Appendix 3

Timber Supply Analysis Report

File: 19710-40/53

June 14, 1999

Doug Perdue
Operations Forester
Dunkley Lumber Ltd.
PO Box 173
Prince George, British Columbia
V2L 4S1

Dear Doug Perdue:

The Timber Supply Analysis for Tree Farm Licence 53 (TFL 53), Management Plan No. 3 (MP No. 3), dated March 1999, has been reviewed and is accepted.

Acceptance of the Timber Supply Analysis does not mean that the Ministry of Forests (MOF), or the Ministry of Environment, Lands and Parks (MELP), endorse all aspects of the analysis. During the Allowable Annual Cut (AAC) determination information session, MOF and MELP staff will advise the Deputy Chief Forester regarding the technical validity of the analysis and the implications of the assumptions and results. The Deputy Chief Forester will consider this advice as she develops the rationale for her determination of the AAC for TFL 53. If the Deputy Chief Forester requires additional information for her determination, I may request further documentation and/or analysis.

One of the issues raised in the timber supply analysis review was the cumulative effect of the growth and yield assumptions. Research Branch staff indicated that each of the assumptions used to generate yield tables appear reasonable and are supported with data. However, they indicate that in general, each of these growth and yield assumptions tends to favor higher than average yields. They concluded that these assumptions in combination may lead to yields that are overestimated by 10 to 20 %.

.../2

Ministry of Forests
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If you have any questions regarding the acceptance of the timber supply analysis, please call me at (250) 953-3836.

Yours truly,

Susann Brown, RPF
Timber Supply Forester
Timber Supply Branch

pc: Bronwen Beedle, Deputy Chief Forester, Ministry of Forests
Ray Schultz, Regional Manager, Prince George Forest Region
Phil Zacharatos, District Manager, Prince George Forest District
Charlie Klasen, Timber Tenures Forester, Resource Tenures and Engineering Branch
Albert Nussbaum, Growth and Yield Applications Specialist, Research Branch
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APPENDIX III

TREE FARM LICENCE #53

TIMBER SUPPLY ANALYSIS REPORT
in support of
MANAGEMENT PLAN # 3

March 1999

Prepared by:
DUNKLEY LUMBER LTD.

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Doug Perdue, R.P.F.
Operations Forester

with technical assistance from
INDUSTRIAL FORESTRY SERVICE LTD.

____

Robert Schuetz, R.P.F.
Timber Supply Analyst

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DUNKLEY LUMBER LTD.
TREE FARM LICENCE #53

TIMBER SUPPLY ANALYSIS REPORT
in support of
MANAGEMENT PLAN # 3

1.0 INTRODUCTION

In accordance with Section 35(1) (vii) of the Forest Act of British Columbia, Dunkley Lumber Ltd. has undertaken a timber supply analysis on Tree Farm Licence (T.F.L.) #53, in support of and leading to the preparation of Management Plan (M.P.) # 3.

The Statement of Management Objectives, Options and Procedures (SMOOP) was submitted to the Prince George Regional Manager on February 27, 1998 and was accepted on August 7, 1998.

The Timber Supply Information Package (IP) was submitted to Timber Supply Branch on December 22, 1998. Conditional approval was received on February 3, 1999. A complete Information Package, incorporating the issues raised in the approval letter, is provided in Appendix I.

This analysis will assess the short and long-term timber supply implications of three sets of management objectives. These are:

1. The current operational management procedures, which have been implemented and documented over the term of M.P. # 2, to assist in the determination of the Allowable Annual Cut (AAC) for the term of M.P. # 3.

2. Potential management options, which will be investigated and/or implemented during the term of M.P. # 3 and may be included in the base case analysis for M.P. # 4.

3. The potential management strategies, which might be legislated during the term of M.P. #3.

The results of the scenarios presented in the SMOOP are reported in this document. Each scenario is designed to isolate the impact that an individual management action had, or will have on the future timber supply for the T.F.L. The scenarios were designed in this manner in order to meet these basic objectives:

- Assess the impact that alternative licensee management strategies would have on timber supply; thereby providing Dunkley Lumber Ltd. with information on the impact of management activities, beyond the basic activities required by the Ministry of Forests (MOF).

- Assess the impact that alternative, legislated management strategies would have on the timber supply; thereby providing the MOF with information required to ensure decision making which is informed and in keeping with the social, political, ecological and economic objectives of the Crown.
- Assess the sensitivity of uncertainties on the land base, management assumptions and growth and yield forecasts for the base case harvest level.

2.0 EXECUTIVE SUMMARY

The current AAC for T.F.L. # 53 was set in 1993 at 204,700 m3 per year. The land base supporting this harvest level was 72,892 hectares. The AAC Rational in support of this harvest level indicated that more information was required in support of: (a) land base productivity; (b) non-recoverable losses; and (c) scenic area resources.

During the term of M.P. #2, Dunkley addressed these concerns. The completion of Terrain Ecosystem Mapping for the T.F.L. and a Biogeoclimatic Ecosystem Classification have shown that the overall productivity of T.F.L. #53 is higher than previously estimated. Non-recoverable losses are less than the estimated assumption from M.P.#2, and an upgraded visual landscape inventory has been completed. The current Timber Harvesting Land Base is 70,142 hectares. This land base can support a harvest level of 249,000 m3 per year, for the next 50 years. Although a small drop of 3.6 percent to 240,000 m3 per year in harvest is indicated in years 51-60, several enhanced forestry initiatives, or changes in T.F.L. management policy could easily fill this hole. The long term level for the T.F.L. is reached in 161 years. At this time, a maximum non-declining harvest level of 345,000 m3 per year is attainable.

Sensitivity analysis shows that the initial base case harvest level of 249,000 m3 per year strongly resists downward pressures on timber supply. Potential uncertainties in managed stand yield estimates have little impact in the initial harvest level forecast. Additional sensitivity analyzes suggest that the base case harvest level can be increased, and will likely be increased in the timber supply analysis for M.P. #4.

The current AAC contributes only 30 percent of the annual fibre requirements to the Dunkley sawmill. The base case harvest flow would represent a significant gain to Dunkley's secure, long-term fibre supply. Its importance to the local economies, and the livelihood of more than 266 employees and their families cannot be overstated.

Dunkley Lumber Ltd. supports the allocation of an AAC, which is in keeping with the social and economic objectives of the Crown, with the nature and fibre requirements of their timber processing facility and with the productive potential of the tree farm.

3.0 DESCRIPTION OF TREE FARM LICENCE #53

Tree Farm Licence #53 (T.F.L.) is managed by Dunkley Lumber Ltd., and is located in the Prince George Forest District, east of Strathnaver and southeast of the town of Hixon. The T.F.L. comprises one 'block' of land, which covers a gross area of 87,660 hectares. Figure 1 provides a key to the location of T.F.L. #53 within the Prince George Forest District.

T.F.L. #53 lies primarily within the Sub Boreal Spruce (SBS) biogeoclimatic zone. A small portion of the T.F.L. (i.e., 8606 ha or about 10%) occurs within the Engelmann Spruce Subalpine Fir (ESSF) biogeoclimatic zone. These biogeoclimatic zones are divided into several subzones. Within the SBS, the subzones includes the wk1, dw, mk1 and mw. The ESSF biogeoclimatic zone contains only the wk1 subzone. Forest stands within the SBS are primarily interior white spruce, lodgepole pine, or coniferous mixed-wood. Interior Douglas fir is also found, mostly as a minor component of stands on some of the dryer sites, but its occurrence is relatively infrequent. Deciduous and deciduous mixed wood stands exist primarily in the western portion of the T.F.L., being relatively young (30-50 years of age) and of fire origin.

T.F.L. #53 is located between the eastern edge of the Interior Plateau and the western edge of the Quesnel Highlands. Terrain here is undulating, with rolling hills dispersed around several smaller lakes and minor drainages. Although neither alpine rock nor alpine forests exist within the tree farm, elevations of up to 1,600 metres above sea level are reached in the north-central portion of the T.F.L.

T.F.L. # 53 contributes to the Mid-Fraser Watershed and represents some of the most productive forest land in what was originally part of the Prince George Timber Supply Area (TSA). The T.F.L. has had a relatively long history of activity related to its natural resources. Mining boomed in the late 1800's and again in the 1930's. Logging and milling operations commenced in the 1930's and continue today. As a consequence, the T.F.L. area has been extensively modified by human activity and has a well-developed transportation network in place.

The Dunkley sawmill, which is located on the western edge of the T.F.L. in the community of Strathnaver, has been in operation since 1951. Since the mid-1960's, Dunkley's quota position has been insufficient to meet its mill demands. Currently, the allowable annual cut satisfies approximately 30 percent of the sawmills requirement. It was for these reasons that the Company decided in 1978 that a T.F.L. would be the most efficient form of tenure for providing a secure timber base. This type of tenure also provides a greater incentive to manage the forest lands to maximize productive potential, thereby maintaining the employment base in the Hixon and Strathnaver area. Nineteen-eighty-nine saw the culmination of Dunkley's T.F.L. application with the conversion of Dunkley's quota into T.F.L. #53.

Within the T.F.L. #53 landbase, Management Plan # 2 identified 72,892 hectares of productive land which supports the current AAC. The AAC Rationale from M.P. # 2, covering the period January 1, 1994 to December 31, 1999, apportioned a timber harvest level of 204,700 m^3 per year as follows:

Dunkley's Harvest	176,080 m^3
S.B.F.E.P. contribution	28,620 m^3
Woodlots	0 m^3
TOTAL CURRENT HARVEST	**204,700 m^3**

A partitioned cut has been allocated to residual balsam-leading stands that contain volumes between 50 m^3 and 140 m^3 per hectare. The cut equates to 4,100 m^3 per year, (up to 20,500 m^3 over five years) and is included in Dunkley's harvest rate.

Much of the labour involved with a timber supply review commences upon receipt of the Chief Forester's Rationale for an AAC Determination. The AAC Rationale from Management Plan # 2, expressed the MOF's concerns about: (1) the classification of poor productivity or low-site stands; (2) the need to better confirm or quantify estimates of non-recoverable losses and (3) the impact of protecting visual quality in the Highway 97 viewshed.

The period since the Chief Forester's AAC Rationale has been used by Dunkley Lumber Ltd. to gather and improve upon information, in order to better address these concerns.

- Classification of poor productivity stands or low-site stands have been addressed through the completion of a site index - biogeoclimatic ecosystem correlation project to give a better understanding of the growth potential of the T.F.L. land base.
- Dunkley has supplied updated information in the Information Package to better estimate non-recoverable losses.
- The landscape inventory for the Highway 97 viewshed was updated during the term of M.P. #2. Several scenarios in this timber supply analysis explore the impacts of visual quality management on the T.F.L.

It is the vison and goal of Dunkley Lumber Ltd.'s resource managers to secure 60 percent of the mills requirements in some form of secure forest tenure. Among other ventures, the enhanced forestry which is practiced on T.F.L. #53 provides a solid base in Dunkley's quest to this reach this goal.

The importance of the tree farm licence to Dunkley's secure wood supply is the motivating factor behind the innovative forest management programs that have been initiated over the term of the first 2 management plans. Programs to improve resource information, increase site productivity and minimize reductions to the productive forest land base have been conducted over the past 10 years.

Past and ongoing programs include:

- Stocking standards which exceed 'basic' MOF requirements,
- planting genetically superior seedlings,
- road deactivation programs exceeding Forest Practices Code requirements,
- aggressive salvage of blowdown, beetle attack areas and fires,
- conversion of backlog NSR to free growing status,
- conversion of residual balsam intermediate utilization stands to second growth forests,
- studies on the effects of plantation fertilization,
- studies on specific biodiversity requirements,
- alternative harvesting systems which include: helicopter logging, horse logging, shelterwood systems, selective harvesting, and commercial thinning,
- a transition in the primary logging system from landings to roadside,
- a Biogeoclimatic Ecosystem Classification (BEC) of the T.F.L.

These programs are beyond the legislated management practices required of the tree farm licence holder, and have been initiated primarily to increase the secure fibre supply, both in the short term for our employees, and in the long term for future generations.

Communities which surround T.F.L. #53 include Strathnaver, Hixon, Prince George and Quesnel. In particular, Strathnaver and Hixon are heavily reliant on the current and continued operations of the Dunkley sawmill. As other companies have shut mills and moved operations, a very close relationship has developed between company and community. Dunkley is the only major employer in this community and almost half of our work force lives in Hixon and the surrounding area. The rest of Dunkley's employees are from Quesnel and Prince George. This unique situation makes us a corporate citizen in all three communities.

For those employees who live in these communities, their financial security is tied to Dunkley's ability to continue operating the sawmill on two-shifts. In turn, this security depends on Dunkley's ability to secure timber in the long term.

The current apportionment for the T.F.L. contributes approximately 30 percent of the wood processed in the Dunkley sawmill. The remaining volume is acquired by Dunkley through non-replaceable forest licenses (10 percent), the small business forest enterprise program (40 percent), other provinces/territories (10 percent) and private purchases (10 percent). Table 1 describes Dunkley's employment and financial commitment to the local communities and to the Province of B.C.

Table 1 shows that T.F.L. #53 represents a secure source of fibre which is only 30 percent of the total sawmill requirement. This translates into 0.708 direct jobs per 1000 cubic metres, or one job for every 1412 cubic metres of wood harvested and processed at the Dunkley Lumber sawmill.

Table 1. Socioeconomic value

		All Sources of Fibre	T.F.L. #53
Wood Fibre Utilized (m3)		600,000	204,700
Direct Employment (jobs)	Sawmill [1]	164	49
	Management [2]	11	10
	Timber Harvesting [3]	55	50
	FRBC	36	36
	Total	266	145
Secondary Employment (jobs) [4]		239	130
Salaries, Wages, Benefits		$13,000,000	$7,086,500
Purchases of Goods and Services		$6,000,000	$2,047,000
Stumpage, Royalties and Taxes		$8,881,578	$2,664,473

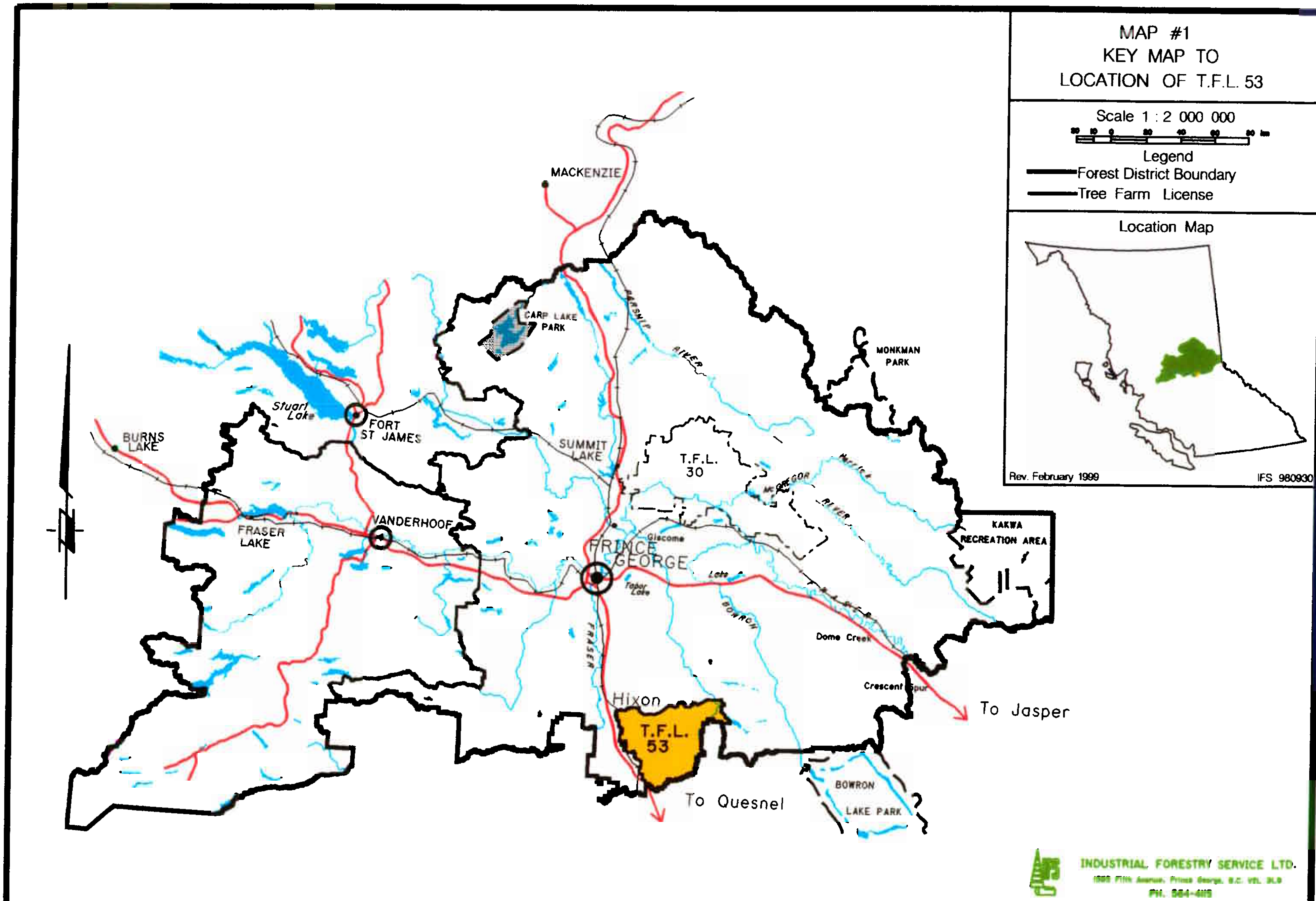
Maintenance of this employment and revenue is heavily dependent on Dunkley achieving their goal of obtaining 60 percent of mill requirements in some form of secure tenure. The T.F.L. land base and the management activities undertaken by Dunkley, are a key component to meeting this goal

1 Referenced in the SMOOP, the T.F.L. provides 30% of the volume processed in the sawmill.

2 Referenced in the SMOOP, the T.F.L. a F.L and a TSL divide management attention. T.F.L. 53 provides 89% of the secured fibre under forest tenure.

3 Referenced in the SMOOP, the T.F.L. a F.L. ,a T.S.L. and the SBFEP volume attributed to the T.F.L. provides fibre in support of 55 jobs in total. T.F.L. 53 provides 90% of fibre in support of these jobs.

4 Calculated as 0.9 indirect and induced jobs per direct job. P.G. TSA Socio-Economic Analysis March 1995 page 95.


MAP #1
KEY MAP TO
LOCATION OF T.F.L. 53
Scale 1 : 2 000 000
Legend
Forest District Boundary
Tree Farm License
Location Map
Rev. February 1999
IFS 980930
MACKENZIE
CARP LAKE PARK
MONKMAN PARK
Stuart Lake
FORT ST JAMES
BURNS LAKE
SUMMIT LAKE
T.F.L. 30
FRASER LAKE
VANDERHOOF
PRINCE GEORGE
Giscome
KAKWA RECREATION AREA
Dome Creek
Crescent Spur
To Jasper
Hixon
T.F.L. 53
To Quesnel
BOWRON LAKE PARK
INDUSTRIAL FORESTRY SERVICE LTD.

4.0 INFORMATION PREPARATION FOR THE TIMBER SUPPLY ANALYSIS

A tremendous amount of effort goes into preparing information for a T.F.L. timber supply review. A high level of detail involving timber supply modeling inputs are made possible through the extensive local knowledge that Dunkley has gathered for T.F.L. #53. The relatively small landbase and good road access enable accurate and precise estimates of the data used in the timber supply modeling process. This information falls into three categories: landbase inventory, growth and yield, and management practices.

4.1 Landbase Inventory

The land base inventory information for T.F.L. #53 exists in an ARC-INFO file format linked to a data base containing information on each forest stand (polygon) in the T.F.L. Information for each stand includes area, species, age, height, stocking density, and other notable features such as environmental sensitivity and biogeoclimatic zones. These polygons are then linked to a file which contains additional information, such as visual quality, riparian reserve areas and road right-of-way buffers.

The inventory information for T.F.L. #53 was accumulated in 1991-1993. It has been updated annually to incorporate new information on such things as logging history and visual areas. Disturbance history is current to April 1997. Information regarding forest age, tree height and stocking levels have been mathematically projected to 1998.

T.F.L. #53 consists of forest stands, lakes, rivers and streams, meadows, brush patches, road networks, recreation sites, a range tenure, and wildlife habitat. As such, the entire T.F.L. area is not suitable for timber harvesting operations. However, the entire area is managed by Dunkley Lumber Ltd. under the direction of the MOF. In this analysis, the term Timber Harvesting Land Base (T.H.L.B.) is used to define those forests which have, or will have sometime in the future, sufficient timber value to conduct logging operations, while incorporating due care for other resources. The area identified as outside the T.H.L.B. is managed by Dunkley Lumber Ltd. for resource values other than timber. These values may include wildlife habitat, landscape biodiversity, scenic quality, or recreation opportunities. Management by Dunkley Lumber Ltd. and the MOF occurs in the form of inventory descriptions, site quality assessments, protection from insects, disease and fire, and a prescribed set of timber harvesting guidelines, expressed explicitly within the Forest Practices Code Act of British Columbia (FPC).

Within T.F.L. #53, the following areas do not contribute to the timber harvesting land base:

- Non-forest areas such as rock, water, roads, rivers, clay banks, and clearings;
- Non-productive areas such as swamp and brush patches;
- Non-commercial cover, which is defined as non-merchantable forest stands occupying productive forest land;
- Environmentally sensitive areas such as steep slopes, sensitive soils or "plantability" problem areas which would impede the establishment of a new tree crop;
- Recreation Sites such as campsites;
- Legislated Lakeshore Reserves as directed by the FPC;
- Legislated Wetland Reserves around swamps, marshes etc, as directed by the FPC
- Stream Riparian Reserves around existing streams and rivers as directed by the FPC;
- Wetland Management Zones beyond the wetland reserve which has special management constraints as directed by the FPC;
- Stream Riparian Management Zones beyond the stream riparian reserve which is managed to protect stream riparian reserves;
- Prince George District Policy Lake Management Area which extends the no harvest buffer around Class A and C lakes, beyond that which is required by the FPC;
- Low Productivity Sites which are occupied by forest with low timber-growing potential;
- Problem Forest Types where the existing stand characteristics are currently considered unmerchantable due to trees being too short, too thin, or too sparse.
- Existing roads, trails and landings identified on the inventory files as forest land, but which have since been harvested for access development;

Table 2 summarizes the area in each category. A more detailed description of each area is provided in the Information Package in Appendix I.

Table 2: Timber Harvesting Land Base Determination

Classification	Area (ha)	Percent of Productive Forest
Total Area (Incl. Water)	87,660.7	
Less: Non -forest	4,881.0	
Total Productive T.F.L. Forest Area	82,779.7	100.00%
Reductions to T.F.L. Forest Area:		
Non-productive	1,462.0	1.77%
Non-commercial cover	330.3	0.40%
Environmentally sensitive areas	1,366.3	1.65%
Recreation sites	160.2	0.19%
Legislated lakeshore reserves	70.5	0.09%
Legislated wetland reserves	322.2	0.39%
Stream riparian reserves	1,856.8	2.24%
Wetland management zones	229.3	0.28%
Stream riparian management zones	1,362.6	1.65%
District policy lake mgmt. area	233.8	0.28%
Low productivity sites	539.1	0.63%
Problem forest types (merchantability)	3,422.4	4.13%
Existing roads, trails and landings	1,281.9	1.55%
Plantations with incorrect site index	733.7	0.90%
N.S.R.	1,451.7	1.75%
Total Reductions to Productive Forest	14,822.8	17.91%
Net Land Base	67,956.9	82.09%
Additions to the Net Land Base:		
N.S.R.	1,451.7	1.75%
Plantations with incorrect SI	733.7	0.90%
Initial Timber Harvesting Land Base	**70,142.3**	**84.70%**
Losses to Future Roads	764.5	0.90%
Future Timber Harvesting Land Base	69,377.8	83.80%

Figure 1. Total and productive land classifications within T.F.L. #53

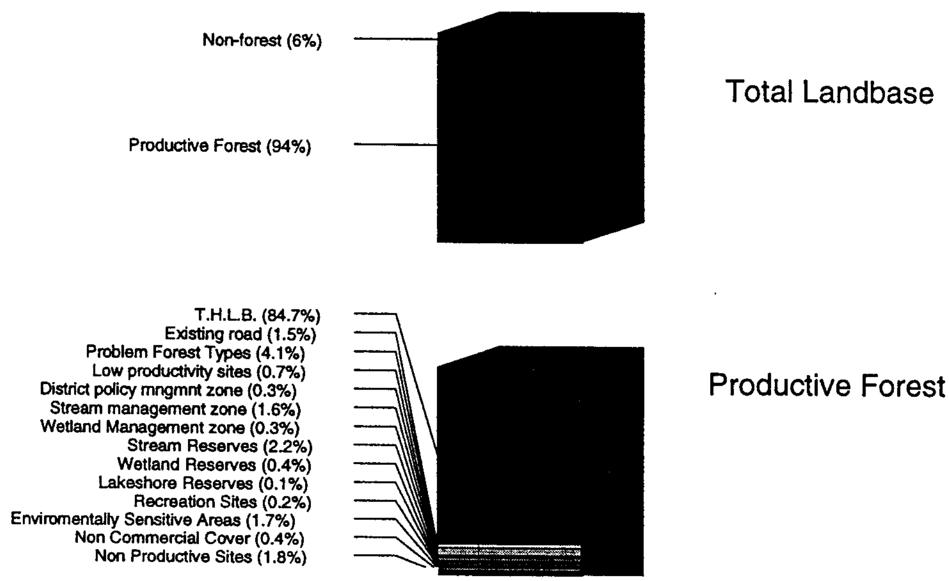
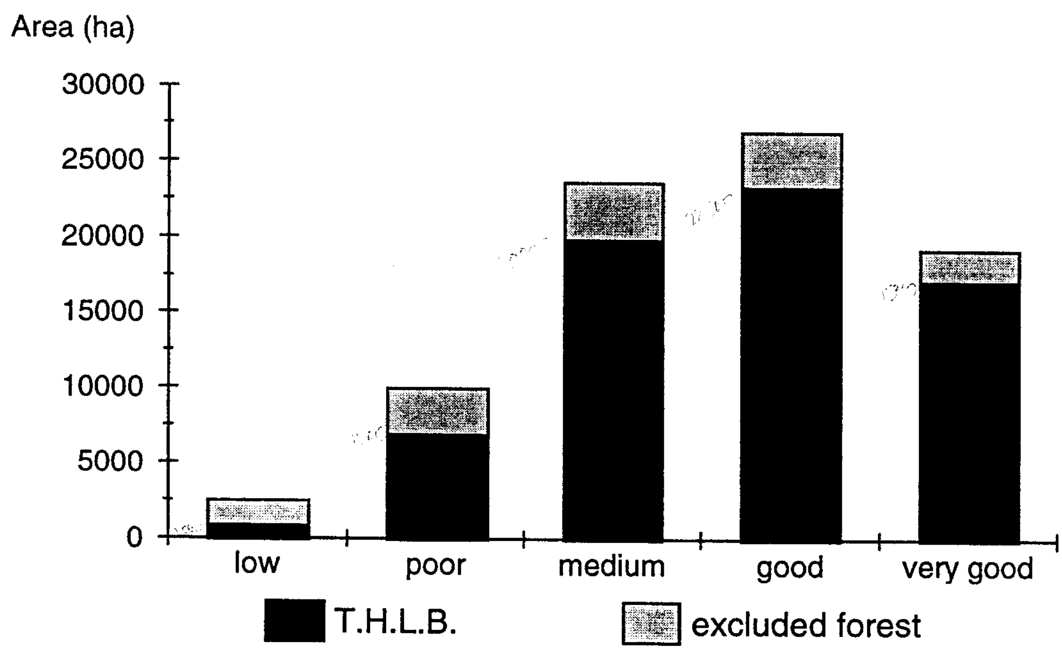
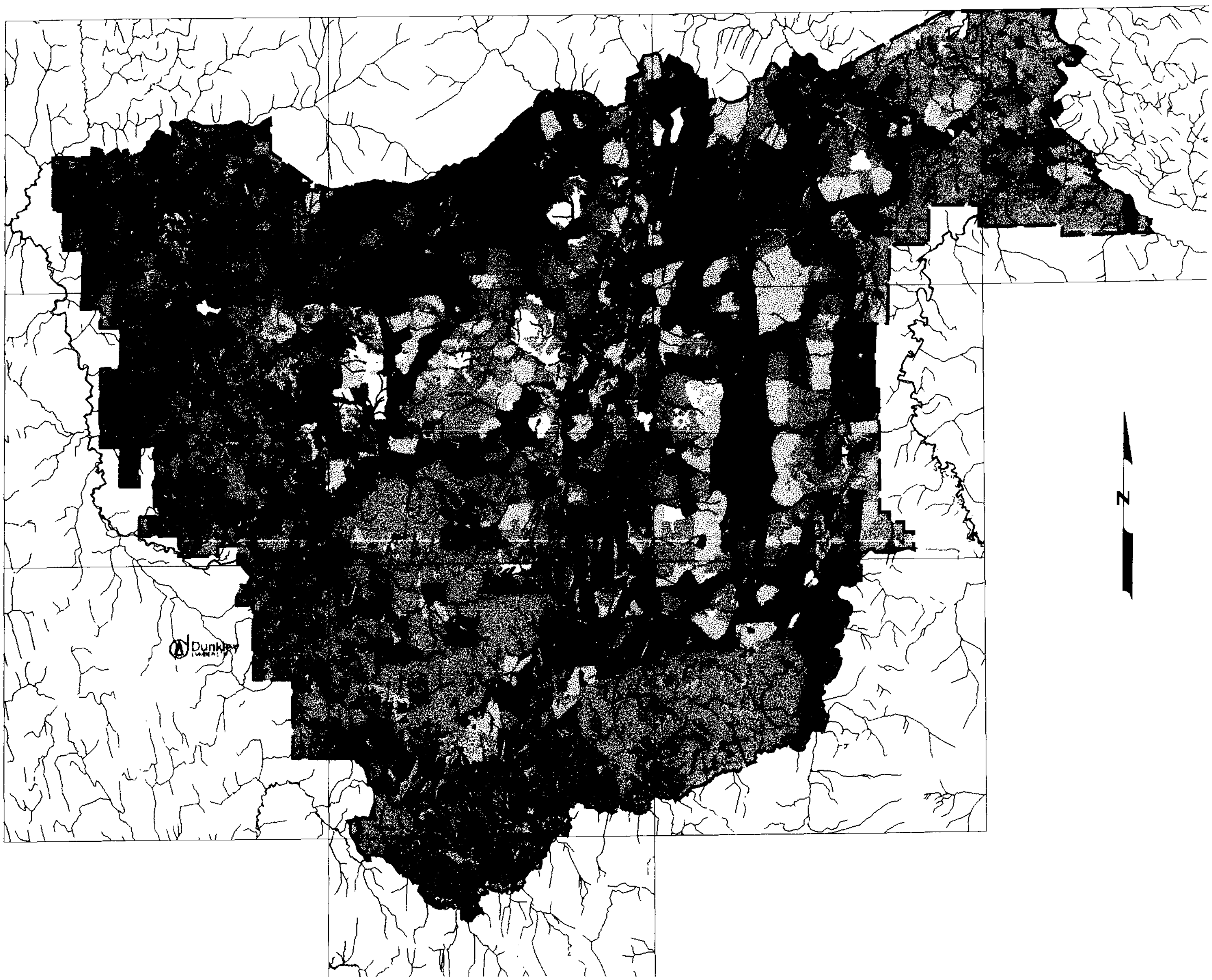


Figure 2. Site class distributions within T.F.L. #53





Dunkley LUMBER LTD.

TFL 53

Map 2 - Forest Land Base

Scale: 1:250 000

2500 1250 0 2500 5000 7500

Metres

Timber Reference

- Excluded Areas
- Streams, Lakes, & Rivers
- Non- Forested
- NSR
- Deciduous Stands
- Spruce, Balsam, Fir, age group 1 height < 3 metres
- Pine, age group 1 height < 3 metres
- Immature Stands
- Thrifty Stands
- Mature Stands

IFS

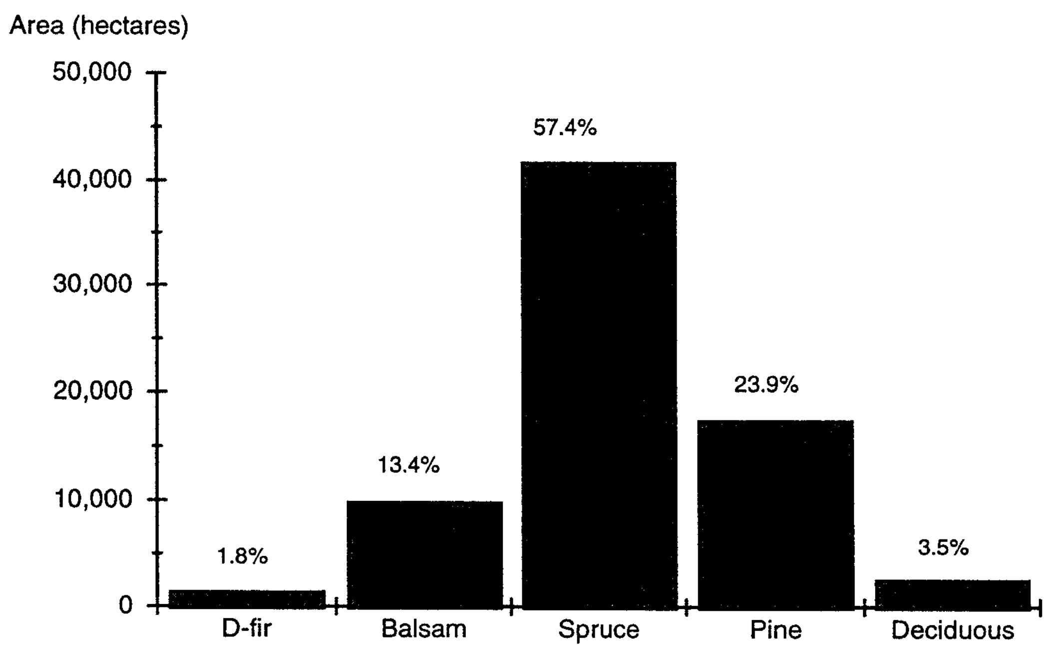
25 February 1999
Version 1
Industrial Forestry Service Ltd.
Geographic Information Systems

Map 2 and Figure 1 illustrate both the total and the productive land base within the T.F.L. Productive forest constitutes 94 percent of the T.F.L. land base. Within the productive land base, almost 85 percent is considered available for timber harvesting (including NSR). Reductions to the productive forest land base total only about 15 percent. These percentages indicate one of the highest T.H.L.B. to Productive Forest Area ratios in the Interior.

Figure 2 provides an overview of the quality of growing sites within the tree farm, and the relative quality of excluded forest area outside the T.H.L.B. The forest area which is excluded from harvesting is relatively evenly proportioned between site classes. This occurs because the area excluded for reasons of poor productivity accounts for only 27 percent of the total excluded area. The remaining forest area is outside the T.H.L.B. for reasons such as environmentally sensitive areas (ESAs), riparian reserves and recreation sites. Approximately 60 percent of the area within the T.H.L.B. is classified as having good or very good growing potential (i.e., the site index is > 16). These percentages confirm the fact that T.F.L. #53 is one of the most productive timber producing sites within the Central Interior of B.C.

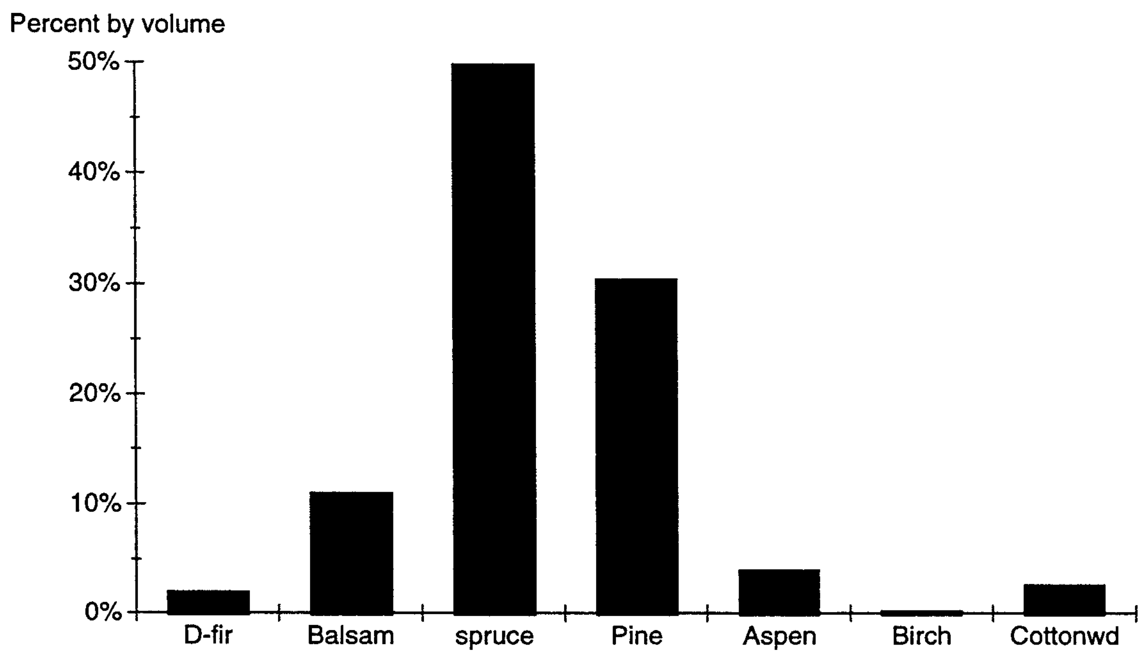
Figure 3 shows the current distribution of **forest area** based on the timber types in T.F.L. #53. At 57.4 percent, spruce stands make up the leading component of forested area within the T.F.L. Lodgepole pine constitutes 23.9 percent of the stand types, and balsam, Douglas fir and deciduous contribute the remaining 18.7 percent.

Figure 3. Species distribution by leading timber type



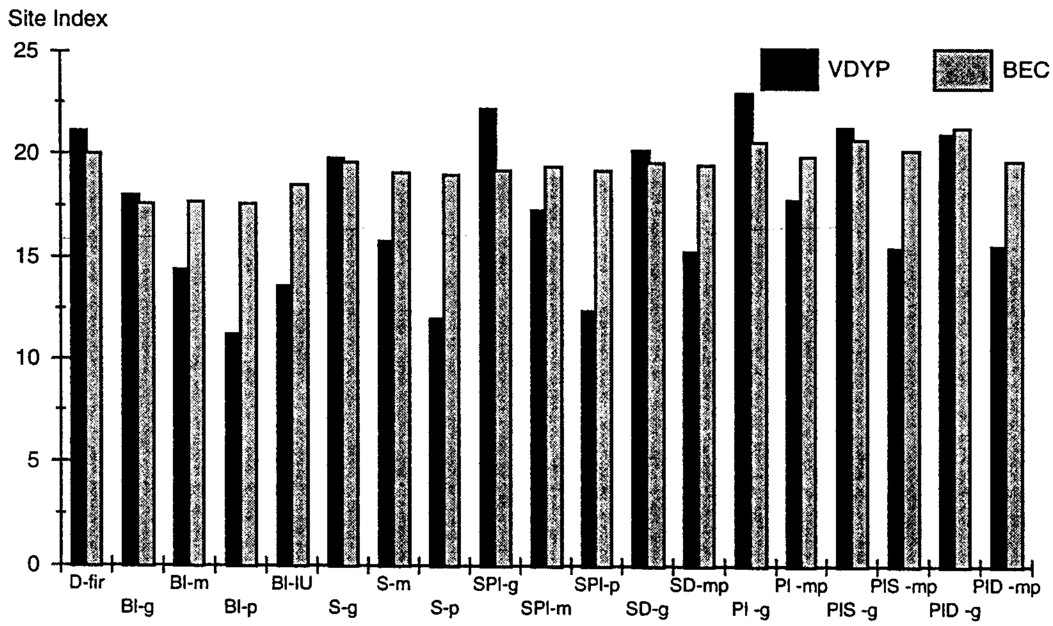
Within each of the timber types shown in Figure 3, the proportion of the different tree species varies considerably. For instance, poor-site leading spruce stands have a balsam component which constitutes 23 percent of the volume of these stands. Figure 4 shows the proportion, **by volume,** of mature trees in the T.H.L.B. The distribution of timber has changed slightly from Figure 3. White Spruce contributes 50 percent of the mature T.F.L. volume, lodgepole pine represents 30 percent and balsam 11 percent. The deciduous components shown in Figure 5 constitute volume which currently exists in leading coniferous stands. The trembling aspen exists primarily as a minor component of medium productivity spruce stands. Cottonwood exists primarily within high productivity spruce stands. In T.F.L. #53, 10,334,000 m^3 of timber is currently considered merchantable (i.e., at or above the regional priority cutting age). This is 76.6 percent of the total inventory existing in the T.H.L.B. (i.e., 13.5 million m^3).

Figure 4. Distribution of mature and thrifty volume within the T.H.L.B.



Site growth potential was recently assessed on the T.F.L. using terrestrial ecosystem mapping (TEM). The completion of T.E.M. allows Dunkley Lumber Ltd. to improve the site index classification of the land base through the BEC system. This differs from the system used in Management Plan # 2, wherein existing and future stand growth potential was estimated using the MOFs Variable Density Yield Prediction (VDYP) model to derive a site index based on a curve relating stand age and tree height. In this analysis, stands (i.e., analysis units) were aggregated together using the VDYP model to predict site quality. Figure 5 shows the difference in site index by stand types, when the BEC site index is compared to the VDYP site index. Apparent in this figure is that site index changes occur in both directions. For some analysis units, the VDYP site index was greater, for others BEC was greater. Overall, the area-weighted VDYP site index for the T.F.L. is calculated to be 17.4. The corresponding area-weighted BEC site index is 19.4. The variability of site index is notably greater using the VDYP versus the BEC system.

Figure 5. Comparison of site index by analysis unit - VDYP vs BEC



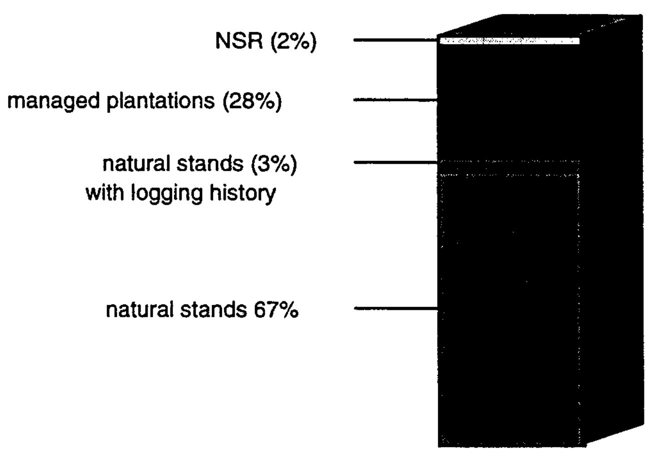
In this analysis, low productivity sites were identified using the VDYP estimate of a site index. As well, forest stands (i.e., analysis units) were aggregated based upon their VDYP calculated site indexes. The completion of the BEC in November 1998, occurred too late in the process to make changes to aggregations or the definition of the T.H.L.B. However, the area-weighted BEC site index for each analysis unit was used to predict the growth of existing and future managed stands.

4.2 Timber Growth and Yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Many attributes within a stand change over time. Height, diameter, volume and species component are examples of these attributes. In timber supply analysis, the volume of stands per unit area is the most relevant measure of stand growth. In British Columbia, this measure is in terms of cubic metres per hectare (m^3/ha).

Growth and yield attributes can be strongly influenced through forest management practices. Stem density (controlled via planting, thinning), species composition (controlled via planting, vegetation management) and volume (controlled via genetics, fertilization, cutting age, utilization levels) can all be managed in a manner which provides a greater yield over time, than a stand which regenerates naturally without direct management influences. The majority of existing stands on T.F.L. #53 are natural stands. Of the 70,142 hectares contributing to the T.H.L.B., 19,259 hectares or roughly 28 percent are managed plantations. This is shown in Figure 6.

Figure 6. Stand attributes within the T.H.L.B.



The growth and yield of managed plantations are differentiated from the growth and yield of existing natural stands. Natural stands are assumed to grow along a curve which is created using the MOF's VDYP model. Existing and future managed stands are assumed to grow along a curve predicted using the MOF's Table Interpolation Program for Stand Yields (TIPSY).

Dunkley Lumber Ltd. has investigated and implemented forest management practices focused toward maximizing the yield on all existing and future managed stands. These programs include:

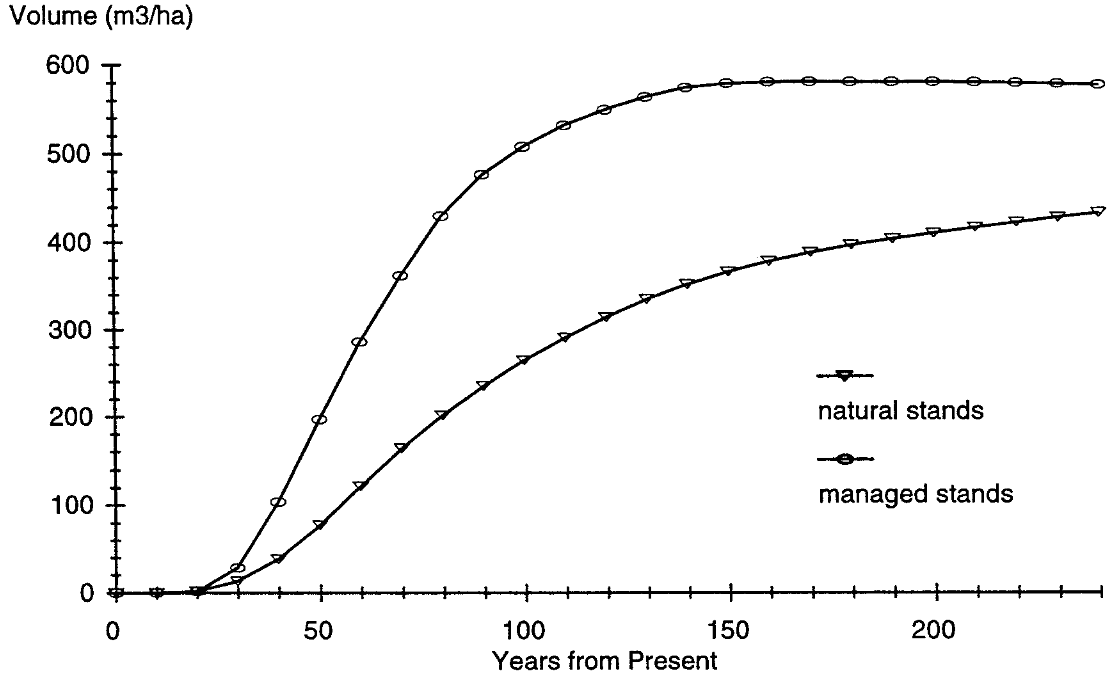
- Increase planting densities (1800-2000 stems /hectare) which are used to:
  1. Reduce the impact of seedling mortality;
  2. Reduce the impact of spacing on managed stand operational adjustment factors;
  3. Reduce the impact of vegetation competition;
- Planting of genetically superior spruce seedlings to realize accelerated volume and height growth;
- Roadside logging and road deactivation to reduce the impact of soil compaction and minimize losses to the productive forest land base;
- Fertilization trials to assess potential accelerated volume and height growth;
- Minimal regeneration delay (1 year) to reduce the impact of vegetation competition
- Commercial thinning trials to improve the attributes of thrifty stands;
- Pre-commercial thinning to reduce the impact of high stem density in young plantations;
- Planting a mixture of species in harvested areas (where ecologically appropriate) to reduce the dangers inherent with monocultures;
- Aggressive control of insects via selection logging, helicopter single tree selection, trap trees and baiting;

All of these factors contribute to the growth and yield of a managed stand which will realize significantly greater volume over a shorter rotation. Figure 7 shows the difference between the growth and yield curves of an average natural stand and an average managed stand in T.F.L. #53.

Volume estimation and prediction in B.C. are subject to some uncertainty. More so for managed stands then for natural stands. The inventory information, which describes natural and managed stands existing in T.F.L. #53, was measured for accuracy through an inventory audit preformed by the MOF and published in February 1998. The audit results indicated that the inventory volumes predicted for existing mature natural stands compared closely to the audit volumes. Conversely, the audit results showed that the inventory site index predicted for immature managed stands was consistently lower then the site index calculated by the inventory audit. Overall, the inventory audit supports the natural stand yield estimates used in this analysis.

Potential uncertainty continues to exist in the volume estimates for managed stands. This is primarily due to the limited experience with second growth plantations within the B.C. Interior. Sensitivity analyzes, described in Section 6.5, addresses the impact of over and underestimating stand volumes.

Figure 7. Comparison of area-weighted yield curves



4.3 MANAGEMENT PRACTICES

Information which better describes the various management modeling assumptions, and corresponding practices which justify these assumptions, are included in Appendix I. The following general silviculture and harvesting assumptions reflect current forest management on T.F.L. #53:

- Silviculture practices describe the reforestation activities used by Dunkley Lumber Ltd. to establish free growing stands of merchantable tree species. Silviculture practices can be best described by the performance of a 1 year regeneration delay between logging and planting, and by the establishment of 1,600 coniferous seedlings per hectare one year after harvesting (by planting 1,800 sph to account for first year mortality).
- Forest health and non-recoverable losses describe the predicted average loss in volume on the T.F.L. from fire, insects and disease. The extremely aggressive salvage operations which occur on the T.F.L. result in an average loss of 2 hectares of forest area, or 678 cubic metres of volume, per year.
- Utilization describes the minimum size of trees and logs that are removed from a

stand during harvesting. Standard "close utilization" is currently described by harvesting lodgepole pine stands with a minimum dbh of 12.5 cm + and all other species, 17.5 cm + dbh. Plantation management of second growth stands should result in an improved uniformity in stems, as compared to what is currently obtained from natural stands. This uniformity, in combination with the versatility of the Dunkley sawmill, will allow the minimum dbh for all species to be reduced to 12.5 cm + dbh in plantations. It is assumed that all trees are harvested leaving a maximum 30 cm stump and a minimum 10 cm top (dib).

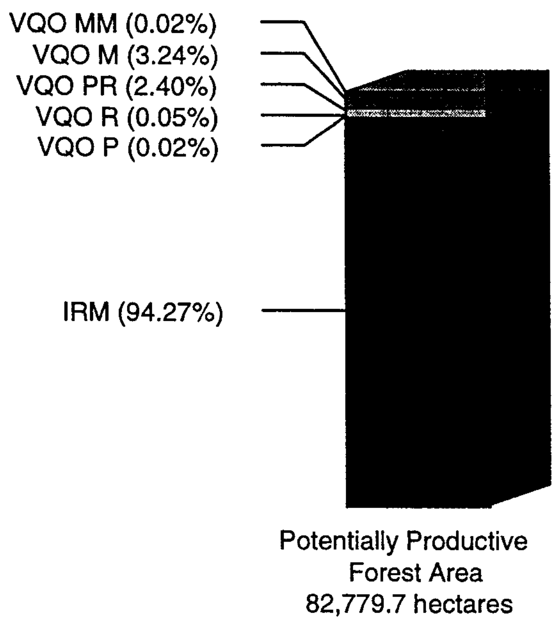
- Forest cover age group constraints and green-up are used to prevent timber harvesting from becoming overly concentrated in any one area. The majority of the T.F.L. is administered under the principle that the T.F.L. is a working forest. The working forest is managed such that no more than 33 percent of the area within the T.H.L.B. will ever be less than 3 metres in height.
- Management of scenic resources occurs by limiting the visual evidence of harvesting activities to certain levels. Management occurs by applying forest cover age constraints to the gross forested land base. Management also occurs through an increased green-up delay appropriate to the slope and the visual sensitivity of the area. Within T.F.L. #53 scenic areas have been grouped into five zones. Management activities are applied to each as follows:
    1. The preservation zone has a gross forest area of 11.6 hectares and harvesting is limited to 1 percent of the total forest, with a visually effective green-up height of 5.4 metres.
    2. The retention zone has a gross forested area of 37.3 hectares. Harvesting is limited to 5 percent of the total forest, with a visually effective green-up height of 4.4 metres.
    3. The partial retention zone has a gross forested area of 1889.8 hectares. Harvesting is limited to 15 percent of the total forest, with a visually effective green-up height of 4.4 metres.
    4. The modification zone has a gross forested area of 2,554.1 hectares. Harvesting is limited to 25 percent of the total forest, with a visually effective green-up height of 4.6 metres.
    5. The maximum modification zone has a gross forested area of 14.7 hectares. Harvesting is limited to 33 percent of the total forest, with a visually effective green-up height of 5.3 metres.
- The minimum harvest age of a stand defines the youngest age at which the stand is expected to become eligible for harvest. Actual harvest age is usually something greater then this age. Natural stands growing on the T.F.L. will be eligible for harvest when the minimum harvest age, defined by the Prince George Regional Office as the

Regional Priority Cutting Age, is achieved. All managed stands will be eligible for harvest when the culmination age of the stand is achieved. Culmination age is the age at which a timber stand reaches its highest mean annual increment, and the optimal biological rotation age to maximize volume production from a growing site.

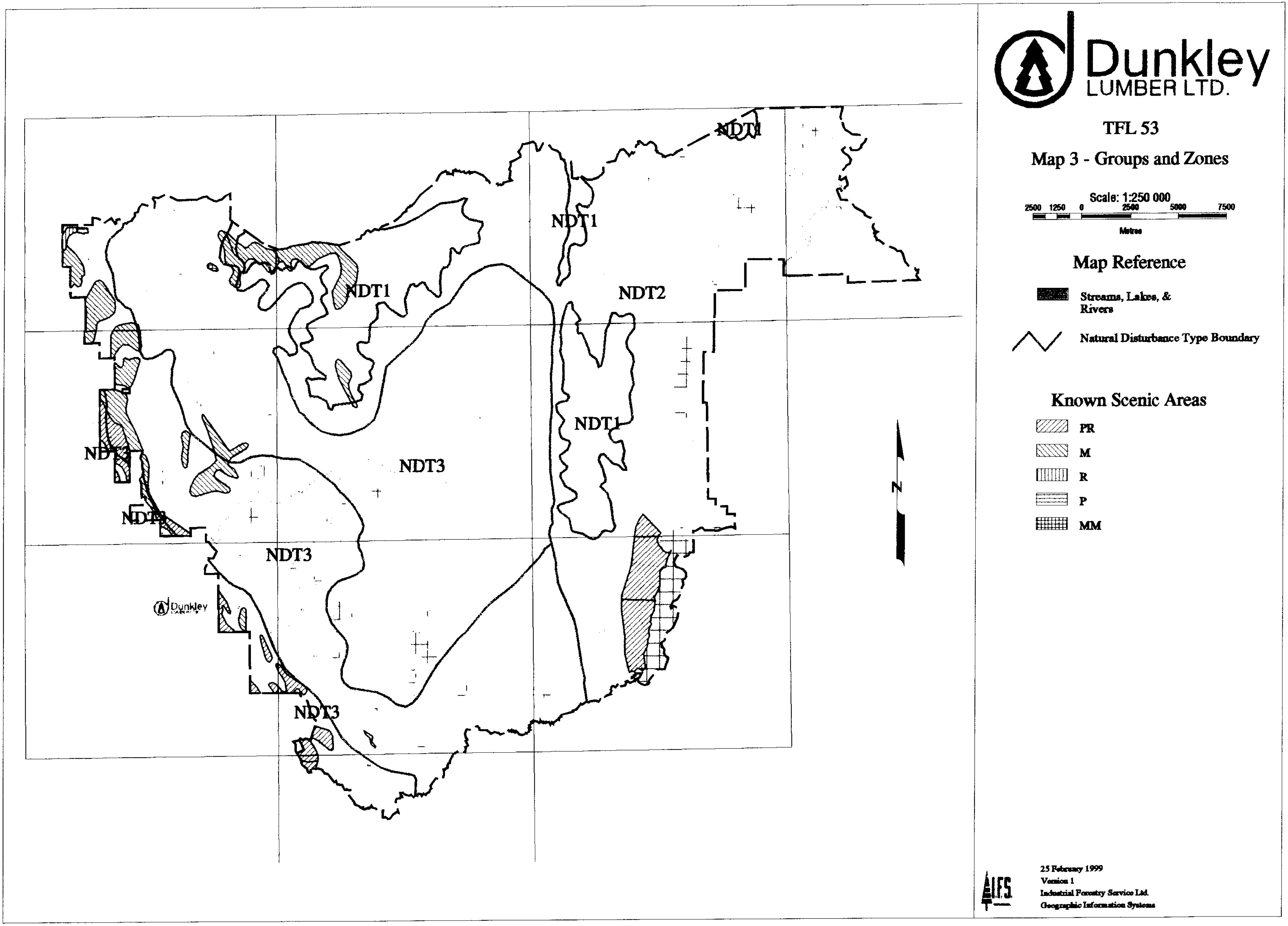
- Landscape level biodiversity is not currently managed for on an operational level on T.F.L. #53. This is due to the delay in having landscape units formally declared by the District Manager. However, landscape level biodiversity is modeled in the timber supply analysis, because biodiversity considerations are being incorporated into operational planning and the landscape unit planning process for the Province. Biodiversity is managed through requirements on how much area must be covered by stands with old-growth forest characteristics. The amount depends on the ecosystems within the T.F.L. as well as the level of emphasis placed on biodiversity for an area.
- The maintenance of wildlife habitat occurs through the exclusion of riparian reserves around streams, rivers and lakes, the maintenance of old growth stands, the distribution of cutblocks, green-up adjacency delays, excluded forest areas which include unmerchantable forest stands and ESAs, and the maintenance of wildlife tree patches in harvested areas. Wildlife tree patches are managed on the assumption that these areas will be retained until they can be replaced by a similar patch of trees offering replacement habitat and structural diversity. This usually occurs after the replacement patch reaches an age of 160 years or greater.

To facilitate the analysis of the different management regimes, the T.F.L. was divided into three groups and five zones. Old Growth biodiversity was managed at the group level utilizing the Natural Disturbance Types within the entire forested land base. The scenic values were modeled at the zone level using the known scenic inventory for the T.F.L. Zones within each group were modeled for specific forest cover constraints. Figure 8 and Map 3 describe the size and distribution of these groups and zones.

Figure 8. Resource emphasis zones within T.F.L.#53



The known scenic areas visible in T.F.L. #53 are identified by their visual quality objective (VQO). These VQOs include areas of maximum modification (MM), modification (M), partial retention (PR), retention (R) and preservation (P). These areas have remained unchanged since Management Plan # 2. They account for 5.7 percent of the total forested land base. The remaining area is the working forest. Herein, integrated resource management (IRM) is carried out with consideration given for other resources, such as fish and wildlife habitat, recreation, sensitive areas and water quality.


Dunkley
LUMBER LTD.
TFL 53
Map 3 - Groups and Zones
Scale: 1:250 000
2500 1250 0 2500 5000 7500
Metres
Map Reference
Streams, Lakes, & Rivers
Natural Disturbance Type Boundary
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25 February 1999
Version 1
Industrial Forestry Service Ltd.
Geographic Information Systems

5.0 TIMBER SUPPLY ANALYSIS METHODS

The purpose of this analysis is to examine the short and long term timber harvesting opportunities within T.F.L. #53, in light of current forest management practices. Several tools are used to assist an analyst in accomplishing this task. Forest inventory files and a geographic information system (GIS) are utilized to define the current state of the gross, forested and timber harvesting land bases. This state is defined in terms of tree species, age, site quality and volume. The change in stand volume, through growth over time, is predicted using Ministry of Forest's growth and yield models. A growth curve predicting the change in volume over time for natural stands, is produced for every stand in the timber harvesting land base. These curves are then aggregated, to produce a few representative curves for different species and site qualities. The growth of plantations for each of these aggregations is then predicted using a different set of yield curves. This set of curves incorporates the expected growth response from forest management practices such as planting density, species conversions, thinning, and regeneration delay.

The information regarding inventory, growth and yield, and forest management assumptions are compiled within a forest estate harvest simulation model. The model used for this analysis was the model developed by the B.C. Ministry of Forests - FSSIM. The model is used to assist the timber supply analyst in determining how a whole forest (collection of stands within specific geographic areas) could be managed to obtain an annual harvest forecast over time. The goal is the simulation of the maximum annual harvest that is achievable, with consideration for other forest resources and without adversely affecting future timber supply's.

This type of analysis is used by the BC Ministry of Forests in all the Timber Supply Areas (TSA) of the Province. The MOF's goal in TSAs, is to determine the timber supply implications of one particular timber harvesting regime. Typically, this is the regime which best describes current operational practices that may be carried out by a number of different forest licence holders. Tree farm licensees frequently take the process one step further. The timber supply analysis is also used as a planning tool to predict the harvest forecast implications of any of a number of forest management practices. The short and long term harvest impact of plantation fertilization, increased planting density to improve visually effective green-up (VEG), commercial thinning and selective harvesting are a few of the management practices examined by Dunkley in this analysis. The positive or negative results of any of these activities from a harvest forecast perspective, may impact the decision to pursue or not pursue a given management regime.

6.0 RESULTS

This section presents the results of the timber supply analysis for T.F.L. #53. The results are divided into seven sections. The first section provides the greatest amount of detail. It is the part of the timber supply analysis which examines the base case harvest forecast. The base case analysis, in combination with Section 6.6 (sensitivity analysis) would typically have the greatest impact in the determination of a revised AAC. Sections 6.2, 6.3, 6.4 and 6.5 describe various management options that Dunkley Lumber Ltd. committed to investigate in their approved SMOOP. These are the sections describing the various forest management initiatives, which might be undertaken during the term of Management Plan # 3. In short, these sections are describe below:

1. Section 6.1 describes current operational procedures and is defined as the 'base case'.
2. Section 6.2 assesses various biodiversity management issues.
3. Section 6.3 assesses the impact of varying levels of visual resource management.
4. Section 6.4 assessed improved forest utilization
5. Section 6.5 investigates the effect of enhanced forest management programs.
6. Section 6.6 was recently requested by the MOF and is supplemental to the commitments Dunkley made in the SMOOP for M.P. #3. It provides information regarding the effects of uncertainties surrounding base case management and yield assumptions.
7. Section 6.7 is supplemental to Dunkley's commitments made in the SMOOP. This section provides information on the harvest impact of a combination of management scenarios. In some respects, this information best describes the short term trend in forest management on the T.F.L.

Several criteria were used to define the base case harvest forecast. These criteria are:

- All harvest forecasts were modeled over a 400-year period.
- A maximum, non-declining harvest flow was determined by examining the total timber growing stock over time.
- The non-declining harvest level was achieved when the growing stock remained relatively stable over the last 200 years of the simulation period.

Once derived, the short-term harvest level was increased slightly to demonstrate the point in time when timber harvest availability will be under the greatest level of constraint within the T.F.L. For T.F.L. #53, this constraint period occurs in period 6 (i.e., 51-60 years from present). Illustrating the constraint period and having this period occur 51 years into the future allows Dunkley the opportunity to assess management options for alleviating the pressure on timber availability at this point in time.

Some of these options may be then implemented over the term of M.P. #3.

Sensitivity analyzes which are more constraining then the base case harvest forecast, have been presented by maintaining the current base case harvest level for as long as possible. If and when the harvest must drop due to constrained timber availability, the harvest is shown to fall no more than 10% per decade. The rationale for this step down in harvest is social and economic in nature. A sudden drop in the AAC which is greater then 10 percent per decade, would have significant impact on the people dependent on T.F.L. #53 for employment and for their financial and social well being.

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 harvest flow in period 6. If the scenario fills this hole, the initial harvest level is increased until a "flat line" harvest is no longer possible for an eighty-year period.

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

- The effect on the short term harvest level of increasing managed stand yields as a result of planting genetically superior stock,
- The effect of overestimating future yields when genetic gains have not been proven beyond 80 years,
- The effect on the short-term harvest level of utilizing the seral succession of aspen conifer stands to conifer leading,
- The short-term effect of reducing operational adjustment factors (OAFs) on existing and future managed stands as a result of OAF surveys preformed by Dunkley Lumber Ltd.,
- Utilization of Regional Priority Cutting Age instead of culmination for existing natural stands,
- Wildlife tree patches (WTPs) should be managed over 3 rotations, so that WTPs existing in future plantations are greater than 160 years of age.

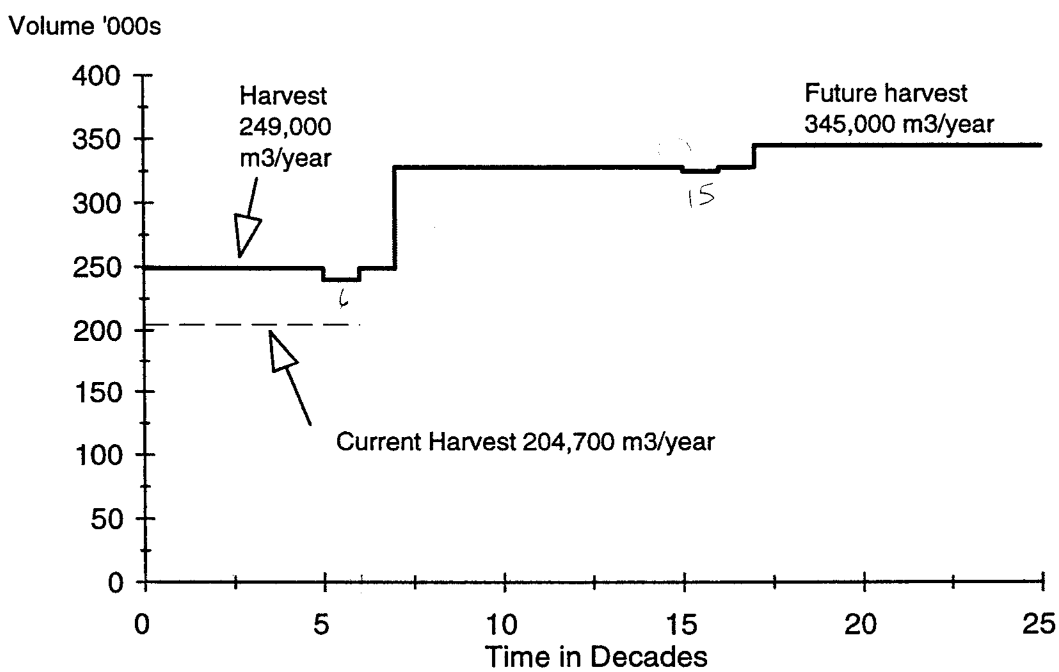
This analysis addresses each of these concerns by changing model input assumptions and/or by reviewing output parameters. Issues such as modeling the future management of wildlife tree patches have been addressed and modeled according to the constraints indicated in Appendix I. Issues such as the short term affect on the harvest level of genetically superior stock, seral succession, operational adjustment factors had no impact on the short term harvest level in the base case. Further discussion is included in the results of this analysis.

Unsalvaged losses of 678 cubic metres per year were applied to all of the harvest flows reported in this document. Unsalvaged losses are applied to the harvest forecasts to estimate the amount of volume lost annually to fire, insects and disease.

6.1 Base Case Harvest Forecast

Figure 9 describes the base case harvest forecast for T.F.L. #53. The current allowable annual harvest level is 204,700 m^3 per year. This can be immediately increased 22 percent to 249,000 m^3 per year and maintained for five decades, without causing significant timber supply shortages in the future. This harvest level is shown to drop by 3.6 percent in period 6, to 240,000 m^3 per year; it returns to 249,000 m^3 per year in period 7, and is followed by a substantial increase in available harvest in period 8, to 328,000 m^3 per year. A small drop in harvest occurs in period 15 to 325,000 m^3 per year. After 160 years, existing natural stands (other then those reserved for old growth) have been converted to managed plantations and timber harvesting is concentrated primarily in these plantations. At this point in time, the estimated long run sustained yield can increase to 345,000 m^3 per year. Table 3 shows the harvest flow for the base case.

Figure 9. Base Case Harvest Forecast for T.F.L. #53



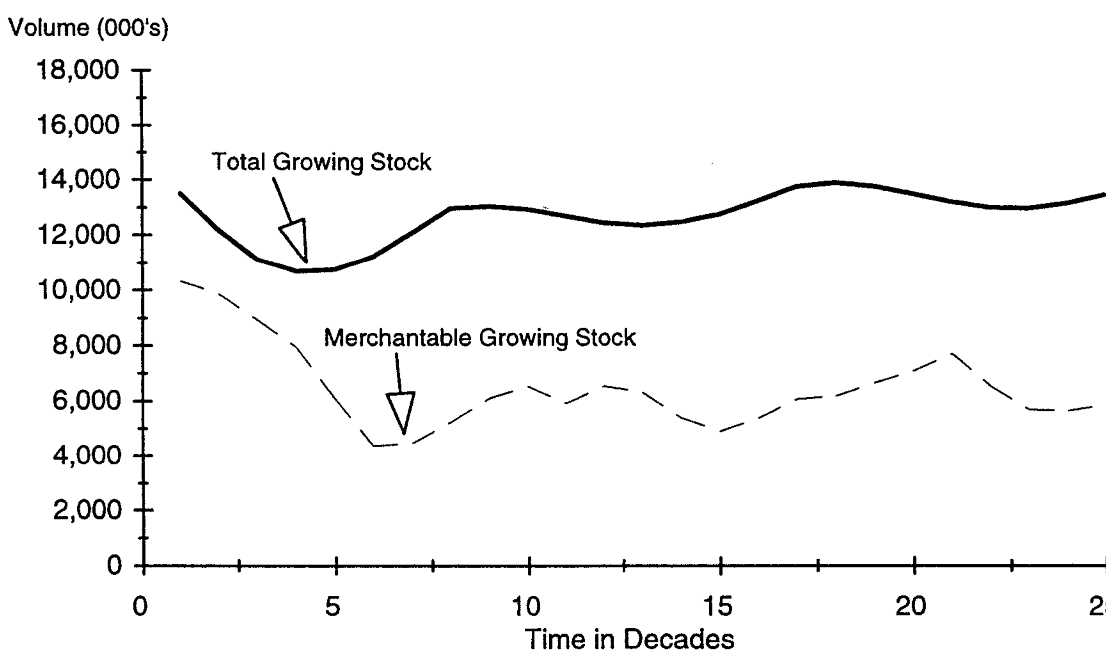
To reiterate the criteria used to define the base case harvest flow, the short term harvest level was increased enough to show the future period of greatest constraint. For T.F.L. #53, this harvest level needs only to be decreased to 247,500 m^3 per year, and the drop in the harvest flow in period 6 would disappear. This is discussed further in Section 6.5 under alternative harvest flows.

Table 3. Summary of Analysis Results - Base Case Harvest Forecast

Scenario	Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
Base Case	70,142	249,000	249,000 / period 1-5, 7 240,000 / period 6 328,000 / period 8-14, 16 325,000 / period 15 345,000 / period 17 - 40

Figure 10 shows the changes in growing stock over time as a result of the base case harvest forecast.

Figure 10. Change in total and merchantable growing stock over time



Total growing stock is defined as the total volume of mature and immature timber currently existing in the timber harvesting land base. The total growing stock is currently 13,500,000 m^3. The majority of this growing stock, 10,334,000 m^3 or 76.6 percent, is of merchantable age. Over the next 30 years the total growing stock volume within the T.F.L. decreases by about 20 percent as existing mature and over-mature stands are harvested and replaced with managed plantations. After 50 years, growing stock begins to rise as harvesting begins to occur within existing managed stands. In 100 years time, total growing stock has stabilized between 12.5 and 13.5 million cubic metres of fibre.

The difference between the total growing stock and the merchantable growing stock is the amount of volume below the minimum cutting age. Throughout the planning horizon, a significant amount of growing stock remains merchantable. The 10.5 million cubic metres of merchantable growing stock currently in the T.F.L. represent an excessively large amount of mature and over mature timber which is increasing as a result of underutilization of the resource. Harvesting at the rate indicated by the base case harvest flow will reduce this merchantable growing stock to a level between five and seven million cubic metres. A significant portion of this merchantable growing stock exists in wildlife tree patches and in areas constrained due to visual sensitivity.

The base case harvest flow is supported by the fact that the current average volume per hectare harvested from existing natural stands is 375 m^3 per hectare. Over the next 80 years, this average volume per hectare decreases slightly as harvesting moves increasingly to the younger, natural stands in the southern and western portions of the T.F.L. After 120 years, the average volume per hectare harvested from existing and future managed plantations increases to approximately 425 cubic metres per hectare. This is an increase of only 13 percent. The curves shown in Figure 7 would suggest that this difference should be significantly higher. The volume difference is small because, for natural stands 150 years of growth is required to achieve 375 m^3 per hectare. Managed plantations should require only 80 years of growth to obtain 425 m^3 per hectare. The age difference required to bring a stand to a merchantable level is the greatest advantage gained.

Management activities such as the planting of genetically superior stock, high density planting, vegetation competition, fertilizations, 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 for natural and managed stands.

Figure 11. Average volume per hectare harvested over time

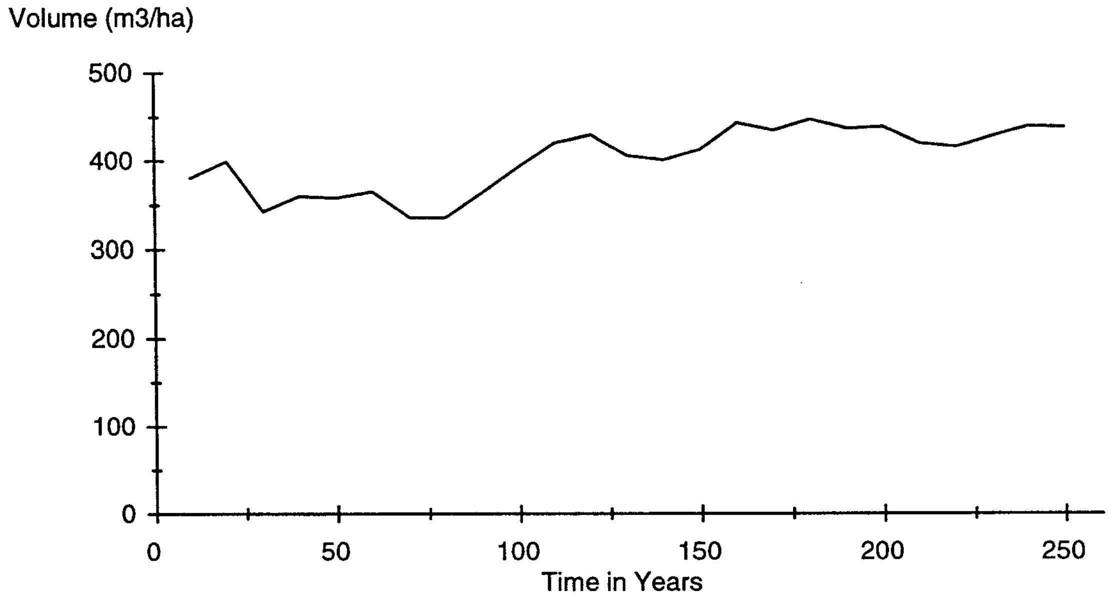


Figure 12. Change in area harvested per year

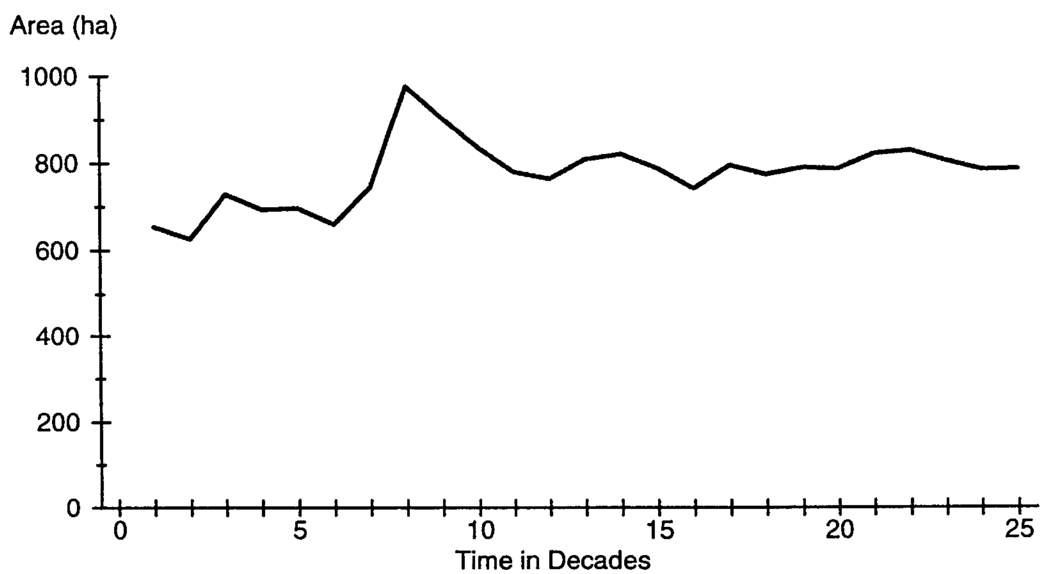
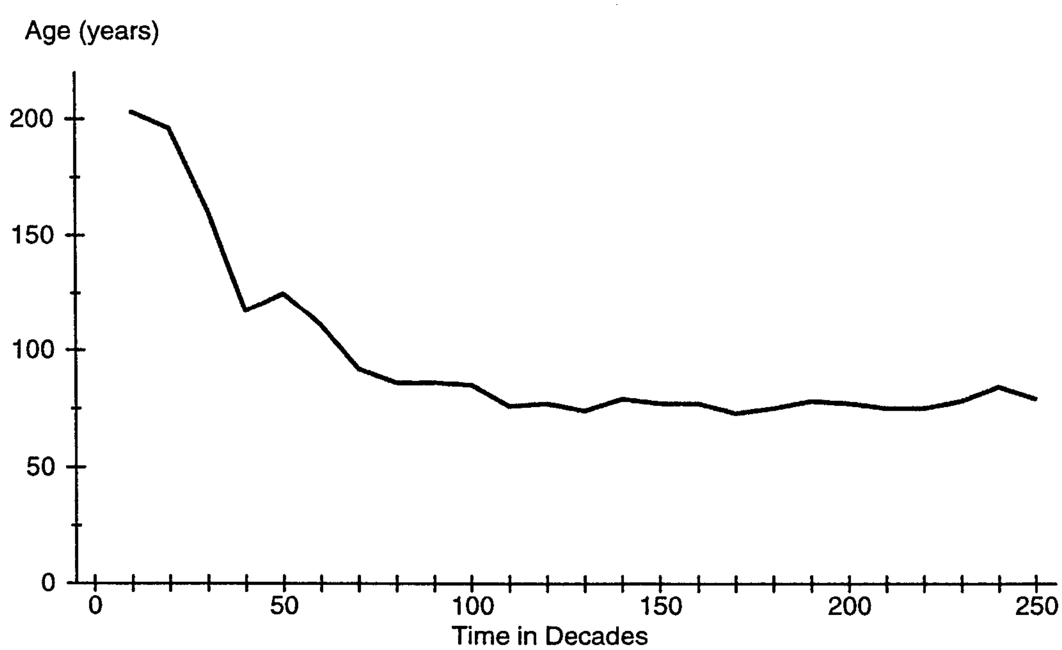


Figure 12 shows that the area harvested each year would change marginally if the base case harvest flow was followed for the next 250 years. The area currently harvested each year in T.F.L. #53 is approximately 550 hectares. An immediate increase to about 650 hectares would reflect the increased harvest level indicated in the base case. Harvested area would rise to as high as 950 hectares per year in period 8, when a large jump in the harvest flow is possible and a harvest level of 328,000 m^3 per year is obtained. An average of 800 hectares would need to be harvested annually, when the long term harvest level of 345,000 m^3 per year is targeted. As was indicated in Figure 9, the period of greatest constraint occurs 51-60 years from present. A review of the stands harvested during this period showed that none of the aspen-conifer stands contributed to the harvest level at this point in time. However, roughly eighteen hundred hectares of existing plantations must be available for harvesting over this 10-year period (i.e., 180 hectares per year). These stands, which are currently about 25 years of age, should continue to be targeted for intensive management, in order to meet and possibly exceed the projected volume predicted for these stands, 50 years in the future.

Figure 13 shows that the average age of stands harvested over time decreases steadily within the T.F.L. The graph exaggerates an operational reality over the first 50 years, since the forest estate model applied an oldest first rule to harvesting timber. Operationally, adjacency constraints would force Dunkley Lumber Ltd. into many younger stands over the next 20 years.

Figure 13. Change in the average age of stands harvested



The oldest first harvest rule does not liquidate all of the old growth forest within the T.F.L. Biodiversity constraints, which were applied by NDT, would 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 portion of the forested land base is reserved for wildlife habitat and old growth. In about 80 years, harvesting is concentrated almost entirely in plantations. The average age harvested from these plantations is just above culmination age. This trend in the average age of stands harvested should alleviate concerns that the use of an adjustment factor to account for the growth of genetically superior stock is unsubstantiated beyond 80 years.

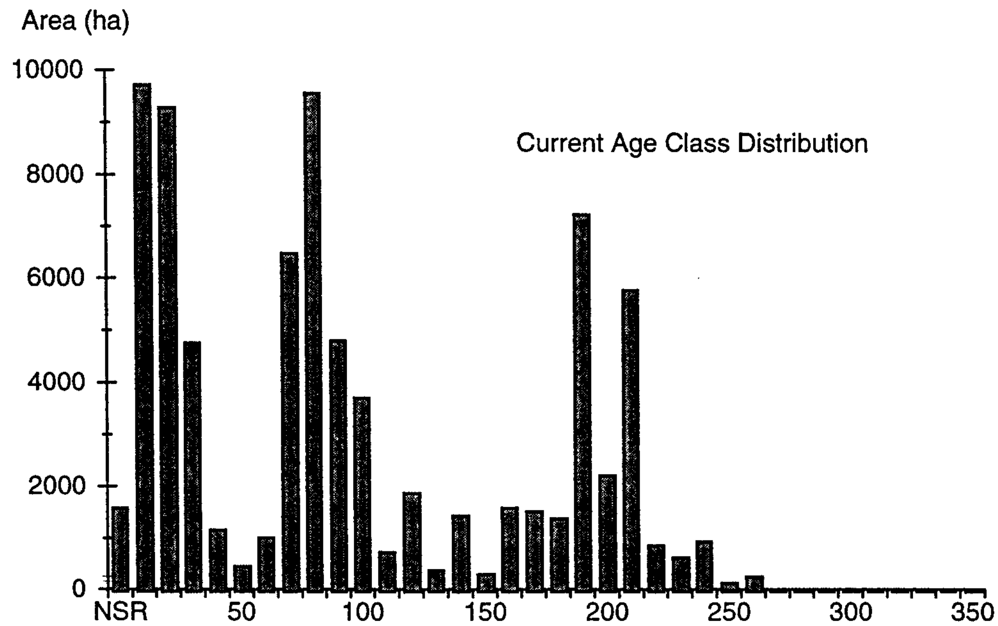
Figure 14 shows the change in the age composition of the forest over the next 200 years, if the base case harvest forecast was followed. The current age class distribution is irregular, although it shows a fairly even spread of forest area between mature and immature. Of the 70,142.3 hectares in the T.H.L.B., approximately 30,000 hectares or 42% are currently mature. Note from this figure that although, a significant portion of the T.F.L. is located in NDT 1 and 2, very little forest exists naturally to contribute to "old" seral stage biodiversity.

Within fifty years, the age class distribution begins to look more "normal." Stands aged 190 - 210 years have moved into the older age classes (i.e., beyond 250 years), or have been converted to plantations. The remaining natural stands aged 110 to 130 years will be critical to maintaining the harvest in period 6.

In one hundred years, most of the T.H.L.B. exists in plantations. At this point in time, 78 percent of the forested land base is less than 90 years of age. The remaining forest area is relatively evenly distributed between 100 and 300 years. This area is primarily forest land which has been excluded from the T.H.L.B. or it exists as wildlife tree patches.

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. Almost no area exists in the age classes between 120 and 180 years. Stands older than 180 represent approximately 15 percent of the forested land base. Old growth forests have aged beyond 350 years and include forest stands which 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.

Figure 14. Age class distribution of the forested land base, T.F.L. #53. (*Continued*)



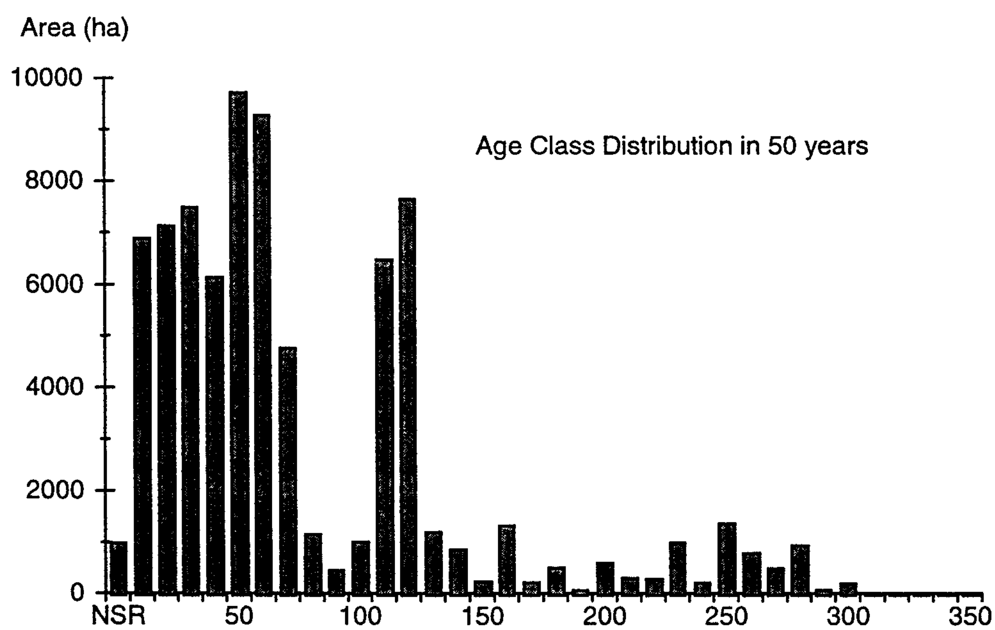


Figure 14. Age class distribution of the forested land base, T.F.L. #53. (*Concluded*)

6.2 Sensitivity Analysis on Biological Diversity

Building on the management assumptions used in the base case analysis, four scenarios were examined which quantify the impact of biodiversity management on the sustainable harvest level of the T.F.L. These scenarios are:

- Assess the impact of removing (a) the Prince George Forest District Policy of additional lake shore reserves around Class A and C lakes, and (b) eliminating wildlife tree patch management.
- Assess the impact of applying a low biodiversity emphasis to the T.F.L.
- Examine the impact of a T.F.L. #53 specific plan for biodiversity emphasis. *Information regarding this plan was unavailable in time to incorporate in this timber supply analysis.*
- Assess the impact of reducing the age which the FPC *Biodiversity Guidebook* has defined as old seral stage forest for NDT's 1 and 2. In this scenario old seral stage forest was defined as stands in NDT 1 or 2, having an age greater than 180 years.

Table 4 details the impact of these issues on the harvest flow for T.F.L. #53.

Table 4. Summary of Analysis Results - Biological Diversity

Scenario		Net Area (ha)	Net Short-term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
1.1	Exclude P.G. Forest District Lakeshore guidelines and WTP management	70,359	256,000	256,000 / period 1-7 334,000 / period 8- 16 354,000 / period 17 - 40
1.2	Manage for low emphasis biodiversity	70,142	257,000	257,000 / period 1-7 325,000 / period 8 332,000 / period 9-16 345,000 / period 17-40
1.4	Reduce the definition of "old growth" in NDT's 1 and 2 to be > 180 years	70,142	255,000	255,000 / period 1-7 314,000 / period 8 332,000 / period 9-16 345,000 period 17 - 40

6.2.1 Eliminate P.G. Forest District Policy Lakeshore Reserves and WTP management

The elimination of the Prince George Forest District Policy Lakeshore Reserve guidelines resulted in a 0.3 percent increase in the T.H.L.B. to 70,359 hectares. As a result of the increase in land base, total growing stock increased 0.4 percent to 13,554,000 cubic metres, and merchantable growing stock increased by 5 percent. This additional growing stock, in combination with the opportunity to harvest WTPs over one rotation, allowed the short term harvest level to increase to 256,000 m^3 per year. At this rate of harvest, there is no drop in period 6. In all else, the harvest flow mimics the pattern set by the base case. The midterm harvest level can increase to 334,000 m^3 for periods 8 to 16, and then increase the long term non-declining harvest level to 354,000 m^3 per year.

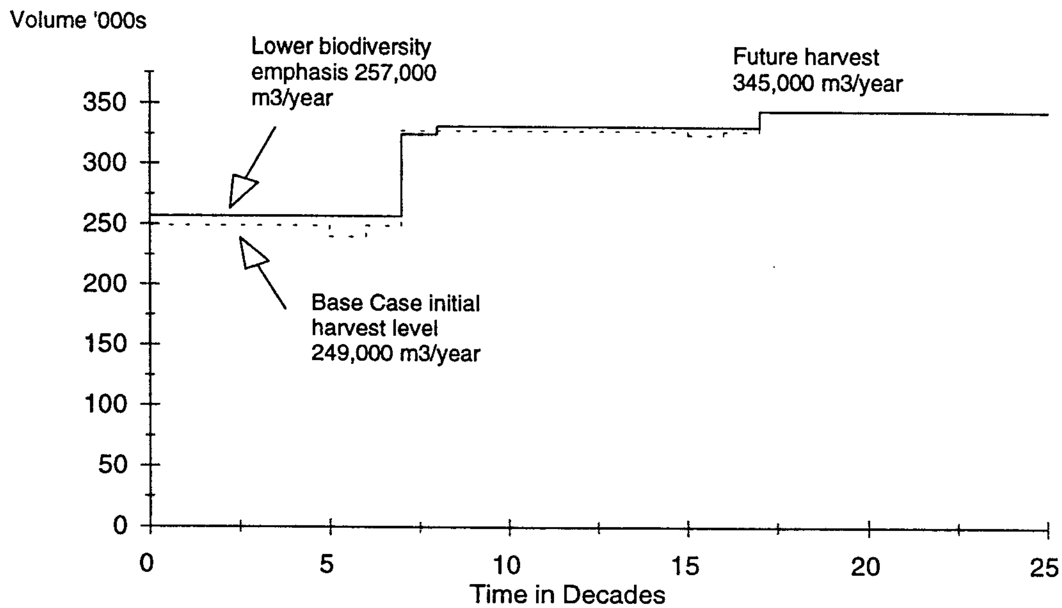
6.2.2 Apply low biodiversity emphasis

Indications from the MOF and the MELP are that the T.F.L. will be a low biodiversity emphasis area if landscape unit objectives are officially established. The application of low biodiversity emphasis was assessed to model the implications of this zonation.

In the base case analysis, biodiversity management was applied on the assumption that 45 percent of the T.F.L. was low biodiversity emphasis, 45 percent was intermediate emphasis, and 10 percent had high emphasis. Low emphasis was factored in over a 140-year period. These are the standard base case assumptions prescribed by the MOF for timber supply reviews, where actual biodiversity emphasis assignments have not been legally established.

In this scenario, 100 percent low biodiversity emphasis was factored in over a 140-year period. The impact is a 3.2 percent increase in the short-term harvest above the base case. Figure 15 shows this harvest flow in comparison to the base case. A short term harvest level of 257,000 m^3 per year can be maintained for 70 years. The mid and long terms harvest levels remain relatively unchanged. In the long-term (i.e., 140 years and beyond) the amount of forest cover in old growth differs from the base case by less than 1 percent and the old seral stage age class distribution is almost identical to that which would be a result of the base case harvest forecast.

Figure 15. Impact of low biodiversity emphasis



6.2.3 Reduce definition of old seral stage in NDT's 1 and 2

A reduction in the age definition of old growth (from the value suggested in the *FPC Biodiversity Guidebook*) is consistent with the occurrence of old growth characteristics recorded in the terrestrial ecosystem mapping project on the T.F.L. Given the current lack of stands meeting the FPC *Biodiversity Guidebook's* definition of old in NDT 1 and 2 on the T.F.L. (i.e., 0.7 percent of forest stands in NDT 1 are currently > 250 years old; 0.7 percent of forest stands in NDT 2 are currently > 250 years old), the reduction of this age to equal 180 years, would better reflect the modeling of old stands on the T.F.L. in the short term. An old growth age equal to 180 years was selected as the age most consistent with the genesis of old growth characteristics recorded in the TEM project on the T.F.L.

The reduction in the definition of old seral stage forest in natural disturbance type's (NDT) 1 and 2 have a significant effect on the harvest flow. In the short term, the amount of merchantable growing stock made available as a consequence of the relaxation of this constraint, allowed the initial harvest level to be increased to 255,000 m^3 per year. The harvest flow steps up to 314,000 m^3 in decade 8, 332,000 m^3 per year for decades nine to 16, and then to the long term harvest level indicated by the base case of 345,000 m^3 per year. After 70 years, the old seral stage age definition has little to no impact. Forest stands outside the timber harvesting land base have aged sufficiently to contribute to the *FPC Biodiversity Guidebook* definition of old growth.

6.3 Sensitivity Analysis on Scenic Areas

To isolate the downward pressure on timber supply as it relates to scenic area management, six scenarios were examined. The known scenic landscape inventory which was modeled in the base case is a holdover from M.P. # 2. Although this landscape inventory represents the "known" visual areas for T.F.L. #53, a new inventory was undertaken during the term of M.P. #2, and completed in April 1998. This new inventory generally follows the old information, but with some minor changes in polygon lines. At this time, the inventory has been approved by the District Manager but not formally made 'known'. By using portions of this new landscape inventory, with each scenario building on a preceding one, the timber supply impact of management alternatives can be quantified. To assist the approval process, these scenarios are:

- Scenario 2.1 - Assess the impact of the revised landscape inventory for the Highway 97 viewshed. The viewshed was categorized according to proposed visual quality classes (VQC). These VQCs have the same definition as the visual quality objectives (VQO) in the base case.
- *Scenario 2.2* - Building on Scenario 2.1, incorporate the Ahbau Lake viewshed.
- *Scenario 2.3* -Building on Scenario 2.2, incorporate the visual area around recreation sites and constrain harvesting in these areas using a visually effective green-up height of 4.2 metres.
- *Scenario 2.4* - Building on Scenario 2.3, assess the impact of incorporating the proposed VQCs around the recreation sites with the VQCs from the Highway 97 and the Ahbau Lake viewsheds.
- *Scenario 2.5* - Building on Scenario 2.2, assess the impact of eliminating forest cover constraints in the preservation, retention and partial retention VQC zones, by partial cutting within these zones.
- *Scenario 2.6* - Building on Scenario 2.2, assess the impact of reducing the VEG height requirement in VQC zones by 22 percent, to reflect the visual benefit from higher planting densities.

The results of these scenarios are provided in Table 5.

Table 5. Summary of Analysis Results - Sensitivity of changes to scenic area management

Scenario		Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
2.1	Assess the impact of adjusting the landscape inventory to include only the revised highway viewshed	70,142	250,000	250,000 / period 1-7 325,200 / period 8 327,000 / period 9-16 345,000 / period 17 - 40
2.2	As per Scenario 2.1, but include the Ahbau Lake VQCs	70,142	249,500	249,500 / period 1-5, 7 249,200 / period 6 321,700 / period 8 327,000 / period 9-16 344,000 / period 17-40
2.3	As per Scenario 2.2, but include the new inventory for recreation sites using VEG height as the only constraint	70,142	249,500	249,500 / period 1-5, 7 249,200 / period 6 316,500 / period 8 327,000 / period 9-16 344,000 period 17 - 40
2.4	As per Scenario 2.3, but model the forest cover constraints using the VQCs associated with the recreation sites	70,142	249,500	249,500 / period 1-5, 7 245,200 / period 6 319,000 / period 8 327,000 / period 9-16 344,000 period 17 - 40
2.5	As per Scenario 2.2, but model partial cutting in preservation, retention and partial retention VQCs	70,142	249,500	249,500 / period 1-5, 7 243,600 / period 6 320,400 / period 8 325,000 / period 9-16 343,000 period 17 - 40
2.6	As per Scenario 2.2, but model a 22% reduced VEG height requirements in all VQCs	70,142	250,500	250,500 / period 1-7 320,000 / period 8 328,000 / period 9-16 345,000 / period 17-40

6.3.1 Revised Highway 97 VQCs

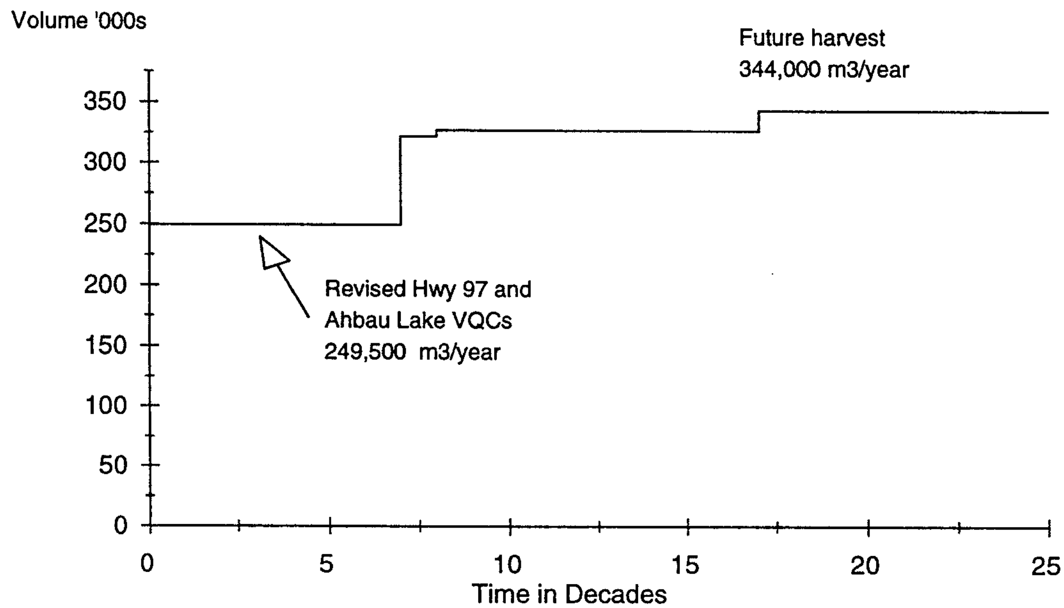
The application of the revised landscape inventory (as it applies to the Highway 97 viewshed), resulted in a very small increase in the short-term harvest level to 250,000 m^3 per year. The greatest benefit is that this harvest level can be maintained for 70 years without dropping. Any harvesting above this level would once again result in a hole developing at years 51-60. The harvest flow then follows the pattern set by the base case. Harvesting can increase to 325,200 m^3 per year in decade 8, adjust to 327,000 m^3 per year for decades 9-16 and then level off at the long term harvest level of 345,000 m^3 per year.

6.3.2 Revised Highway 97 and Ahbau Lake VQCs

This scenario includes both the revised Highway 97 and the revised Ahbau Lake landscape inventory. It is the scenic area scenario which most closely mimics the management assumptions used in the base case, while reflecting the updated inventory. In this scenario, the net area in the IRM zone differs from the base case scenario by only 165 hectares. In the revised landscape inventory, the area within the preservation and retention VQCs remained unchanged. The partial retention area increased by 100 hectares, and the modification area dropped by 517 hectares. Maximum modification VQC areas increased by 582 hectares. The net effect of the changes in the delineation of scenic areas, and the corresponding change in the composition of the forests within the visual zones, will allow an increase in the short term yield from the base case.

The harvest flow is shown in Figure 16. A short term harvest level of 249,500 m^3 per year can be maintained for 70 years. A very small drop to 249,200 m^3 per year occurs in period 6. In period 8, the harvest level can increase to not more than 321,700 m^3 per year. Another step up to 327,000 m^3 per year is achievable between periods 9 and 16. In the long term, the harvest level would stabilize at 344,000 m^3 per year. This is 1000 m^3 per year less than the long term level reported in the base case. The reason for the short term increase and the long term decrease is a function of timber availability. In the short term, the revised age class distribution of stands within the VQC zones, and the forest cover constraints applied to these areas improves timber availability. In the long term, plantation forestry will be constrained as a result of the 165 hectares of IRM forest, which are now subject to VEG height requirements.

Figure 16. Harvest flow as a result of the revised Hwy 97 and Ahbau Lake VQCs



6.3.3 Revised VQCs, and VEG height around recreation sites

When a 4.4 metre VEG height is applied to the visual area around recreation sites, there is no impact on the short term harvest level. The impact of this management constraint only becomes apparent in period 8, when the harvest could only increase to 316,500 m^3 per year. This is 5,200 m^3 per year less then was available when recreation VEG height was not modeled. The remainder of the harvest flow does not change.

6.3.4 Apply VQCs around recreation sites

In this scenario, forest cover constraints were applied to the VQCs in recreation sites (i.e., in addition to the VQCs within the highway and Ahbau Lake viewshed). Although this is operationally more constraining then the previous scenario, there was no impact on the initial harvest level. However, in period 6 a 1.8 percent drop in the harvest level occurred when the harvest level dropped from 249,500 m^3 per year to 245,200 m^3 per year. The remainder of the harvest flow was relatively unchanged from the previous scenario.

6.3.5 Model partial cutting in some of the visually sensitive areas

This scenario utilized the visual landscape inventory associated with the revised Hwy 97 and Ahbau Lake viewsheds. The application of a partial cutting management strategy was modeled in preservation, retention and partial retention VQC zones. The result was a very slight decrease in the short and long term harvest flow. A level of 249,500 m^3 per year was still achievable for the first five periods as well as the 7^{th} period. In period 6, a 2.4 percent drop in the harvest level occurred when partial cutting was modeled. The long term harvest level of 343,000 m^3 per year is also 1000 m^3 per year less then reported for scenario 2.2.

The results of this scenario should be treated with caution. Timber supply analysis into the effects of partial cutting must make broad assumptions on how to model this silviculture system, since there are no concrete guidelines. If the assumption is used that partial cut stands will grow at the same mean annual increment (MAI) as would be achieved by the stand at culmination age, then an increase in the harvest flow would have been seen. In this scenario, it was assumed that stands would grow at a rate which was less than culmination MAI (i.e., stand growth was the average MAI for the 40-year period prior to culmination age.) It was felt that this would give a more reasonable estimate of the regrowth in partial cut stands. Better growth and yield data on the effect of partial cutting natural stands in the Interior of BC does not exist. This assumption, in combination with the fact that clear cutting in VQCs would occur using the high visual absorption capacity (VAC) of the site, resulted in a negative impact when partial cutting is used as a silviculture system in VQCs on T.F.L. #53.

6.3.6 Model the impact of reduced VEG height in the VQCs

Utilizing the revised Hwy 97 and Ahbau Lake landscape inventory, the impact of reducing VEG height in VQC zones as a consequence of increased planting density was assessed. VEG height was reduced by 22 percent in this scenario. This reduction resulted in a 1000 m^3 per year short term gain in harvest. A level of 250,500 m^3 per year can be maintained for 70 years. In period 8, an increase to 320,000 m^3 per year may occur, and can be followed with an increase to 328,000 m^3 per year from periods nine to 16. Beyond period 17, the harvest level is unchanged at 345,000 m^3 per year.

6.4 Sensitivity analysis on improved utilization

Of the three scenarios which were proposed to assess changes in timber utilization, two have been dropped from this analysis. The remaining scenario assessed the impact of utilizing the aspen in aspen- conifer stands. In the base case analysis, aspen-conifer stands were included in the timber harvesting land base. It was assumed that over time, they would succeed to leading conifer (i.e., after 160 years and with a projected volume of one half of that predicted by the growth of natural stand yield tables).

In this scenario, Dunkley Lumber Ltd., wished to assess the impact of harvesting the aspen-conifer stands at a minimum harvest age of 61 years. It was assumed that by harvesting these stands gradually over the next 50 years, sufficient mature volume would be reserved to mitigate the period of constraint in the 6th decade. This scenario builds on the base case harvest forecast. The impact is an increase in the short term harvest level to 251,000 m^3 per year for the first 7 decades. The harvest flow then increased to 329,000 m^3 per year for periods 8 to 16 and leveled at 345,000 m^3 per year from period 17 onwards.

Harvesting aspen conifer stands not only filled the hole in the base case in period 6, but allowed the initial harvest level to increase by 2000 m^3 per year. This occurred because a) the minimum harvest age for these stands was reduced, b) the volume per hectare obtained from these stands was doubled, since losses to tree mortality in old aspen stands were assumed not to occur, and c) the stands were available to harvest in the 6th period (note: a review of the base case results indicated that none of these stands were available for harvest in period 6). An increase in the long term harvest level above the base case was not realized. This harvest level remained unchanged because in the long-term, both scenarios converted these aspen conifer stands to leading conifer. Only the timing of this conversion changed.

The results of this scenario are shown in Table 6.

Table 6. Summary of Analysis Results - Sensitivity of changes in utilization

Scenario		Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
3.3	Assess the impact of harvesting aspen-conifer stands at age 61.	70,142	251,000	251,000 / period 1-7 329,000 / period 8-16 345,000 / period 17 - 40

6.5 Sensitivity analysis on enhanced management

Over the term of M.P. #2, Dunkley Lumber Ltd., has investigated some enhanced forest management practices on T.F.L. #53. Fertilization and commercial thinning are activities which have occurred to some extent within the T.F.L. These programs have not been incorporated into the base case analysis, since the programs are still relatively minor occurrences. To assess the impact of these types of programs on the short and long term harvest flow, five scenarios were examined. Each building off the base case, these scenarios are:

- Explore the effect of an expanded commercial thinning program.
- Assess the effect of forest fertilization.
- The impact of doubling the road deactivation program was explored.
- Reduce the green-up delay across the T.F.L. to equate to 2.5 metres.
- An enhanced level of plantation management assessed the impact of reducing the OAFs for managed stand yields by 1/3 for pine and 1/2 for spruce.

The results of these scenarios are shown in Table 7.

Table 7. Summary of Analysis Results - Enhanced forest management

Scenario		Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
4.1	Impact of commercial thinning	70,142	249,000	249,000 / period 1-5, 7 248,400 / period 6 328,000 / period 8-14, 16 306,000 / period 15 345,000 / period 17 - 40
4.2	Impact of forest fertilization	70,142	249,000	249,000 / period 1-5, 7 241,700 / period 6 329,000 / period 8-14 345,000 / period 17 - 40
4.3	Impact of an expanded road deactivation program	70,142	249,000	249,000 / period 1-5, 7 240,300 / period 6 328,000 / period 8-16 346,000 / period 17 - 40
4.4	Impact of a 2.5 metre green-up height requirement	70,142	250,500	250,500 / period 1- 7 320,000 / period 8 329,000 / period 9-16 345,000 / period 17 - 40
4.5	Impact of enhanced plantation management to reduce OAFs	70,142	249,000	249,000 / period 1-5, 7 242,000 / period 6 340,000 / period 8-16 363,000 / period 17 - 40

6.5.1 Impacts of commercial thinning

This scenario targeted 3,330 hectares of good-site leading pine stands between the ages of 41 and 80 years, for an expanded commercial thinning program. It was assumed that 30 percent of the existing volume from candidate stands would be removed. After a 40-year delay, the stand was assumed to have recovered the volume that it had lost, and became eligible for clearcut harvesting. Once clearcut, the commercial thinning program was assumed to end for that stand. The impact of commercial thinning on growth and yield need to be better understood to improve modeling this scenario. If commercially thinned stands recover all of the thinned volume, then these results are a good representation of the impact.

In modeling this scenario, the majority of the commercial thinning programs occurred in the first decade. The effect is to offset some of the mature volume that would otherwise have been taken in the first period. Although this mature volume is eventually taken sometime in the next 20 to 50 years, the net result is more merchantable growing stock available in period 6. As a result, the hole is almost entirely filled. The base case initial harvest level can be maintained for five decades. In decade 6, 248,400 m^3 per year is available. This represents only a 0.3 percent drop in the initial harvest level. The remainder of the harvest flow remains relatively unchanged from the base case, although the hole in period 15 has increased to almost 7 percent. This increase in the drop occurs primarily as a function of change in the rotation age for some of the thinned stands. Those stands closest to 80 years would be eligible for harvest in 10 years. Commercial thinning removes 30 percent and prolongs the re-entry by 40 years, before the original stand volume is available.

6.5.2 Impact of fertilization

In cooperation with the MOF, long-term, intensive fertilization trials were begun on T.F.L. #53 in 1993. The trials have targeted stands between 9 and 15 years of age. The results have been dramatic. Much more work is required to quantify the effects of fertilization on stand growth. In this scenario, to assess the impact of fertilization in reducing the "hole" in the base case harvest flow, approximately 2,100 hectares of pine and spruce plantations were given a very conservative 5% gain in yield. The scenario applied fertilization as a one-time occurrence to existing plantations between 15 and 25 years of age. Fertilization of these plantations had the added benefit of reducing the culmination/minimum harvest age. For medium/poor site pine stands this cutting age was reduced to 60 years.

The net short term result was a small reduction in the hole in period 6, to 241,700 m^3 per year. Even with the reduced cutting age on some of the pine stands, and the increase in yields, there was not enough extra growing stock available to fill the hole. The mid term harvest level was able to increase to 329,000 m^3 per year without a hole in period 15. The long term harvest level remained the same.

6.5.3 Examine an enhanced road deactivation program

Dunkley's current road deactivation program on T.F.L. #53, restores to productive forest 12.5 percent of all newly constructed roads. The impact of doubling this road deactivation program was explored. Currently, 1.09 percent of all stands greater than 31 years of age will convert to a permanent road after harvesting. This scenario assessed the impact of reducing the reduction in future roads to 0.82 percent. The effect of this program is negligible in the short term. The initial harvest of timber still occurs on the same amount of road. It is only when stands grow to maturity on the rehabilitated road that a benefit occurs. The results of this scenario indicated that the short term harvest level would remain at 249,000 m^3 per year, and the hole in period 6 would decrease by only 0.1 percent to 240,300 m^3 per year. In the long-term, the small hole in period 15 disappears, and the long term harvest level can be increased to 346,000 m^3 per year.

6.5.4 Model a reduced green-up delay

Given that T.F.L. #53 should be managed as a "working forest", the impact of applying a 2.5 metre green-up delay to the IRM zone was explored. The result was a reduction in the current average green-up delay by one year (i.e., from 15 years to 14 years). The reduction in the green-up delay resulted in an increase in the short term harvest level to 250,500 m^3 per year. At this rate, the harvest will not drop in period 6. In the long term, the harvest level does not change from 345,000 m^3 per year.

The reason for the short term increase and no effect in the long term, is a result of the change in the distribution of age classes within the T.F.L. over time. The current uneven age class distribution results in periods when large patches of mature timber exist within the T.F.L., but are unavailable due to minor adjacency constraints. Once the T.F.L. has converted to a normal age class distribution after about 150 years, the patchwork distribution of timber within the T.F.L. negates the existence of adjacency problems.

The change in the short term is smaller might be expected because the forest estate model is not very sensitive to 0.5 metre changes in green-up height. The operational implications are likely much more significant.

6.5.5 Reduce OAFs for managed spruce and pine stands

Gaps often occur in the stocking of managed plantations, and reductions in volume occur due to insects and disease. To account for this, managed stand yield tables had operational adjustment factors (OAFs) applied them to reduce the maximum predicted yield. The OAF (i.e., OAF1) for leading spruce plantations is a 12 percent reduction in yield, and for leading pine plantations, a 10 percent reduction in yield. The impact of reducing these OAFs (i.e., OAF 1 reduced 1/3 for pine and 1/2 for spruce) was assessed on the assumption that OAFs could be reduced through enhanced plantation management. This management strategy has very little impact on the short term harvest level. A maximum harvest of 249,000 m^3 per year can still be maintained for 50 years. In period 6, the hole has filled slightly, so that the drop is only 2.8 percent. The impact is marginal at this point, since very few of the existing managed plantations are available for harvesting during this period. In the long term, the reduction in OAFs has a pronounced effect. The midterm harvest level can increase 3.7 percent above the base case, and the long term harvest can increase 5.2 percent to 363,000 m^3 per year.

6.6 MOF Sensitivity analysis on base case assumptions

In any long term timber supply analysis there is uncertainty surrounding whether or not all of 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. These sensitivity scenarios were requested by the MOF, and are outside the commitments made in the SMOOP. The scenarios include:

- Alternative harvest flows
- Uncertainty in minimum harvest ages
- Uncertainty in natural stand yield estimates
- Uncertainty in managed stand yield estimates
- Uncertainty in forest cover objectives (adjacency)
- Uncertainty in landscape level biodiversity requirements
- Uncertainty in forest cover objectives for visual quality
- Uncertainty in the size of the T.H.L.B.

The results of these scenarios are briefly described in the sections that follow. A summary of the results are shown in Table 8.

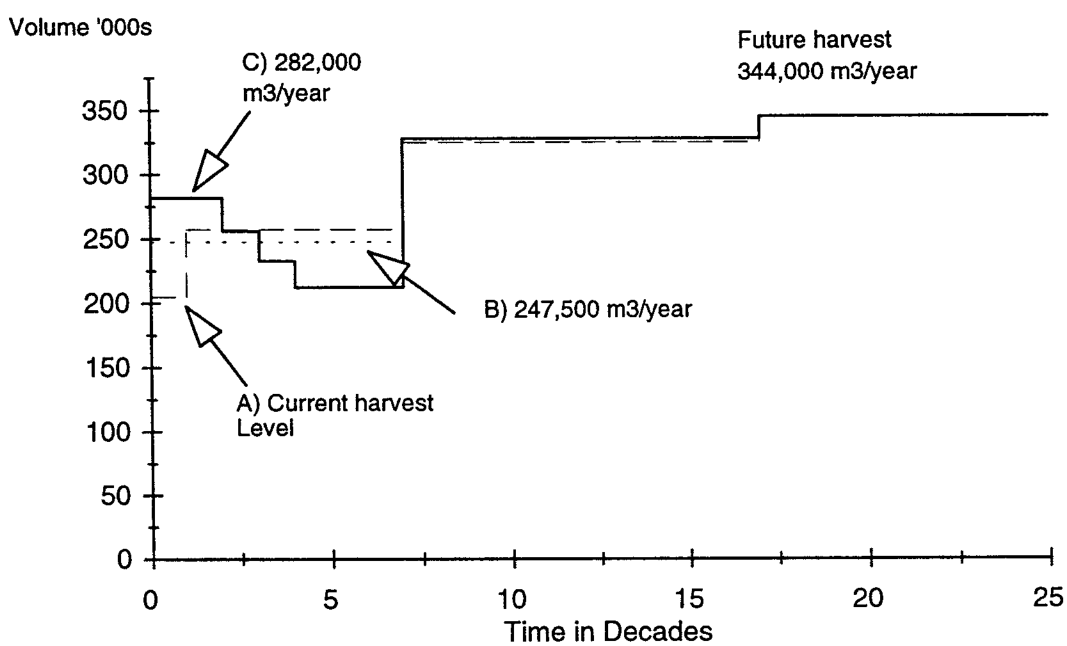
Table 8. Summary of Analysis Results -MOF Standard Runs

Section	Scenario	Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
6.6.1	Alternative harvest flow: Maximum 20 year accelerated cut (Alternative C)	70,142	282,000	282,000 / period 1-2; 256,000 / period 3 233,000 / period 4; 212,000 / period 5-7 328,000/ period 8-16; 345,000 / period 17-40
6.6.2	Apply a minimum cutting age equal to culmination for existing natural stands	70,142	249,000	249,000 / period 1-5, 7; 227,400 / period 6 326,500 / period 8-16 345,000/ period 17 - 40
6.6.3	Increase natural stand yields by 10%	70,142	272,000	272,000 / period 1-7; 329,000 / period 8-16 346,000 / period 17 - 40
	Decrease natural stand yields by 10%	70,142	249,000	249,000 / period 1-2; 226,000 / period 3 205,000 / period 4, 5, 7; 202,700 / period 6 327,000 / period 8-16; 345,000/ period 17 - 40
6.6.4	Increase managed stand yield tables by 10 %	70,142	249,000	249,000 / period 1-5, 7; 244,000 / period 6 356,000 / period 8-15; 376,000 / period 17-40
	Decrease managed stand yield tables by 10 %	70,142	249,000	249,000 / period 1-5, 7; 236,000 / period 6 295,000 / period 8; 299,000 / period 9-15 314,000/ period 17 - 40
6.6.5	Decrease adjacency forest cover constraints by 10%	70,142	249,000	249,000 / period 1-5, 7; 240,700 / period 6 328,000 / period 9-16; 344,000 / period 17 - 40
	Increase adjacency forest cover constraints by 10%	70,142	249,000	249,000 / period 1-5, 7; 240,700 / period 6 297,700 / period 8; 328,000 / period 9-14, 16 324,500 / period 15; 345,000 / period 17 - 40
6.6.6	Model mature plus old landscape biodiversity seral-stage targets	70,142	249,000	249,000 / period 1-5, 7; 100,500 / period 6 328,000 / period 8-13, 16 250,100 / period 14; 239,000 period 15 345,000/ period 17-21, 24,25 322,700 / period 22; 215,700 / period 23
	Model full old seral stage targets at time 0	70,142	249,000	249,000 / period 1-5, 7; 176,000 / period 6 328,000 / period 8-13, 15,16 314,300 / period 14; 345,000 / period 17 - 40
6.6.7	Use the mid range VAC for VQC zones instead of the high VAC	70,142	249,000	249,000 / period 1-4; 236,000 / period 5-7 326,000 / period 8-16; 344,000 / period 17 - 40
6.6.8	Increase land base by 5%	73,649	259,500	259,500 / period 1-5, 7; 343,500 / period 8-16 363,000 / period 17 - 40
	Decrease land base by 5%	66,635	238,000	238,000 / period 1-5, 7; 220,700 / period 6 311,000 / period 8-16; 328,000 / period 17 - 40

6.6.1 Alternative Harvest Flows

The base case harvest flow shown in Figure 9 and described in Section 6.0, defined the criteria which was used to derive the harvest flow for all scenarios. The criteria were developed in order to avoid excessive drops in harvest from decade to decade. However, there are many other possible harvest flows, with varying declining rates, potential starting points and potential takeoffs between short-term and long term harvests. Figure 17 shows 3 different harvest flow alternatives.

Figure 17. Alternative harvest flows



Alternative (A) demonstrates what happens when the existing rate of harvest (i.e., 204,700 m^3 per year) is maintained for the next 10 years. The short term harvest level can increase to 257,000 m^3 per year without any drops or holes in the future. In part, this is a contributing factor as to why the projected harvest flow from each of the three Management Plans has increased. **As long as the harvest rate is set below the biological potential of the forest, mature timber is reserved and is available to increase the short term level in the next timber supply review.** This scenario however, carries increased risks. It assumes that the existing growing stock can be maintained at current levels without significantly higher losses as a result of forest health problems. The containment of forest health problems, such as Mountain Pine Beetle activity (which is growing to epidemic levels in the adjacent Quesnel TSA), indicate that this may not be possible without a large effort and expense.

Alternative (B) shows that the base case harvest would need to be reduced only 1,500 m^3 per year in order to fill the hole in the base case in period 6. It is a good example of a long term, non-declining harvest flow pattern.

Alternative (C) demonstrates the maximum rate of harvest that can be maintained for 20 years, without falling below the current apportioned AAC. An initial rate of 282,000 m^3 per year can be maintained for the next 20 years. The harvest would then have to drop 10 percent per decade and level off at 212,000 m^3 per year. In contrast to Alternative A, this run results in a lower risk to forest health problems, by minimizing the existing standing over-mature inventory sooner. The trade off is that alternative wood supply would need to be secured in the future to offset the declines in periods 3, 4 and 5.

There is no change in the long term harvest level for any of these harvest flows.

6.6.2 Uncertainty in minimum harvest ages

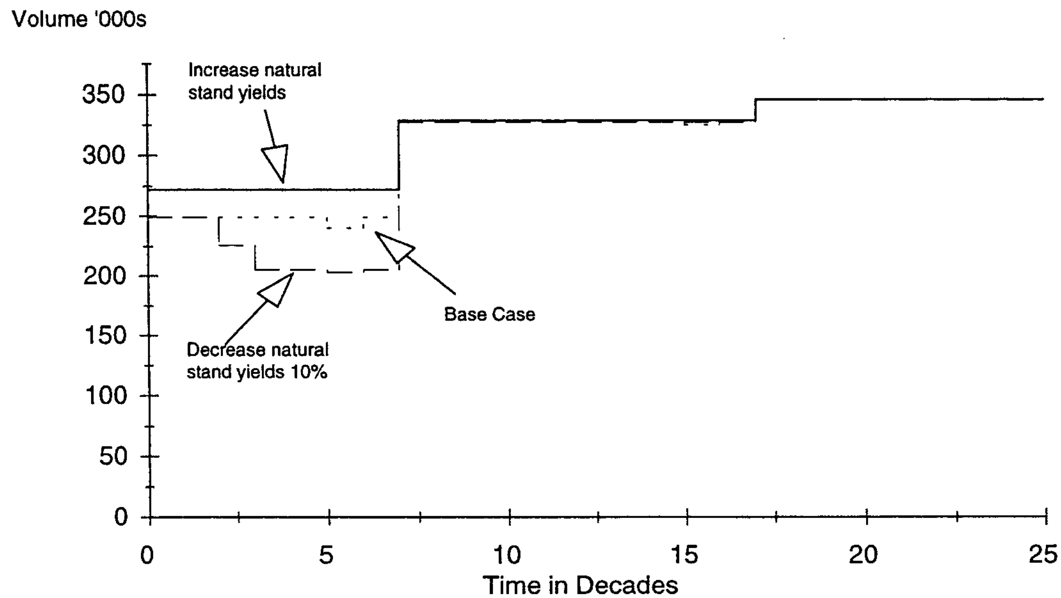
The initial information package submitted by Dunkley Lumber Ltd., indicated the desire to use culmination age as the minimum harvest age for existing natural stands. The Prince George Forest District MOF Office, suggested that Regional Priority Cutting Age (RPCA) would be more appropriate, and indicative of current operational practice on existing natural stands. The result of using culmination age for existing natural stands was an increase in the size of the hole in period 6. The harvest in this period would drop to 227,400 m^3 per year, which is 8.7 percent below the initial harvest of 249,000 m^3 per year. The reason for the increase in the size of the hole is due to an increase in the constraint on timber availability. The weighted average RPCA cutting age is 100 years. The weighted average culmination age for existing natural stands is 109 years. This alone accounts for the decrease in timber availability.

6.6.3 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 T.F.L. Although the inventory audit recently completed for the T.F.L. 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 which occurs during harvesting.

Figure 18 shows that T.F.L. #53 is very sensitive to changes in natural stand yield estimates. A 10 percent increase in natural stand yields would allow the short term non-declining harvest rate to increase to 272,000 m^3 per year. A 10 percent decrease in natural stand yields would result in a drop in the base case harvest flow after 30 years. In the 3rd decade, 226,000 m^3 per year could be maintained, followed by a drop to 205,000 m^3 per year for decades 4, 5 and 7. In decade 6, final drop to 202,700 m^3 per year occurs. The mid and long-term harvest levels remain relatively unchanged as managed stand yields have more of an effect.

Figure 18. Effect of 10% uncertainty in natural stand yield estimates



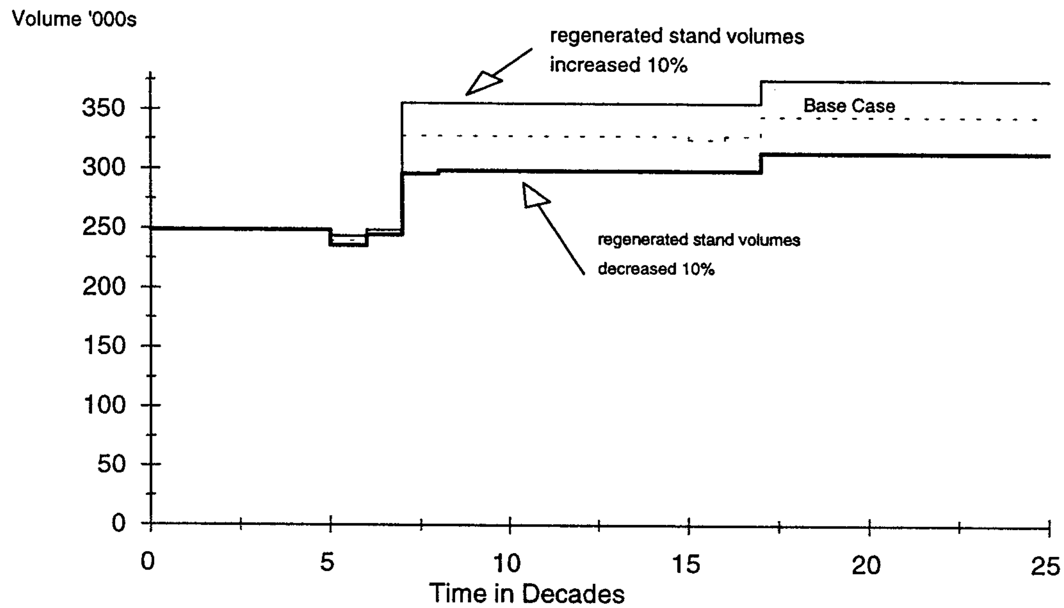
6.6.4 <u>Uncertainty in managed stand yield estimates</u>

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 Dunkley's investigations into the effects of fertilization. Figure 19 shows the effect of under and overestimating managed stand yields by 10 percent. In the short 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 hole in period 6 decreases slightly to 244,000 m^3 per year, which is 2 percent below the initial base case harvest level. In the mid and long term, harvest levels are impacted dramatically. The harvest in periods 8 to 16 can increase to 356,000 m^3 per year, and then increase again to 376,000 m^3 per year in period 17.

When managed stand yields are decreased 10 percent, the hole in period 6 increases to a 5.2 percent drop below the base case level of 249,000 m^3 per year. In the mid and long terms, the harvest levels increase to 299,000 and 314,000 m^3 per year respectively.

Figure 19. Regenerated stand volume estimates changed by 10%



6.6.5 Uncertainty in forest cover objectives (adjacency)

Although it is difficult to define the exact forest structure required to meet management objectives, forest cover objectives are used by the MOF as a proxy for adjacency requirements. The completion of a 20-year plan as part of the management plan process also adds weight in support of the forest cover objectives used in the base case. Nevertheless, to ensure these forest cover requirements are a reasonable representation of adjacency, the sensitivity of increasing and decreasing the requirements by 10 percent is assessed.

If forest cover requirements were more accurately approximated by decreasing the maximum allowable disturbance in the working forest by 10 percent, then short term harvest level would not change. The initial harvest level could only be maintained for five periods before dropping to 240,700 m^3 per year in period 6. The harvest would increase to 297,700 m^3 per year in period 8, increase to 328,000 m^3 per year in periods nine to 16 and increase to 344,000 m^3 per year after period 17.

If forest cover requirements are increased by 10 percent in the working forest zones, there is no change in the harvest flow.

6.6.6 Uncertainty in landscape level biodiversity requirements

Stand level biodiversity has been incorporated into the base case analysis by the management of wildlife tree patches in a manner that maintains half the area in stands over 160 years. It was also incorporated by factoring old seral stage biodiversity targets on the assumption that 45 percent of the T.F.L. has low biodiversity emphasis, 45 percent has intermediate biodiversity emphasis and 10 percent has high biodiversity emphasis. Low biodiversity emphasis conditions were factored into the T.F.L. over a 140-year period. Only 33 percent of the condition 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 low 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 Table 8.

Without adjusting the initial harvest level, the impact of mature seral targets would be felt quite severely in period 6, when the harvest level would fall 59.6 percent to 100,500 m^3 per year for a 10-year period. This period of constrained mature timber availability would cycle again in periods 14 and 15, and again in periods 22, and 23.

Without adjusting the initial harvest level, the impact of applying full old seral stage targets immediately would not be quite as severe. The hole in period 6 drops 29.3 percent to 176,000 m^3 per year. After this point in time, the timber in the excluded land base has aged sufficiently to the old seral targets that the remainder of the base case harvest flow is unaffected.

6.6.7 Uncertainty in forest cover objectives for visual quality

In the base case analysis, the high range for the visual absorption capacity (VAC) of all visual quality classes was used. The VAC is the value describing the amount of denudation that a scenic landscape can sustain and still maintain its visual quality objective. Justification for Dunkley's use of the "high" VAC exists in the approved Information Package found in Appendix I, Section 10.2.1. The impact of using the mid range VAC was assessed in this scenario at the request of the MOF.

In the short term, the harvest level is not very sensitive to this change. The base case harvest level of 249,000 m^3 per year can be maintained for 4 decades. The harvest level must then decrease 5.2 percent to 236,000 m^3 per year until period 8. At this point, an increase in harvest to 326,000 can be sustained until period 16, and an increase to 344,000 m^3 per year from period 17 on.

6.6.8 Uncertainty in the size of the timber harvesting land base

Uncertainty in the size of the timber harvesting land base exists, because the land base was defined using the forest inventory estimate of forest site productivity. In this timber supply analysis, the T.H.L.B. was defined based upon the VDYP estimate of productivity (i.e., comparison of existing stand height and age). A map which shows the excluded forest areas suggests that much of that area in T.F.L. #53 which was excluded as low site productivity or problem forest types could potentially contribute to the T.H.L.B. Some of these excluded areas are stands where harvesting had occurred in the 1960s and 1970s. In these areas the VDYP site index may be inaccurate as a result of the removal of the older spruce trees. This I.U. logging often resulted in the retention of a older aged spruce balsam understory wherein the height was suppressed due to the overstory.

These areas were removed from the T.H.L.B., because the forest inventory estimate of the site indexes for these stands were very low. The BEC site index for many of these sites is significantly higher. The total area reduced from the T.H.L.B. for low sites and problem forest types are 3961 hectares. Some of this area will likely be incorporated into the base case for M.P. # 4.

The effect of increasing and decreasing the land base by 5 percent is not difficult to predict. A 5 percent increase in the T.H.L.B. resulted in a short term increase to a non-declining harvest level of 259,500 m^3 per year. Similarly, the long term harvest level increased 5.2 percent to 363,000 m^3 per year.

A 5 percent decrease in the T.H.L.B. resulted in a reduction in the short term harvest level to 238,000 m^3 per year for periods one to five. In period 6, a 7.2 percent drop to 220,700 m^3 per year occurred. The long term harvest level decreased by 5 percent.

6.7 Sensitivity of Future Management Activities and Assumptions

Supplemental to Dunkley's commitments in the SMOOP, four scenarios were examined to satisfy Dunkley's interest in the possible short and long term potential of the T.F.L., and to reflect realistic information and the management direction for the T.F.L. The following four scenarios build on possible levels of uncertainty and change which may happen in the near future.

- Scenario 6.1 builds on the base case and examines the impact of capping the growth and yield tables which represent the volume obtained from leading spruce stands.
- Scenario 6.2 builds on the base case and examines the combined effect of applying low biodiversity emphasis with the revised Hwy 97 and Ahbau Lake landscape inventory.
- Scenario 6.3 builds on scenario 6.2, and includes the capped spruce yield tables.
- Scenario 6.4 is a "crystal ball" look into the future potential of yields from T.F.L. #53. It illustrates the biological potential of T.F.L. #53, when sustainable forestry is given priority over other social and political values.

The harvest flow for all of these scenarios is the maximum non-declining yield possible, without any drops or holes as a result of constrained availability. Figure 20 and Table 9 provide details to the results of these scenarios.

Figure 20. Enhanced forest zonation and Capped Spruce Yields

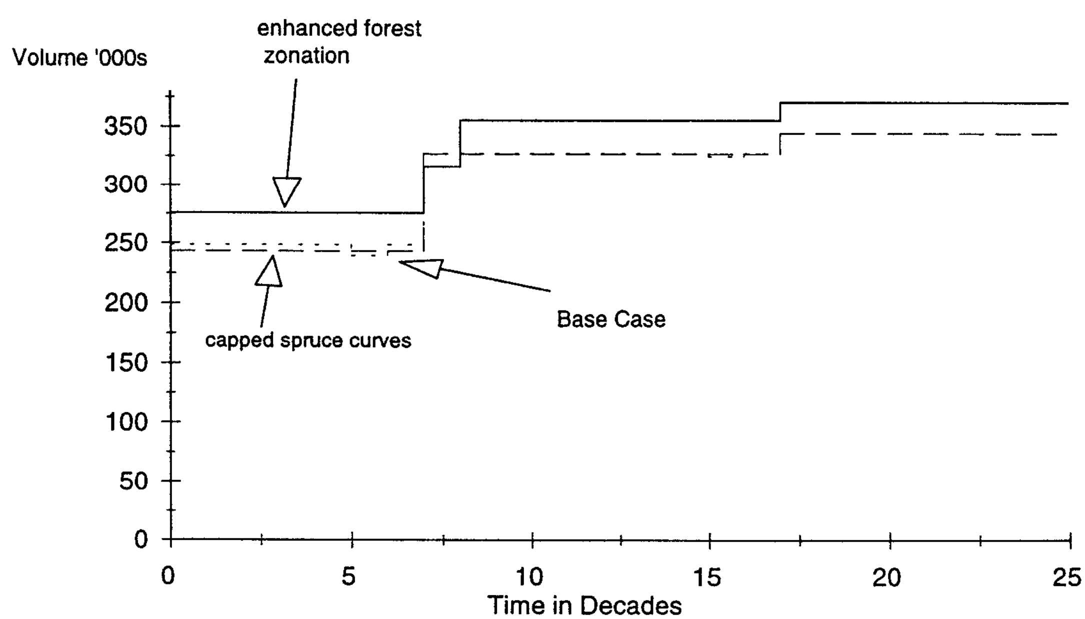


Table 9. Summary of Analysis Results - Sensitivity of changes to future management

	Scenario	Net Area (ha)	Net Short-Term Yield (m3/year)	Net Harvest Forecast Per Period (m3/year)
6.1	Cap natural stand spruce curves at 180 years	70,142	243,500	243,500/ period 1-7 327,500 / period 8-16 345,000 / period 17 - 40
6.2	Apply low biodiversity emphasis and the revised landscape inventory	70,142	258,000	258,000 / period 1-7 310,500 / period 8 332,000 / period 9-16 345,000 / period 17-40
6.3	As per scenario 6.2 but cap natural stand spruce curves	70,142	253,500	253,500 / period 1-5, 7 311,000 / period 8 327,000 / period 9-16 344,000 / period 17 - 40
6.4	Enhanced forest zonation	70,359	276,000	276,000 / period 1-7 316,800 / period 8 356,000 / period 9-16 371,000 period 17 - 40

6.7.1 Capped Yield Tables for leading spruce stands

Natural stands of leading white spruce comprise about 50 percent of the forest in T.F.L. #53. While Dunkley Lumber Ltd. supports the yields predicted for natural stands as they currently exist within the T.F.L., the assumption that these yields will continue to increase as predicted by the VDYP tables is subject to some uncertainty. A comparison between the VDYP polygon generated volumes and VDYP yield table volumes was provided to the MOF, when approval was being sought for the natural stand yield tables used in this analysis. The comparison indicated that the VDYP polygon generated volumes for leading spruce stands were very close to what the yield tables predicted. Similarly, the inventory audit preformed by the MOF on T.F.L. #53 supports the inventory volume information. Nevertheless, the question arose whether younger-mature, natural spruce stands, will gain the 450 + cubic metres per hectare that the growth and yield model predicts. If these concerns are justified, there may be a short term impact. Building off the base case, this scenario examined the impact of capping the projected yields for natural stands of white spruce at 180 years.

The impact is an initial non-declining yield of 243,500 m^3 per year. In period 8, this yield can increase to 327,500 m^3 per year until 160 years from present. The long term harvest level of 345,000 m^3 per year can then be supported indefinitely.

Dunkley investigated this scenario due to the results found in the timber supply analysis for M.P. #2. Here the simulation model (i.e., IFSYIELD) selected those stands which provided the best future mean annual increment. The resulting average volume per hectare harvested was not indicative of the volumes that Dunkley was harvesting operationally at that time. The model used for M.P. #3 utilizes a harvest rule which targets the oldest stands first. The resulting volume per hectare obtained from existing natural stands is representative of the volumes currently obtained operationally within the T.F.L. Operationally, neither model mimics the harvest pattern that is influenced by such factors as adjacency and blowdown. Capping the spruce curves therefore provides a conservative scenario of the future harvest volumes obtained from natural stands on the T.F.L.

6.7.2 Low biodiversity emphasis and revised highway and Ahbau Lake visual inventory

Dunkley feels that the revised inventory for the Highway 97 and Ahbau Lake viewsheds may become the 'known' scenic area for the T.F.L. The likelihood of low biodiversity emphasis designation is also a reasonable possibility for T.F.L. #53. Indications from the Prince George Forest District confirm this.

The combined impact of these two management initiatives is an increase in the short term harvest level to 258,000 m^3 per year. The mid term harvest level can be supported in periods 9-16 at 332,000 m^3 per year. There is no impact in the long term harvest level.

6.7.3 Low biodiversity emphasis, revised VQCs and capped spruce yields

This scenario combines the assumptions used in Sections 6.7.2 and 6.7.1. The impact of low biodiversity emphasis, revised highway 97 and Ahbau Lake VQCs, and capped spruce yields was assessed.

The result is an initial non-declining yield of 253,500 m^3 per year. In period 8, the harvest can increase to 311,000 m^3 per year, and then increase again to 327,000 m^3 per year for periods nine to 16. The long term harvest level is 1000 m^3 per year below the base case.

6.7.4 Enhanced forest zonation

The impact of a several management initiatives, and legislated assumptions are assessed in combination. These assumptions include the following:

- Utilize the increased T.H.L.B. which has P.G. District Policy Lakeshore guidelines removed, and WTP management eliminated,
- Apply low biodiversity emphasis,

- Remove the visual landscape inventory management from the analysis,
- Cap the projected yields for natural spruce stands at 180 years,
- Reduce green-up to a 2.5 metre height,
- Reduce the operational adjustment factors for managed plantations: 1/3 for spruce and 1/2 for pine,
- Reduce the minimum harvest age for balsam I.U. stands to 40 years,
- Apply commercial thinning to good site pine stands between 40 and 80 years of age,
- Apply a 25 percent increase in the yield of selected stands to represent the impact of fertilization.

Enhanced forest zonation, incorporating the assumptions above, provides a very promising outlook for the potential future harvest flow for T.F.L. #53. A short term harvest level of 276,000 m3 per year is 11 percent higher than the current base case harvest level. At this level, a hole in period 6 does not exist. The long term harvest level is 7.5 percent higher than the base case. A harvest level of 371,000 m3 per year is sustainable after the 17^{th} period. These results provide some measure of the impact that an enhanced forest zonation could provide on the sustainable harvest flow, as a result of various management initiatives, and changes to government policies. They also provide a target for forest managers to work towards using enhanced forestry activities on T.F.L. #53.

7.0 CONCLUSION

In the long term, there is very little difference between the long term harvest levels reported for the majority of the scenarios analyzed. This is a result of the assumption that the current age class distribution of the excluded forest will not remain static, but will contribute an increasing amount of area to old growth as time passes. The effect of this assumption is to mitigate the long term impact of forest cover constraints.

In the short term (periods 1 through 7), the base case harvest level of 249,000 m^3 per year is the technically supportable harvest level for T.F.L. #53 given current management practices. This initial harvest level reacts extremely well to downward pressures on timber supply. Issues such as the uncertainty in future managed stand yields have almost no impact in the short term. Dunkley's familiarity with the T.F.L. and the level to which resource inventory information has been acquired suggests that significant errors or uncertainties regarding site productivity, or land base are negligible. If anything, the site productivity used to define the T.H.L.B. will likely improve the situation for Dunkley in the future.

With an initial harvest level of 249,000 m3 per year, a harvest flow with substantial future increases, is possible on T.F.L. #53. This is a result of the effort Dunkley has placed on improving resource information and the high level of resource management undertaken over the past 2 management plans. This historic performance is a good indication that the small 3.6 percent drop in the harvest level in 50 years provides little cause for concern, since the drop occurs primarily as a result of temporal constraints rather than physical ones.

In the near future, the resolution to define "Enhanced Resource Management Areas" will likely place a significant amount of upward pressure on the harvest level for T.F.L. #53 This item alone, in combination with the inventories and management strategies that have begun on T.F.L. #53, suggests that over the term of M.P. #3, justification for further increases in the yield will be inevitable.

8.0 DISCUSSION

8.1 Social Impacts

The allowable annual cut set for T.F.L. #53 will impact the social and economic well-being of over 260 people directly. Children, wives, and other dependents have not been factored into this equation. The owners of Dunkley Lumber Ltd. have a long-standing commitment to these employees and their dependents. The employees have responded by working to evolve the company into a highly productive organization, both in the sawmill and in the woods. It is a working environment with which employees and managers are immensely proud. Part of Dunkley's social contract to the employees is to provide long term job security. This is directly tied to a secure fibre source.

The security of the community depends not only on the tree farm licence, but on Dunkley's ability to acquire sufficient wood supply to meet their current fibre requirements of 600,000 cubic metres per year. Currently, 30 percent of this fibre demand is met by a secure tenure (i.e., T.F.L. #53) and 10 percent is met under non-replaceable forest licenses. The remaining volume must be acquired on an open market over which Dunkley has little control. Thus to the local communities of Hixon and Strathnaver, the importance of this tree farm, and the ability to increase harvest levels, cannot be overemphasized.

At a provincial level, T.F.L. #53 has much to offer to the people of B.C., in terms of the revenues generated through taxation, stumpage, and the spinoffs from the wages to local employees. If an AAC was set at 249,000 cubic metres per year for the duration of M.P. # 3, the 21.6 percent increase in harvest would accrue the following benefits beyond those provided in Table 1:[1]

- provide a keystone towards improving sawmill job security;
- create additional full time equivalent jobs in forest management;
- additional full time equivalent jobs in timber harvesting would be created;
- new jobs in secondary employment would be created;
- $1,533,600 in annual wages and benefits worth would be generated;
- $ 716,000 annually in personal income taxes
- $ 67,600 in personal employment insurance and CPP benefits
- $ 443,000 of additional purchases of good and services could be forecast;
- $ 576,630 of additional corporate tax, stumpage and royalties revenue would be generated for the Crown.

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1 Most of these figures are pro-rated from the information provided in Table 1, based on an increase in AAC of 21.6 percent.

The current AAC contributes only 30 percent of the annual fibre requirements to the Dunkley sawmill. The base case harvest flow would represent a significant gain to Dunkley's secure, long-term fibre supply. Its importance to the local economies, and the livelihood of more than 266 employees and their families cannot be overstated. This increase can be achieved within the framework of the FPC and biodiversity management, and help to better meet the social and economic objectives of the Crown.

8.2 Technical Results

The sustainable harvest level reported for T.F.L. #53 has increased substantially over the term of the past 2 management plans. Given the advent of the Forest Practices Code, biodiversity guidelines and riparian reserve zones, visual landscape inventories which are constraints on timber supply, why has this happened? There is no "one" answer to this question, but a multitude of factors which include:

- a substantial investment by Dunkley in managing the T.F.L. for all resources,
- better estimations of site productivity - present and future,
- a change in modeling philosophy which includes allowing the entire forested land base (rather then just the commercially defined T.H.L.B.) to contribute to forest cover constraints,
- a change in the forest estate model,
- good local knowledge of the land base,
- a historic harvest level below the long run sustained yield.

In all, the actual productivity of the land base has not changed. However, the assumptions with which timber supply analysts work have improved with regard to the growth and yield of a stand, the impact of various management strategies on the visual aesthetics of the landscape, and the impact of harvesting on old growth and wildlife habitats. These assumptions will continue to change through research and development until the "right" answer is reached. In the meantime, as long as the AAC is set at a level below the maximum non-declining yield, mature merchantable stands of timber, beyond that which is required for old growth, aesthetics and wildlife, will continue to grow and contribute to a higher LRSY at each subsequent timber supply analysis.

This timber supply analysis supports a harvest level for Tree Farm Licence #53 of 249,000 m^3 per year. This is a 21.6 percent increase over the current AAC, set in 1993. The technical information supporting this harvest level exceeds the information used in previous management plans. Few timber supply areas in B.C. have a knowledge base that exceeds the information which was used in this analysis. All indications are that a higher base case harvest level can be achieved in M.P. # 4. In light of this, a harvest level in keeping with the sustainable level of timber production of the T.F.L., and the nature, production capacity and timber requirements of the established timber processing facility is recommended.

APPENDIX I

DUNKLEY LUMBER LTD.
TREE FARM LICENCE #53
NAVER

(Refer to Appendix 2 in Management Plan # 3)

Timber Supply Analysis Information Package
in support of
Management Plan # 3

Appendix II - Timber Supply Analysis Report
Supplementary Analysis

June 1999

T.F.L. #53
Supplemental Timber Supply Analysis

Sensitivity of Variant Level Biodiversity Modeling

After the completion of the Timber Supply Analysis Report for T.F.L. #53, the Ministry of Forests informed Dunkley Lumber Ltd., of an oversight which occurred on the part of both the MOF and Dunkley. The item which was inadvertently missed was the level at which biodiversity would be modeled in the timber supply analysis.

Direction had been given in late 1998 to model seral stage biodiversity at the NDT/Biogeoclimatic zone/variant level. The areas in NDT's 1 and 2 were limited to only 1 biogeoclimatic zone and one variant in either case (i.e., NDT 1 contained only ESSF wk1; NDT 2 had only SBS wk1 within it). So there was no problem with the modeling in these two natural disturbance types. However, the area included in NDT 3 SBS contained 3 different variants, dw1, mk1 and mw. In the base case analysis preformed by Industrial Forestry Service Ltd. the area in all three variants in NDT 3 were grouped together.

*In the supplemental analysis t*he sensitivity of dividing the area in NDT 3 into three groups was tested. As well, the sensitivity of changing the harvest flow rule from oldest first to relative oldest first was tested. Lastly, a meeting with the Chief Forester at Dunkley's mill in June 1999, resulted in assurance that the Regional Landscape Unit Planning Strategy which has proposed the T.F.L. as one landscape unit with a low biodiversity emphasis option would be taken into *serious* consideration in the AAC determination. Thus, the effect of low biodiversity emphasis in conjunction with variant level modeling was explored.

In summary four scenarios were tested. These are:

- Scenario A.1 - Assess the impact of variant modeling by dividing the area within NDT 3 into three groups based on the variant and apply the original forest cover constraints from NDT 3 to each of the groups.
- Scenario A.2 - Building on scenario A.1, apply the relative oldest first harvest rule.
- Scenario A.3 - Building on Scenario A.1, apply low emphasis biodiversity to the T.F.L.
- Scenario A.4 - Building on Scenario A.3, apply the relative oldest first harvest rule.

Table A details the impact of these scenarios on the harvest flow for T.F.L. #53.

<u>A.1 Division of NDT 3 into 3 Groups</u>

The division of the area within NDT 3 into three groups based on variant resulted in a 12,000 m3 per year (4.8 percent) decrease in the initial harvest level from what was indicated in the base case. The reason for the decrease is a result of historic harvesting operations concentrated within NDT 3 SBS mk1. Harvesting in this area has resulted in approximately 27 percent of the operable area being below greenup age, thus constraining timber availability in the short term. In the base case analysis, the forested area within the other two variants offset this availability constraint. Since almost 30 percent of the T.F.L. exists within the SBS mk1, the short term impact of dividing the NDT 3 area into 3 parts is quite dramatic. In the long term, the age class distributions within each variant will become "normal", and the effect of old seral stage biodiversity targets which has been placed upon the variants is removed.

Table A. Summary of Post Analysis Results- Variant Modeling

Scenario		Net Area (ha)	Net Short Term Yield (m3/year)	Net Harvest Forecast per Period (m3/year)
A.1	Divide NDT 3 into three groups based on variant	70,142	237,500	237,500 / period 1-5, 7 229,000 / period 6 323,000 / 8-13, 15, 16 318,000 / period 14 345,000 / period 17-40
A.2	As per scenario A.1, but use the relative oldest first harvest rule	70,142	244,500	244,500 / period 1-7 327,000 / period 8-16 345,000 / period 17 -40
A.3	As per scenario A.1, but apply low biodiversity emphasis to the T.F.L.	70,142	249,500	249,500 / period 1-5, 7 247,200 / period 6 327,500 / period 8-16 345,000 / period 17-40
A.4	As per scenario A.3, but use the relative oldest first harvest rule	70,142	256,000	256,000 / period 1-7 331,000 / period 8-16 345,000 / period 17-40

A.2 Apply the relative oldest first rule to Scenario A.1

The oldest first harvest rule was used in the base case timber supply analysis. Changing the harvest rule to relative oldest first changes the way in which stands are targeted for harvesting within the timber supply model. Relative oldest first targets those stand which have the greatest age difference between their current age and their designated minimum harvesting age. In the Base Case, this harvest rule had a negligible effect on the harvest flow. However, the division of NDT 3 into its variant components gives significant upwards pressure on the harvest flow. A 7,000 m3 per year (2.9 percent) short term increase in Scenario A.1 (with no fall down in period 6) is achievable using this harvest rule.

A.3 Apply low biodiversity to Scenario A.1

The Regional Unit Landscape Planning Strategy has proposed that the T.F.L. be managed with a low biodiversity emphasis option. This is supported, in part, by the LRMP designation of the T.F.L. .as an enhanced forest resource management zone. In light of this, low biodiversity seral stage targets for old timber were applied to Scenario A.1. The short term result is that the base case harvest forecast of 249,500 m3 per year could be maintained with only a small drop in period 6 to 247,500 m3/year. The mid and long term harvest flow changes little from the base case.

A.4 Apply relative oldest first rule to Scenario A.3

The relative oldest first harvest priority rule was once again applied in this supplementary analysis. The result is an increase in the non-declining short term harvest level to 256,000 m3 per year. In period 8 the harvest level can increase to 331,000 m3 per year, and then increase once again in period 17 to the long term harvest level of 345,000 m3/year.