DUNKLEY LUMBER LTD.

TREE FARM LICENCE #53
NAVER

TIMBER SUPPLY ANALYSIS REPORT
in support of
MANAGEMENT PLAN # 4

Version 1

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Table of Contents

page #

List of Tables

Page #

List of Figures

List of Maps

List of Appendices

1 Results

This section presents the results of the timber supply analysis for TFL #53. The results are divided into three sections. Section 5.1 provides the greatest amount of detail. It is the part of the timber supply analysis that examines the Base Case harvest forecast. The Base Case analysis, in combination with Section 5.2 (standard sensitivity analysis) would typically have the greatest impact in the determination of a revised AAC. Section 5.3 describes various management considerations that may have a significant harvest impact when dealing with the beetle epidemic. In short, these sections are described below:

1. Section 5.1 describes current operational procedures and is defined as the 'Base Case'.
2. Section 5.2 examines standard Ministry of Forests' sensitivity scenarios around the

Base Case management and growth and yield assumptions.

3. Section 5.3 examines non-standard sensitivity scenarios with regards to various management and modeling assumptions.

Several criteria were used to define the Base Case harvest forecast. These criteria are:

< The initial harvest levels were set at the volume harvested in 2003 and the AAC set in June 2003 (i.e., 500,000 cubic metres per year).
< The mid-term harvest level was determined when it became apparent that future elevated harvest was no longer directed primarily at high and moderate risk pine.
< The mid-term harvest level was maximized to identify the greatest constraint period. This period occurs in Year 49.
< The harvest was then raised to derive a late mid-term level. The point of constraint was identified again, after which the long-term non-declining harvest level was determined.
< The non-declining harvest level was achieved when the growing stock remained relatively stable over the last 200 years of the simulation period.
< All harvest forecasts were modeled over a 400-year period (annually for the first 100 years followed by modeling 10 year periods).

Sensitivity analyzes which are more constraining than the Base Case harvest forecast, have been presented by maintaining the current Base Case harvest level for as long as possible. If or when the harvest must drop due to constrained timber availability, the harvest is shown to fall immediately to the mid-term harvest level.

Sensitivity analyzes that are less constraining then the Base Case have been illustrated by maintaining the current Base Case to see the effect of the scenario on the mid-term harvest flow. If the scenario fills the "hole" that otherwise occurs in Year 49, the mid-term harvest level is increased until a "flat line" harvest is no longer possible.

During the development of the information package, which was presented to the various resource agencies prior to commencing this timber supply analysis, several questions were raised regarding some of the assumptions that were to be used in the Base Case analysis. These concerns included:

< Whether visual quality objectives were being modeled on an aggregated area by VQO or by each individual visually sensitive polygon. This analysis was adjusted to model according to individual VQO polygons.
< An error was identified regarding the future managed stand yield tables presented in the information package. This was corrected. The appended IP contains the correct yield tables.
< A sensitivity analysis was included to assess the impact of incorporating recommended visual quality classes on scenic areas without formal VQOs.

Unsalvaged losses of 600 cubic metres per year are applied to the harvest forecast results presented in this report. These unsalvaged losses address uncertainties regarding fire, windthrow, disease and insects (other than MPB).

1.1 Base Case Harvest Forecast

Figure 9 describes the Base Case harvest forecast for TFL #53. The current allowable annual harvest level is 500,000 m^3 per year. This can be maintained for the next 6 years before the harvest falls to the mid-term level of 226,000 cubic metres per year. This mid-term harvest level is only 13,500 cubic metres (4%) less than Dunkley's annual harvest level prior to the 2003 MPB uplift. The fact that the mid-term harvest impact is not considerably lower is due largely to the application of low biodiversity emphasis constraints for the TFL versus the weighted low intermediate and high biodiversity emphasis that was applied in the MP#3 analysis.

In fifty years the harvest level is forecast to increase to 310,000 cubic metres per year as the transition from harvesting natural to managed stands begins to take effect. In 190 years the long-term harvest level of 329,000 cubic metres is achieved. Both these levels are slightly less than the harvest flows identified during these periods in the analysis completed for Management Plan #3. The difference lies primarily with the use of a random harvest rule in the current analysis versus an oldest first harvest rule, and reduced old seral biodiversity constraints. Table 2 identifies the harvest flow for the Base Case.

Figure 1 Base Case Harvest Flow

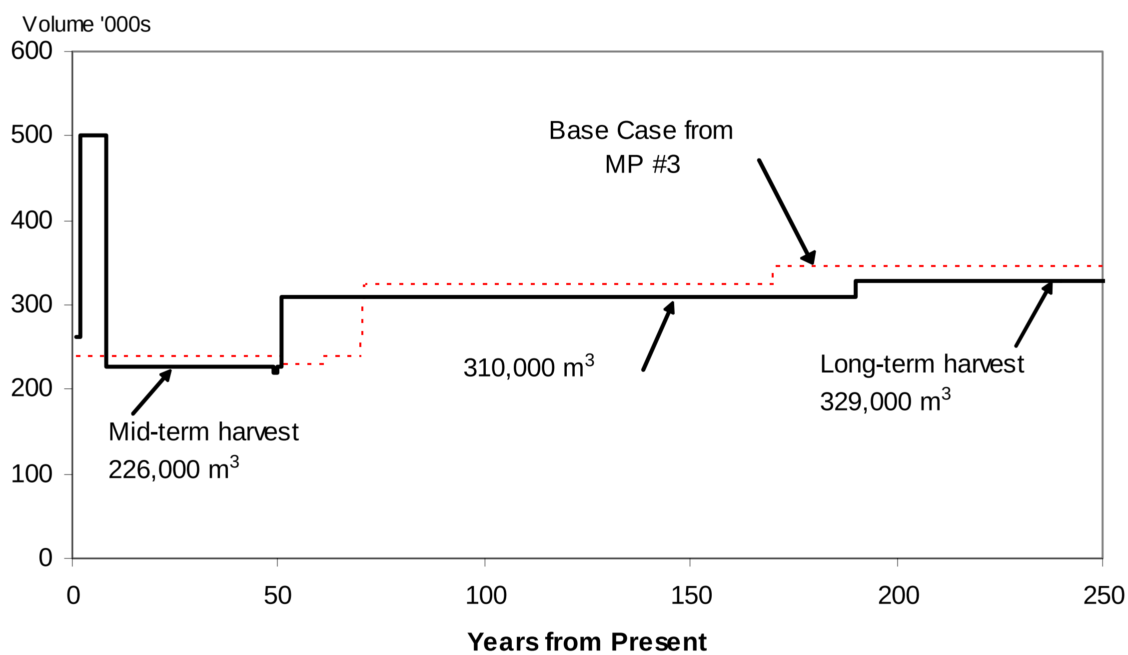


Table 1 Summary of Analysis Results - Base Case Harvest Forecast

Scenario	Net Area (ha)	Net Yield (m3/year)	Duration (years)
Base Case	68,644.4	263,000	1
		500,000	2-6
		226,000	7-50
		310,000	51-180
		329,000	181+

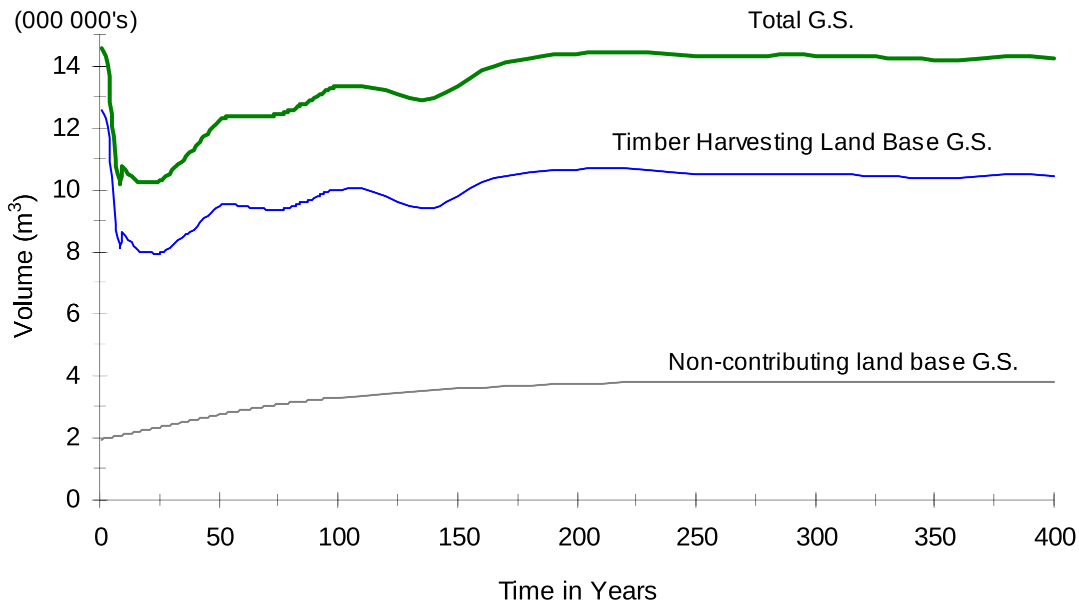
Occasionally, small dips appear in the harvest flow figures shown in this report. These dips have been indicated intentionally and show that the harvest flow is maximized over that period of time. They also indicate the period of time when timber availability is constrained the most.

Figure 10 shows the changes in growing stock over time as a result of the Base Case harvest forecast. Total growing stock is defined as the total volume of mature and immature timber (contributing and non-contributing to the AAC) currently existing in the TFL. Total growing stock is currently estimated to be 14,500,000 m^3. The majority of this growing stock, 12,557,802m^3 is included in the THLB.

Over the next 8 years this volume is predicted to decrease by about 35% to 8.1 million m^3, primarily through the depletion of the pine growing stock. The years following the collapse of the epidemic shows a steady recovery in growing stock as managed stands begin to produce volume at an exponential rate. In about 150 years, the total and THLB growing stock is forecast to stabilize at 14 and 10 million cubic metres respectively.

Over time, the growing stock supporting the non-contributing landbase (NCLB) is shown to increase slightly and stabilize at approximately 4 million cubic metres. This is somewhat unrealistic given that the area in the NCLB contains pine trees that will also be attacked by beetle. The mortality and regeneration of stands of pine in the non-contributing landbase was not explicitly modeled. Undoubtedly, mixedwood stands will continue to contribute to seral stage biodiversity. The degree that pure pine stands will contribute to biodiversity is uncertain and only time and updated forest inventories will address this uncertainty with any degree of confidence.

Figure 2 Growing Stock - Base Case Scenario



The average volume per hectare forecast to be harvested from existing natural stands over the next 10 years is 350 m^3 per hectare. Over the next 80 years, this average volume per hectare decreases slightly to 340 m^3 per hectare. After 100 years, the average volume per hectare harvested from existing and future managed plantations continues to average approximately 350m^3 per hectare. The curves shown in previously in Figure 6 would suggest that this difference should be significantly higher. The volume difference is small because the average natural stand requires 150 years of growth to achieve 350 m^3 per hectare. Managed plantations should require only 70 years of growth to obtain 350 m^3 per hectare. The age difference required to bring a stand to a merchantable level is a result of silviculture activities related to plantation management. Management activities such as the planting of genetically superior stock, high density planting, vegetation competition, fertilization, site preparation and thinning to improve tree spacing are all activities which should ensure that this volume is achieved or exceeded in the future. Figure 11 shows the change in volume harvested over time from natural and managed stands. Figure 12 reveals that this steady volume contribution will come increasingly from managed stands at a greatly reduced harvest age. After 100 years the average age of stands harvested is 71 years.

Figure 3 Average Volume per Hectare Harvested

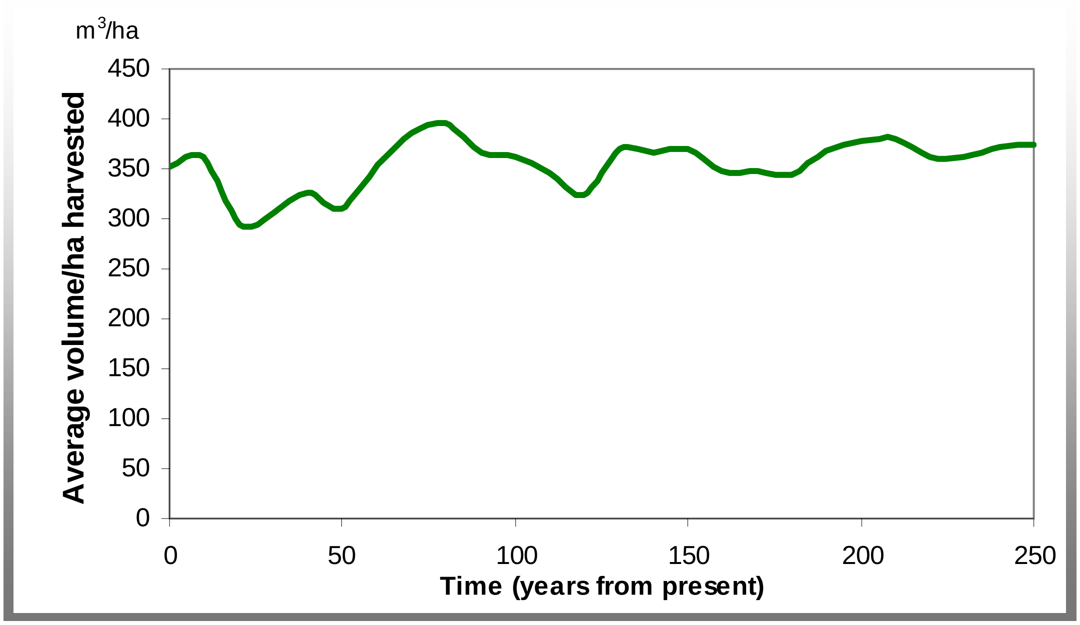


Figure 4 Average Age of Stands Harvested

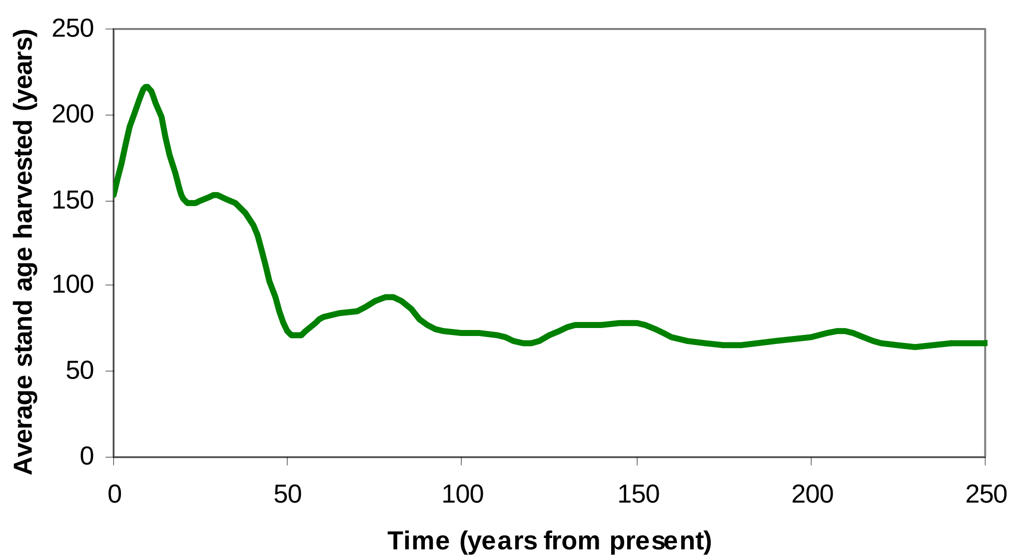
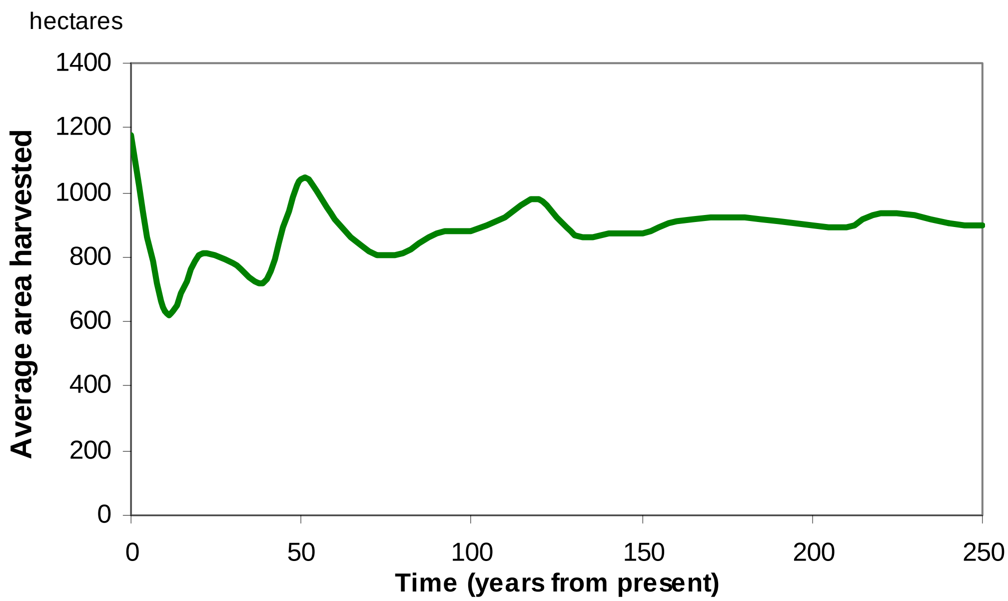


Figure 13 shows that the area harvested each year would change marginally if the Base Case harvest flow was followed for the next 250 years. The area harvested each year over the past 5 years has averaged approximately 550 hectares. Control measures directed towards the MPB infestation will increase this to approximately 1100 hectares over the next 6 years. After this period, the area harvested reflects the mid-term fall down and the step up to the long-term sustainable harvest level. Over the long-term the harvest area is approximately 900 hectares per year. This is an increase of about 100 hectares as predicted in the MP#3 analysis. The increase is attributable to the random harvest rule which does not maximize harvesting in areas with the greatest volume (i.e., oldest stands selected first).

Figure 5 Area Harvested per Year



Harvesting under the Base Case management assumptions does not liquidate all of the old growth forest within the TFL. Biodiversity constraints, which were applied by Natural Disturbance Type (NDT) to each biogeoclimatic zone, subzone and variant, will ensure that a significant amount of old growth forest will remain. The changes to the age class distribution shown in this section reveal that an increasing proportion of the forested landbase is reserved for wildlife habitat and old growth. In about 75 years harvesting is concentrated almost entirely in plantations. The average age harvested from these plantations is just above culmination age.

Figure 14 shows the change in the age composition of the forest over the next 200 years under Base Case management assumptions. The current age class distribution is irregular although it shows a fairly even spread of forest area between mature and immature. Of the 68,644 hectares in the THLB, approximately 38,000 hectares or 55% are currently either mature or young pine areas at risk of attack by MPB.

The age class distribution in 20-years (i.e., the end of the 20-Year Plan that accompanies this report as part of the Management Plan) shows that although a significant reduction in area was made in the current age classes of 195-215, a reasonable distribution of old stands still exist within the TFL to support the mid-term annual harvest of 226,000 cubic metres. The remaining natural stands aged 110 to 130 years will be critical to maintaining the AAC until harvesting switches to managed plantations.

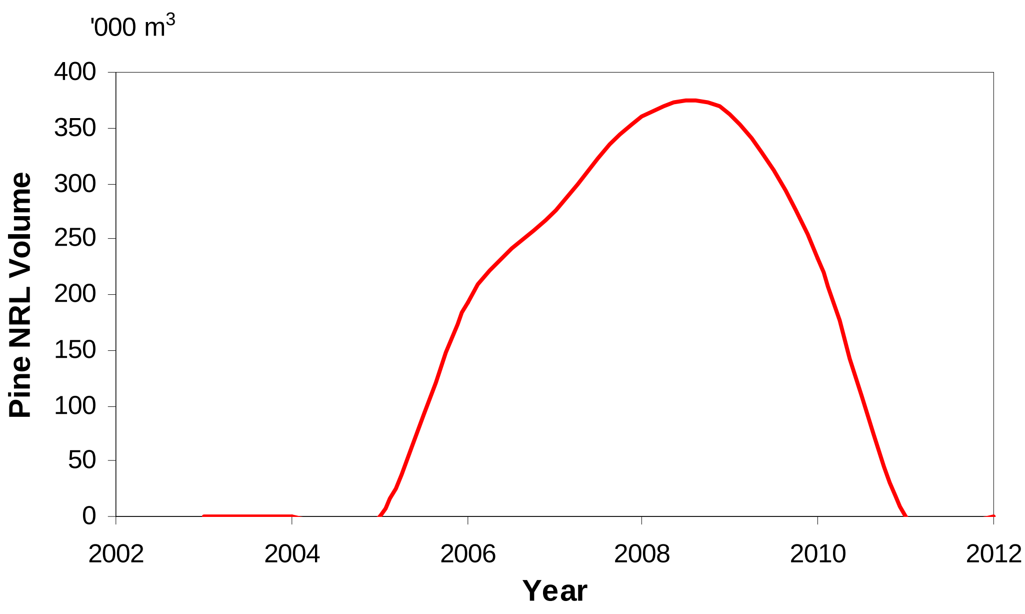
Within fifty years the age class distribution begins to look more "normal." In one hundred years most of the THLB exists in plantations. At this point in time, 97 percent of the THLB is less than 90 years of age. In the non-contributing landbase, forest area is primarily old growth wherein 57 percent is greater than 200 years of age.

A "normal" working forest age class distribution is achieved by 200 years. The area in each age class is relatively equal. Stands are harvested very soon after reaching culmination age. The 500 hectares of THLB remaining in these older age classes is primarily THLB area in visually sensitive sites. Stands with ages older than 180 years comprise approximately 15 percent of the forested landbase. Old growth forests have aged beyond 300 years and include forest stands that are 440 years of age. While the trees themselves may not live this long, stand structure will have changed from even-aged or two storied, to multistory or an irregular canopy that is self perpetuating in the absence of catastrophic events such as fire.

The initial Base Case harvest flow is focused upon a suppression strategy to combat the MPB. The success of this strategy is very difficult to model due to operational considerations, as opposed to a strategy devised in a computer model. In this analysis, pure pine stands attacked by the MPB were given a priority in the annual selection of stands eligible for harvesting. Stands where the pine component averages 65 percent were given a slightly lower priority. Stands with a pine component of between 30-50 percent, lower still. When these stands are harvested, incidental volume in the form of spruce, balsam, aspen, cottonwood and Douglas fir are also extracted. Thus the ability of the model, and operationally on the ground, to extract only the MPB attacked pine volume is not possible. Non-recoverable losses must result under this modeling methodology. Otherwise, the action of harvesting all stands with an attacked pine component will result in almost the entire liquidation of the growing stock in the TFL above 60 years of age.

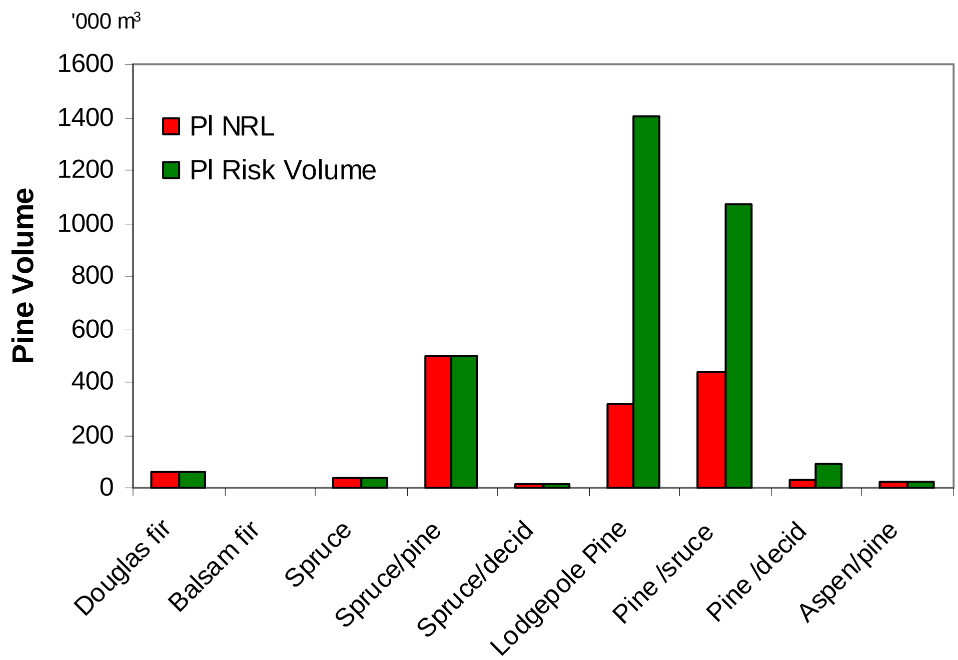
The success of the various scenarios modeled in this report were analyzed subject to the reduction in non-recoverable losses (NRLs) associated with MPB. Figure 15 shows the amount of NRL that is forecast to accumulate over the next decade under the modeling assumptions describing the Base Case. While the validity of these assumptions will be proven within the next few years, the results provide at least a sense of measure of the impact of the MPB on pine trees within the TFL.

Figure 6 Pine NRLs Forecast from the MPB Infestation – Base Case Scenario



The total pine volume lost to the mountain pine beetle is estimated to be 1,424,000 cubic metres. Most of this volume is in mixed wood stands of spruce/pine and pine/spruce. This is shown in Figure 16 where the pine component of stands presently at risk are compared to the pine volume that is lost from these stands over the next 10 years. The graph shows that almost all of the pine volume in spruce-leading stands will be lost. This is partly due to the minimum harvest age set for spruce stands where pine in these stands will not be available for harvesting if the stand age is less than 100 years. As well, the priority placed on harvesting these stands was below that of leading pine or pine/spruce stands. On the positive side, a total of 2.061 million m^3 of pine volume-at-risk is salvaged under the Base Case harvest forecast.

Figure 7 Risk Volume and NRLs by Stand Type



1.2 Standard Sensitivity Analysis around Base Case assumptions

In all long-term timber supply analyses there is uncertainty surrounding whether or not the information used in the analysis is accurate. Assumptions must be made on complicated and ever changing social, economic, and biological values. To deal with uncertainty regarding how certain values of interest would affect the Base Case harvest forecast, the sensitivities of various assumptions were examined. The scenarios include:

- Uncertainty in the size of the THLB
- Uncertainty in natural stand yield estimates
- Uncertainty in minimum harvest ages
- Uncertainty in forest cover objectives (adjacency)
- Uncertainty in landscape level biodiversity requirements
- Uncertainty in managed stand yield estimates
- Alternative harvest flows

The results of these scenarios are briefly described in the sections that follow. A summary of the results are provided in Table 3.

Table 2 Sensitivity Analysis - Scenario Results

Scenario Description		Volumes (cubic metres)							Percent change from Base Case					
		Growing Stock	NRLs in MPB Pl volume	MPB Volume harvested	short term harvest (yr 1-10)	Mid-term harvest (yr 10-50)	Long-term harvest (yr 51-180)	Very Long-term Harvest (years 181+)	Grow-ing Stock	NRLs	Short-Term harvest (years 1-10)	Mid-term harvest (years 10-50)	Long term harvest (years 71-230)	Very Long-term Harvest (years 231-440)
s1	Base case	12,574,083	1,424,063	2,061,875	500,000	226,000	310,000	329,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
s2.1	5% incr THLB	13,202,785	1,679,714	2,255,607	500,000	235,000	327,000	341,000	5.0%	18.0%	0.0%	4.0%	5.5%	3.6%
s2.2	5% decr THLB	11,945,375	1,325,723	1,973,311	500,000	213,000	297,000	312,000	-5.0%	-6.9%	0.0%	-5.7%	-4.2%	-5.2%
s2.3	10% incr Unman Yield Tables	13,814,246	1,772,869	2,072,146	500,000	248,000	303,000	329,000	9.9%	24.5%	0.0%	9.7%	-2.3%	0.0%
s2.4	10% decr Unman Yield tables	11,333,918	1,121,081	2,004,192	500,000	204,000	311,000	329,000	-9.9%	-21.3%	0.0%	-9.7%	0.3%	0.0%
s2.5	Min Harv Age = Culmin	12,574,083	1,424,063	2,061,875	500,000	223,000	308,000	329,000	0.0%	0.0%	0.0%	-1.3%	-0.6%	0.0%
s2.6	5 Yr incr Min Harv Age	12,574,083	1,423,830	2,061,875	500,000	208,000	312,000	328,000	0.0%	0.0%	0.0%	-7.9%	0.6%	-0.3%
s2.7	5 Yr decr Min Harv Age	12,574,083	1,424,063	2,061,875	500,000	250,000	304,000	325,000	0.0%	0.0%	0.0%	10.6%	-1.9%	-1.2%
s2.8	10% incr IRM for cover constr	12,574,083	1,424,063	2,061,875	500,000	226,000	310,000	329,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
s2.9	10% decr IRM for cover constr	12,574,083	1,424,063	2,061,875	500,000	226,000	310,000	329,000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
s2.10	Mat + Old Seral Stage objectives	12,574,083	1,424,063	2,061,875	500,000	226,000	310,000	328,298	0.0%	0.0%	0.0%	0.0%	0.0%	-0.4%
s2.11	Old Seral Stages full	12,574,083	1,401,692	2,082,991	500,000	226,000	310,000	329,000	0.0%	-1.6%	0.0%	0.0%	0.0%	0.0%
s2.12	10% incr MSYT	12,591,025	1,424,063	2,061,875	500,000	228,000	340,000	361,000	0.1%	0.0%	0.0%	0.9%	9.7%	9.7%
s2.13	10% decr MSYT	12,557,141	1,424,063	2,061,875	500,000	223,000	281,000	295,000	-0.1%	0.0%	0.0%	-1.3%	-9.3%	-10.3%
s2.14a	accelerate @ 400,000 for 6 years	12,574,083	1,881,958	1,628,331	400,000	229,000	297,000	329,000	0.0%	32.2%	-20.0%	1.3%	-4.2%	0.0%
s2.14b	accel @ 600,000 for 6 years	12,574,083	1,278,634	2,193,363	600,000	225,000	312,000	329,000	0.0%	-10.2%	20.0%	-0.4%	0.6%	0.0%
s2.14c	accel @ 700000 for 5 years	12,574,083	1,222,031	2,240,971	700,000	224,000	313,000	328,000	0.0%	-14.2%	40.0%	-0.9%	1.0%	-0.3%
s2.14d	accel @ 800,000 for 5 years	12,574,083	1,085,052	2,364,429	800,000	219,000	315,000	329,000	0.0%	-23.8%	59.9%	-3.1%	1.6%	0.0%
s3.1	MPB epidemic ends in 2004!	12,574,083	468,598	966,682	500,000	271,000	304,000	323,000	0.0%	-65.7%	0.0%	19.9%	-1.9%	-1.8%
s3.2	5 year shelf-life instead of 2 years	12,574,083	957,459	2,531,142	500,000	225,000	313,000	329,000	0.0%	-32.8%	0.0%	-0.4%	1.0%	0.0%
s3.3	75% mortality in Pl at risk	12,574,085	838,393	1,749,328	500,000	240,000	300,000	315,000	0.0%	-41.1%	0.0%	6.2%	-3.2%	-4.2%
s3.4	100% mortality in High-risk, 50% in Moderate Risk	12,574,083	1,217,609	2,079,291	500,000	230,000	300,000	315,000	0.0%	-14.5%	0.0%	1.8%	-3.2%	-4.2%
s3.5	Decrease economic limit to 100m3/ha	12,574,083	1,421,824	2,063,446	500,000	227,000	312,000	329,000	0.0%	-0.2%	0.0%	0.4%	0.6%	0.0%
s3.6	OGMAs removed from THLB	12,574,083	1,416,364	2,068,842	500,000	223,000	307,000	326,000	0.0%	-0.5%	0.0%	-1.3%	-1.0%	-0.9%
s3.7	Convert NRLs to MSYT in 3 years	12,574,083	1,424,063	2,075,303	500,000	226,000	313,000	329,000	0.0%	0.0%	0.0%	0.0%	1.0%	0.0%
s3.8	What if there were no MPB	12,574,083	0	0	301,000	301,000	336,000	336,000	0.0%	n/a	n/a	33.1%	8.4%	2.1%
s3.9	Proposed RVQCs in scenic areas	12,574,049	1,501,771	1,992,013	500,000	223,000	308,000	328,000	0.0%	5.5%	0.0%	-1.3%	-0.6%	-0.3%

1.2.1 Uncertainty in the size of the timber harvesting land base

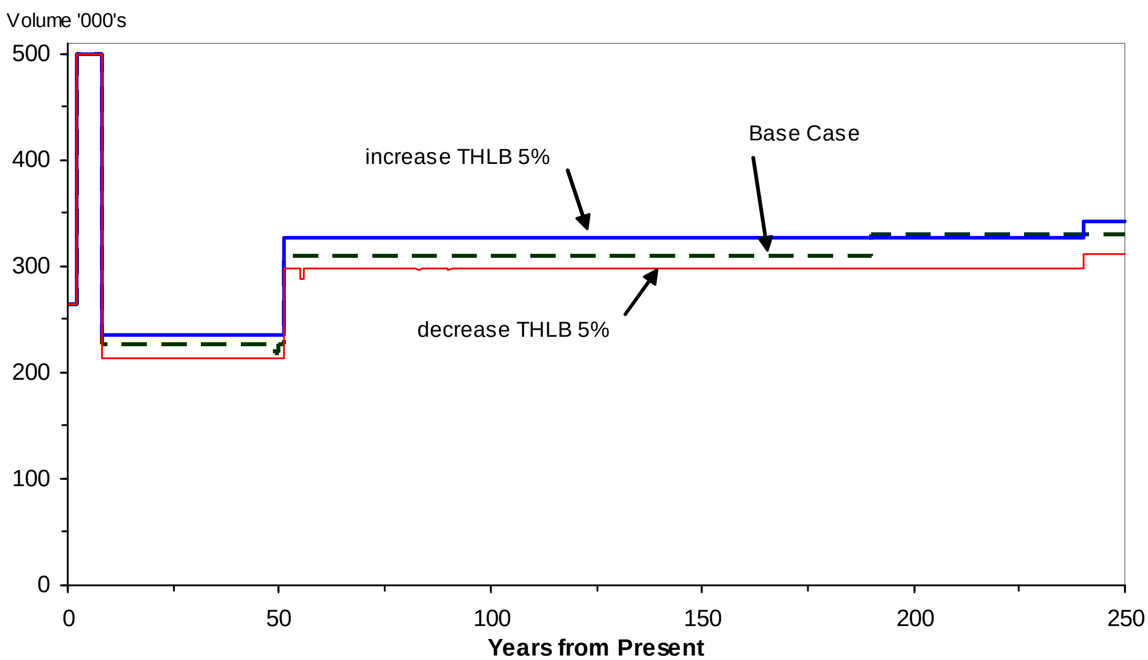
Uncertainty in the size of the timber harvesting land base exists in the amount of area required for wildlife habitat, the estimates for terrain stability and to a small extent the productivity of sites excluded from the THLB as problem forest types.

The effect of increasing and decreasing the landbase by 5 percent is analyzed with respect to the mid-term and long-term harvest levels. The initial harvest level of 500,000 remained unchanged.

A 5 percent increase in the THLB resulted in mid and long-term harvest levels ranging from 3.6 to 5.5 percent higher than the Base Case. In the mid-term the harvest level is only able to increase 4%. Non-recoverable pine losses have increased by 18 percent as a result of the expanded volume at risk. In the long-term, harvest levels are predicted to increase by 5.5 and then 3.6 percent respectively.

A 5 percent decrease in the THLB resulted in a reduction in the mid, long and very long-term harvest levels of 5.7%, 4.2% and 5.2 %. Pine NRLs also decrease by 7 percent. The results of these 2 scenarios are shown in Figure 17.

Figure 8 Sensitivity of Changing the THLB by 5 Percent



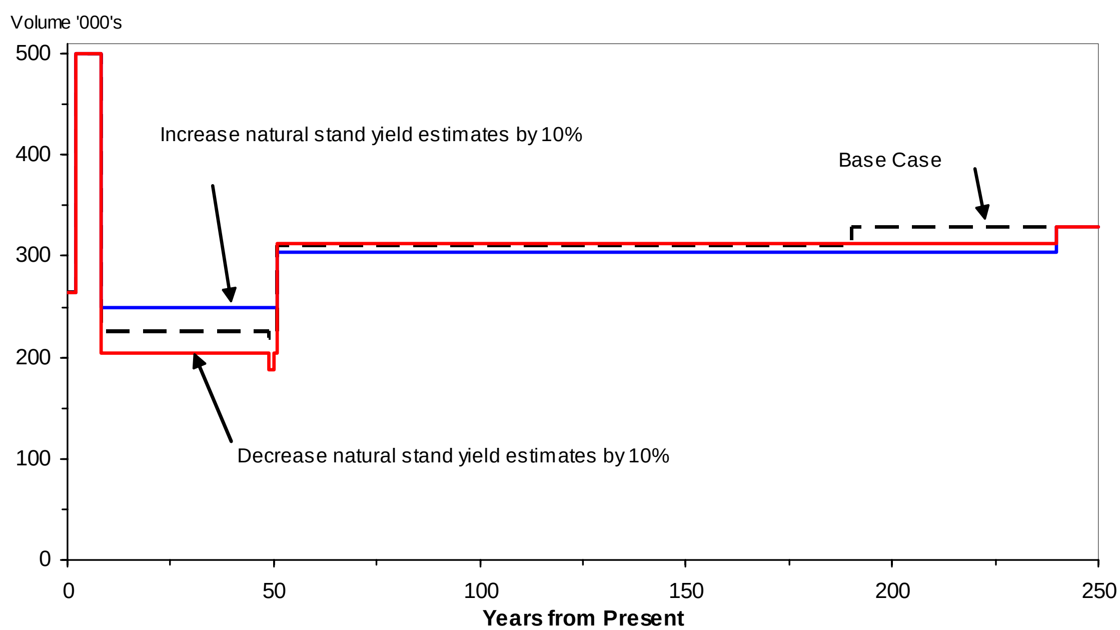
1.2.2 Uncertainty in Natural Stand Yield Estimates

Natural stand yield estimates are subject to some uncertainty because they are based upon inventory classifications. These classifications have been extrapolated from the field measurements of a small group of stands scattered around the TFL. Although the inventory audit completed in 1998 for the TFL supports the accuracy of the existing mature inventory, it also suggests that the site index of the immature inventory may be underestimated. Uncertainty may also stem from estimates of the volume lost to decay within standing trees, and the waste and breakage that occurs during harvesting.

Figure 18 shows that TFL #53 is very sensitive to changes in natural stand yield estimates. A 10 percent increase in natural stand yields would allow the mid-term harvest rate to increase by 9.7 percent to 248,000 m^3 per year. A 10 percent decrease in natural stand yields would result in a drop in the Base Case harvest flow by 9.7 percent to 204,000 m^3 per year. The mid and long-term harvest levels remain relatively unchanged as managed stand yields support the harvest flow during this time period.

The Base Case used a modeling assumption that all of the high and moderate risk pine growing stock will die due to the mountain pine beetle. The pine volume was either harvested or removed from the growth and yield estimates if not salvaged. This represents the upper limit of pine mortality possible from the beetle infestation. As such, the natural stand yields are conservative as they were applied in the Base Case.

Figure 9 Sensitivity of Adjusting Natural Stand Yield Estimates by 10%

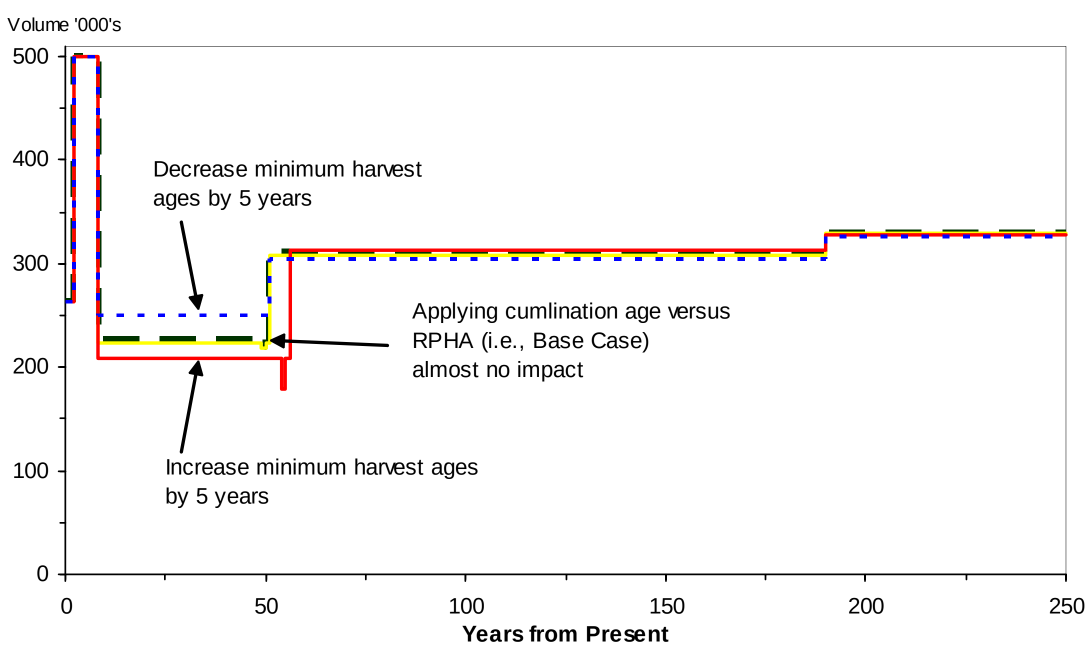


1.2.3 Uncertainty in Minimum Harvest Ages

The Prince George Forest District MOF Office has set Regional Priority Cutting Ages (RPCA) for the harvesting of stands in the Prince George Forest District. These ages are 81 for pine, 101 for spruce, 111 for Douglas fir, and 121 for Balsam fir. These ages were used in the Base Case analysis, with exception made to leading pine stands at high and moderate risk of attack by MPB. The minimum harvest age for these leading pine-at-risk stands was reduced to 61 years. In analysis of alternatives to the minimum harvest age, the minimum age for pine-at-risk stands remained at 61 years. Three scenarios were examined: harvesting natural stands at their culmination age, increasing all minimum harvest ages (i.e., RPCA for natural stands and culmination age for managed stands) by 5 years and decreasing all harvest ages by 5 years.

The first scenario shows that the use of culmination age as the minimum harvest age has a small impact on the mid and long-term harvest flows. The other scenarios show that while increasing and decreasing the minimum harvest age has only a negligible impact on the long-term and very long-term harvest levels, the mid-term harvest level is impacted. Increasing minimum harvest ages results in a decrease in the mid-term harvest level by 8% to 208,000 cubic metres for the 40 years following the MPB infestation. Similarly, reducing the minimum harvest age by 5 years alleviates the pressure in Year 49 and increases the mid-term harvest level 10.6% to 250,000 m^3 per year. All of these harvest flows are shown in Figure 19.

Figure 10 Sensitivity of Changes to the Minimum Harvest Age



1.2.4 Uncertainty in Forest Cover Objectives (Adjacency)

Forest cover objectives are used by the MOF as a proxy for adjacency requirements. In this analysis, forest cover adjacency constraints are not applied during the harvest period used to combat the MPB infestation. They are applied after the harvest fall-down and for the remainder of the simulation period. The sensitivity of increasing and decreasing the adjacency requirements by 10 percent was assessed. In either case there was no measurable impact. The harvest level derived in the Base Case continued to be sustainable (and maximized) with increases or decreases in the adjacency targets for green up in the IRM zone. The completion of a 20-year plan as part of the management plan process supports the application of the forest cover objectives used in the Base Case.

1.2.5 Uncertainty in Landscape Level Biodiversity Requirements

Forest level biodiversity has been incorporated into the Base Case analysis by the maintenance of old seral stage biodiversity targets across the TFL. Low biodiversity emphasis targets were factored into the TFL over a 140-year period. Only 33 percent of the target had to be met immediately, 66 percent in 70 years and 100 percent in 140 years. There is no assumption made for the maintenance of mature seral stage conditions.

Sensitivity analysis assessed the impact of 1) applying mature seral targets to the Base Case and, 2) applying full "old" old seral targets immediately. Both of these runs were designed so that the full impact of the FPC biodiversity guidelines on the projected harvest flow could be evaluated for possible application in forest development planning. The results of applying these changes in biodiversity emphasis are shown in Figures 20 and 21; where without adjusting the initial harvest level the Base Case harvest targets are applied

The impact of mature seral targets is predicted to cause a harvest short-fall in year 49, with a harvest level drop to 21,000m^3. Periods of constrained mature timber availability would cycle again in the 9^{th}, 17^{th} and 23^{rd} decades.

The mid-term impact of applying full old seral stage targets at the present time is quite severe. A hole develops in the harvest flow between years 44 and 50, whereby the harvest level drops to almost nothing. After this point in time, the timber in the excluded landbase has aged sufficiently so that the remainder of the Base Case harvest flow is unaffected.

Figure 11 Sensitivity of Mature + Old Biodiversity Targets

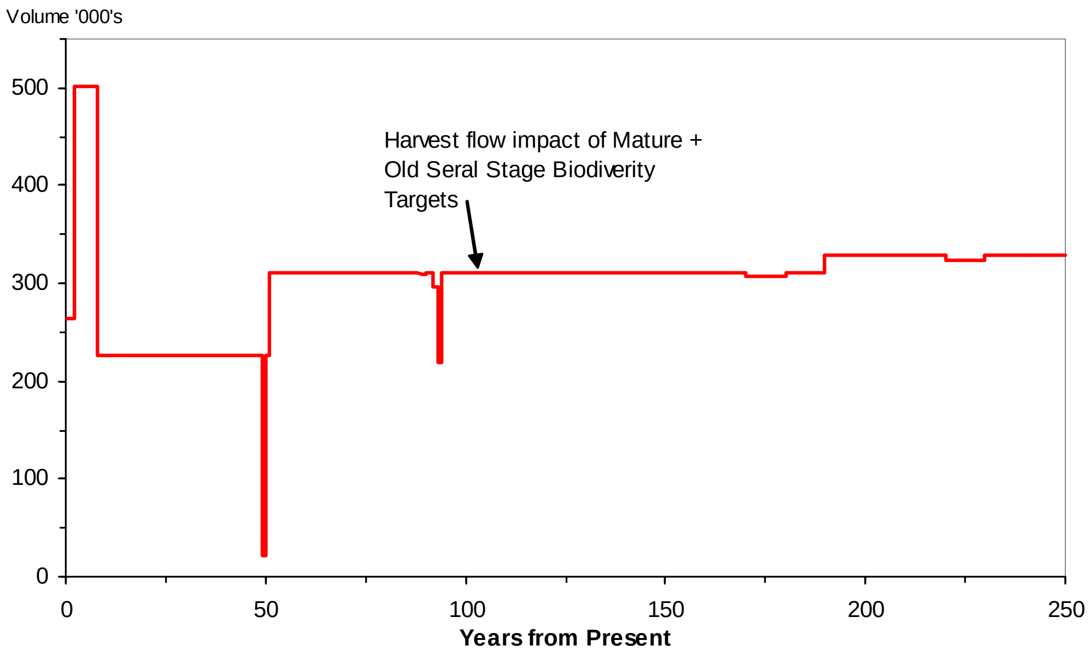
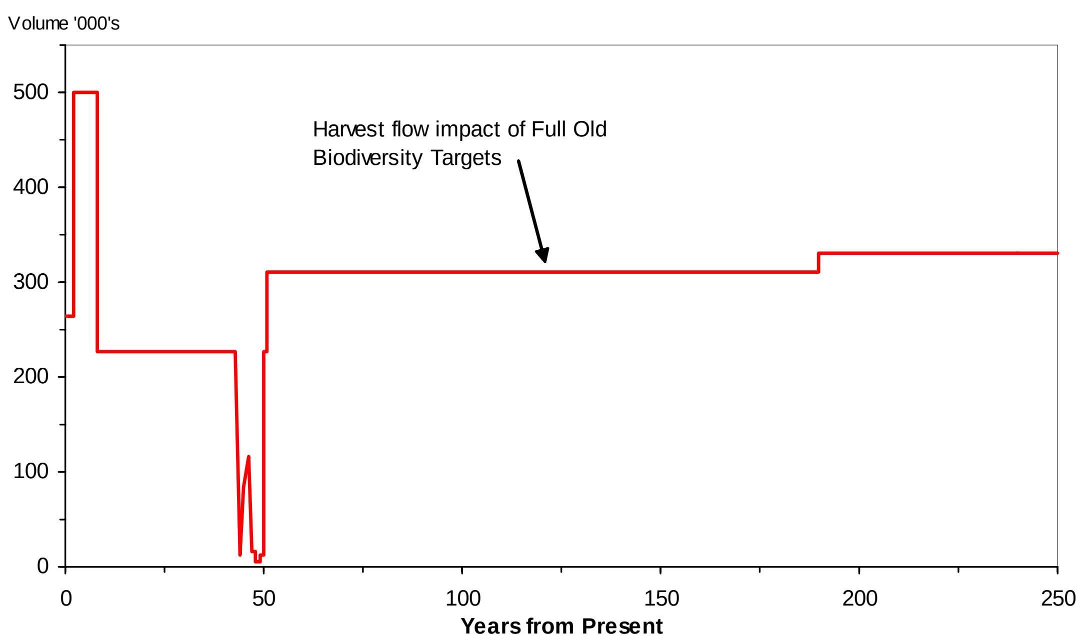


Figure 12 Sensitivity of Full Old Biodiversity Targets



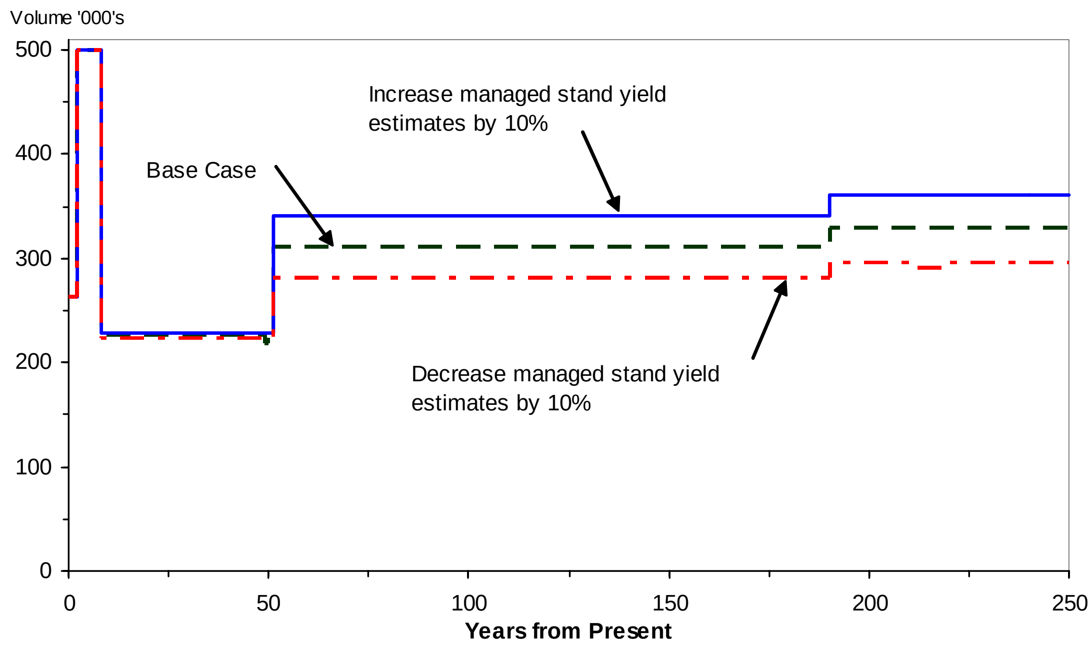
1.2.6 Uncertainty in Managed Stand Yield

Estimates of regenerated timber volumes in managed stands are uncertain for reasons that are similar in nature to existing natural stands. Some of this uncertainty has been removed by Dunkley Lumber Ltd. through terrestrial ecosystem mapping, the completion of a biogeoclimatic ecosystem classification of site productivity, the use of genetically superior spruce seedlings, higher planting densities and by a stand fertilization program. Figure 22 shows the effect of under and overestimating managed stand yields by 10 percent. In the short-term and in the mid-term, since these stands are largely unavailable for harvest until 50 or more years from now, there is almost no impact.

When managed stand yields were increased 10 percent, the mid-term harvest level increased by 1 percent to 228,000 m^3 per year, the long-term harvest increased 9.7 percent to 340,000 and the very long-term 9.7 percent to 361,000 m^3 per year.

When managed stand yields are decreased 10 percent, the mid-term harvest level declined 1.3 percent to 223,000 m^3 per year. In the long-terms, the decline was 10 percent with harvests of 281,000 and 295,000 m^3 per year.

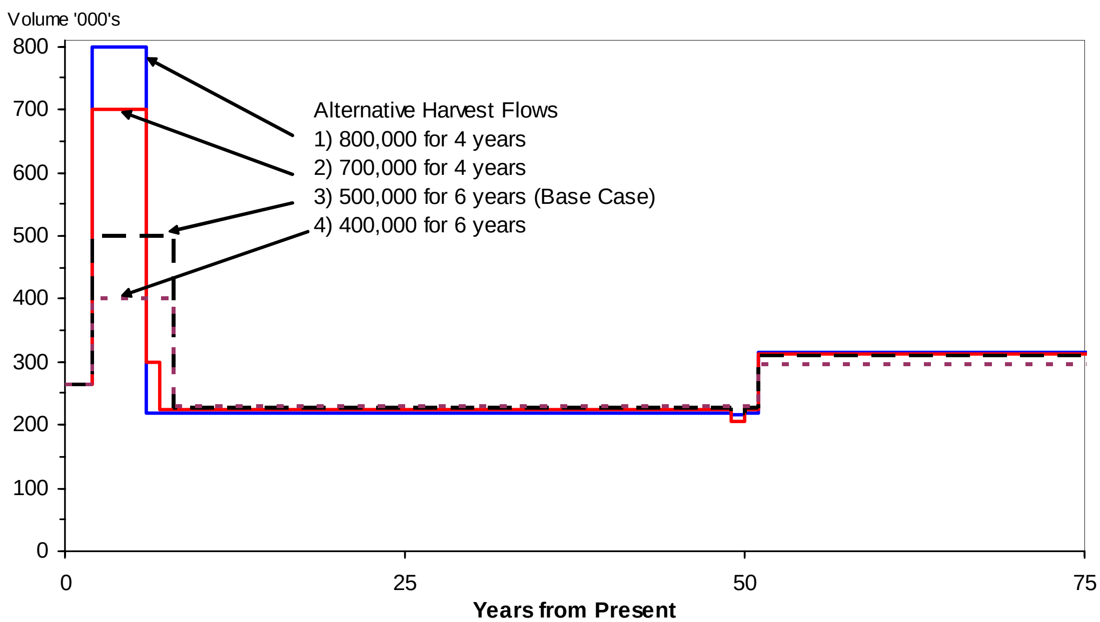
Figure 13 Sensitivity of Changes to Managed Stand Yield Estimates



1.2.7 Alternative Harvest Flows

The Base Case harvest flow shown in Figure 8 and described in Section 6.1 provided the basis against which all of the sensitivity scenarios are measured. This harvest flow was chosen because it reflects Dunkley's current harvest level with which they can utilize up to 400,000 cubic metres annually to help control the MPB infestation. This harvest level was developed in the 2003 timber supply analysis in support of an AAC uplift, as a response to surveys indicating an overwhelming number of green and red attacked trees. An uplift is necessary to avoid excessive drops in the future as a result of excessive NRLs and long rehabilitation periods. There are however, many other possible harvest flows with varying declining rates, potential starting points and potential takeoffs between short-term and long-term harvests. Figure 23 shows four different harvest flow alternatives.

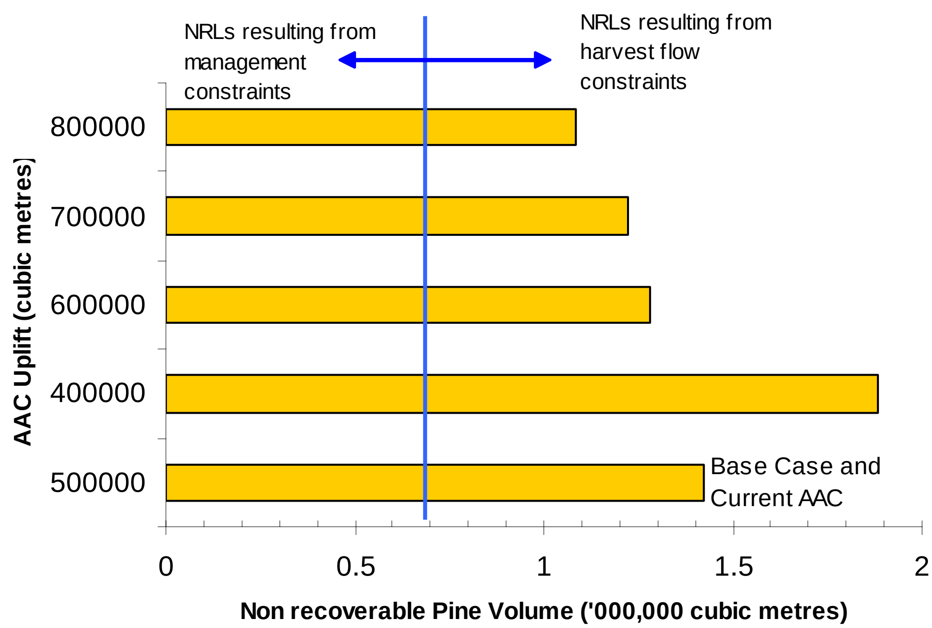
Figure 14 Alternative Harvest Flows



There is no change in the very long-term harvest level from any of these harvest flows. During the mid-term, and the period after the fifth decade, the changes are slight. The reason for the small variance in the harvest forecast is the assumption that if Dunkley does not harvest the volume that is being attacked by beetle, it will die anyway. Elevating the harvest will simply return the infested area to productive forest that much sooner. Figure 23 shows that there are some small mid-term harvest implications. This occurs because, as a result of harvesting beetle attacked pine, other incidental volume in the form of spruce and fir will also be removed. Figure 24 shows the comparative results with respect to the amount of non-recoverable pine volume lost as a result of 5 alternative short-term harvest flows. Very apparent is that a reduction in harvest below the current AAC of 500,000m^3 would result in a considerable increase in Pine NRLs. The shift from 500,000 to 800,000 cubic metres annually reduces

NRLs but not as dramatically. As the harvest level is increased, more volume is taken from mixed wood stands. Thus the incremental reduction in NRLs is not proportional to the increase in AAC. This could be alleviated operationally through partial cutting of only the pine component. However, this is not the method employed in this model.

Figure 15 Predicted Pine NRLs from Alternative Initial Harvest Levels



The levels of NRLs that are predicted in this analysis are considerable. However, a large portion of these will occur simply because of constraints placed upon the landbase with respect to minimum harvest ages, visual quality objectives and old-growth biodiversity objectives. If these constraints were maintained, but the initial harvest level was increased to capture all available volume without consideration for future timber supply, NRLs of 694,000 m^3 would be a product of assumptions modeled in this analysis. This is reflected by the vertical blue line shown in Figure 24. Of the minimum 694,000 m^3 of NRLs resulting from modeling assumptions, 23 percent occur as a result of minimum harvest age constraints, the remainder due to old growth reserves and visual quality objectives.

Operationally, pine NRLs can be reduced by focusing a small scale salvage program in the stands where pine is not the leading species. These stands contain pockets with a higher proportion of pine that, if removed, would assist in reducing the pine NRLs.

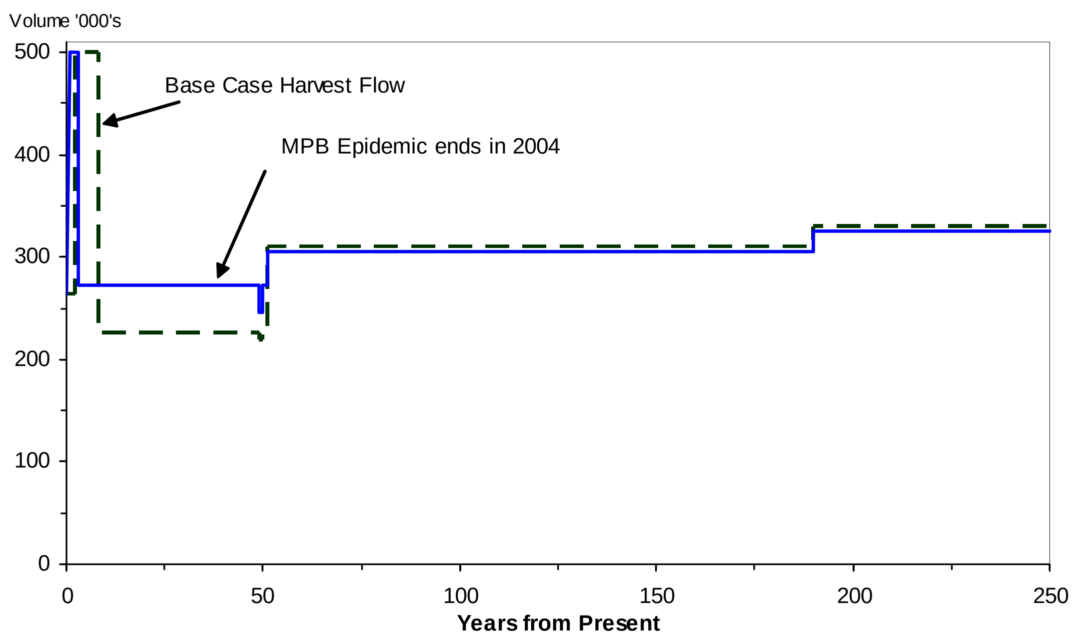
1.3 Non Standard Sensitivity Analysis

Considerable uncertainty exists in the short-term as to the intensity of the mountain pine beetle infestation and the assumptions regarding the fall-out of the epidemic. Additional analysis was undertaken to help quantify the impact of some of the assumptions that directly relate to uncertainties in modeling MPB. An additional scenario was also added to this analysis upon the acceptance of the Information Package in December 2003. This scenario is included in this section and examines the impact of adopting the recommended visual quality classes (RVQCs) from the visual inventory completed for TFL 53 in 1998.

1.3.1 Sensitivity Impact of the Infestation Ending in 2004

If the duration of the current epidemic is consistent with past mountain pine beetle infestations, the duration of which is typically 8-10 years, there is some hope that the current epidemic might be destroyed by a climatic cold-weather event. If such an event occurs in 2004, Dunkley would require the current AAC uplift for at least an additional year to deal with the salvage of existing red and green attacked trees. The impact of ending the infestation in 2004 and thereby reducing the AAC uplift in 2005 was examined. The results of this scenario are shown in Figure 25. Here the initial elevated harvest level is maintained through 2005. The fall to the mid-term harvest of 271,000 m3/year is sustainable for 50 years and is 14 percent higher than the Supplementary Base Case AAC identified in the MP #3 analysis. Under this scenario, pine NRLs would be assumed to drop to 488,000 cubic metres. The majority of these NRLs are the minor pine component in young spruce or fir stands.

Figure 16 The MPB Epidemic Ends in 2004



1.3.2 Sensitivity of the Shelf-Life Period

The Base Case scenario assumed that the standing shelf-life of pine attacked trees is 2 years. This is calculated as 4 years from infestation wherein the first year classifies the tree as green attack, the second year as red attack and the following 2 years, after the tree has lost most of its needles, as grey attack. The current shelf life of stands attacked by beetle is variable, depending on site conditions, weather, humidity, etc. In the Cariboo-Chilcotin the shelf-life has been known to extend to 15 years (albeit at considerably reduced economic value). A two-year shelf life was selected in the Base Case, owing to the wetter climate associated with the geographic area of the TFL and the consequently higher rates of decay. The impact of increasing the shelf life of standing dead pine to 4 years was assessed. In this scenario the initial AAC uplift was extended for 2 additional years. NRLs were subsequently reduced by 33 percent to 957,000 cubic metres. The mid-term harvest level dropped very slightly to 225,000 m^3 per year, while the long-term increased slightly from 310,000 to 313,000 m^3 per year. In the very long-term, the harvest level remained unchanged.

1.3.3 Sensitivity of the Mortality Levels in Pine-at-Risk Stands

The Base Case scenario has risk-rated all forest polygons within the TFL and assumed 100 percent mortality of the pine component of all high and moderate risk stands. The risk rating methodology employed in this analysis was relatively simplistic in that all stands 60 years or older, with more than a 30 percent pine component, were assigned to high risk. Stands with 1-30 percent pine were assigned to moderate risk. Initial risk-rating calculation utilized information from the Canadian Forest Service's entomology division, but resulted in ratings that were uncharacteristic of the current level of infestation within the TFL. The first mortality scenario (i.e., Scenario 3.3 in Table 3) examines the impact of 75 percent pine mortality of all stands classified as high or moderate. The second scenario (i.e., Scenario 3.4 in Table 3) examines the impact of 100 percent pine mortality in high risk stands and 50 percent mortality in moderate risk stands. The harvest impact from these two scenarios is slight. In the mid-term the harvest level would increase by 6.2 percent and 1.8 percent respectively. In the long-term the model indicated a harvest level decline of 3-4 percent in both scenarios. This decline is more a result of the random harvest flow rule used in the simulation, than a reflection of the long-term productivity of the landbase as was derived in the Base Case scenario.

1.3.4 Sensitivity of Reducing Economic Limits

The Base Case scenario was constructed so that stands that had less than 140 m^3 per hectare of non-pine species remaining after the infestation were assumed to regenerate to a natural stand after a 10 year delay. If, after the infestation, the stand lost the pine component but still had more than 140 m^3 per hectare, it was considered economic to harvest sometime in the future. The ingress of a pine understory, or the accelerated growth of the residual non-pine species, was not modeled. Reducing the minimum economic limit of these stands from 140 to 100 m^3 per hectare will only have a very minor positive impact on the mid and long-term harvest flows (i.e., less then 1%). The impact at the stand level was that medium site pine/spruce and pine/deciduous stands would, with a reduced economic limit, have sufficient residual volume to be eligible for harvesting sometime after the collapse of the epidemic. The impact is minor because very little area (i.e., 894 ha) exists within these stands as high or moderate risk.

1.3.5 Sensitivity of Old Growth Management Areas

Potential Old Growth Management Areas have been proposed for TFL 53 through work performed for Dunkley by Keystone Wildlife Research. The areas identified by Keystone are localized heavily to riparian areas and a few larger polygons as shown in Map 6. Existing and recruitment areas are identified. Within TFL 53, approximately 2,700 hectares of potential old growth management areas have been identified. This impacts the timber harvesting land base by 824 hectares. The removal of this area from the THLB would result in a 1 percent reduction in the mid, long and very long-term harvest levels.

Map 1 Potential Old Growth Management Areas

1.3.6 Sensitivity of the Pine Rehabilitation Period

Leading pine stands that are at-risk, and then attacked by the mountain pine beetle, are prioritized for harvesting. Those stands which are not harvested before the shelf-life period expires are assumed to regenerate to natural stands after a 10-year delay, if the residual stand does not have more than 140 m^3/ha. This scenario investigates the impact of rehabilitating these stands through silviculture and regenerating them within 3 years.

The results from this activity are almost negligible. Under the harvest rules and the harvest priorities employed in this analysis, the majority of pine-leading stands are harvested prior to the expiration of their shelf-life period.

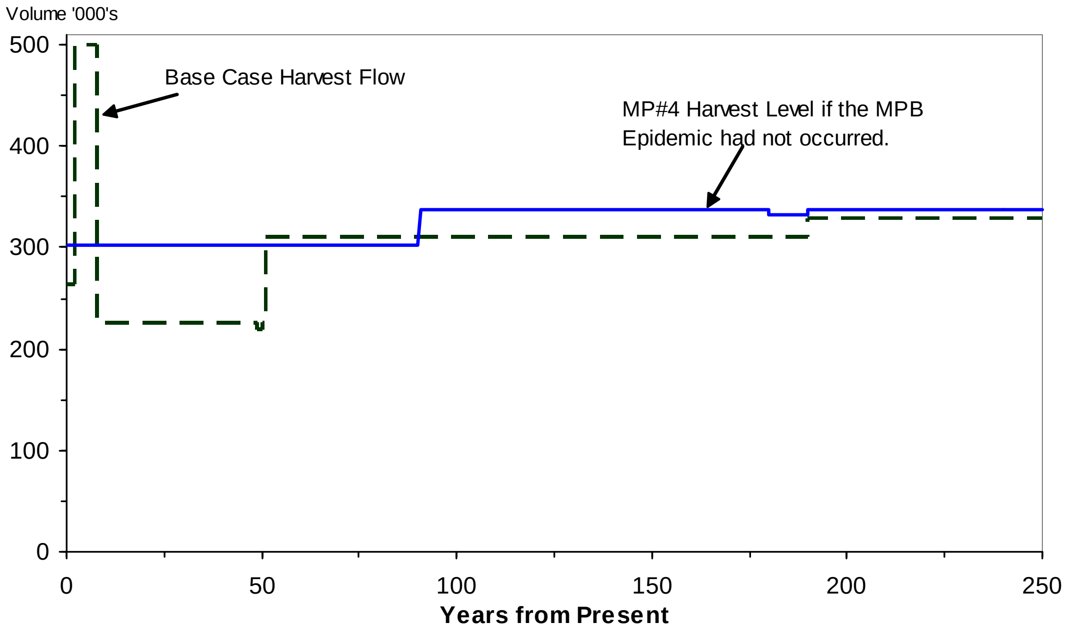
1.3.7 Sensitivity of the MPB Epidemic

The timber supply cost of the MPB epidemic was analyzed not to provide management information but rather to provide information and comparative examination against the results of the Management Plan #3 analysis. If the MPB epidemic had not occurred, Dunkley would not have petitioned for an AAC uplift in 2003 to help control NRLs. The resultant Base Case using the stand level management assumptions identified in this Management Plan's analysis would have looked considerably different. The results of this analysis are shown in Figure 26 where an initial harvest level of 301,000m^3/year for the next 90 years is calculated. This is an increase of 26 percent above the supplementary Base Case determined in MP#3. There are several reasons for this dramatic increase in the sustainable harvest level.

a) During the term of MP #3, Dunkley improved their inventory information regarding the site productivity of many plantations and Balsam IU stands. This updated information has increased the overall site index of the land base.
b) Deciduous utilization in MP#3 was reduced to 50 percent. This reduction was not applied in the current analysis.
c) The MP #3 analysis utilized an oldest first harvest rule. This scenario utilized a relative oldest first rule.
d) Low biodiversity was applied in this Base Case versus a weighted low, intermediate and high biodiversity in MP #3.
e) The ESSFwk 1 covers approximately 13,500 hectares. In MP#4 this area was smaller (i.e., 7,800 hectares) but managed as NDT1. The current analysis applies NDT 2 biodiversity constraints to the ESSFwk1 as being more appropriate for this transitional area.
f) Providing a negative impact on the harvest level, the THLB has declined by 2 percent.

All of these factors contribute to producing the comparative harvest flow shown in Figure 26.

Figure 17 Relative Harvest Impact of the MPB in MP #4



1.3.8 Sensitivity of the application of Recommended Visual Quality Classes

A final scenario was analyzed at the request of the MOF. The impact of the application of recommended visual quality classes on the TFL result in respective harvest level declines of 1.3, 0.6 and 0.3 percent in the mid, long and very-long term planning horizons. The impact of the RVQCs occurs due to an increase in the area assigned a partial retention, modification and maximum modification VQC.

2 Summary

Table 3, shown previously, provides a detailed account of the harvest flow and NRL implications as a result of various initial harvest levels and management assumptions. Table 4 following provides a verbal summary of the impact of the various scenarios examined.

Table 3 Summary of Scenario Results

Scenario	Result
Base case	This reflects the current AAC and indicates that a mid-term harvest of 226,000 m3/year can be expected after the epidemic.
5% change in the THLB	Results in a 5% change in mid and long-term harvest levels.
10% change in unmanaged stand Yield estimates	Results in a 10% change in mid-term harvest levels.
Harvest unmanaged stands at their culmination age	The harvest flow is not sensitive to this.
5 year increase or decrease in the minimum harvest age of all stands	Results in a 8-10% change in harvest in the mid-term.
10% change in IRM forest cover adjacency constraints	No impact.
Mature + old seral stages biodiversity targets, or full old seral targets	Harvest fall down occurs in the 4th decade.
10% change in managed stand yield estimates	Results in a 10% change in the long-term harvest forecast.
Set initial AAC to 400,000 m3	Results in a 32% increase in NRLs.
Set initial AAC to 600,000 m3	Results in a 10% decrease in NRLs.
Set initial AAC to 700000 m3	Results in a 14% decrease in NRLs.
Set initial AAC to 800,000 m3	Results in a 23% decrease in NRLs.
MPB epidemic ends in 2004	Mid-term harvest increases to 271,000 m^3/year
5 year shelf life instead of 2 years	Results in a 32% decrease in NRLs, the mid-term is relatively the same.
75% mortality in Pine-at-risk	41% decrease in NRLs and 6 % increase in mid-term harvest.
Pine mortality 100% in high risk, 50% in moderate risk stands	14% reduction in NRLs, only slight mid-term gain.
Decrease economic merchantability limit to 100m3/ha	Very slight positive impact.
OGMAs removed from THLB	1% negative impact.
Convert NRLs to managed stand yield tables in 3 years	Very slight positive impact.
What if there was no MPB	Base Case would have been 301,000m^3/year.
Apply VQOs to the recommended VQCs in scenic areas	5% increase in NRLs, 1% reduction in mid term harvest.

3 Discussion

Historically, timber supply analyses in British Columbia have been carried out to determine a short-term allowable annual cut, giving substantial consideration to long-term management assumptions, growth predictions and social demands on the desired condition of the forest estate. This timber supply analysis is exceptional in that the overwhelming factor under consideration is the Mountain Pine Beetle epidemic. The short and mid-term impact of the infestation on the merchantable pine growing stock supercedes almost all other management concerns. However, that does not make these traditional considerations less important. This exercise has served to review the current status of TFL #53 with respect to inventory, yield estimates and management considerations. The analysis substantiates that we continue to face considerable uncertainty about the duration, the extent and the intensity of the mountain pine beetle epidemic. We are unsure of the economic shelf-life of residual pine-attacked trees localized to the TFL. We can only speculate on the volume ingress that will occur in mixed-wood stands with a dead pine component. Undoubtedly, the residual stand yield will be better than if the remaining trees had to continue to compete for light and nutrients with the original pine stems.

The results of this analysis should be considered an exercise in establishing the potential impact of many short and long-term “what if” statements. Dunkley needs to deal aggressively with the epidemic in the short-term, in order to mitigate the depth of the mid-term harvest shortfall. Flexibility is required to address unknown variables related to the MPB. We hope that this flexibility can be achieved through an AAC that allows Dunkley to deal with the MPB proactively. Monitoring and evaluation of the MPB infestation during the next 10 months will help immensely in the determination of a new AAC Rationale that is consistent with the flexibility achieved through the AAC that was approved in June 2003.