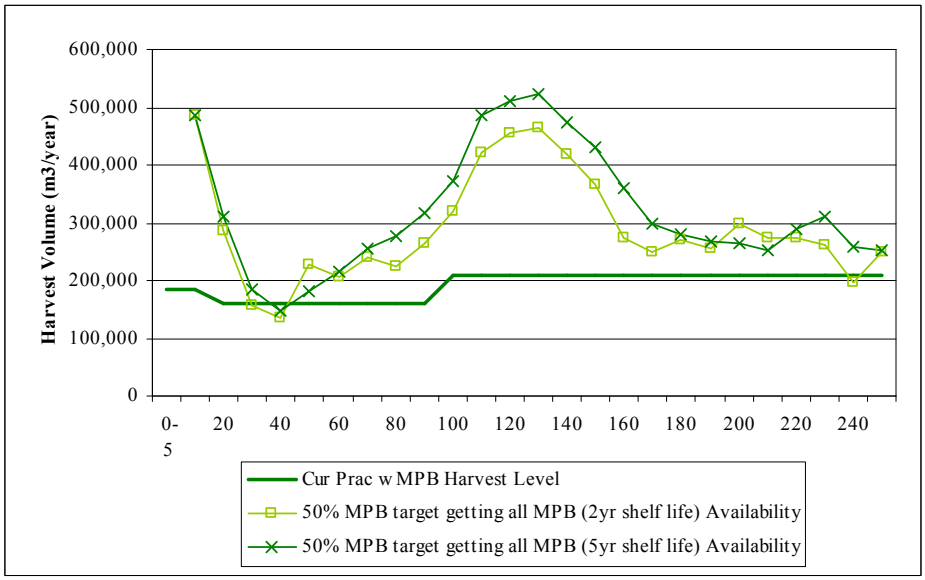

Figure 8.18 Timber Availability- Shelf Life Sensitivity on harvest all MPB in 50% of Cut

Table 8.19 presents the volume loss associated with MPB mortality in this sensitivity. With a 5 year shelf life, 97% of the total VS MPB attacked stands were harvested. By using a 2 year shelf life, this decreased to 78%.

Table 8.19 MPB Loss- Shelf Life Sensitivity around harvest all MPB in 50% of Cut

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
5 year VS	9,173	8,897	277
2 year VS	9,173	7,142	2,031

8.1.10 Faster MPB Spread

This sensitivity tests the timber supply impact of the MPB spread projections being 5 years faster than predicted. Table 8.20 and Figure 8.19 show the harvest level of this sensitivity. With faster MPB spread the mid term harvest level drops to 154,000m^3/year and the long term harvest level is unchanged.

Table 8.20 Harvest Level- Faster MPB Spread

Year	Harvest Level (m^3/year)	
	Cur Prac w epidemic MPB	**Faster MPB Spread**
2006-2020	186,000	186,000
2021-2110	159,000	154,000
2111-2270	209,000	209,000

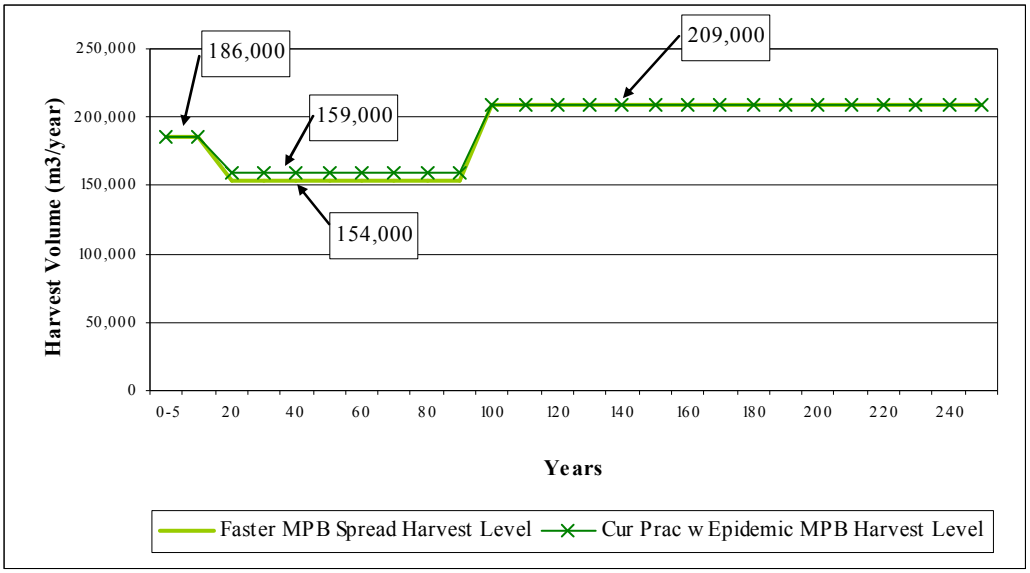

Figure 8.19 Harvest Level- Faster MPB Spread

Figure 8.20 shows the timber availability for the current practice with epidemic MPB and this sensitivity.

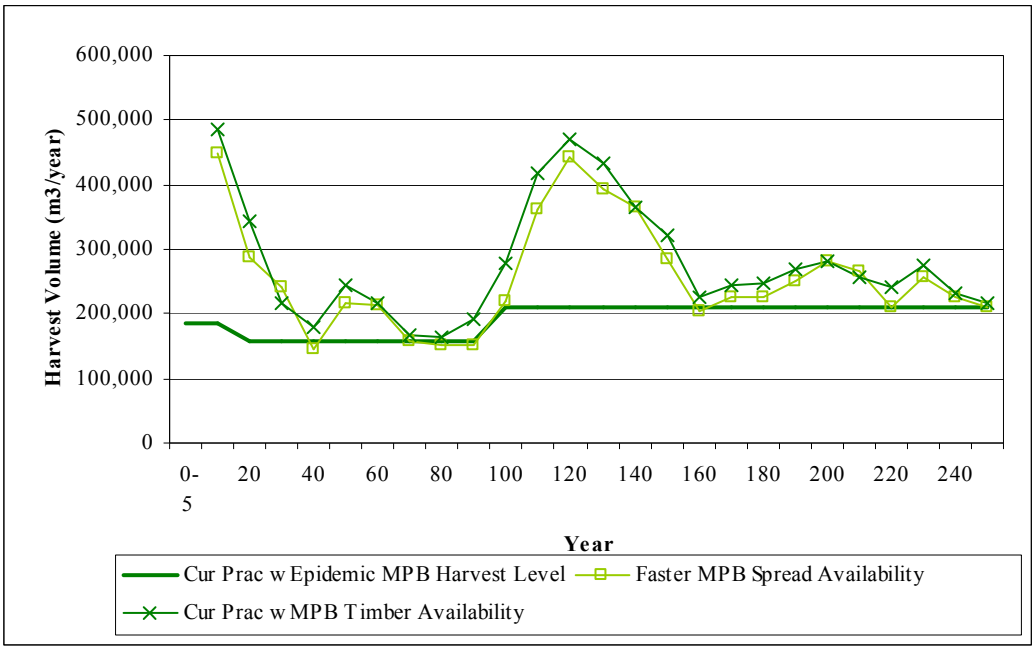

Figure 8.20 Timber Availability- Faster MPB Spread

Table 8.21 shows the volume loss associated with MPB mortality in this sensitivity. In the current practice with epidemic MPB, 40% harvested of the total VS MPB-attacked stands were harvested. In this sensitivity, this figure dropped to 20% harvested.

Table 8.21 MPB Loss- Faster MPB Spread

	Area THLB (ha)		
	Total	**Harvested**	**MPB Mortality**
VS THLB	9,173	1,821	7,353

8.2 Summary of MPB Sensitivities

Table 8.22 summarizes the results from the various MPB sensitivities outlined in the above sections. This table includes shelf life, % MPB targeted for harvest and the VS MPB-attack harvested and lost to MPB mortality.

Table 8.22 Summary of Mid Term Harvest Level MPB VS Harvest/Mortality

Scenario	Shelf life	% MPB Targeted	Short Term	Mid Term	VS Harvested	VS Mortality
Current Practice w Endemic MPB	N/A	35%	186,000	186,000	N/A	N/A
1a-shelf life 2yrs -35%MPB target	2	35%	186,000	155,000	2,893	6,280
1b*-shelf life 5yrs -35%MPB target	5	35%	186,000	159,000	3,624	5,549
1c-shelf life 7yrs -35%MPB target	7	35%	186,000	160,000	4,774	4,399
2-shelf life 5yrs -10%MPB target	5	10%	186,000	143,000	801	8,372
3a-shelf life 2yrs -50%MPB target	2	50%	186,000	165,000	4,585	4,588
3b-shelf life 5yrs -50%MPB target	5	50%	186,000	166,000	5,713	3,460
3c-shelf life 7yrs -50%MPB target	7	50%	186,000	171,000	7,450	1,723
4a-shelf life 2yrs -70%MPB target	2	70%	186,000	175,000	7,219	1,954
4b-shelf life 5yrs -70%MPB target	5	70%	186,000	183,000	8,987	186
5a-shelf life 2yrs -50%MPB target- all MPB	2	50%	259,000	145,000	7,142	2,031
5b-shelf life 5yrs -50%MPB target- all MPB	5	50%	259,000	152,000	8,896	277
5c-shelf life 7yrs -50%MPB target- all MPB	7	50%	259,000	154,000	9,023	150
Faster MPB Spread	5	35%	186,000	154,000	1,820	7,353

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.

J.S. Thrower & Associates (JST), 2006. Potential Site Index Estimates for Major Commercial Tree Species on TFL 8. Contract Rep. to Pope & Talbot. Project number PTM-020, December 21 2006. 12 pp

Timberline Natural Resource Group, 2007. Timber Supply Analysis Information Package for TFL 8, TSR 3. Contract

Appendix 1:
Information Package