APPENDIX 6 Timber Supply Analysis

Item	Submitted	Approved
Timber Supply Analysis	December 1, 1999	March 7, 2000

BRITISH COLUMBIA

3VB		Forestry	
AW		AT	
Logging		RGH	
DJC		GH	
RM		KW	
TM		DM	
SA		AF	
		PNJ	
DW		AM	
GH		PS	
RM			
VAULT			

File: 12850-20/33

March 7, 2000

Jeff Lipsett, R.P.F.
Corporate Forestry Superintendent
Federated Co-operatives Limited
Box 70
Canoe, British Columbia V0E 1K0

Dear Jeff Lipsett:

Re: Timber Supply Analysis for Management Plan No. 8 - Tree Farm Licence (TFL) 33

I have reviewed your Timber Supply Analysis report for TFL 33 dated November 25, 1999, and a subset of the modelling input and output files provided by Bill Kuzmuk of Timberline Forestry Consultants Limited.

As the Ministry of Forest timber supply analyst responsible for reviewing this analysis, I accept the information contained in the report with the following notes:

- In the analysis report there are a few minor editorial needs (e.g., incorrect disturbance heights in Table 6.1, addition of all time periods in Tables 8.5 and 9.5). It should also be noted that as commonly occurs there are some small differences in the total amount of area in various zones as reported in the accepted Information Package and those used in the final timber supply analysis (e.g., Tables 5.2, 5.3 and Fig. 3.1). Bill Kuzmuk has clarified these numbers and the appropriate information was used in the timber supply analysis. For consistency of records, you may wish to update the analysis report to reflect the above.

- The Salmon Arm Forest District indicates that the operability mapping presented to the district needs to be rationalized. The methods used in the analysis are acceptable given that this operability mapping is not available. However, it would be desirable in the future to use an approved operability mapping rather than conditions projected based on polygon characteristics.

- As stated in the letter of acceptance for the Information Package, it was desired that treed non-productive lands not be used for seral stage contributions and if included be done so only as a critical issues analysis. For these areas to be used, it is desirable that their inclusion be

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based on field observation. These areas were included in the analysis. However, given their age distribution, their impact should be nil for the initial periods; therefore, I am accepting the analysis with their inclusion.

- The Okanagan-Shuswap Land and Resource Management Plan (LRMP) option shows a decreasing level of inventory. A subsequent run by Timberline Forestry Consultant Limited. for a 400-year period indicated that the LRMP option harvest flow was not sustainable at the identified long term harvest level and a revised harvest flow was calculated. However, this flow also appears to indicate a continuing decreasing level of inventory.

- It is likely that for the AAC determination, my presentation of the information contained in the analysis will stress first the base case option and not the Okanagan-Shuswap LRMP option as the LRMP is not an approved higher level plan. However, the LRMP option provides useful background information that will be presented.

- Acceptance of the analysis report does not imply an acceptance of any of the management practices (e.g., contribution of non-TFL lands towards seral stage requirements).

Yours truly,

Jeff Stone
Timber Supply Forester
Timber Supply Branch

pc: Ron Beals, Timber Officer, Salmon Arm Forest District

FEDERATED CO-OPERATIVES LIMITED

SICAMOUS TREE FARM LICENCE 33
MANAGEMENT PLAN #8
TIMBER SUPPLY ANALYSIS

Prepared by:

Federated Co-operatives Limited
&
Timberline Forest Inventory Consultants Ltd.

November 25, 1999

Reference: 9841006.3.1

Timberline
Forest Inventory Consultants

EXECUTIVE SUMMARY

An evaluation of the timber supply on TFL 33 as part of the requirements for Management Plan #8 has been completed. Many of the analysis inputs and assumptions follow current management including Forest Practices Code and updated inventory data. In addition, analysis simulations were developed using the expected guidelines associated with Okanagan-Shuswap Land and Resource Management Plan (LRMP).

Three analysis scenarios were completed:

- Base Case – uses assumptions based on current management for the TFL;
- LRMP - follows the most recent guidelines associated with the LRMP; and
- Additional Incremental Silviculture – evaluates the impact of additional tree improvement (genetic gains) and fertilization programmes.

The following table summarises the harvest levels developed for each of the scenarios completed for the analysis.

LRMP Analysis Annual Harvest Results

Simulation Periods	Start & End Years	Annual Harvest (m3/year)		
		Base Case	LRMP	Additional Incremental Silviculture
1	1 - 5	8,400	22,500	11,300
2	6 - 10	8,400	22,500	11,300
3	11 - 15	12,000	20,250	13,500
4	16 - 20	12,000	20,250	13,500
5 - 16	21 - 80	12,000	18,100	13,500
17 – 50	81 - 250	14,350	18,750	15,500

The current AAC of 22,500m3/year can be maintained in the LRMP option for the first 10 years of the 250-year planning horizon. In the Base Case the initial harvest rate is reduced to 37% of the current AAC, while in the Additional Incremental Silviculture option it is reduced by approximately 50%.

The long-term harvest rate increases by 70% (over the initial level) in the Base Case as existing young stands grow to sufficient green-up height and additional harvesting opportunities develop. Similarly, in the Additional Incremental Silviculture option, the long-term harvest is 38% higher than the initial rate. Conversely, the long-term harvest estimate in the LRMP option is 17% below the harvest estimated for the first period of simulation.

The key factors affecting the timber supply on TFL 33 include:

- Existing state of green-up and disturbance;
- The lack of inventory currently 40 to 60 years of age; and
- The need to reserve mature timber to satisfy old growth requirements.

Forest cover constraints related to visual quality objectives play a significant role in determining the harvest during most of the 250-year planning horizon, but especially during the short-term as evidenced by the difference between the Base Case and LRMP options. Modification to the percent disturbance or green-up height (modelled as age) can both affect the harvest dramatically.

At the time when second growth stands are expected to contribute to the annual harvest 60 to 80 years into the future, the lack of (currently) 40 to 60 year old timber limits the potential harvest as mature timber is unavailable because of old growth requirements.

Old seral requirements are satisfied on the ICHmw3/NDT-3 at the commencement of the analysis for all three main options. In the remaining three LU-BEC/NDTs old seral objectives are reached in 55 to 95 years. Including low emphasis mature seral objectives does not impact significantly on the harvest level. However, if intermediate emphasis seral constraints are assigned to the analysis, the short and mid-term harvest rates are reduced significantly for both the Base Case and LRMP options.

Caribou mature and old forest cover constraints influence the mid-term harvest in the LRMP option. They dictate that additional forest reserves be established which requires a mid-term decline in the harvest for this option. In the absence of caribou forest cover requirements the harvest during the mid and long-term increases by as much as 9%.

Changes to growth and yield inputs did not have as significant an impact on harvest compared to modifications to forest cover constraints. Natural stand (VDYP) volume adjustments caused changes of up to 15% in the initial harvest rate in the Base Case or provided sufficient volume to maintain the initial harvest for five extra periods in the LRMP option. Managed stand (TIPSY) yield adjustments affected the long-term harvest by 5 to 10% in the sensitivity analyses completed for the Base Case and LRMP options.

Although the timber supply is sensitive to forest cover constraints, the guidelines associated with the LRMP will provide a stable management framework for operations on the TFL. Operational management on the TFL will likely follow the Okanagan-Shuswap LRMP as modelled in this analysis, similar to the Okanagan TSA TSR-2 analysis. Therefore the TFL 33 annual harvest can be maintained at the current level for at least the next 10 years.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

TFL 33 MP #8 Information Package (under separate cover)

1.0 INTRODUCTION

An analysis of the timber supply on the Sicamous Tree Farm Licence (TFL 33) has been completed on behalf of Federated Co-operatives Ltd. (FCL) as part of the Management Plan #8 (MP #8) submission. The analysis has considered current management requirements and expected requirements associated with the Okanagan-Shuswap Land and Resource Management Plan (LRMP). Requirements for both timber and non-timber resources and the users of these resources have been included. All analysis scenarios have included current forest management guidelines associated with the Forest Practices Code (FPC).

Timber supply is the quantity of timber available for harvest over time. It is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth and the social and economic environment that effect the availability of timber for harvest, change with time.

Timber supply analysis is the process of assessing and predicting the current and future supply from a management unit. The Chief Forester of British Columbia uses this information in determining a permissible harvest level for a management unit. Timber supply projections made in support of TFL management plans look 250 years into the future. However, due to uncertainty surrounding both the information used in analysis, and future forest management objectives, these projections are not viewed as static or prescriptive. They remain relevant only as long as the supporting information is relevant. In recognition of this, TFL licencees are required to re-evaluate timber supply for each successive management plan.

Three options have been identified and analysed for this Timber Supply Analysis Report in support of Management Plan #8:

- Base Case;
- Okanagan-Shuswap LRMP; and
- Additional Incremental Silviculture.

For the Base Case and LRMP options, various sensitivity analysis results are presented which can be used to isolate the effects of changes to analysis inputs. It is important to note that the Base Case is only one of many theoretical possibilities for estimating the timber supply on TFL 33. Forest cover constraint assumptions modelled in the Base Case are an approximation of what is occuring operationally.

The following objectives were used in developing harvest schedules:

- Achieve the maximum flow of timber while addressing the requirements of other resources and resource users;
- Manage the land base in a manner consistent with the principles of integrated resource use; and
- Identify a reasonable balance between present and future absorption of any required harvest fall down.

Analysis inputs and assumptions are provided in the *Sicamous Tree Farm Licence 33 Management Plan #8 Timber Supply Analysis Information Package* (FCL and Timberline, June 1999) (Information Package). A copy of the Information Package is included as an Appendix to this report. Any departures from the inputs and assumptions presented in the Information Package are provided in this report. For example forest cover constraints related to visually sensitive areas were modified for the LRMP option.

Timber supply analysis involves three main steps:

1. Collection and preparation of information and data. This information has been documented in the Information Package. Summary and additional data can be found in Sections 2 and 3 of this report.
2. Use of the data with a forest estate model to develop harvest forecasts. The sensitivity of timber supply to input values is also tested. Methods are described in Section 4.
3. Reporting and interpretation of results. Sections 5 through 9 present analysis results. Section 10 is a discussion of results, which contains a proposed AAC.

Section 11 provides the important last step in discussing data needs that have been identified and which will be addressed within the next planning cycle.

2.0 DESCRIPTION OF THE LICENCE AREA

TFL 33 is located north of Sicamous on the eastern shore of Shuswap Lake. The TFL, comprising approximately 8,365 ha, was acquired in 1965 with the purchase of Shuswap Timbers Ltd. FCL has been operating in the Shuswap area for 53 years.

For a more complete description of TFL 33 please refer to Management Plan #8.

3.0 INFORMATION PREPARATION

Many pieces of information are required to conduct a timber supply analysis. Each piece falls into one of three categories: land base and inventory; timber growth and yield; and management practices.

3.1 Land Base and Inventory

Data synthesis and aggregation is required to prepare the forest inventory for analysis. Inventory and ancillary data has been prepared using a geographic information system (GIS) in order that modelling will be as "spatially aware" as possible. For example, existing roads are buffered to provide specific area reductions from the net harvesting land base. The forest cover inventory is updated for disturbance and projected for growth to December 31, 1998.

The digital database contains information for all land within the licence area, including areas on which harvesting operations are not expected to take place. The timber harvesting land base (also referred to as the working forest or net operable forest) consists of all the productive land expected to be available for harvest over the long-term. This land base is determined by reclassifying the total land base according to specified management assumptions. The details of the reductions are available in the appendix. Figure 3.1 provides a graphic representation of the land base reductions.

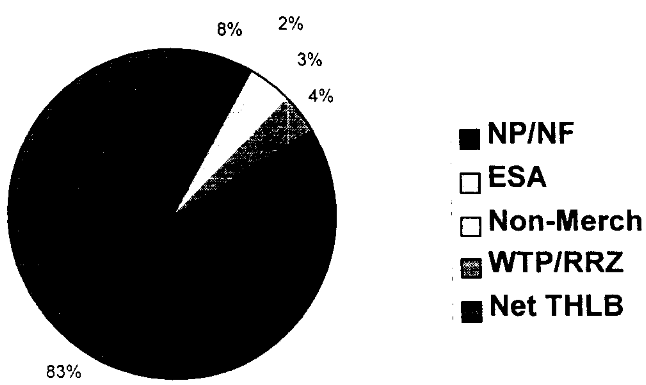

Figure 3.1 – Land Base Area Summary

Figure 3.2 provides the current leading species and age class distribution. Age classes are MoF standard definitions.

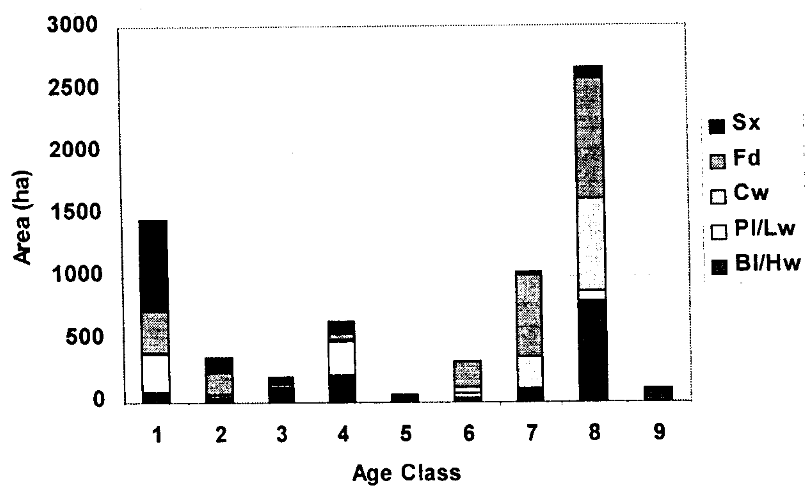

Figure 3.2 – Existing Leading Species & Age Class Distribution

3.2 Timber Growth and Yield

Timber growth and yield refers to the prediction of growth and development of individual forest stands over time. Yield curves for stands of natural origin have been prepared using the MoF program Variable Density Yield Prediction (VDYPbatch) version 6.4. These are referred to as natural stand yield tables. Managed stand yields have been prepared for stands regenerated and conforming to minimum stocking standards. These managed stand yield tables were created using the Table Interpolation Program for Stand Yields (BatchTIPSY).

Table 3.1 provides average productivity estimates for the Base Case based on both natural and managed stand yields. The long-run harvest level is estimated for the entire THLB (6,979 ha) for each yield type.

Table 3.1 - Theoretical Long-term Productivity Estimates

Yield Estimate	Average Culmination Mean Annual Increment (m^3/ha/yr)	Weighted Average Culmination Age (yrs)	Theoretical Long Run Harvest Level (m^3/yr)
Natural stands	2.4	103	16,773
Managed stands	3.1	95	21,495

3.3 Management Practices

Timber supply is directly linked to forest management activities. Current practices are modeled by matching inputs to actual activity and using the functionality of CASH6.2.

To model landscape level biodiversity objectives (seral stages) the land base was classified into units based on landscape unit (all Anstey LU), biogeoclimatic ecological classification (BEC) and natural disturbance type (LU-BEC/NDT). Seral stage requirements (old growth) were assigned to the four LU-BEC/NDTs identified on TFL 33. Areas from outside TFL 33 within the Anstey LU were included in the determination of old growth constraints. Section 7.1 of the Information Package summarises these units.

Landscape level old growth is based on the MoF methodology of developing a weighted average constraint using 45% low emphasis, 45% intermediate emphasis and 10% high emphasis for each of the LU-BEC/NDTs identified on the land base.

The land base has also been assigned to resource emphasis areas (REAs or management zones) for modelling purposes. REAs facilitate the application of management criteria. Specifically, REAs are defined on the basis of wildlife habitat and the maintenance of visual quality. Details of the zone assignments can be found in Section 7.2 of the Information Package.

Management on TFL 33 is best summarized by these commitments which appear in the Statement of Management Objectives, Options and Procedures document (98.10.02):

- Continued use of alternate harvest systems such as cable and selection and alternate silviculture systems such as patch cut and group selection;
- To include an inventory of licenced and unlicenced water users in the vicinity of the TFL;
- To complete operability mapping including an indication of harvest methods; and
- To update the stream inventory.

4.0 ANALYSIS METHODS

4.1 Forest Estate Modelling

CASH6.2, a forest-level simulation model, was used to model all analysis scenarios presented in this report. The model incorporates all integrated resource management considerations. Maximum disturbance and minimum old growth constraints are explicitly implemented. Productive forest stands that are excluded from timber harvesting are included in the analysis to better model forest structure and disturbance levels.

Two forest cover constraint classes are used for modeling:

- Disturbance - the maximum area that can be younger than a specified age or shorter than a specified height. This is intended to model cutblock adjacency and green-up requirements.
- Retention - the minimum area that must be older than, or as old as, a specified age. This is intended to model both retention of mature/thermal cover and retention of old growth.

The use of forest cover constraints as described above improves forest management modelling by ensuring that non-timber resources are given appropriate consideration. Constraints for various REAs may be overlapped to ensure that all management objectives are satisfied.

In addition to those described above, CASH6.2 allows a second level of constraints to be applied. These are used to monitor seral stage distribution guidelines for the maintenance of landscape level biodiversity.

Outputs from CASH6.2 include:

- Harvest and inventory levels;
- Forest cover status reports for disturbance, mature and old growth constraints; and
- Seral stage status reports for up to five seral stages.

All analysis simulations use a 250-year planning horizon with five year periods. Non-recoverable losses (NRLs) modelled in the CASH6.2 simulations (assumed to be 450m^3/year) are not included in harvest levels presented in this report.

4.2 Analysis Results

Results of the various analysis scenarios are presented in graphic and tabular form. Tables provide actual harvest levels achieved during each period of the simulation. All reported harvest levels are net of NRLs, estimated at 450m3/year. Graphic results display trends in timber inventory (stock) and harvest levels, and age class distributions . Three categories are presented in the inventory figures:

- Operable – the total inventory on the timber harvesting landbase;
- Available – the estimated portion of the operable timber that is not excluded from harvest by forest cover constraints;and
- Periodic harvest.

Starting and ending operable and available inventory levels are provided.

5.0 BASE CASE

Inputs for this scenario have been described in previous section and in the Information Package. The harvest level developed for this analysis option is summarized in Table 5.1.

Table 5.1 – Base Case Annual Harvest

Simulation Period	Start & End Years	Annual Harvest (m3/year)
1	1 - 5	8,400
2	6 - 10	8,400
3 – 16	11 - 80	12,000
17 50	81 - 250	14,350

It was not possible to achieve the current AAC of 22,500m3/year at any time during the 250-year planning horizon. Initially the harvest is limited to 37% of the current AAC. The long-term harvest level is well below the theoretical LRSY 21,496m3/year. This reduced rate of harvest is mainly caused by forest cover constraints related to visual quality.

Typically alternative harvest flows are presented for the Base Case but an even-flow level would be limited to 8,400m3/year due to the initial harvest rate. Similarly there was no potential to increase the harvest during years 11 to 70 years without having a significant shortfall at year 71.

Figure 8.1 provides an overview of the inventory levels over the 250-year planning horizon for the Base Case.

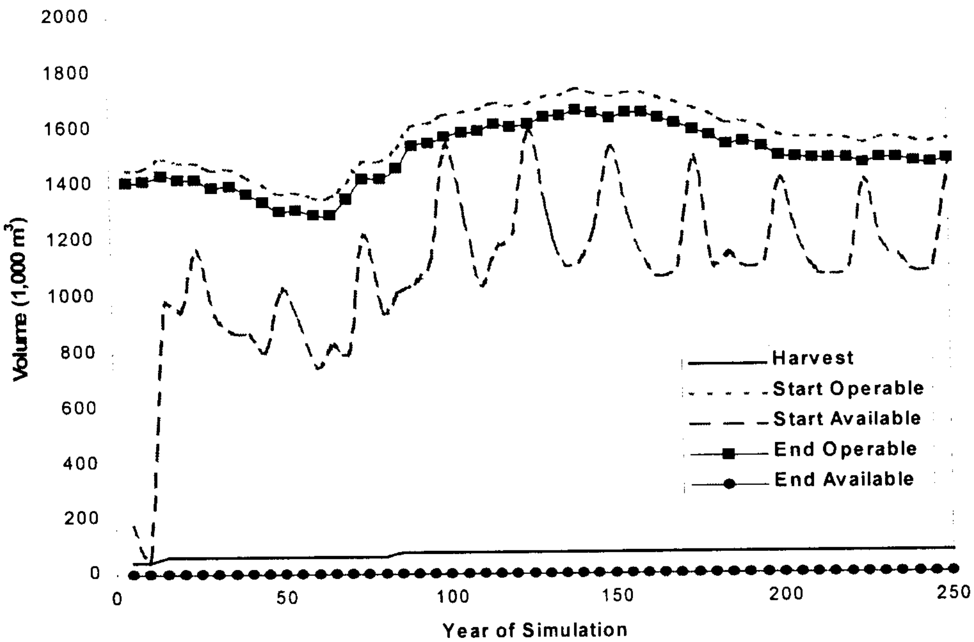

Figure 5.1 – Base Case Inventory & Harvest Levels

The key entry in Figure 5.1 is the starting available inventory which is less than 50,000m3 at year 5 of the simulation. This limits the harvest to only 8,400m3/year during the first 10 years. A large recovery is evident at year 10 as many areas achieve green-up age and permit additional harvesting. The large fluctuations in the available harvest line in Figure 5.1 represent the timing of VQO areas reaching green-up age (green-up age for VQOs is 20 to 28 years). As soon as there is available timber in the VQO zones, the harvest shifts to these areas.

The current inventory of approximately 1.4 million m3 is more than sufficient to carry the current AAC of 22,500m3/year but disturbance constraints limit access to much of this inventory. Over the entire 250-year planning horizon the operable inventory maintains a very stable level, averaging 1.57 million m3.

The gap between the operable and available stock levels in Figure 5.1 demonstrates how much timber (up to 600,000 m3) is locked out of harvest due to forest cover constraints. Ending available inventory is at zero for all of the 250-year planning horizon. This demonstrates that all available timber is being utilized during each simulation period.

In addition to the initial shortfall in available timber, harvesting is limited between years 60 and 80 of the Base Case simulation. This is caused by a combination of three factors:

- Forest cover constraints associated with VQO disturbance;
- The need to reserve mature timber for old growth requirements; and
- The shift to harvesting second growth stands which are just reaching minimum harvest age at this time.

After year 80 the harvest rate is increased to the long-term level of 14,350m3/year. Figures 5.2 through 5.6 show the changes in age class distribution over time for the Base Case.

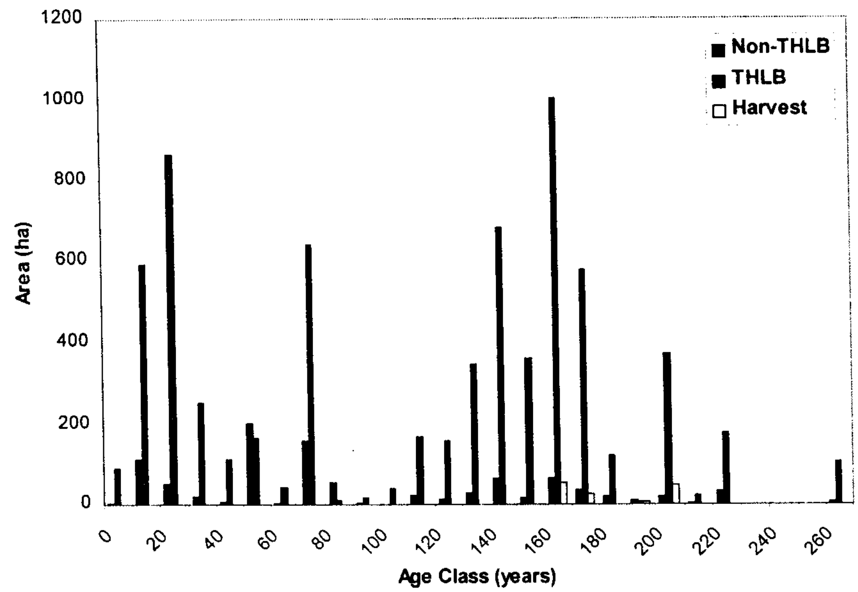

Figure 5.2 – Base Case Age Class Distribution at Year 1

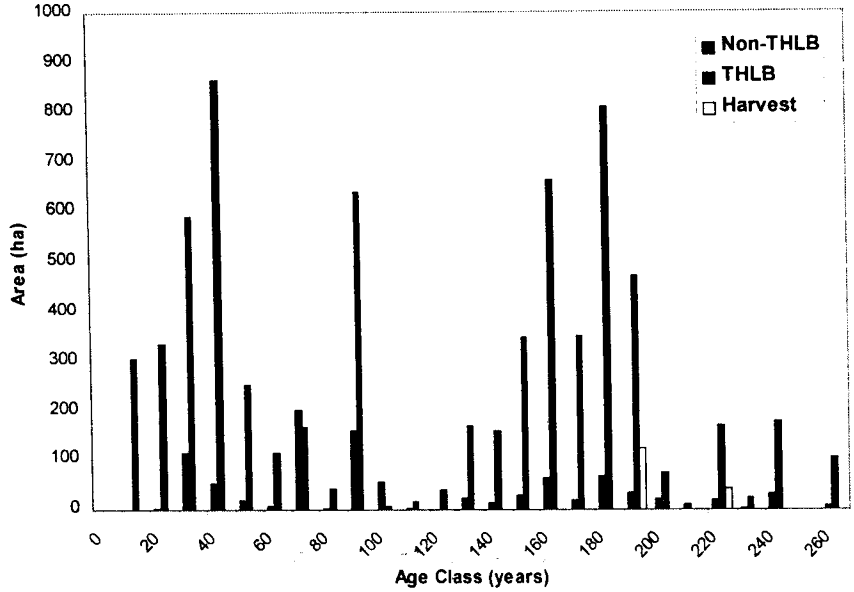

Figure 5.3 – Base Case Age Class Distribution at Year 20

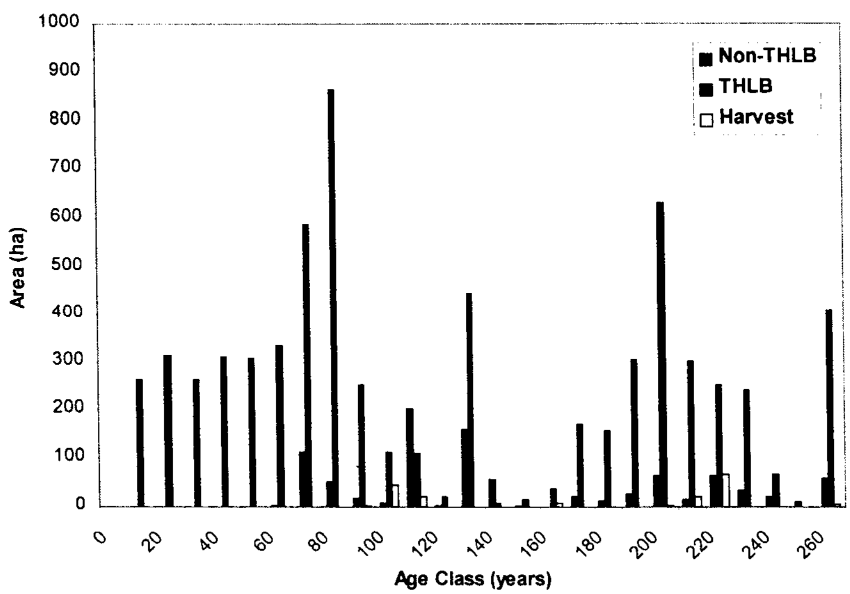

Figure 5.4 – Base Case Age Class Distribution at Year 60

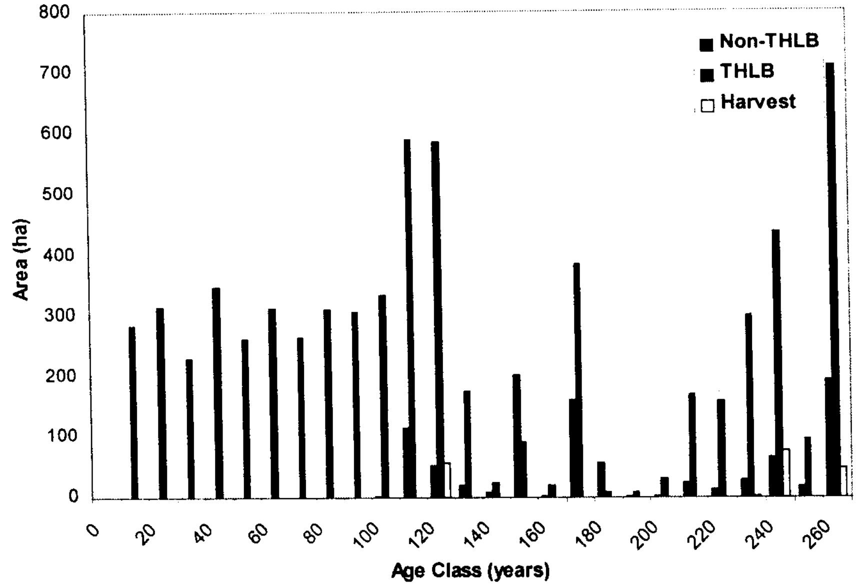

Figure 5.5 – Base Case Age Class Distribution at Year 100

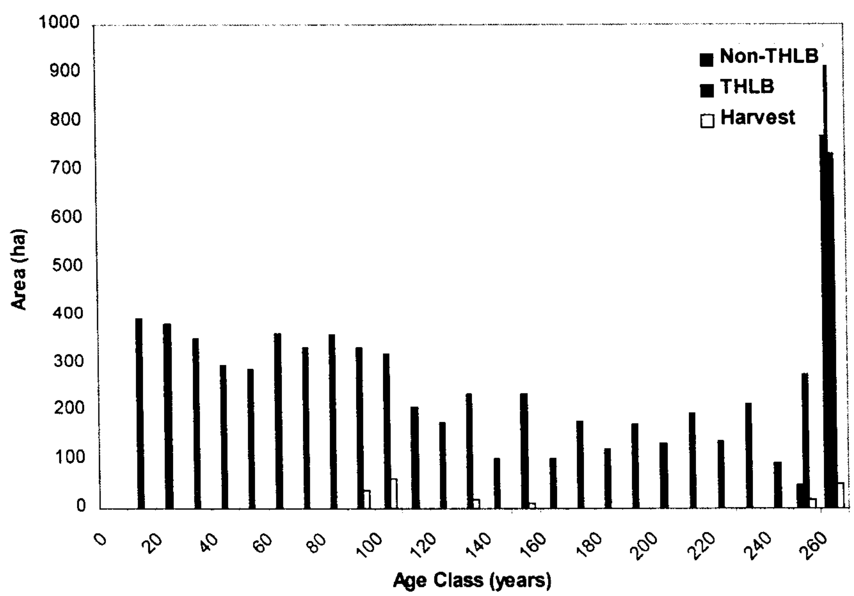

Figure 5.6 – Base Case Age Class Distribution at Year 250

The lack of inventory currently 40 to 60 years old and less than 10 years old affects the timber supply during the first 80 years because this component of the forest will eventually support a portion of the harvest approximately 60 to 80 years into the future. This is partly overcome by the existing inventory of mature timber currently older than 100 years of age. 100 years into the simulation, the age classes are evenly distributed for stands up to 100 years of age.

The mature and overmature inventory still present at years 100 and 250 is a result of limited access to areas being modelled with VQO constraints. Rates of harvest in these areas are very slow and therefore timber is retained much longer than in other REAs. In addition, the non-timber harvesting land base (non-THLB) cannot satisfy all of the old forest requirements. Therefore a portion of the old growth requirement must be satisfied from the timber harvesting land base and this results in the retention of older stands.

At year 250 of the simulation there is a significant amount of timber aged 120 to 250+ years old. This may be unrealistic in that eventually many of these older stands may break-up (decay, fire, *etc.*) and revert to young stands. The "harvest" areas in the age class distribution figures confirm that many of the older stands are retained for the entire planning horizon as a result of forest cover constraints. Otherwise the harvest would be concentrated in the 80 to 120 year age categories, matching minimum harvest ages.

Figure 5.7 provides a summary of average harvest statistics for the Base Case harvest scenario.

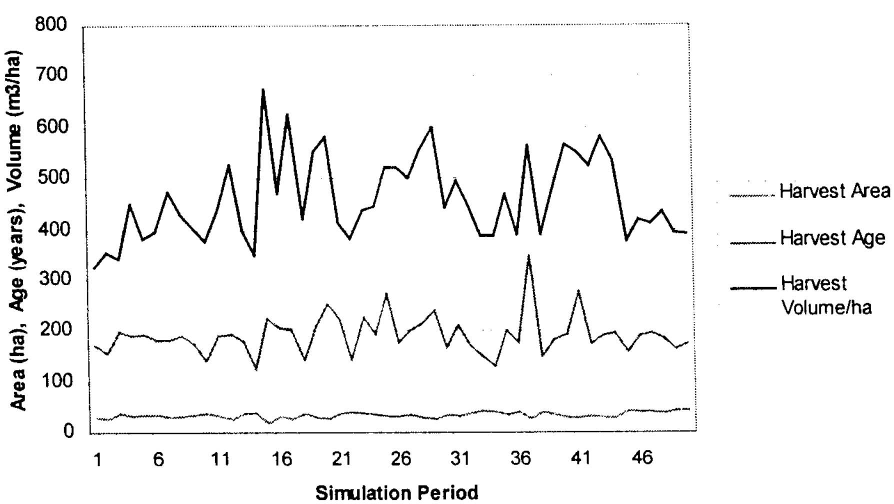

Figure 5.7 – Base Case Average Harvest Statistics

An important feature indicated by Figure 5.7 is the high average harvest age compared to average minimum harvest ages. Over the 250-year planning horizon the average harvest age is 193 years compared to the average minimum harvest age of 95 years for managed stands. This shows that stands are being retained for very long periods to satisfy forest cover requiremens. As a result, average harvest volumes approach 700m3/ha in some periods. Some existing mature stands on the most productive sites are not being harvested until they are well over 250 years of age, giving the high yield per hectare.

An important aspect of the average information is that older stands are still being included in the periodic harvest in the later years of the simulation. The oldest stands are retained to satisfy old forest requirements.

The overwhelming factor in reducing the harvest from the current AAC is the limited access to areas classified as VQOs. All of the non-grizzly VQO REAs are excluded from harvest for the initial 10 to 20 years of the Base Case simulation. These areas currently exceed the specified disturbance limits. VQO zones comprise almost 5,000 ha (71%) of the net harvesting area on TFL 33. During the simulations, CASH6.2 will prevent any harvest within a REA once the maximum disturbance level is reached.

After these VQO REAs achieve acceptable levels of green-up in 10 to 20 years, harvesting resumes but it is eventually suspended because the maximum perimitted disturbance is reached. This is the case during most of the remaining planning periods. The long green-up periods, up to 28 years, result in very infrequent access to the VQO REAs.

Harvest in deer winter range zones, which overlap with VQO retention and partial retention REAs, is also limited by the more significant constraints associated with VQOs. Retention objectives associated with deer winter range do not limit the harvest at any time during the 250 planning horizon. This is because, by default, older forests are retained because of significant disturbance and green-up constraints on the majority of the TFL.

In the Base Case, areas from outside TFL 33 (within the Anstey LU) influence the old growth status within the TFL. Seral stage (old growth) conditions are below the specified objectives in three of the LU-BEC/NDTs at the commencement of the Base Case simulation. The ICHmw3/NDT-3 unit is well above the required level during all analysis periods. This is due to the lower old growth age (140 years) and the impact of non-TFL 33 areas. The other three LU-BEC/NDTs reach acceptable old growth levels in the first 55 to 95 years of the simulation. Table 5.2 summarises the seral stage compliance of the LU-BEC/NDTs defined for the TFL 33 analysis at years 20, 50, 100 and 250, as well as the existing condition.

Table 5.2 – Base Case Old Growth Seral Stage Compliance

LU-BEC/NDT & Analysis ID	Area (ha)	Old Growth Requirement (% > years)	Status at Year of Simulation				
			Existing	20	50	100	250
1 Anstey ESSFwc3/NDT-1	1,776	14.4 > 250	0.3	0.3	1.6	14.5	23.3
2 Anstey ICHwk1/NDT-1	2,424	11.4 > 250	4.2	4.2	12.0	12.3	16.2
3 Anstey ICHmw2/NDT-2	2,069	9.4 > 250	0.1	0.1	7.3	9.8	21.0
4 Anstey ICHmw3/NDT-3	1,642	1.9 > 140	58.7	67.5	70.7	61.8	75.9

6.0 OKANAGAN-SHUSWAP LRMP

This analysis option evaluated the impact of modelling the non-timber resource requirements associated with the Okanagan-Shuswap LRMP. Alternative riparian and wildlife tree patch (WTP) reductions were used in assigning the land base to the timber harvesting or non-timber harvesting land base. In addition, the forest cover constraints for VQOs and caribou were modified from the Base Case constraints.

Recent changes to VQO disturbance and green-up requirements and the methods to develop final constraint values are provided in the *Okanagan / Shuswap Land and Resource Management Plan Visual Quality Guidelines* (September 8, 1999) (pages 14 – 16). All other REA forest cover constraints are the same as listed in the Information Package. Table 6.1 summarizes the new VQO forest cover constraints for the LRMP option.

Table 6.1 – Revised LRMP Forest Cover Constraints

REA Level 1 - Visuals	Maximum Disturbance (% < years)
1 - VQO–R	15% < 20 years (6m)
2 - VQO–PR	22.5% < 18 years (5m)
3 – VQO-PR/Grizzly	21.2% < 21 years (5m)
4 - VQO–M	30% < 19 years (5m)
5 – VQO-M/Grizzly	30% < 22 years (5m)

Table 6.2 lists the harvest results from the LRMP option for the TFL 33 analysis. The Base Case results are included for comparison.

Table 6.2 – LRMP Annual Harvest

Simulation Period	Start & End Years	Annual Harvest (m3/year)	
		Base Case	LRMP
1	1 - 5	8,400	22,500
2	6 - 10	8,400	22,500
3	11 - 15	12,000	20,250
4	16 - 20	12,000	20,250
5 – 16	21 - 80	12,000	18,100
17 - 50	81 - 250	14,350	18,750

The current AAC of 22,500m3/year can be maintained for the first 10 years. 10% declines occur at years 11 and 21 before a minor increase to the long-term level of 18,750m3/year at year 81. Figure 6.1 provides a graphic summary of the harvest and inventory levels for the LRMP option of the TFL 33 analysis.

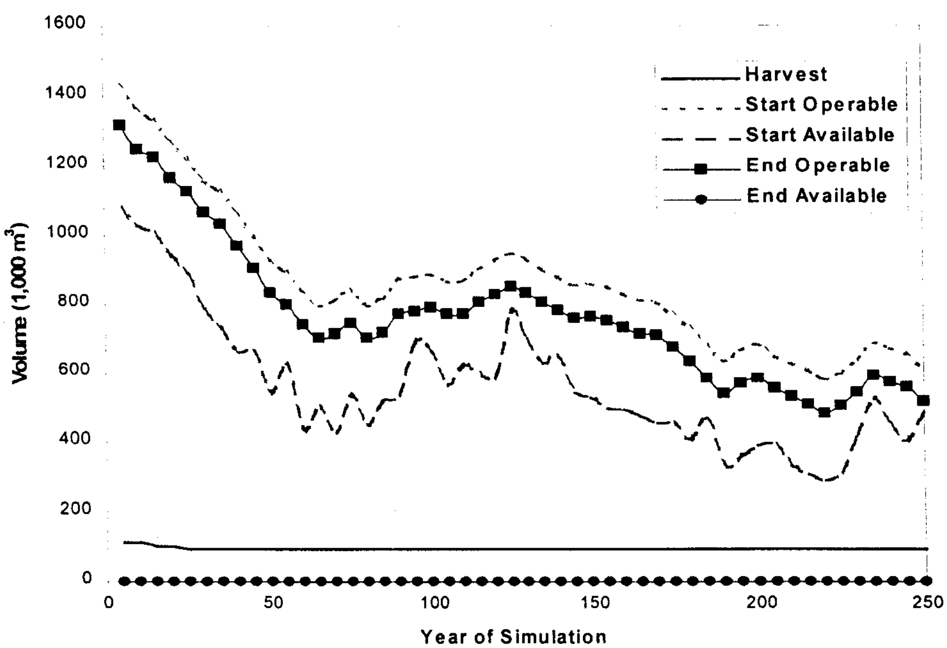

Figure 6.1 – LRMP Inventory & Harvest Levels

The "starting available" inventory does not display the same shortfall as noted for the Base Case. The existing inventory of mature timber is used to support the harvest over the first 60 years of the simulation. After that time a significant portion of the the mature inventory is retained to meet caribou and landscape level biodiversity (old seral) requirements. In the long-term the LRMP simulation retains only about half of the inventory retained in the Base Case. However, this does not imply an unstable timber supply. Access to timber in the Base Case is very limited and this results in a significant amount of timber being placed in a reserved state over the 250-year planning horizon.

Figures 6.2 through 6.6 summarise the age class distributions at various times during the 250-year planning horizon for the LRMP option.

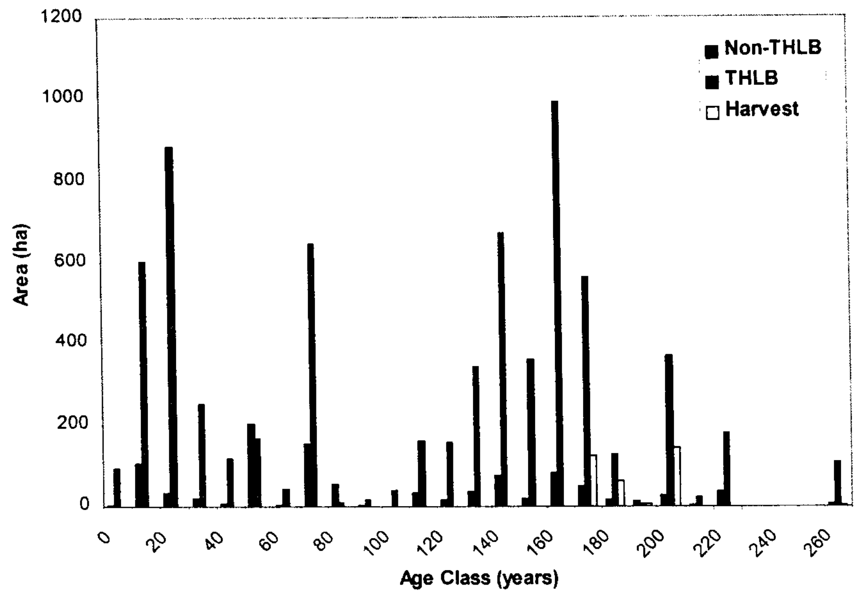

Figure 6.2 – LRMP Age Class Distribution at Year 1

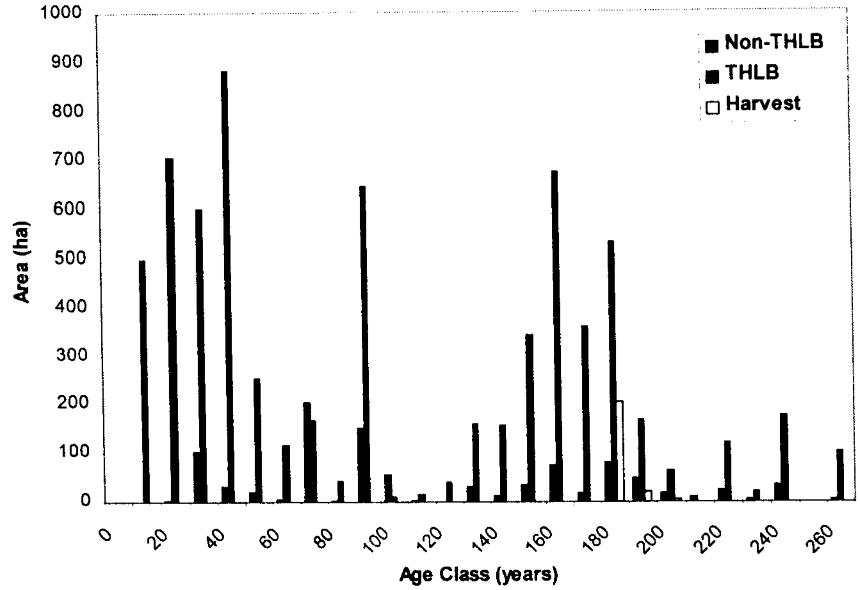

Figure 6.3 – LRMP Age Class Distribution at Year 20

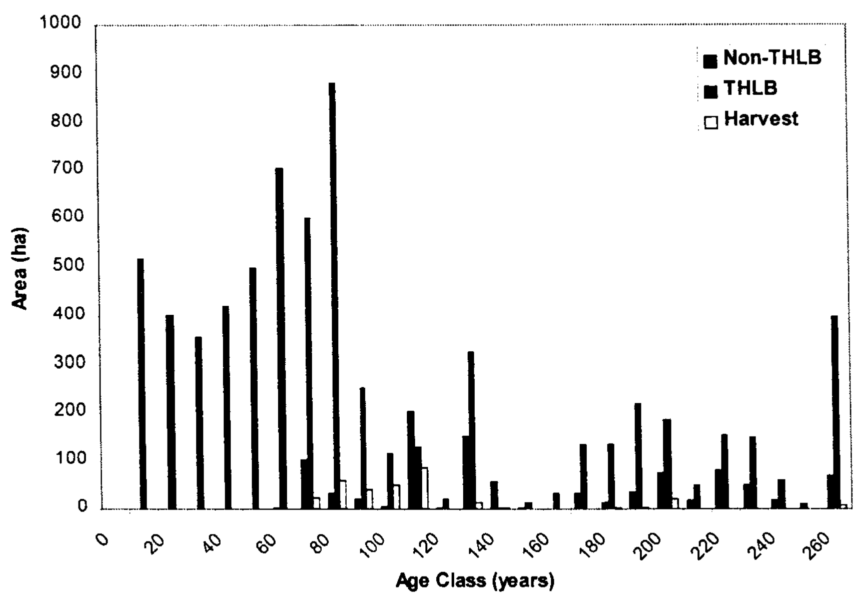

Figure 6.4 – LRMP Age Class Distribution at Year 60

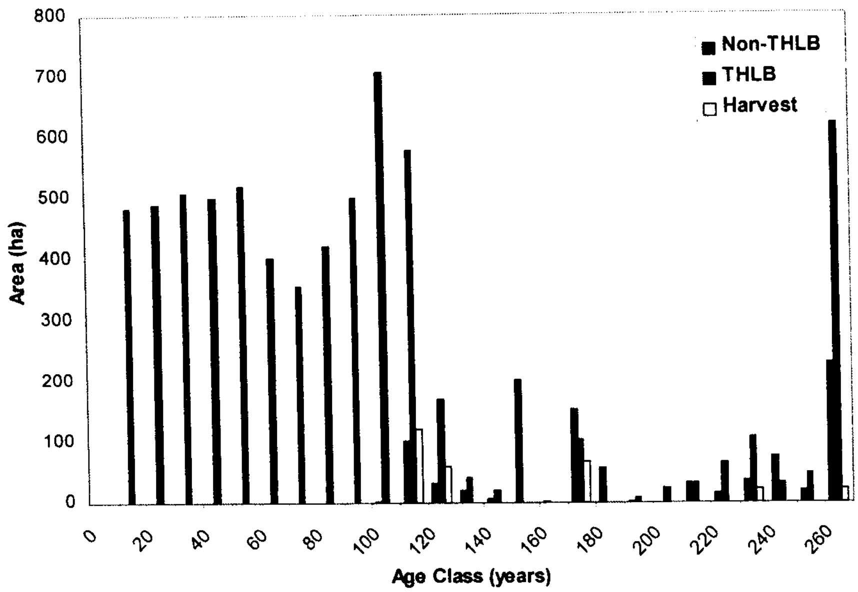

Figure 6.5 – LRMP Age Class Distribution at Year 100

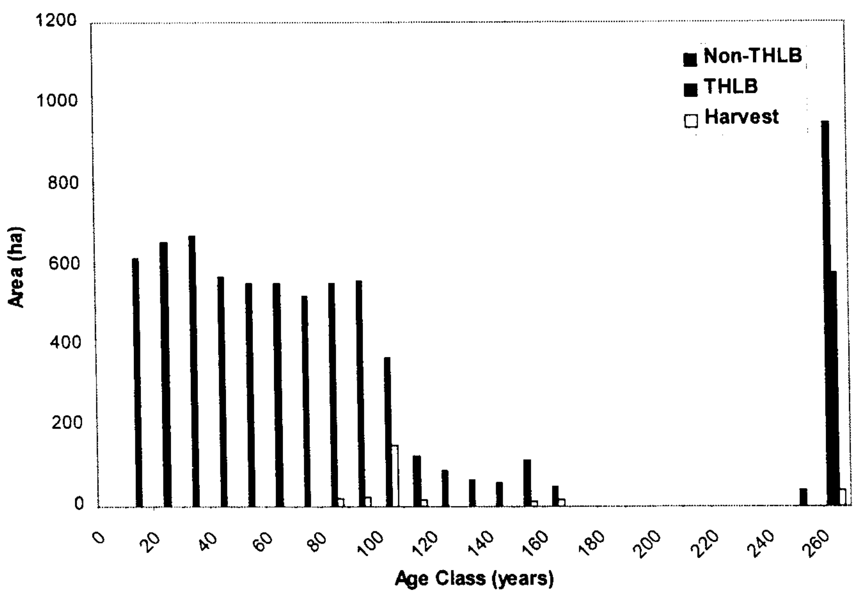

Figure 6.6 – LRMP Age Class Distribution at Year 250

There is reduced inventory in ages 110 to 170 and complete absence of inventory between 180 and 250 years in the LRMP option (Figure 6.6). This is noticeably different from the Base Case which had a considerable amount of inventory in these age classes at the end of the analysis simulation because of forest cover constraints.

Average harvest age for the LRMP option is 140 years compared to 193 years for the Base Case. Again this demonstrates the earlier access to timber in the LRMP scenario. However, it is still almost 50 years older than the average minimum harvest age for managed stands on the TFL, indicating that forest cover constraints still limit the harvest.

The harvest rate developed for the LRMP option demonstrates the significant impact of VQO forest cover constraints on timber supply for the TFL. LRMP constraints, which include both higher disturbance percentages and reduced green-up heights (or ages) provide immediate opportunities for harvest. The maximum disturbance limits within the VQO zones were not reached in every simulation period. This indicates that other factors were influencing the final harvest level for the LRMP option.

LRMP VQO forest cover constraints take into account operational activities that reduce the impact of harvesting on visual quality including cutblock size, silvicultural system, visual absorption capability and viewing distance. Therefore a more refined approach to modelling visual quality has been used in this scenario.

Caribou mature and old forest cover constraints were also included in this option. These constraints play an important role in determining the mid and long-term harvest rate. Approximately 265 ha of the Caribou Early and 200 ha of Caribou Late REAs (timber harvesting land base) are kept in permanent reserve to address caribou requirements. Similarly, it takes approximately 80 years to reach the specified old growth objectives for caribou (both early and late). These mature and old constraints become limiting before the VQO disturbance limits are reached during the mid and late stages of simulation.

Old seral requirements at the LU-BEC/NDT level were the same for the LRMP option as they were for the Base Case. Table 6.3 summarises the old growth status at selected times during the 250-year planning horizon for the LRMP scenario.

Table 6.3 – LRMP Old Growth Seral Stage Compliance

LU-BEC/NDT & Analysis ID	Area (ha)	Old Growth Requirement (% > years)	Status at Year of Simulation				
			Existing	20	50	100	250
1 Anstey ESSFwc3/NDT-1	1,777	14.4 > 250	0.3	0.3	1.6	19.8	47.2
2 Anstey ICHwk1/NDT-1	2,424	11.4 > 250	4.2	4.2	12.5	11.2	12.7
3 Anstey ICHmw2/NDT-2	2,073	9.4 > 250	0.1	0.1	7.3	9.3	12.1
4 Anstey ICHmw3/NDT-3	1,646	1.9 > 140	58.7	54.0	33.8	18.6	18.0

In this analysis option old growth levels are maintained closer to the required levels compared to the surplus of old growth exhibited in the Base Case. More frequent access to timber in the LRMP option reduces the amount of old forest on the TFL. However there is always a trend towards meeting the old growth requirement during the short-term. Required objectives are met between years 55 and 85 for all LU-BEC/NDTs except for the ICHmw3/NDT-3 which satisfied the old growth constraint in its existing state.

7.0 ADDITIONAL INCREMENTAL SILVICULTURE OPTION

In this analysis option the levels of fertilization and improvements from genetically improved planting stock (in addition to those programmes already in place) were evaluated. Three scenarios were completed for this option:

- Additional tree improvement;
- Additional tree improvement and fertilize Douglas-fir good sites (SI50 > 18.0);and
- Additional tree improvement and fertilize Douglas-fir good/medium sites (SI50 > 15.0).

All other analysis inputs and assumptions used are from the Base Case. Harvest schedules developed for these three scenarios are summarized in Table 7.1.

Table 7.1 – Additional Incremental Silviculture Annual Harvest

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)			
		Base Case	Tree Improvement	Tree Improvement & Fertilize G	Tree Improvement & Fertilize G/M
1	1 - 5	8,400	11,300	11,325	11,325
2	6 - 10	8,400	11,300	11,325	11,325
3 - 16	11 - 80	12,000	13,500	13,550	13,575
17 – 50	81 - 250	14,350	15,500	15,525	15,550

The short-term harvest is improved by approximately 35% over the Base Case but is still only half of the current AAC of 22,500m3/year. Long-term harvest levels were approximately 8% higher than the Base Case. Figure 7.1 displays the harvest and inventory over time for the Additional Tree Improvement option. Due to the similar nature of the results for the three scenarios completed for this option, discussion and graphic presentation centre around the "Tree Improvement" scenario beginning with Figure 7.1.

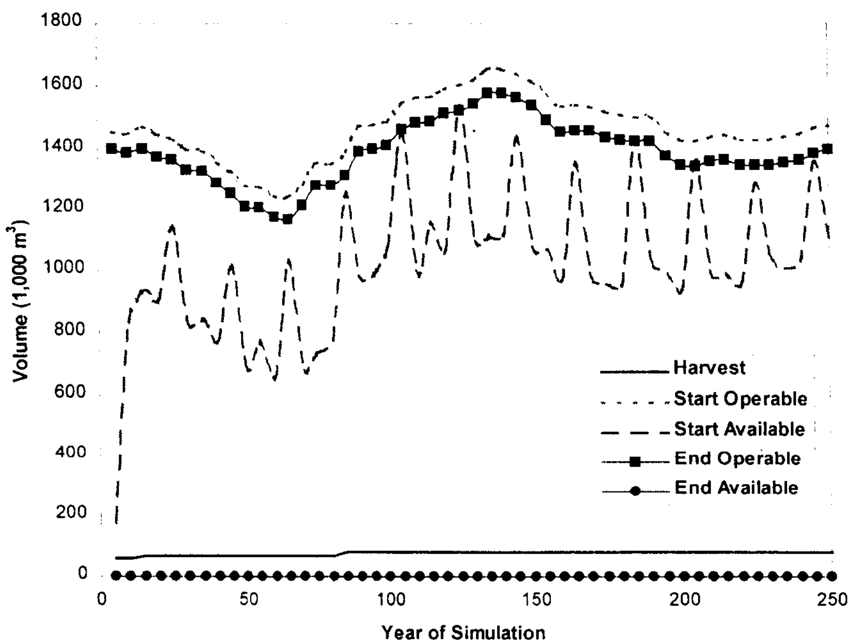

Figure 7.1 – Additional Tree Improvement Inventory & Harvest Levels

Many of the features of the various inventory levels shown for the Base Case in Figure 5.1, are also evident in this option. Supply is very limited during the first 10 years as existing second growth stands grow to green-up height.

The main reason for the increase over the Base Case is due to reduced green-up times as a result of the various silviculture treatments. Based on managed stand age-height information provided by TIPSY, years to green-up were reduced by 2 – 3 years for this option. However there is still significanly less access than permitted in the LRMP option. Generally the VQO forest cover constraints limit the harvest during the entire planning horizon.

Increased long-term harvest is a result of improved managed stand yields. The average culmination MAI for the improved yields is 4 – 8% higher than the average for the Base Case yields. Limitations on harvest caused by visual forest cover constraints offset much of the improvement from incremental silviculture activities.

Figures 7.2 to 7.6 provide the age class distributions at various times for the Additional Incremental Silviculure option.

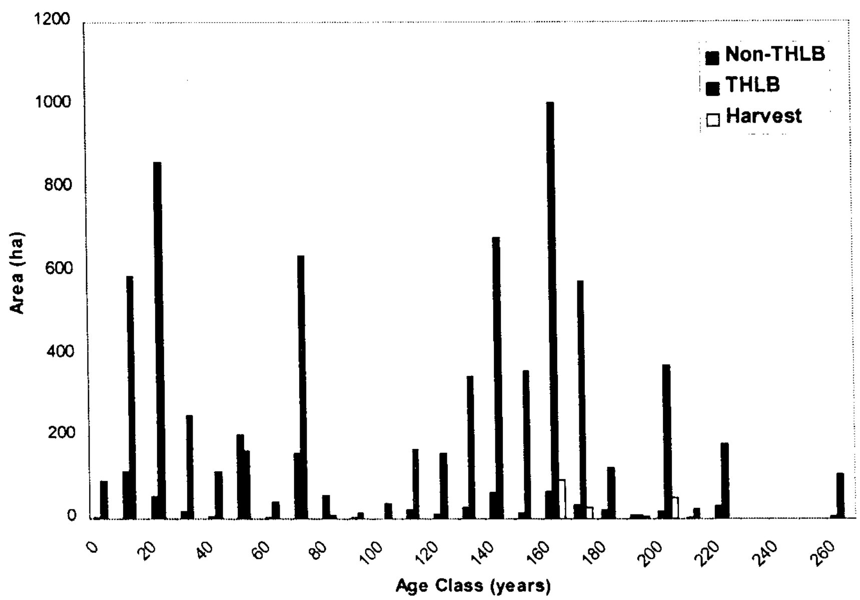

Figure 7.2 – Additional Incremental Silviculture Age Class Distribution at Year 1

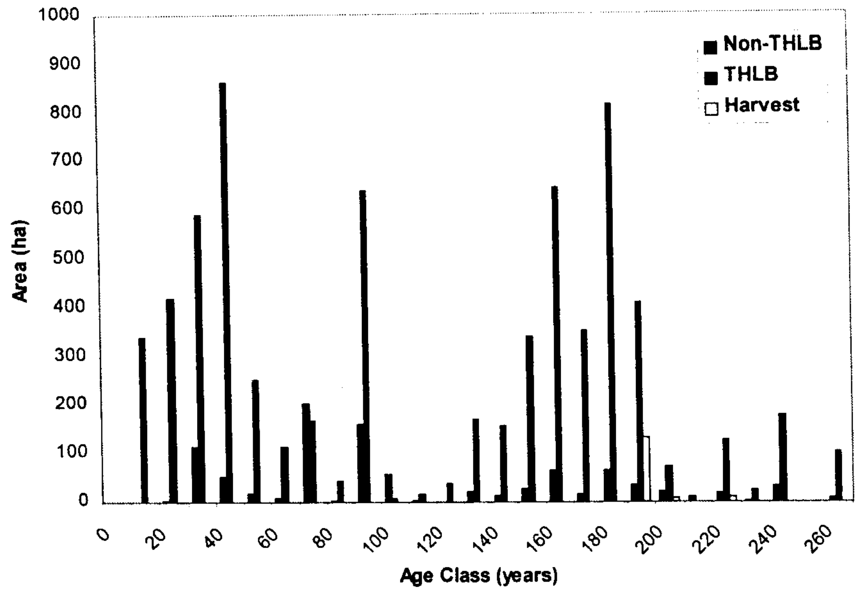

Figure 7.3 – Additional Incremental Silviculture Age Class Distribution at Year 20

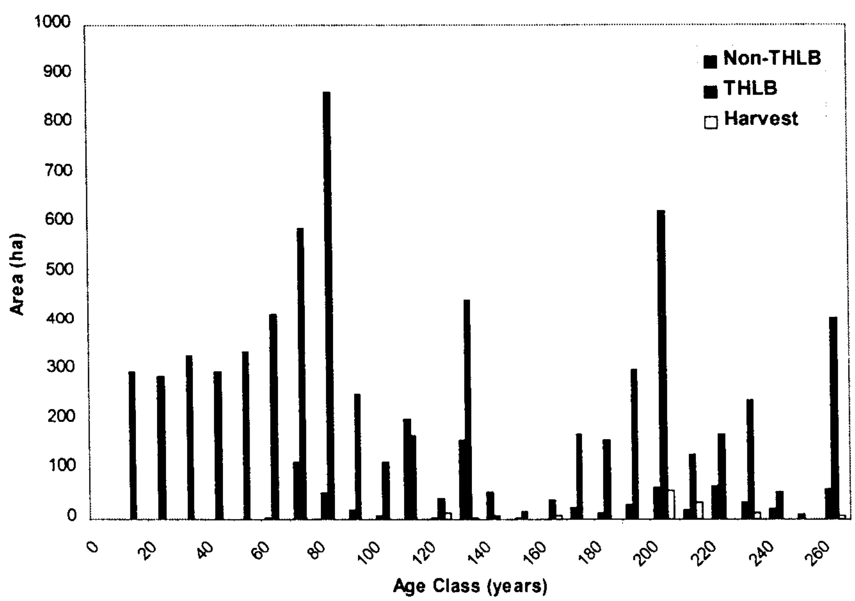

Figure 7.4 – Additional Incremental Silviculture Age Class Distribution at Year 60

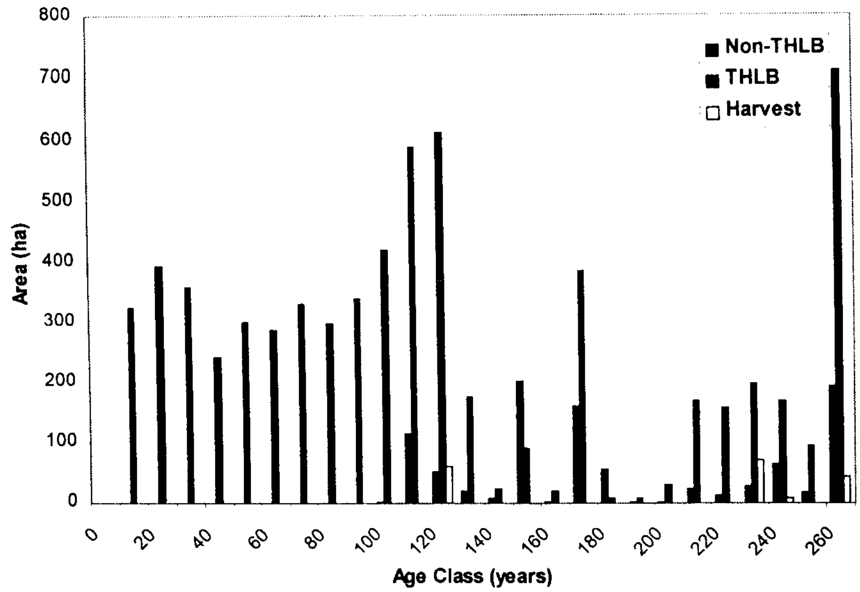

Figure 7.5 – Additional Incremental Silviculture Age Class Distribution at Year 100

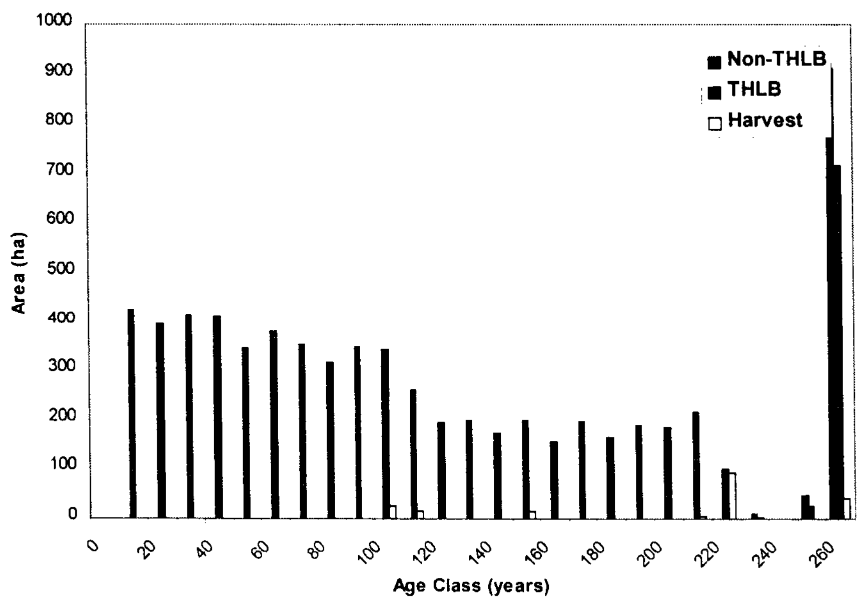

Figure 7.6 – Additional Incremental Silviculture Age Class Distribution at Year 250

The pattern of distribution is similar for the Additional Incremental Silviculture option and the Base Case. As the simulation progressed beyond year 100 less inventory is retained in older ages. However, there is still significantly more area in stands aged 100 to 240 in this option compared with the LRMP option.

8.0 BASE CASE SENSITIVITY ANALYSES

Many inputs used in the Base Case were subjected to sensitivity analysis. Forest cover constraints and growth and yield inputs were modified in the various simulations as documented in the following sections.

8.1 Growth and Yield

8.1.1 VDYP Natural Stand Yields

Table 8.1 summarizes the annual harvest results for the VDYP natural stand yield table sensitivity analyses.

Table 8.1 – VDYP NSYT Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)		
		Base Case	Volume +10%	Volume –10%
1	1 - 5	8,400	9,700	8,300
2	6 - 10	8,400	9,700	8,300
3 - 10	11 - 50	12,000	13,200	10,700
11 - 16	51 - 80	12,000	13,200	11,100
17 - 50	81 - 250	14,350	15,050	13,300

Reducing existing volumes by 10% lowers the mid-term harvest by approximately 10%. This is during the critical period when many mature stands are being placed into reserves to accommodate old growth requirements. In addition, second growth stands are just becoming part of the annual harvest. The lack of second growth inventory currently aged 40 to 60 years of age also contributes to the drop in harvest. The long-term harvest is also reduced (by approximately 7%) because existing natural stands continue to make up part of the annual harvest right through the 250-year planning horizon.

Increasing natural stand volumes by 10% allows an immediate 15% increase in the harvest rate compared to the Base Case. In the mid-term the increase is approximately 10% and in the long-term, when natural stands contribute less to the annual harvest, the increase is only 5%.

8.1.2 TIPSY Managed Stand Yields

Table 8.2 provides the results of the TIPSY managed stand yield senstivity analyses.

Table 8.2 – TIPSY MSYT Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		Base Case	Min Harvest Age -10 Years	Min Harvest Age +10 Years	Volume +10%	Volume -10%
1	1 - 5	8,400	8,400	8,400	8,400	8,400
2	6 - 10	8,400	8,400	8,400	8,400	8,400
3 - 10	11 - 50	12,000	12,250	11,400	12,000	12,000
11 - 16	51 - 80	12,000	12,850	11,400	12,000	12,000
17 - 50	81 - 250	14,350	14,200	14,400	15,050	13,500

Reducing minimum harvest age by 10 years has a minimal effect on the Base Case harvest rate. During the mid-term (to year 80) the harvest increases as much as 7% before reaching the long-term level which is 1% below the Base Case level. Second growth stands are able to contribute to the harvest a few years earlier than in the Base Case. Having managed stands available 10 years sooner offers some flexibility in the harvest selection. The long-term harvest is reduced because the managed stands provide less volume at the reduced ages.

Increasing managed stand minimum harvest ages reduces the mid-term harvest by approximately 5%. Limiting access to second growth stands during the critical period 60 to 80 years into the future is exaggerated in this sensitivity analysis. The long-term harvest rate is virtually the same as in the Base Case. This minimal difference is because many stands are not harvested until they are much older than the minimum age required for harvest in all of the analysis simulations.

An increase in managed stand volume raises the long-term harvest rate by 5%, no other changes were possible. This indicates that the timing of stand availability is more important than the volume provided by the stands.

Similarly, decreasing managed stand volume by 10% only impacts the long-term harvest rate. In this sensitivity the long-term harvest drops by approximately 6%.

8.2 Forest Cover Constraints

8.2.1 Disturbance and Green-Up

A number of sensitivity analyses related to zonal disturbance and green-up were completed for the Base Case. Table 8.3 provides a summary of the results for changes in disturbance limits and green-up heights.

Table 8.3 – REA Disturbance Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		Base Case	Increase Disturbance	Decrease Disturbance	VQOs 4m REAs 2m	VQOs 6m REAs 4m
1	1 - 5	8,400	10,100	1,750	12,500	2,450
2	6 - 10	8,400	10,100	6,600	12,500	5,900
3	11 - 15	12,000	14,050	7,700	12,500	9,350
4	16 - 20	12,000	14,050	7,700	12,500	9,350
5 – 16	21 - 80	12,000	15,650	7,700	12,500	9,350
17 - 20	81 - 100	14,350	15,650	10,100	14,075	11,700
21 – 50	101 - 250	14,350	15,650	10,100	14,075	11,700

Increasing REA disturbance makes an immediate improvement of 20% in the annual harvest. Mid-term and long-term harvest rates are 17% and 9% higher, respectively than the Base. These harvest levels are still considerably lower than the current AAC however. This indicates that the time required for second growth stands to reach green-up plays an important role in determining the harvest potential.

Reducing REA disturbance has a significant impact on harvest during the entire 250-year planning horizon. Initially the harvest is only 20% of the Base Case level and 8% of the current AAC. Harvest is 30 – 36% lower than the Base Case in the remainder of the simulation. The additional area that must reach acceptable green-up in the short-term and the reduced access throughout the simulation force this decline.

Reducing green-up heights by 1 metre allows a more significant (49%) increase in the initial harvest level. This shows that recovery of existing second growth stands to the appropriate height is an important issue in developing a harvest rate on the TFL 33. The long-term harvest is approximately the same as in the Base Case. This is because the maximum disturbance has not been changed and old growth reserves limit the harvest in some areas.

Conversely, increasing green-up heights by 1 metre causes a dramatic reduction in annual harvest, similar to reducing disturbance limits. Short-term harvest is 70% below the Base Case, while the mid and long-term levels are approximately 20% lower. Again the additional time to reach acceptable green-up reduces the harvest potential on remaining mature areas within the various REAs.

Table 8.4 summarises additional green-up and regeneration delay sensitivity analysis results for the Base Case.

Table 8.4 – REA Green-Up Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		Base Case	Green-up Height -20%	Increase Disturbance & Green-up Height -20%	Regen Delay 0 Years	Regen Delay 4 Years
1	1 - 5	8,400	15,100	19,125	8,600	8,400
2	6 - 10	8,400	15,100	19,125	8,600	8,400
3	11 - 15	12,000	15,100	19,125	12,200	10,550
4	16 - 20	12,000	15,100	19,125	12,200	10,550
5 - 8	21 - 40	12,000	13,750	19,125	12,200	10,550
9 - 14	41 - 70	12,000	13,750	17,750	12,200	10,550
15	71 - 75	12,000	15,400	17,750	12,200	10,550
16	76 - 80	12,000	15,400	17,750	12,200	10,550
17 - 20	81 - 100	14,350	15,400	17,750	14,400	13,150
21 – 50	101 - 250	14,350	15,400	17,075	14,400	13,150

Reducing green-up height by 20% (3 to 8 years depending on REA) allow a short-term increase of approximately 80% and a long-term increase of 7% in the annual harvest compared to the Base Case. This indicates that the current state of green-up on the TFL is critical to the short-term supply under the Base Case assumptions.

A combination of reduced green-up heights and increased disturbance allows the harvest to climb to within 15% of the current AAC, or more than double the Base Case short-term harvest rate. This approach to disturbance management is similar to that outlined for the LRMP option.

Regeneration delay plays a similar role to green-up in that it adds years to the final green-up age required in the simulation. However, changes of 2 years make only minor changes to the harvest (up to 2%) in the Regen Delay 0 Years scenario.

Increasing regen delay to 4 years reduces the mid and long-term by approximately 9%. FCL currently achieves a 2-year or shorter regen delay on its harvested areas. In some cases cutblocks are planted in the same year as harvesting.

8.2.2 *Landscape Level Biodiversity*

A number of landscape level biodiversity (seral stages requirements, *etc.*) sensitivity analyses were completed for the Base Case. Estimates of the annual harvest rates for this group of sensitivity analyses are provided in Table 8.5

Table 8.5 – Landscape Level Biodiversity Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		Base Case	No Non-TFL 33	Low Emphasis Old Growth	Low Emphasis Mature & Old	Intermediate Emphasis Early, Mature & Old
1	1 - 5	8,400	8,250	8,500	8,400	100 **
2	6 - 10	8,400	8,250	8,500	8,400	100**
3	11 - 15	12,000	11,150	12,200	12,100	5,800
4	16 - 20	12,000	11,150	12,200	12,100	5,800
5 – 16	21 - 80	12,000	11,150	12,200	12,100	12,450
21 – 50	101 - 250	14,350	14,050	14,400	14,400	13,500

** Harvest level did not consider 450m3/year of NRLs.

Removing the influence of the non-TFL 33 component of the Anstey landscape unit on the seral stage requirements for the Base Case has a minimal impact, reducing the harvest between 2 and 6%. The mid-term harvest is most affected because during this time additional areas of old forest have been placed into reserves to address the old seral objectives. Therefore fewer mature stands are available for harvest. In the long-term, other areas grow old enough to satisfy either the old forest or harvest requirement.

Substituting low emphasis old growth requirements for the 45-45-10 approach used in the Base Case has no impact on the harvest schedule. The old growth percentages were similar for both scenarios.

Similarly, adding mature seral (low emphasis) requirements has virtually no impact on the Base Case harvest level. The mature requirements may be met by old forest, which is the case in this scenario.

Imposing intermediate emphasis biodiversity constraints on the land base has a significant impact over the first 20 years of the simulation. There was only sufficient timber available to accommodate 100m3/year of harvest, without the estimated at 450m3/year of NRLs. A significant portion of the older forest is immediately placed into reserve to address the mature and old seral requirements. This requirement, coupled with the disturbance forest cover constraints virtually locks out harvest for 20 years. In addition, the early seral requirements have smaller percentages than the REAs occupying the same area. As areas grow to acceptable green-up and eventually minimum harvest age, the harvest increases to within 6% of the Base Case long-term harvest rate.

9.0 LRMP SENSITIVITY ANALYSES

A group of sensitivity analyses similar to those conducted on the Base Case were also completed for the LRMP option.

9.1 Growth and Yield

9.1.1 VDYP Natural Stand Yields

Table 9.1 summarizes the natural stand yield sensitivity analyses completed for the LRMP option.

Table 9.1 – VDYP NSYT Sensitivity Analysis Annual Harvest (LRMP)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)		
		LRMP	Volume +10%	Volume –10%
1	1 - 5	22,500	22,500	22,500
2	6 - 10	22,500	22,500	22,500
3	11 - 15	20,250	22,500	20,250
4	16 - 20	20,250	22,500	18,100
5	21 - 25	18,100	22,500	16,300
6	26 - 30	18,100	22,500	16,300
7 - 9	31 - 45	18,100	22,500	15,400
10 - 16	46 - 80	18,100	18,775	15,400
17 - 50	81 - 250	18,750	19,075	18,675

Increasing natural stand volumes by 10% allows the current AAC to be maintained for 45 years compared to 10 years in the LRMP baseline analysis. The long-term harvest is only 2% higher in this sensitivity compared to the LRMP. Additional volume from the areas harvested translates to less disturbance and permits the increased harvest during the short-term.

Reducing existing volumes for natural stands creates a more pronounced drop in the mid-term annual harvest. During this period less area is available because of the assignment to reserves for old forest. In addition, second growth stands have not yet reached minimum harvest age. Therefore the existing mature stands are the only source of harvest. Long-term harvest is approximately the same as in the LRMP option.

9.1.2 TIPSY Managed Stand Yields

Table 9.2 provides the results of the TIPSY managed stand yield senstivity analyses for the LRMP option.

Table 9.2 – TIPSY MSYT Sensitivity Analysis Annual Harvest (Base Case)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		LRMP	Min Harvest Age -10 Years	Min Harvest Age +10 Years	Volume +10%	Volume –10%
1	1 - 5	22,500	22,500	22,500	22,500	22,500
2	6 - 10	22,500	22,500	22,500	22,500	22,500
3	11 - 15	20,250	20,250	20,250	20,250	20,250
4	16 - 20	20,250	20,250	20,250	20,250	20,250
5 - 16	21 - 80	18,100	18,150	17,350	18,325	18,000
17 - 20	81 - 100	18,750	18,775	18,625	20,400	18,000
21 - 50	101 - 250	18,750	18,775	18,625	20,400	16,800

Reducing managed stand minimum harvest age by 10 years has no measureable impact on the LRMP annual harvest. Increasing minimum harvest ages reduces the mid-term harvest by about 4%. The long-term harvest level is very similar to the LRMP. This indicates that forest cover constraints – disturbance, caribou, old growth – have more influence on the harvest rate than managed stand minimum harvest ages.

Increasing managed stand volumes by 10% allows a minimal increase in years 21 through 80 and a 9% increase in the long-term harvest. Similarly, reducing managed stand volumes by 10% causes a drop of 10% in the long-term harvest rate of the LRMP option. The increase in managed stand harvest in the LRMP option (compared to the Base Case) is comparable the managed stand volume improvement.

9.2 Forest Cover Constraints

9.2.1 Disturbance and Green-Up

A number of sensitivity analyses related to zonal disturbance and green-up were also completed for the LRMP option. Table 9.3 provides a summary of the results for changes in disturbance limits.

Table 9.3 – REA Disturbance Sensitivity Analysis Annual Harvest (LRMP)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)			
		LRMP	Increase Disturbance	Decrease Disturbance	No Caribou Mature & Old
1	1 - 5	22,500	22,500	8,950	22,500
2	6 - 10	22,500	22,500	16,900	22,500
3	11 - 15	20,250	20,350	16,900	22,500
4	16 - 20	20,250	20,350	16,900	22,500
5	21 - 25	18,100	18,150	16,900	22,500
6	26 - 30	18,100	18,150	16,900	20,250
7 - 16	31 - 80	18,100	18,150	16,900	19,100
17 – 50	81 - 250	18,750	18,750	16,900	19,950

Increasing REA disturbance has virtually no effect on the LRMP harvest schedule. This is because of the other factors that dictate the supply during the mid and long-term of the planning horizon – old forest and caribou habitat contraints.

Reducing disturbance forces in an immediate drop in the harvest rate to a level similar to the Base Case. Once existing plantations reach green-up, the harvest increases to a level above the Base Case because of the reduced years to green-under the rules of the LRMP. Long-term harvest is approximately 10% lower than that developed for the LRMP baseline.

Removing the early and late caribou requirements for mature and old forest allows the current AAC to be maintained for 25 years. In addition, the long-term harvest is increased by approximately 6% over the LRMP baseline level. This demonstrates the impact of caribou constraints on the short and mid-term harvest for the TFL using the LRMP management assumptions.

Table 9.4 summarises additional green-up and regeneration delay sensitivity analysis results for the LRMP.

Table 9.4 – REA Green-up Sensitivity Analysis Annual Harvest (LRMP)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)			
		LRMP	Green-up Height -20%	Regen Delay 0 Years	Regen Delay 4 Years
1	1 - 5	22,500	22,500	22,500	22,500
2	6 - 10	22,500	22,500	22,500	22,500
3	11 - 15	20,250	20,350	20,250	20,250
4	16 - 20	20,250	20,350	20,250	18,050
5 - 16	21 - 80	18,100	18,125	18,100	18,050
17 – 50	81 - 250	18,750	18,925	19,025	18,050

As with the Increased Disturbance sensitivity run, reducing green-up by 20% (3 – 5 years) makes very little difference to the LRMP harvest rate. Again caribou and old growth constraints limit the harvest potential on the TFL, after the first 10 years of simulation.

Setting regen delay at 0 years results in a minor (2%) increase in the long-term harvest rate. No other changes to the harvest rate were possible. Increasing regen delay to 4 years forces the harvest to drop to the mid-term level 5 years earlier than in the LRMP baseline. Long-term harvest is approximately 4% lower than the LRMP harvest. These results indicates that disturbance and green-up are not as critical in the LRMP option as they were in the Base Case.

9.2.2 Landscape Level Biodiversity

Similar landscape level biodiversity sensitivity analyses to the Base Case were completed for the LRMP option. Harvest results are provided in Table 9.5

Table 9.5 – Landscape Level Biodiversity Sensitivity Analysis Annual Harvest (LRMP)

Simulation Period	Start & End Years	Annual Harvest Levels (m3/year)				
		LRMP	No Non-TFL 33	Low Emphasis Old Growth	Low Emphasis Mature & Old	Intermediate Emphasis Early, Mature & Old
1	1 - 5	22,500	22,500	22,500	22,500	20,400
2	6 - 10	22,500	22,500	22,500	22,500	17,500
3	11 - 15	20,250	20,250	20,450	20,400	4,900
4	16 - 20	20,250	20,250	20,450	20,400	10,250
5 – 16	21 - 80	18,100	17,350	18,250	18,200	18,100
21 – 50	101 - 250	18,750	18,550	18,800	18,800	18,450

As with the Base Case sensitivity analyses for landscape level biodiversity, very little impact on harvest is noticed with all but the Intermediate Emphasis scenario. Similar factors are influencing the harvest in the other three sensitivities and the LRMP baseline. Biodiversity assumptions do not change enough between the various sensitivities and the LRMP to impact on the harvest.

Assigning intermediate emphasis biodiversity seral stage requirements has a considerable impact on the LRMP harvest rate. The initial level drops by 10% and by up to 76% in the first 15 years of simulation. Eventually the harvest increases to a similar long-term level as reported for the LRMP option. The additional forest reserves required in the Intermediate Emphasis sensitivity limit many of the harvest opportunities in the LRMP option, even with increased disturbance and reduced green-up ages.

10.0 DISCUSSION AND CONCLUSIONS

10.1 Upward Pressures on Supply

A number of alternative management practices and analysis inputs have positive influences on the timber supply. Increasing existing natural stand volumes allows increases in the Base Case short-term harvest. Alternatively, the short-term harvest is maintained for an additional five periods in the LRMP option. Improvements to managed stand volumes increase the harvest, however significant increases are delayed until year 81 of any simulation. Information used to model stand yields is considered acceptable based on the recent MoF audit. Only the influence of additional genetic gains and stand treatments are likely to improve the managed stand yields which could increase the long-term supply.

Reducing green-up height or increasing the allowable disturbance associated with visual quality has been demonstrated to improve the harvest during most of the 250-year planning horizon. This is somewhat offset by caribou mature and old growth constraints in the LRMP option (caribou management was not modelled in the Base Case). FCL belives that the estimates of the time (years) to achieve green-up are considerably longer than what actually occurs in the field. Within the next few years additional information will be collected to confirm green-up ages.

Removal of caribou management mature and old growth constraints allows the LRMP short-term harvest to be maintained for up to 25 years. The mid and long-term harvest estimates are also increased by up to 6%.

Regeneration delay reductions allow a minimal increase in the annual harvest, mainly in the long-term. This management assumption will likely become more important as FCL continues on the trend of regenerating cut-over areas within one year of harvest (or less) coupled with reduced years to green-up from improved managed stand age-height information.

10.2 Downward Pressures on Supply

Reductions in existing stand volumes cause a minor decrease in annual harvest during years 11 to 80 of the planning horizon, based on the sensitivity analyses. Similarly, minor reductions in the long-term harvest result from reductions in managed stand volumes. As stated above for existing stands, volume estimates are considered to be reasonable for the analysis.

Decreasing the allowable disturbance or increasing the green-up height can negatively impact on the timber supply. This result was demonstrated in both the Base Case and LRMP scenarios. However, the most likely approach to modelling disturbance and green-up is that used in the LRMP option.

An increase in regeneration delay to four years can reduce the mid and long-term harvest level. It is highly unlikely that the entire land base would have regeneration delays of this magnitude based on current management and trends to reduce the delay to less than two years.

Excluding the influence of the non-TFL 33 portion of the Anstey LU has a minor negative impact on the annual harvest rate. Given the small area occupied by the TFL, management for landscape level biodiversity will likely consider the remainder of the

Anstey LU. This is based on the average landscape unit size for the remainder of the Salmon Arm District and the general approach to landscape level biodiversity outlined in the FPC.

Assigning the Anstey LU to "intermediate" biodiversity emphasis results in a significant short and mid-term decline in the estimated harvest rate. This is due to additional area from within the timber harvesting land base being placed in reserves to address seral stage requirements. Under the draft LU assumptions, the Anstey LU is assigned to low emphasis.

10.3 Conclusions

As demonstrated by the analysis results, there is considerable variation in the potential timber supply from TFL 33. However, the Okanagan-Shuswap LRMP will likely direct forest management during the period of MP #8 and beyond. Therefore the LRMP option represents the most likely scenario.

The severe impact of forest cover constraints imposed to address visual quality in the Base Case forces the harvest to only 37% of the current AAC of 22,500m3/year. The Base Case does not entirely reflect current operational management. Cutblock design and in-block reserves are being used and these allow FCL to exceed the conventional disturbance limits without compromising the overall visual quality objectives. In addition, the time to achieve visual green-up is believed to be considerably less than modelled in the Base Case. However, the analysis inputs were based on TIPSY managed stand age-height information in the absence of alternative information from FCLs inventory records.

As stated in the *Forest Practices Code Timber Supply Analysis* (MoF, February 1996), a number of FPC provisions such as riparian and biodiversity requirements, increased partial cutting, and smaller cutblocks are expected to reduce visual impacts. In addition, cutblock design and additional in-block reserve areas will help to reduce these impacts. These mitigating factors have been considered in the LRMP option, and are being addressed in FCLs current management. In his AAC determination for MP #7, the Chief Forester considered these management practices and clearly stated that the Base Case is not an AAC recommendation.

It is important to consider cutblock-level management of harvesting in the visually sensitive areas and how this management allows harvesting to proceed without causing significant negative impacts on the landscape. Requirements related to the FPC including riparian, wildlife, and stand and landscape-level biodiversity, have been addressed in this analysis, which gives additional backing to the harvest estimates presented here.

Additional stand treatments and genetic gains may provide opportunities for maintaining the current AAC beyond the next 10 years (under the assumptions of the LRMP). Similarly, improved growth and yield information related to managed stands (age-height, harvest volumes, *etc.*) will give additional confidence in the results of future timber supply analyses for TFL 33.

The Base Case does not provide a realistic assessment of management on the TFL for the period of MP #8 and beyond. Under the more reasonable assumptions of the LRMP scenario, the timber supply on TFL 33 is stable and the current AAC can be maintained for 10 years or longer.

11.0 DATA REQUIREMENTS

In the process of completing this timber supply analysis for TFL 33, information gaps that contribute to uncertainty in the planning and management process have been identified as follows:

- OAF-1 – (TIPSY managed stand yield table adjustment factor) may be overestimated. Localised estimates would provide more reliable managed stand yield predictions.
- Stream classification – some of the stream classification was estimated for use in the timber supply analysis database but will be completed during the period of MP #8.
- Managed stand productivity estimates – localised information for managed stand productivity (SI50) would provide more accurate estimates of future stand yields and green-up.

In addition, updating to Vegetation Resource Inventory (VRI) standards would provide improved stand attribute and volume estimates for the existing inventory. FCL expects to collect some of the information listed above during the period of MP #8 to improve their timber supply estimates and assist in their operational management.