WESTERN FOREST PRODUCTS INC.

Tree Farm Licence 19

MANAGEMENT PLAN 10

October 2010

Mike Davis, *R.P.F*
Planning Forester
Western Forest Products Inc.

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1 Introduction

This is the first Management Plan (MP) prepared for Tree Farm Licence (TFL) 19 to meet the requirements of the *Tree Farm Licence Management Plan Regulation* (B.C. Reg. 280/2009). This regulation, enacted by the provincial government in November 2009 (with associated amendments to the *Forest Act*), includes content requirements, submission timing and public review requirements for TFL Management Plans. These content requirements (in regulation) replace the MP content requirements listed in the tree farm licence document and reduce the duplication of Forest Stewardship Plan matters (objectives and strategies).

2 Description of TFL 19

TFL 19 is located on the west side of Vancouver Island in the vicinity of Nootka Sound, approximately 80 kilometers due west of Campbell River (refer to Figure 1). The total area of the TFL is approximately 172,000 hectares of Crown land including timber licenses. The eastern boundary abuts onto Strathcona Provincial Park, while to the west it borders Tahsis Inlet and Nootka Island. The western boundary has a diverse shoreline by virtue of several inlets (Espinosa, Zeballos, Tahsis, Tlupana, Muchalaht), which dissect the coastal rainforest landscape.

The topography of TFL 19 is mountainous and steep with massive limestone outcrops and formations dominating the landscape. The licence area is drained by numerous rivers and streams. Numerous streams support significant anadromous fish populations. Large animals, notably Roosevelt elk, Columbia black-tailed deer, cougars and black bears are abundant throughout the licence area. Numerous other large and small animals, reptiles, amphibians, fish and birds can also be found.

The forests of TFL 19 lie within the wetter and very dry maritime coastal western hemlock biogeoclimatic zone. Annual precipitation levels reach 3,000 to 5,000 mm. The climate is characterized by short winters with intermittent wet snow storms. The summer period from July to September can be dry and warm. The dominant timber species is western hemlock, which occurs in conifer stands mixed with varying amounts of amabilis fir, western red cedar and Douglas fir. Lesser amounts of Sitka spruce, yellow cedar and mountain hemlock also occur.

There are six communities within the licence area. These are Gold River, Tsaxana (Mowachaht-Muchalaht First Nation), Tahsis, Zeballos, Ehatis (Ehattesaht First Nation) and Oclugjie (Nuchatlaht First Nation) as noted in Figure 1. The livelihood of these communities and their stability depends mostly or in part on the economic activities generated in the Nootka Sound region. Western Forest Products Inc. (WFP) harvesting operations in TFL 19 and adjacent forest and timber licences are major employment activities in Nootka Sound. There is also economic activity from fish farming, commercial and recreational fishing and expanding tourism.

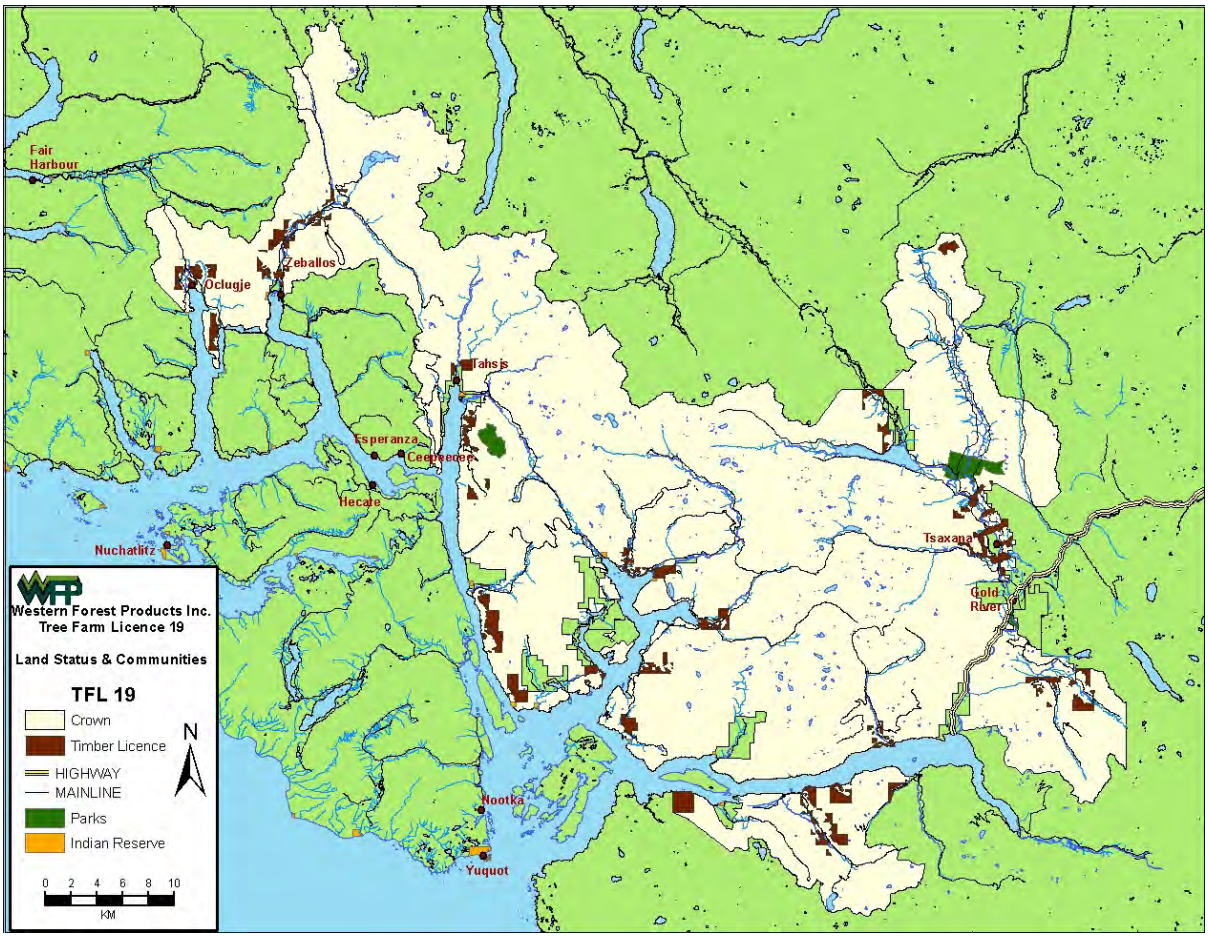

Figure 1 - TFL 19

3 TFL 19 Licence Holder History

Forest Management Licence (FML) No. 19 (Tahsis) was originally awarded in 1954. FMLs were later renamed Tree Farm Licences (TFLs). The licence holder has changed over time with successive corporate re-structurings, acquisitions and mergers (see Table 1).

Table 1 - TFL 19 Licence Holders

Licence	Date listed company became licence holder	Licence Holder	Description
FML 19 (Tahsis)	December 23, 1954	Tahsis Company Ltd.	Original FML
TFL 19	January 1, 1982	Tahsis Company Ltd.	TFLs replace FMLs
TFL 19	January 1, 1985	CIP Forest Products Inc.	Company name change
TFL 19	August 22, 1985	CIP Inc.	Company name change
TFL 19	January 1, 1989	Canadian Pacific Forest Products Limited	Company name change
TFL 19	August 2, 1993	Pacific Forest Products Limited	Assignment to subsidiary
TFL 19	December 8, 1997	Doman-Western Lumber Ltd	Purchase of licence
TFL 19	September 10, 2004	4018982 Canada Inc.	Company name change
TFL 19	March 31, 2005	WFP Western Lumber Ltd.	Company name change
TFL 19	May 1, 2006	Western Forest Products Inc.	Company amalgamation

4 TFL 19 Consolidations and Subdivisions

There have been no consolidations or subdivisions associated with TFL 19.

5 Major TFL 19 Boundary Changes

Table 2 lists changes to the TFL area involving over 200 hectares and the date of those changes. There have been multiple minor (< 200 ha) area revisions since 1982 to accommodate other land uses such as town sites and services; Indian reserve relocation; gravel pits; transmission line, highway and forest service road right-of-ways.

Table 2 - TFL 19 Major Boundary Changes

Date	Boundary Change	Area (ha)
December 15, 2001	Instrument 67 – Deletion of five parcels of private lands not owned by licence holder Doman-Western Lumber Ltd. (were owned by Bowater at the time)	292
January 23, 2007	Forest Revitalization Act order to delete area near Gold river town site for woodlot with AAC of 5,300 m^3	781
January 31, 2007	Forest Revitalization Act order to delete area near Hisnit Inlet for woodlot with AAC of 4,700 m^3	614 (plus further 125 ha effective July 10, 2011)
January 31, 2007	Instrument 70 – Deletion of all private land	2,007
July 15, 2009	Instrument 72 – Deletion of BCTS operating area	16,596

6 TFL 19 Planning Documents

Table 3 indicates the publicly available planning documents used by WFP to guide forest management and operations within TFL 19:

Table 3 - TFL 19 Publicly Available Planning Documents

Plan Type	Plan Title	Description	Web link (as of January 20, 2010)
Regional Land Use Plan	Vancouver Island Summary Land Use Plan (February 2000)	Provides the key components of strategic land and resource management decisions made by the provincial government for Vancouver Island.	http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/vancouver_island/index.html
Higher Level Plan	Vancouver Island Land Use Plan Higher Level Plan Order (effective December 1, 2000)	An order that established Resource Management Zones (RMZs) and Resource Management Zone Objectives within the area covered by the Vancouver Island Land Use Plan.	http://ilmbwww.gov.bc.ca/slrp/lrmp/nanaimo/vancouver_island/plan/vihlp.htm
Forest Stewardship Plan (FSP)	Nootka Forest Stewardship Plan (FSP #18)	The FSP, amended to April 2008, specifies results and strategies that have been deemed to be consistent with the Forest and Range Practices Act (FRPA) and the government objectives that apply to the landbase covered by the FSP. Forestry activities in turn must be consistent with the results and strategies specified in the FSP. This is the main planning document used to guide operations.	http://www.westernforest.com/company/stewardship/nootka_fsp.php

7 Public Review Strategy Summary

This section will be completed following the review period and be included in the final MP submission to the Ministry of Forests and Range.

Appendix A: AAC Determination

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File: 12850-20/19
CLIFF 125282

AUG 1 0 2010

Mr. Mike Davis
Planning Forester
Western Forest Products Inc.
118 – 1334 Island Highway
Campbell River, British Columbia
V9W 8C9

Dear Mr. Davis:

I am writing to you regarding the allowable annual cut (AAC) determination for Tree Farm Licence (TFL) 19.

In accordance with Section 8(3.1) of the *Forest Act*, I have determined the AAC for TFL 19 to be 730 000 m^3, effective August 10, 2010. This decision will remain in effect until the next determination which will occur no later than August 10, 2020.

The reasons for my decision are included in the attached Tree Farm Licence 19 Rationale for Allowable Annual Cut (AAC) Determination, signed August 10, 2010.

If you have any questions about this letter or the attached rationale, please contact Doug Layden, Timber Supply Forester, Forest Analysis and Inventory Branch by telephone at 250-356-694 or by email at Doug.Layden@gov.bc.ca.

Yours truly,

M. Boyce

Melanie Boyce, RPF
Deputy Chief Forester

Attachment

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Albert Nussbaum, A/Director, Forest Analysis and Inventory Branch
Rory Annett, District Manager, Campbell River Forest District
Rhonda Morris, Manager – Timber Tenures, Resource Tenures Branch
Bud Koch, Senior Analyst – TFLs, Forest Analysis and Inventory Branch
Doug Layden, Timber Supply Forester, Forest Analysis and Inventory Branch

BRITISH COLUMBIA
MINISTRY OF FORESTS AND RANGE

Tree Farm Licence 19

held by
Western Forest Products Inc.

Rationale for Allowable Annual Cut (AAC) Determination

Effective August 10, 2010

Melanie Boyce, RPF
Deputy Chief Forester

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Objective of this document

This document provides an accounting of the factors I have considered, and the rationale I have employed in making my determination, under Section 8 of the *Forest Act*, of the allowable annual cut (AAC) for Tree Farm Licence (TFL) 19. This document also identifies where new or better information is needed for incorporation in future determinations.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider a number of specified factors in determining AACs for timber supply areas (TSAs) and TFLs. Section 8 of the *Forest Act* is reproduced in full as Appendix 1 of this document.

In accordance with Section 23(3) of the *Interpretation Act*, the deputy chief forester is expressly authorized to carry out the functions of the chief forester, which include those required under Section 8 of the *Forest Act*.

Description of the TFL

Tree Farm Licence 19 is held by Western Forest Products Inc. (WFP, 'the licensee') and is administered by the Ministry of Forests and Range (MFR) Campbell River Forest District office in Campbell River. The TFL is located on the west coast of Vancouver Island near Nootka Sound. It is bordered by the Strathcona TSA and Strathcona Provincial Park to the east, the Strathcona TSA to the west, WFP's TFLs 37 and TFL 39 to the north, and the Arrowsmith TSA to the south. The total land base of TFL 19 is 171 722 hectares of which 139 767 hectares, or 81 percent of the area, are considered to be productive forest. The long-term timber harvesting land base on TFL 19 is assumed to be 75 312 hectares.

The TFL is composed of rugged marine coastline, with steep mountainous terrain, and deep river valleys and inlets of the Pacific Ocean. The majority of the operable forest lies within the Coastal Western Hemlock (CWH) biogeoclimatic zone, with portions in the higher-elevation Mountain Hemlock (MH) zone. There are also large areas of unforested alpine tundra.

Two First Nations, the Mowachaht / Muchalaht First Nation and the Ehattesaht Tribe, assert traditional territories on TFL 19. There are six communities in the licence area, including Gold River, Tsaxana (Mowachaht / Muchalaht First Nation), Tahsis, Zeballos, and Ehatis (Ehattesaht First Nation). The livelihood of these communities and their economic stability depends mostly or in part on the resource activities within the Nootka Sound region. Harvesting operations in TFL 19 and adjacent forest and timber licenses are the major employment activities in Nootka Sound. Economic activity from fish farming, commercial and recreational fishing and expanding tourism is also important in the area.

History of the AAC

The most recent AAC determined for TFL 19, effective August 1, 2001, was 940 000 cubic metres. In 2007 the private land was deleted and as a result the AAC was reduced to 921 200 cubic metres. Since then a British Columbia Timber Sales (BCTS) area with an AAC of 65 253 cubic metres was also deleted and as a result the AAC was reduced to 855 947 cubic metres.

New AAC determination

Effective August 10, 2010, the new AAC for TFL 19 is 730 000 cubic metres. This level is about 15 percent less than the current AAC. This AAC will remain in effect until a new AAC is determined, which must take place within 10 years of this determination.

Information sources used in the AAC determination

The information sources considered in determining this AAC for TFL 19 include references listed in the licensee's Timber Supply Information Package and Analysis Report and the following:

- *Western Forest Strategy: A program for conserving biodiversity on company tenures*, July 2007;
- *Yield Tables for Existing Stands* accepted by MFR Forest Analysis and Inventory Branch September 27, 2008;
- *Yield Tables for Managed Stands* accepted by MFR Research Branch February 6, 2008;
- *Site Index information* accepted by MFR Research Branch February 6, 2008;
- *Tree Farm License 19 Vegetation Resources Inventory Statistical Adjustment,* J.S. Thrower & Associates Ltd., January 18, 2007;
- *Report on the VRI Site Tree Selection Test at TFL 19, Gold River,* MFR Forest Analysis and Inventory Branch, September 30, 2009;
- *Draft Report on the VRI Site Tree Selection Test at TFL 19, Gold River,* MFR, January 8, 2009;
- *SIBEC and PSI Estimates for Major Site Series in TFL 19,* Timberline Natural Resource Group, June 29, 2007;
- *WFP Tree Farm Licence 19 Timber Supply Analysis Information Package, MP #10,* dated October, 2008;
- *WFP Tree Farm Licence 19 draft Management Plan Number 10, (MP #10)* submitted January, 2009;
- *WFP Tree Farm Licence 19 Timber Supply Analysis, MP #10*, dated January, 2009;
- *TFL 19 Twenty-year Plan*, accepted June 26, 2009;
- *Forest Practices Code of British Columbia Act*, current to March 17, 2010 and regulations and guidebooks;
- *Landscape Unit Planning Guide*, MFR and Ministry of Environment (MoE), March 1999;
- *Forest Practices Code Timber Supply Analysis MFR and MoE,* February, 1996;
- *Higher Level Plans: Policy and Procedures, MFR and MoE,* December, 1996;
- *Forest and Range Practices Act and Regulations,* current to March 17, 2010;
- *Forestry Revitalization Act,* current to March 17, 2010;
- *Tree Farm Licence 19 Rationale for Allowable Annual Cut Determination;* Ken Baker, Deputy Chief Forester, Effective August 1, 2001;

- *Ministry of Forests and Range Act,* current to March 17, 2010;
- *Order #3(4)7-1 – under the Forestry Revitalization Act,* January 23, 2007, Ministry of Forests and Range;
- *Order #3(4)7-2 – under the Forestry Revitalization Act,* March, 2008, Ministry of Forests and Range;
- *Instrument Number 72, TFL 19, Minister of Forests and Range,* July 15, 2009;
- *'Summary of dead potential volume estimates for the management units within the Coastal Forest Region',* April 2006;
- *Identified Wildlife Management Strategy. Accounts and measures for managing identified wildlife: Coast Forest Region. Version 2004.* Province of BC;
- *Establishment of Scenic Areas and Visual Quality Objectives for the Campbell River Forest District*, December 14, 2005, MFR;
- *Notice – Indicators of the amount, distribution and attributes of wildlife habitat required for the survival of species at risk in the Campbell River Forest District*, Ministry of Environment, July 27, 2004;
- *Vancouver Island Land Use Plan Order,* October 2000;
- *Order Establishing Provincial Non-Spatial Old Growth Objectives,* effective June 30 2004;
- *Order - Ungulate Winter Range #U1-014*, December 19, 2004, Deputy Minister of Water, Land and Air Protection;
- *Order - Amendment to Ungulate Winter Range U-1-014, Unit F01d,* January 30, 2006, Deputy Minister of Environment;
- *Order - Amendment to Ungulate Winter Range U-1-014,* November 9, 2007, Deputy Minister of Environment;
- *Six orders establishing Wildlife Habitat Areas (WHAs);*
- *First Nations Consultation Summary – TFL 19 Allowable Annual Cut Determination, Campbell River Forest District,* October 6, 2010;
- *Letter from the Minister of Forests and Range to the Chief Forester,* dated July 4, 2006, stating the Crown's economic and social objectives for the province;
- *Review and evaluation of current operating conditions on TFL 19 through* comprehensive discussions with staff from the Ministry of Forests and Range (MFR) and the Ministry of Environment (MoE), including the AAC determination meeting held in Victoria, B.C. on October 21, 2009.

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires the chief forester to consider biophysical, social and economic information when determining AACs. A timber supply analysis, and the inventory and growth and yield data used as inputs to the analysis, typically form the major body of technical information used in AAC determinations. Timber supply analyses and associated inventory information are concerned primarily with management practices and biophysical factors, such as the rate of timber growth and definition of the land base considered available for timber harvesting.

The analytical techniques used to assess timber supply necessarily are simplifications of the real world. Many of the factors used as inputs to timber supply analysis are uncertain, due in part to variation in physical, biological and social conditions. Ongoing scientific studies of ecological dynamics will help reduce some of this uncertainty.

Furthermore, computer models cannot incorporate all of the social, cultural and economic factors that are relevant when making forest management decisions. Technical information and analysis, therefore, do not necessarily provide the complete answers or solutions to forest management

decisions such as AAC determinations. Such information does provide valuable insight into potential impacts of different resource use assumptions and actions, and thus forms an important component of the information I must consider in AAC determinations.

In determining this AAC for TFL 19 I have considered known limitations of the technical information provided. I am satisfied that the information provides a suitable basis for my determination.

Guiding principles for AAC determinations

The chief forester has expressed the importance of consistency of judgement in making AAC determinations. I also recognize the need for consistency of approach, and am familiar with the guiding principles that the chief forester has employed in making AAC determinations. I find these principles to be reasonable and appropriate and I have adopted them as described below in making my AAC determination for TFL 19.

Rapid changes in social values and in the understanding and management of complex forest ecosystems mean there is always uncertainty in the information used in AAC determinations. In making the large number of periodic determinations required for British Columbia's many forest management units, administrative fairness requires a reasonable degree of consistency of approach in incorporating these changes and uncertainties. To make my approach in these matters explicit, I have set out the following body of guiding principles. In any specific circumstance where I may consider it necessary to deviate from these principles, I will explain my reasoning in detail.

Two important ways of dealing with uncertainty are:

(i) minimizing risk, in respect of which in making AAC determinations I consider particular uncertainties associated with the information before me, and attempt to assess and address the various potential current and future, social, economic and environmental risks associated with a range of possible AACs; and

(ii) redetermining AACs frequently, in cases where projections of short-term timber supply are not stable, to ensure they incorporate current information and knowledge. This principle is central to many of the guiding principles that follow.

In considering the various factors that Section 8 of the *Forest Act* requires the chief forester to take into account in determining AACs, I will reflect, as closely as possible, those forest management factors that are a reasonable extrapolation from current practices. It is not appropriate to base my decision on unsupported speculation with respect to factors that could affect the timber supply that are not substantiated by demonstrated performance or are beyond current legal requirements.

In many areas, the timber supply implications of some legislative provisions remain uncertain, particularly when considered in combination with other factors. In each AAC determination the chief forester takes this uncertainty into account to the extent possible in context of the best available information. In making my determination for TFL 19, as deputy chief forester, I have followed the same approach.

It is my practice not to speculate on timber supply impacts that may eventually result from land-use decisions not yet finalized by government. However, where specific protected areas, conservancies, or similar areas have been designated by legislation or by order in council, these areas are deducted from the timber harvesting land base (THLB). Although I do not consider these areas to contribute any harvestable volume to the timber supply in AAC determinations, they may contribute indirectly by providing forest cover requirements to help in meeting resource management objectives such as for biodiversity.

In some cases, even when government has made a formal land-use decision, it is not necessarily possible to fully analyse and account for the consequent timber supply impacts in a current AAC determination. Many government land-use decisions must be followed by detailed implementation decisions requiring, for instance, further detailed planning or legal designations such as those provided for under the *Land Act* and the *Forest and Range Practices Act* (FRPA). In cases where there is a clear intent by government to implement these decisions that have not yet been finalized, I will consider information that is relevant to the decision in a manner that is appropriate to the circumstance. The requirement for regular AAC reviews will ensure that future determinations address ongoing plan-implementation decisions.

Where appropriate I will consider information on the types and extent of planned and implemented silviculture practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of their timber supply effects.

Some persons have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are incomplete, but this will always be true where information is constantly evolving and management issues are changing. The requirement for regular AAC reviews will ensure that future determinations incorporate improved information.

Others have suggested that, in view of data uncertainties, I should immediately reduce some AACs in the interest of caution. However, any AAC determination I make must be the result of applying my judgement to the available information, taking any uncertainties into account. Given the large impacts that AAC determinations can have on communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless, in making my determination, I may need to make allowances for risks that arise because of uncertainty.

With respect to First Nations' issues, I am aware of the Crown's legal obligation resulting from recent Court decisions to consult with First Nations regarding asserted rights and title (aboriginal interests) in a manner proportional to the strength of their aboriginal interests and the degree to which the decision may impact these interests. In this regard, I will consider the information provided to First Nations to explain the timber supply review (TSR) process and any information brought forward respecting First Nations' aboriginal interests including how these interests may be impacted, and any operational plans and actions that describe forest practices to address First Nations' interests, before I make my decision. As I am able, within the scope of my authority under Section 8 of the *Forest Ac*t, where appropriate I will seek to address aboriginal interests that will be impacted by my decision. When aboriginal interests are raised that are outside my jurisdiction, I will endeavour to forward these interests for consideration by appropriate decision makers.

The AAC that I determine should not be construed as limiting the Crown's obligations under the Court's decisions in any way, and in this respect it should be noted that my determination does not prescribe a particular plan of harvesting activity within TFL 19. It is also independent of any decisions by the Minister of Forests and Range with respect to subsequent allocation of wood supply.

Overall, in making AAC determinations, I am mindful of my obligation as steward of the forest land of British Columbia, of the mandate of the Ministry of Forests and Range as set out in Section 4 of the *Ministry of Forests and Range Act*, and of my responsibilities under the *Forest and Range Practices Act* (FRPA) and the *Forest Act*.

The role of the base case

In considering the factors required under Section 8 of the *Forest Act* to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the Timber Supply Review (TSR) programs for TSAs and TFLs.

For most AAC determinations, a timber supply analysis is carried out using an information package including data and information from three categories – land base inventory, timber growth and yield, and management practices. Using this set of data and a computer simulation model, a series of timber supply forests can be produced, reflecting different starting harvest levels, rates of decline or increase, and potential trade-offs between short- and long-term harvest levels.

From a range of possible forecasts, one is chosen in which an attempt is made to avoid both excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the 'base case' forecast, and forms the basis for comparison when assessing the effects of uncertainty on timber supply. The base case is designed to reflect current management practices.

Because the base case represents only one in a number of theoretical forecasts, and because it incorporates information about which there may be some uncertainty, the base case forecast for a TFL is not an AAC recommendation. Rather, it is one possible forecast of timber supply, whose validity – as with all the other forecasts provided – depends on the validity of the data and assumptions incorporated into the computer simulation used to generate it.

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which resulting predictions of timber supply must be adjusted to more properly reflect the current situation.

These adjustments are made on the basis of informed judgement, using currently available information about forest management, and that information may well have changed since the original information package was assembled. Forest management data are particularly subject to change during periods of legislative or regulatory change, or during the implementation of new policies, procedures, guidelines or plans. Thus, in reviewing the considerations that lead to the AAC determination, it is important to remember that the AAC determination itself is not simply a calculation. Even though the timber supply analysis I am provided is integral to those considerations, the AAC determination is a synthesis of judgement and analysis in which numerous risks and uncertainties are weighed. Depending upon the outcome of these considerations, the AAC determined may or may not coincide with the base case forecast. Judgements that in part may be based on uncertain information are essentially qualitative in nature and, as such, are subject to an element of risk. Consequently, once an AAC has been determined, no additional precision or validation would be gained by attempting a computer analysis of the combined considerations.

Timber supply analysis

The timber supply analysis for TFL 19 was prepared by the licensee using Remsoft's semi-spatial planning system Woodstock.

The inventory used in the analysis was current to the beginning of 2007. As a result, all harvest forecasts presented in the analysis start in 2007. The 870 000 cubic metres per year harvest level modelled for the first five-year period of the base case was calculated by the licensee using the weighted average of two years at the last AAC of 845 947cubic metres, three years at 786 667 cubic metres per year, a level that is seven percent lower than the last AAC, plus a

one-period addition of 60 000 cubic metres per year that represents a 300 000 cubic metre undercut carry forward.

In the base case, the initial harvest level of 870 000 cubic metres per year was maintained for five years, followed by a 13 percent decline to 753 000 cubic metres per year. Over the next 20 years the harvest level declined further by seven percent each five-year period to a mid-term low of 561 700 cubic metres per year. This harvest level was maintained for 45 years before increasing by six percent to 595 700 cubic metres per year at year 71. It was maintained for 15 years. At year 86 the harvest level increased by nine percent to the long-term level of 650 500 cubic metres per year.

In the timber supply analysis, various sensitivity analyses were conducted to assess the potential implications for timber supply arising from uncertainty in data assumptions and estimates. These analyses have also assisted me in considering the factors leading to my determination.

Regarding the accounting for the undercut carry forward in the initial harvest level, I am aware that in order to dispose of the undercut, non-replaceable forest licenses have been issued; however, little of this volume has been harvested to date. It is also uncertain how much will be harvested in the near future as some of these licenses are soon to expire, and whether or not the licensee will continue to undercut the AAC for TFL 19. I note that carried forward undercut volume is often not harvested. For this reason undercut volumes are usually not accounted for in the AAC determination. If the undercut volume does get harvested, the amount of timber volume depleted from the inventory will be accounted for in future determinations. Nevertheless, having reviewed in detail the assumptions and methodology incorporated in the base case, for this determination I am satisfied, subject to the qualifications accounted for in various sections of this document, that this harvest forecast provides a suitable baseline from which I can assess the timber supply for TFL 19.

Consideration of factors as required by Section 8 of the *Forest Act*

I have reviewed the information for all of the factors required under Section 8 of the *Forest Act*. Where I have concluded that the modelling of a factor in the base case appropriately represents current management or the best available information and uncertainties about the factor have little influence on the timber supply projected in the base case, no discussion is included in this rationale. These factors are listed below in Table 1 and grouped according to the section of the *Forest Act* to which they apply.

Table 1. List of factors for which modelling assumptions in the base case have been accepted.

Section of *Forest Act* and description	Factor(s) accepted as modelled
8(8)(a)(i) Composition of the forest and expected rate of growth	Non-productive and non-forested reductions Non-commercial brush Environmentally sensitive areas Non-merchantable forest types Deciduous-leading stands Roads, trails and landings (existing and future) Aggregation procedures Volume estimates for existing unmanaged stands Volume estimates for managed stands Operational adjustment factors Harvest species profile sequencing
8(8)(a)(ii) Expected time for the forest to be re-established following denudation	Regeneration delay Not satisfactorily restocked areas Impediments to prompt regeneration
8(8)(a)(iii) Silvicultural treatments to be applied	Silvicultural systems Regeneration Use of select seed Fertilization, spacing and thinning Non-commercial brush conversion
8(8)(a)(iv) Standard of timber utilization and allowance for decay, waste and breakage	Utilization standards and compliance Decay, waste and breakage
8(3)(a)(v) Constraints on the amount of timber	Adjacency Landscape-level biodiversity Recreation considerations Visual quality management Watershed management Vancouver Island Land Use Plan
8(8)(b) Short and long-term implications of alternative rates of timber harvesting from the area	Alternative rates of harvest
8(8)(d) Economic and social objectives of the government	Employment and community-related factors
(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area	

For other factors, where more uncertainty exists, or where public or First Nations' input suggests contention regarding the information used, the modelling techniques, or some other aspect under

consideration, I have stated below how I considered the information or the issues raised in making my determination.

Section 8 (8)

In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area

Land base contributing to timber harvesting

- general comments

The total area of TFL 19 is 171 722 hectares. For this analysis, 139 767 hectares, or 81 percent of total the area, is considered to be productive forest land.

As part of the process used to define the THLB (i.e., the land base estimated to be biologically and economically available for harvesting), a series of deductions were applied to the productive forest land base. These deductions account for the factors that effectively reduce the suitability or availability of the productive forest area for harvest due to ecological or economic reasons. In the base case for TFL 19, the deductions result in a long-term THLB of 75 312 hectares. This area is about 54 percent of the productive forest land base.

- operability, terrain stability and low productivity

On TFL 19 those portions of the productive forest area that are considered not physically accessible for harvesting, that are physically operable but have low timber growing potential, or that are not expected to be feasible to harvest economically, are categorized as inoperable and excluded when deriving the THLB. Areas classified as marginal, where timber harvesting under normal market conditions is not justified given harvesting costs and the expected value of the timber, were also excluded. For the purposes of this analysis, only areas classified as operable were included in the THLB.

The operability mapping used for this determination is the same as the mapping used for the 2001 determination. When identifying the operable land base, the licensee considered terrain stability as one of the factors that limits the possibility of harvesting an area. In the 2001 rationale, there was concern over the significant area in terrain stability class IV and V on slopes greater than 80 percent that was considered operable. As a result, there was a request that the licensee report annually on the amount of area harvested from terrain stability classes IV and V (least stable terrain) by leading species, height class and slope class. In response, harvest areas by terrain stability class were reported for the term of management plan (MP) No. 9 (2001-2006) and were summarized in the current information package. The reporting completed by the licensee shows they are adequately harvesting stands on terrain stability class IV and V on slopes greater than 80 percent.

The licensee was also requested to report the harvested areas within each operability category, by harvest method (conventional and non-conventional), leading species, and height class as well as confirm the upper Leiner and Berman drainages are operable.

The licensee reported harvesting performance as requested and district staff confirm the licensee is adequately harvesting in the non-conventional land base.

District staff indicate the analysis assumptions in this regard were appropriate. The Berman and the majority of the Upper Leiner drainages have now been confirmed as operable and were again included in the THLB in the base case.

Non-conventional areas comprise approximately 12 percent of the THLB on TFL 19. In the base case, the harvest contribution of the non-conventional areas was limited to 50 000 cubic metres per year, which reflects current performance on the TFL. A sensitivity analysis was completed to test the impact of excluding all non-conventional areas from the THLB. The sensitivity analysis results suggest that mid-term timber supply would be reduced by 20 percent on this account.

I have considered the information regarding operability on TFL 19 and the associated assumptions made in the base case. Given the reported harvest performance in the various operability categories, I am satisfied that the base case assumptions regarding operability appropriately reflect current harvesting practices on TFL 19. As a result, I make no adjustment on this account in this determination. However, I request that the licensee continue to monitor its actual harvesting performance in the non-conventional land base and I will discuss this further under '**Implementation**'.

Existing forest inventory

A Vegetation Resources Inventory (VRI) for TFL 19 was initiated in 2000 and completed in 2007. Phase I (photo interpretation) was completed in 2002, Phase II (ground sampling) in 2004, and Net Volume Adjustment Factor (NVAF) sampling in 2004. The final statistical adjustment of the VRI was completed in 2007.

MFR staff raised concerns during the timber supply review (TSR) process about the quality of the new VRI for TFL 19. These included:

Phase I (photo interpretation): old growth polygons were not re-delineated during phase I of the VRI as is the normal standard. Only the immature polygons were re-delineated to standard.

Phase II (ground sampling): non-standard site tree selection was used when 'intermediate' site trees were chosen rather than standard, 'dominant' and 'co-dominant' site trees.

Height and volume adjustment: a non-standard method of height and volume adjustment was used and, although there was unknown bias to the data, it was concluded the results were reasonable and acceptable for use in the TSR process.

In 2009, due to concerns with the Phase II sampling, the MFR Forest Analysis and Inventory Branch (FAIB) staff completed a field test to determine the difference between heights and ages of stands using the non-standard site tree selection procedures and standard procedures. They found that while the non-standard statistical adjustments applied resulted in decreased heights and ages, particularly in natural mature cedar and cypress stands, the NVAF adjustments largely offset the differences. As a result, MFR staff found that overall the volume estimates derived for mature stands are reasonable using these adjusted attributes and represent the best available information for use in the analysis.

The sampling and statistical adjustment process has also caused some uncertainty in the volume estimates of immature, natural stands. Any impacts to timber supply of incorrect volume estimates for these stands would occur in the mid-term when, in the case of TFL 19, the timber supply is quite sensitive to changes in yield estimates.

Due to the uncertainty associated with the inventory information, in particular with immature natural stands and mature cedar cypress stands, I believe there is a need to review the available inventory data for TFL 19 and explore methods of improving its reliability for the next determination. There is also value in revisiting the Phase II (ground sampling) plots for the

mature cedar cypress stratum. I recommend that the licensee work with FAIB staff to develop a strategy for improving the quality of the inventory information prior to the next determination and I discuss this further under '**Implementation**'. In summary, having reviewed the inventory information with MFR staff, I find the forest inventory is adequate for the term of this determination.

- *coastal log grades*

On the coast of BC, logs from trees that were dead prior to harvest have been harvested, scaled and charged to the AAC. Dead western redcedar and old growth Douglas-fir stems can remain sound and potentially suitable for milling for many years. However, dead potential volume is not currently included in the inventory volumes, and therefore has not been accounted for in previous AAC determinations.

Estimates using inventory audit data show in existing unmanaged stands, the dead potential volume could be as high as 11 percent of the volume estimated for living trees. On the other hand, district staff indicate that dead timber is rarely salvaged as it is unmarketable or downgraded due to checking and defects. Since there is also considerable breakage with this timber, staff estimate that up to two percent is likely salvaged in the short term.

I note dead potential volume is primarily a consideration in old-growth stands, and is not a factor in second-growth stands. Thus any underestimation of timber supply on account of this factor acts only in the short term. For this determination I consider the short-term timber supply has been underestimated by up to two percent and I discuss this further in '**Reasons for Decision**'.

Expected rate of growth

- *site productivity estimates*

The productivity of a site largely determines how quickly trees grow. This in turn affects the time seedlings will take to reach green-up conditions, the volume of timber that can be produced, and the ages at which a stand will satisfy mature forest cover requirements and reach a merchantable size. Site productivity is often expressed in terms of site index (SI), which is based on a stand's height as a function of its age. For this analysis, the licensee obtained site index estimates using different approaches for natural and managed stands.

Site indices for existing natural stands were derived from the adjusted inventory ages and heights. Site indices for existing and future managed stands were based on the provincial site index biogeoclimatic ecosystem classification (SIBEC) system.

MFR staff note that according to the 2007 VRI statistical adjustment report provided by the licensee, the adjusted inventory site indices were on average 19 percent lower than they would have been using the Phase I inventory (unadjusted) heights and ages. As I discussed above under '*Existing forest inventory*', the heights and ages derived in Phase II of the VRI for TFL 19 are subject to uncertainty. As these two parameters form the basis of site index estimation for existing natural stands, site indices for these stands developed using the VRI Phase II information for TFL 19 are also subject to uncertainty.

MFR staff believe the TFL 19 site indices for existing natural mature stands (aged over 120 years) are underestimated; however, the volumes of these stands were assumed to remain static at the currently estimated volume in the inventory until they were harvested in the model. Therefore, for the analysis site index had no additional influence on the volume estimates for mature stands, as NVAF adjusted these volumes.

Immature natural stands were defined in the analysis as stands aged from 46 to 120 years and they cover 10 355 hectares, or 13 percent of the THLB. For these stands the adjusted ages and

heights from Phase II of the VRI were used to estimate site index. MFR staff note that the resulting site indices were on average 16 percent lower than they would have been using the Phase I inventory (unadjusted) heights and ages. The licensee also pointed out that they were much lower than the site indices of similar stands in adjacent management units. This uncertainty is a concern because it affects the volume estimate of stands that will be available for harvest in the mid-term when timber supply is most limited.

For young stands age 0 to 45 years and all stands regenerating in the future, the licensee used SIBEC site index estimates in conjunction with the terrestrial ecosystem mapping (TEM) completed in 2000. This method is generally accepted as reliable; however, to complete the mapping process, additional field data must be collected and an accuracy and quality assessment must be completed in accordance with MFR policy. This has not yet been completed, but the SIBEC data based on the TEM for use in the base case was accepted because it was considered to provide better information about site productivity than the adjusted inventory site indices.

A sensitivity analysis which examined the effect of reducing the SIBEC site index estimates by three metres was provided. The mid-term timber supply in the resulting harvest forecast was reduced by about 11 percent and the long-term level was reduced by about 21 percent.

A second sensitivity analysis was provided in which Timberline's (now known as TECO) preliminary site index (PSI) estimates using data gathered in site index adjustment (SIA) projects for other coastal management units was used. The resulting harvest forecast was similar to the base case in the short- and mid-term, but timber supply increased to the long-term harvest level sooner than in the base case and it was eight percent higher compared to the base case.

Having considered all the information regarding site index for TFL 19, I find the site index estimates used in the base case for existing natural mature stands, while likely representing an underestimation of site productivity, do not affect the timber supply projections in the short term and I make no further adjustments on this account. With respect to existing and future managed stands, I accept the derived SIBEC site indices are the best available information for this determination. However, to reduce the uncertainty in these estimates I request that the terrestrial ecosystem mapping (TEM) be reviewed and the accuracy assessment or an equivalent quality assurance procedure be completed prior to the next determination and I will discuss this further under '**Implementation**'.

With respect to the adjusted inventory site indices for existing, immature natural stands used in the base case, I believe they underestimate the site productivity of these stands, and correspondingly timber supply. As a result, the contribution to mid-term timber supply of stands on 13 percent of the THLB has likely been underestimated by up to 16 percent. I discuss this further under '**Reasons for Decision**'.

- *minimum merchantability criteria*

Minimum merchantability criteria are used to derive estimates of the earliest age at which a forest stand has reached a harvestable condition. In the base case, minimum merchantability criteria were based on stands attaining a minimum volume of 350 cubic metres per hectare. In addition, stands had to reach a minimum age ranging from 50 to 100 years for combinations of three site productivity classes and two species groups. Both the minimum volume and minimum age requirements had to be met before a stand was assumed to be harvestable in the model.

District staff noted that some stands may be uneconomical to harvest given the minimum volume for the merchantability criteria assumed in the base case, particularly in the areas where harvesting is only possible using non-conventional harvest methods. Such areas comprise 12 percent of the THLB on TFL 19.

The licensee prepared a sensitivity analysis to assess the timber supply impacts of increasing the minimum volume criteria to 450 cubic metres per hectare and increasing each of the age minima by 10 years for all stands on the THLB. These changes resulted in a significant reduction in timber supply after the second decade of the harvest forecast relative to the base case.

I have reviewed the minimum merchantability criteria assumed in the base case, and I concur with district staff that, at the volume and ages assumed in the base case, some stands will likely not yet have reached a harvestable condition on the non-conventional land base. The associated risk to timber supply forecasts are likely reduced by the restriction applied in the base case to the harvest contribution from the non-conventional land base of 50 000 cubic metres per year. Nevertheless, I expect there is unquantified risk that the mid-term timber supply has been overestimated on the non-conventional land base, and I will discuss this further under '**Reasons for Decision**'.

(ii) the expected time that it will take the forest to become re-established on the area following denudation:

As noted in Table 1, I accept these factors as modelled in the base case.

(iii) silvicultural treatments to be applied to the area:

Section 8(8)(a)(iii) silvicultural treatments to be applied to the area:

Silvicultural Systems

The majority of TFL 19 is harvested using clearcut and clearcut-with-reserves, and this system was modelled in the base case.

Since the analysis was completed, the licensee has recently implemented its *Western Forest Strategy: a program for conserving biodiversity on company tenures (Forest Strategy)*. The approach involves varying the amount of stand retention by resource management zones as provided in the Vancouver Island Land Use Plan (VILUP) and by ecosection and variant. The retention system results in overall average stand-level retention of 5.6 percent for TFL 19. The licensee estimates this is about three percent more than the amount reserved in the base case for stand-level retention for at least one rotation.

A sensitivity analysis was completed to test the impact of implementing the retention systems according to the licensee's *Forest Strategy*. The results indicate that short-term timber supply is reduced by about four percent (600 000 cubic metres) over the first 20 years and by three percent in the mid-term. Over the entire forecast period, the timber supply was reduced on average by four percent.

I have considered the information regarding the silvicultural systems and the forest strategy now used on TFL 19. I note that practices consistent with the VILUP were assumed in the base case. Now that the new forest strategy has been implemented, as shown by the sensitivity analysis, the short-term timber supply has been overestimated by up to four percent on this account and I will discuss this and any possible overlaps with other assumptions pertaining to forest retention under '**Reasons for Decision**'.

(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area:

As noted in Table 1, I accept these factors as modelled in the base case.

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production:

Integrated resource management objectives

The Ministry of Forests and Range is required under the *Ministry of Forests and Range Act* to manage, protect and conserve the forest and range resources of the Crown and to plan the use of these resources so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. Accordingly, the extent to which integrated resource management (IRM) objectives for various forest resources and values affect timber supply must be considered in AAC determination.

I have reviewed the information presented to me regarding the base case assumptions for several factors related to integrated resource management and I accept these as modelled in the base case. They are listed in Table 1.

- *stand-level biodiversity*

Stand-level biodiversity management includes retaining wildlife tree patches (WTP) within or adjacent to cutblocks to provide structural diversity and wildlife habitat. According to the licensee, total stand-level retention on TFL 19 currently averages 14 percent.

Operationally, where feasible and appropriate, WTPs are often located in areas already retained to meet other objectives, or excluded from harvesting for other factors such as riparian reserves and inoperable areas. Consistent with the guidance in the *Forest Practices Code Timber Supply Analysis,* the licensee assumed that 75 percent of WTP areas are located in this manner. The remaining four-percent retention requirement was applied as a volume reduction to the yield tables used in the base case. The licensee notes that it expects this retention level will also adequately address gulley management areas around non-fish bearing streams and account for basal area retention in riparian management zones and other areas.

As noted below under '*riparian reserves and management zones*', retention to accommodate additional resource features is expected operationally. I note also that according to the licensee's forest stewardship plan (FSP), it expects this amount will increase to an average of seven percent.

Increasing the level of assumed retention from four percent to seven percent represents a three percent overestimate of timber supply over the forecast period. I acknowledge that increased stand-level retention resulting from implementation of the licensee's *Forest Strategy* likely overlaps with retention for WTPs, and I will discuss this further under '**Reasons for Decision**'.

- *riparian reserves and management zones*

Riparian habitat occurs along streams and around lakes and wetlands. Reconnaissance-level fish and fish habitat inventories to resource inventory committee (RIC) standards were completed on the TFL between 1999 and 2002. Detailed mapping of riparian features has been on-going since 1988 as part of development planning.

For the base case, the licensee used the available stream, lake and wetland mapping and applied reserves to streams classified as fish-bearing, lakes and wetlands in accordance with specifications in the *Forest and Range Practices Act*. A total of 3773 hectares (before other, possibly overlapping deductions) were excluded from the THLB on this account.

As noted above, the licensee assumed the volume reduction applied to the yield tables to account for wildlife tree patches would also account for retention within riparian management zones, including along unmapped streams. The licensee indicated these streams are generally narrow

and are not expected to be fish bearing. The licensee documented that based on operational experience, within-block retention in riparian management zones has been minimal and it does not expect this to change in future.

Ministry of Environment staff indicated that breeding ponds for red-legged frogs occur around W4 wetlands and that, while the licensee commits to managing these in its forest stewardship plan, the riparian management zones around these wetlands were not explicitly accounted for in the base case. The licensee indicated that WTPs will be located to protect the frog habitat.

I have reviewed the reduction of 3773 hectares for riparian reserves and I find it to be reasonable. However, I am concerned about the volume reduction for WTPs assumed to account for all the other areas where retention is required, including: unmapped streams that may be fish bearing, riparian management zones, gully management areas around non-fish-bearing streams, red-tailed frog habitat, and culturally modified trees as discussed below. Nonetheless, I note the overlap with the three percent retention, as discussed above under '*stand level biodiversity*', and the increasing retention under the licensee's *Forest Strategy*. I will discuss the interaction of the various assumptions about retention further under '**Reasons for Decision**'. Under '**Implementation**' I have included an instruction that the licensee continue to monitor actual retention levels applied so they can be improved for the next timber supply review.

- wildlife management

While I accept the assumptions applied in the base case for wildlife management for this determination, I wish to highlight ongoing efforts to identify areas suitable for marbled murrelet nesting habitat as described below.

- marbled murrelet

The Ministry of Environment has issued a legal notice for species at risk under Section 7 of the *Forest Planning and Practices Regulation* that requires licensees to prepare results and strategies for marbled murrelet nesting habitat for 1431 hectares of THLB in the Campbell River Forest District. In addition, the notice requires that licensees prepare results and strategies that protect an amount of suitable marbled murrelet nesting habitat in the non-contributing land base equal to the amount designated at the time the Section 7 notice was issued.

WFP has worked with MOE staff and identified a total of 704 hectares of established and draft wildlife habitat areas for marbled murrelet and excluded this area from the THLB for the base case. According to the licensee it tracks the amount of suitable marbled murrelet habitat that is harvested on the non-contributing land base and ensures there is adequate habitat on the THLB to replace the harvested habitat. The licensee indicates that, to date, only three hectares of marbled murrelet habitat have been harvested on the non-contributing land base.

MOE staff suggest that the licensee use the BC Coastal Marbled Murrelet Habitat Suitability Model or low-level aerial survey to assist them in identifying suitable habitat on TFL 19 for the next timber supply review and I concur with this suggestion. For this determination I find the assumptions applied in the base case for this factor are reasonable and I make no adjustment on this account.

- First Nations' archaeological sites, culturally modified trees, and cultural heritage resource values

The *Forest Act* defines a cultural heritage resource as 'an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people'.

In TFL 19, an archaeological overview assessment (AOA) was completed in 1988 and later updated in 2007. AOAs are used in operational planning to assess the potential for finding evidence of historic use, and to identify sites that may require more detailed field assessment. The TFL encompasses a relatively high number of known archaeological sites, and based on an overlay of the *Northern Nuu-chah-nulth Archaeological Overview Assessment* with the THLB, about 12 percent of the THLB has moderate to high potential for culturally modified trees (CMTs) and archaeological features.

Recently, several CMTs were identified on cutblocks within the harvest boundary. According to the licensee, the majority of these were harvested under site alteration permits issued under the *Heritage Conservation Act*. Permits are required when work is to be conducted that would alter ground features such as CMTs that are located within the boundary of a protected archaeological site. It is unlikely that site alteration permits would be issued for all harvest areas given the importance of CMTs to First Nations.

Therefore, in consideration of the *Heritage Conservation Act* and the moderate to high potential for CMTs on the TFL, the licensee has committed to work closely with First Nations to determine archaeological potential, and to determine where to conduct preliminary field reconnaissance. This will include referring the location of cutblocks and roads to First Nations where there is archaeological potential or known features, or where a First Nation has requested a referral. The licensee will also operationally manage archaeological resources including CMTs using the following guidelines:

1. Retention of areas for wildlife tree patches (WTPs) and riparian reserves will be located where CMTs are found;
2. Provisions in the licensee's forest stewardship plan (FSP) for managing, conserving, and protecting cultural heritage resources that are not already covered by other arrangements will be employed to manage archaeological resources. Also under the FSP, opportunities will be maintained for First Nations to access cedar bark and cultural cedar timber.

The Mowachaht/Muchalaht First Nation (MMFN) expressed concern regarding the lack of accounting in the analysis for cultural heritage resources and in particular CMTs. They requested that no further cutting of CMTs be permitted within their territory as they assert CMTs are their standing museum and are representative of their cultural identity.

District staff note that based on recent archaeological assessments, there are likely thousands of bark-stripped CMTs remaining on TFL 19. Therefore, district staff will work with the Archaeology Branch of the Ministry of Tourism, Culture and the Arts, because they regulate archaeological features in British Columbia and provide guidance on when and where CMTs should be preserved, endeavouring to preserve representative samples as appropriate. Both district staff and the licensee are receptive to preserving representative stands where First Nations desire preservation, and I understand that discussions are held between First Nations and the licensee, both at the planning and field reconnaissance stages.

Where archaeological sites or cultural heritage resources have been identified, there has been significant overlap with areas reserved from harvesting for other reasons. As well, where the First Nation has clearly identified that there is to be no impact on any archaeological features, alternative silvicultural systems including uneven-aged management and high retention systems have been utilized by the licensee.

District staff have asked First Nations where and how specific asserted aboriginal rights are practiced so that, where appropriate, protection of the associated values can be addressed in an AAC determination. To date, First Nations have not provided such information to government or

to the licensee. However, I am aware of the importance First Nations place on old-growth red and yellow-cedar and maintaining access to them now and in the future. Retention of these species and the recruitment of younger cedar and cypress stands to provide for future First Nations' cedar requirements is a priority.

From my discussions with district staff I understand that uncertainties remain in the number, size, type and location of archaeological sites, and therefore in the related individual and overall impacts on timber supply. As I indicated under '*riparian resources*', my consideration of the assumptions applied in the base case for WTPs, along with the implementation of higher retention levels under the licensee's *Forest Strategy*, may provide some accounting for management of archaeological resources; however, given the uncertainty, there is a risk to the timber supply that CMTs have not been sufficiently accounted for and I will discuss the interactions and uncertainties further under '**Reasons for Decision**'. As more information on archaeological resources becomes available, this can more accurately be incorporated into future analyses and AAC determinations.

I recommend that a collaborative strategy between the licensee, MFR staff, and First Nations representatives, be initiated to provide guidance when considering First Nations' cedar interests and in particular, to better assess the available supply of cedar.

(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber;

Other information

- *First Nations' considerations*

Two First Nations, the Mowachaht / Muchalaht (MMFN) and Ehattesaht have asserted traditional territory overlapping TFL 19. Both First Nations have forest agreements with MFR, which provide for revenue sharing and forest tenure opportunities. The agreements include provisions for consultation on administrative decisions, including AAC determinations, and these were followed by district staff.

Consultation with these two First Nations on the timber supply review for TFL 19 was initiated by the Campbell River Forest District in February 2008 and concluded in September 2009. The consultation process also included information sharing by the licensee, who provided the draft information package, draft Management Plan #10, and the timber supply analysis report to these First Nations.

The Campbell River Forest District sent a letter to the MMFN and Ehattesaht First Nation to initiate consultation in February 2008. At that time, the licensee also provided the draft information package to the First Nations along with a follow-up letter a few weeks later requesting their review and comment. District staff sent an additional letter in November 2008 reminding First Nations that consultation on the information package was still ongoing. In February 2009, the licensee provided the draft Management Plan #10 and timber supply analysis report to First Nations and asked for their review and comment. The district followed up with a letter encouraging participation and offering to meet.

The Ehattesaht First Nation did not provide input to the timber supply review process for TFL 19. The Ehattesaht asserted traditional territory does not overlap with that of the MMFN in TFL 19. District staff believe that the Ehattesaht's strongest interests are associated with the areas adjacent to ocean shoreline, largely located outside TFL 19, and to a lesser extent freshwater bodies. Although no comments were provided, district staff believe the Ehattesaht is interested in

protecting its traditional aboriginal rights such as hunting, fishing, berry picking, access to cedar and ethnobotanicals, and spiritual uses of the land. The cedar resource is especially important to them for preservation of their culture through traditional carving and other art forms. District staff note that the Ehattesaht typically work closely with the licensee at the operational planning level.

In April 2009 a meeting took place between district staff and the MMFN. Discussion focused on various consultation processes, and the MMFN requested funding for traditional use studies and for the development of an improved consultation protocol. The MFR's preliminary assessment of MMFN's aboriginal interests based on the information available to MFR, the potential impact the proposed AAC decision may have on these interests, and the suggested level of consultation was also shared at this meeting. After this meeting, MMFN's legal counsel requested further information, which led to an exchange of information. In May 2009, a second meeting was held between district staff and the MMFN and issues such as capacity funding, response time for referrals, process related issues, CMT protocol, cultural heritage interests, access to cedar, and the MFR's preliminary assessment of MMFN claims were discussed.

Following the meeting, the MMFN's legal counsel sent a letter outlining MMFN's concerns.

District staff responded to these concerns in a meeting with the MMFN in September 2009. At this meeting, district staff presented an update on the TFL 19 timber supply review consultation and noted any outstanding issues. Discussions were held regarding the concerns, the preliminary assessment, management of CMTs, and district staff requested MMFN to identify any aboriginal interests that may be impacted by an AAC decision. To date, the information provided by the MMFN has been general, and it asserts its aboriginal interests are throughout the traditional territory.

I acknowledge the MMFN has expressed concerns about the operational protection of its interests. I note that in my determination I evaluate whether the timber supply analysis incorporates assumptions that are consistent with practices that would protect aboriginal interests, and I reflect my conclusions in the AAC decision. As stated previously in the analysis, reductions were applied for riparian areas and wildlife tree reserves, and this accounting reflects aboriginal cultural and other interests. I also have taken into account in this determination the timber supply implications of retention areas beyond what was assumed in the base case. In addition, the licensee has included accounting for wildlife habitat and landscape-level biodiversity in its base case, factors that generally reflect requirements for maintenance old growth areas. I believe these areas also overlap with First Nations aboriginal interests.

Further, as referenced under '*First Nations' archaeological sites, culturally modified trees, and cultural heritage resource values*', given the uncertainties about the number of cultural heritage resources and cultural sites on the TFL, I recognize that additional measures beyond those reflected in the base case may be required. It is not certain, however, to what extent my assessment of requirements for retention for other reasons may reflect protection for these features, and I discuss this further under '**Reasons for Decision**'.

I am also aware of MMFN's concerns regarding herbicide spraying, silviculture, the cumulative impacts of forest harvesting, and other factors, and I encourage the licensee and the district to continue to work at the operational level with MMFN to resolve these concerns.

I encourage district staff to continue to seek clarification regarding MMFN's aboriginal interests and I encourage work between the licensee and the First Nation to ensure appropriate operational measures are used to protect aboriginal interests. In addition, I am aware both red and yellow-cedar are important species to First Nations. As mentioned in the previous section, I request district staff, licensees and First Nations work together in developing a cedar strategy for

TFL 19 to address concerns about the management and future availability of red and yellow-cedar.

As noted above, the MMFN has asserted aboriginal title over the land contained in TFL 19. No conclusions have been reached on the extent to which aboriginal title may exist to the land within TFL 19. The MMFN are not currently engaged in a treaty process with the province.

From my review of the consultation summary, consideration of the information presented to me, and discussions with staff, I conclude that reasonable efforts were made by the Campbell River Forest District and the licensee to inform First Nations about the timber supply review and engage them in consultation regarding their aboriginal interests and how these interests may be affected by this AAC determination. The preliminary assessment included a review of information regarding First Nations' aboriginal interests available to MFR, and an assessment of potential impacts my AAC decision may have on those interests or cultural use. The findings from the MFR preliminary assessment were referenced in letters during the consultation process. In consideration of the information, I believe that the level of consultation for the timber supply review of TFL 19 has been adequate. The scope of consultation reflected and was commensurate with MFR's assessment of the aboriginal interests asserted by the relevant First Nations within TFL 19. Furthermore, opportunities were provided to all First Nations to share their concerns related to specific aboriginal interests that may be impacted by this decision.

If new information regarding First Nations' aboriginal interests becomes available that significantly varies from the information that was available for this determination and that may affect timber supply, I am prepared to revisit this determination sooner than the 10 years required by legislation.

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area;

Short-term and long-term implications

- alternative rates of harvest

In addition to the base case, the licensee provided two alternative harvest flows. These represent trade-offs between short- and mid-term harvest rates.

I have reviewed the alternative harvest rates modelled by the licensee and have taken that information into consideration in my determination.

(c) repealed [2003-31-2 (B.C. Reg. 401/2003)]

This section of the *Forest Act* has been repealed [2003-31-2 (B.C. Reg. 401/2003)].

(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia; and

Economic and social objectives

- Minister's letter

The Minister of Forests and Range has expressed the economic and social objectives of the Crown for the province in a letter to the chief forester, dated July 4, 2006 (attached as Appendix 3). The letter stresses the importance of a stable timber supply to maintain a competitive and sustainable forest industry while being mindful of other forest values. In respect of this, in the base case projection and in all of the alternative harvest flow projections with which

I have been provided for reference in this determination, a primary objective in the harvest flow has been to attain a stable, long-term harvest level where the growing stock also stabilizes. I have also considered with care the adequacy of the provisions made both in current practice, and assumed in the analyses, for maintaining a range of forest values.

I am therefore satisfied that this determination accords with the objectives of government as expressed by the Minister.

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

As I indicated in Table 1, I accept the assumptions applied in the base case for this factor.

Reasons for decision

In reaching my AAC determination for TFL 19, I have considered all of the factors required under Section 8 of the *Forest Act* and I have reasoned as follows.

The base case harvest forecast projected an initial harvest level of 870 000 cubic metres per year for five years followed by a step down to 753 000 cubic metres per year. Over the first 25 years in the base case forecast, the harvest level declines by seven percent each five-year period to a low of 561 700 cubic metres per year. This harvest level, once attained, is maintained for 45 years, before increasing by six percent, to 595 700 cubic metres per year at year 71. It is maintained for 15 years at that level and then at year 86, the harvest level increases by nine percent to the long-term level of 650 500 cubic metres per year. I am mindful the base case harvest flow reflects a regulated transition from the current AAC to a mid-term level that is 34 percent lower than the current AAC.

I am satisfied that the assumptions applied in the base case forecast for the majority of the factors applicable to TFL 19 were appropriate. In this section, I have summarized my consideration of those factors for which I deem it necessary to further take into account impacts on the timber supply as projected in the base case forecast.

In determining an AAC for TFL 19, I have identified a number of factors which, considered separately, indicate the timber supply may be either greater than or less than what was projected in the base case. Some of these factors can be readily quantified and their impact on the harvest level assessed with reliability. Others may influence timber supply by adding an element of risk or uncertainty to the decision, but cannot be reliably quantified at this time.

I have identified the following factors in my considerations as indicating that the timber supply projected in the base case has been **overestimated**:

- *Minimum merchantability standards:* Stands in the non-conventional areas covering 12 percent of the THLB will likely not reach a harvestable condition at the volumes and ages assumed in the base case. While the licensee restricted harvesting on the non-conventional land base in the model to 50 000 cubic metres per year, which likely reduces the risk to the timber supply, I consider inclusion of these areas represents an unquantified overestimation in the base case timber supply;
- *Forest retention (wildlife tree patches and riparian management zones)*: Forest retention levels are higher than reflected in the base case for wildlife tree patches, riparian management zones, as well as, implementation of the licensee's *Forest Strategy*. This results in an overestimation in the short-term timber supply of up to four percent;

- *First Nations' archaeological sites, culturally modified trees and cultural heritage resource values:* The number, size, type and location of archaeological sites is currently uncertain; however, due to the high number of known sites I concluded that it is likely these sites are under-represented in the base case. This represents an unquantifiable overestimation of timber supply in the base case timber supply projection.

I have identified the following two factors that indicate the timber supply projected in the base case may have been **underestimated**:

- *Coastal log grades*: The current provincial inventory does not account for the volume potentially available from dead but merchantable trees. These trees are now charged to the AAC and must therefore be accounted for in AAC determinations. I concluded short-term timber supply has potentially been underestimated by two percent;
- *Site productivity*: Site productivity for immature natural stands was derived using heights and ages from phase II of the VRI. Based on site productivity information from phase I of the VRI and from adjacent management units, I concluded that site productivity was underestimated for existing natural immature stands, covering 13 percent of the THLB. As a result, mid-term timber supply was underestimated by an unknown amount.

Having considered the information above, I reason as follows. The base case for TFL 19 projects a declining timber supply for the first 25 years of the forecast, after which a relatively stable mid-term level is reached that is 34 percent lower than the current AAC. The analysis for this timber supply review was completed several years ago; therefore, we are near the second five-year period when the timber supply is projected to decline by 13 percent to 753 000 cubic metres per year. As I am setting the AAC for a maximum of 10 years, I have also considered the subsequent seven percent decline projected to 699 800 cubic metres per year in the third five-year period of the forecast. The average of these two harvest levels is about 730 000 cubic metres per year, and I have used this level as the new base line for assessing further uncertainties and risk. Only two of the factors discussed above suggest the timber supply may be underestimated by the base case projection. The potential increase in volume attributable to dead standing trees may support the short-term timber supply; however, this is subject to some uncertainty. Underestimations in site productivity of existing natural immature stands suggest that mid-term timber supply could be greater than modelled in the base case. However, a number of factors – merchantability standards, retention for wildlife trees and cultural heritage resources – suggest the base case may overestimate timber supply.

While known upward pressures do not entirely offset the downward pressures, I believe the revised baseline reduces the risk from these uncertainties. In consideration of this, and the projections that indicate harvest levels must decline on TFL 19 in a series of step downs to the lower mid-term level, I reason that it is appropriate at this time to reduce the AAC of TFL 19. I determine an appropriate harvest level for TFL 19 at this time is 730 000 cubic metres per year, a level that is approximately 15 percent less than the current AAC. I believe this level represents a reasonable accounting of the uncertainties associated with the assumptions applied in the short- to mid-term timber supply forecasts and the immediate need to begin the step down transition to reach the long-term harvest level over the next several decades.

Determination

I have considered and reviewed all of the factors as documented above, including the risks and uncertainties of the information provided. It is my determination that a timber harvest level that accommodates objectives for all forest resources during the next decade, and that reflects current management practices as well as the socio-economic objectives of the Crown, can be best achieved in the TFL by establishing an AAC of 730 000 cubic metres.

This determination is effective August 10, 2010 and will remain in effect until a new AAC is determined, which must take place within a decade after the effective date of this determination.

If additional significant new information is made available to me, or major changes occur in the management assumptions upon which I have predicted this decision, then I am prepared to revisit this determination sooner than the 10 years required by legislation.

Implementation

In the period following this decision and leading to the subsequent determination, I encourage the licensee staff to undertake the tasks noted below. I recognize that the licensee's ability to undertake these projects is dependent on available staff resource time and funding. However, these projects are important to help reduce the level of risk and uncertainty associated with key factors affecting timber supply on TFL 19. I instruct the licensee to:

- continue to monitor harvesting performance in the non-conventional areas;
- revisit the Phase II (ground sampling) plots and, in conjunction with Forest Analysis and Inventory Branch staff, develop a strategy for improving the quality of the inventory;
- complete the terrestrial ecosystem mapping (TEM) accuracy assessment or an equivalent quality assessment;
- review and update the *Forest Strategy*;
- work with First Nations and MFR staff to develop a cedar strategy to provide guidance when considering First Nations cedar interests and better assess the available supply of cedar;
- continue to monitor actual retention levels applied so they can be improved for the next timber supply review.

Melanie Boyce, RPF
Deputy Chief Forester

August 10, 2010

Appendix 1: Section 8 of the *Forest Act*

Section 8 of the *Forest Act*, Revised Statutes of British Columbia 1996, c. 157, Consolidated to December 30, 2009, reads as follows:

Allowable annual cut

8 (1) The chief forester must determine an allowable annual cut at least once every 10 years after the date of the last determination, for

(a) the Crown land in each timber supply area, excluding tree farm licence areas, community forest agreement areas and woodlot licence areas, and

(b) each tree farm licence area.

(2) If the minister

(a) makes an order under section 7 (b) respecting a timber supply area, or

(b) amends or enters into a tree farm licence to accomplish a result set out under section 39 (2) or (3),

the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area

(c) within 10 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and

(d) after the determination under paragraph (c), at least once every 10 years after the date of the last determination.

(3) If

(a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and

(b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,

the chief forester must determine an allowable annual cut at least once every 10 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).

(3.1) If, in respect of the allowable annual cut for a timber supply area or tree farm licence area, the chief forester considers that the allowable annual cut that was

determined under subsection (1) is not likely to be changed significantly with a new determination, then, despite subsections (1) to (3), the chief forester

(a) by written order may postpone the next determination under subsection (1) to a date that is up to 15 years after the date of the relevant last determination, and

(b) must give written reasons for the postponement.

(3.2) If the chief forester, having made an order under subsection (3.1), considers that because of changed circumstances the allowable annual cut that was determined under subsection (1) for a timber supply area or tree farm licence area is likely to be changed significantly with a new determination, he or she

(a) by written order may rescind the order made under subsection (3.1) and set an earlier date for the next determination under subsection (1), and

(b) must give written reasons for setting the earlier date.

(4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).

(5) In determining an allowable annual cut under subsection (1) the chief forester may specify portions of the allowable annual cut attributable to

(a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area,

(a.1) different areas of Crown land within a timber supply area or tree farm licence area, and

(b) different types of timber and terrain in different parts of private land within a tree farm licence area.

(c) [Repealed 1999-10-1.]

(6) The regional manager or district manager must determine an allowable annual cut for each woodlot licence area, according to the licence.

(7) The regional manager or the regional manager's designate must determine an allowable annual cut for each community forest agreement area, in accordance with

(a) the community forest agreement, and

(b) any directions of the chief forester.

(8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area,

(ii) the expected time that it will take the forest to become re-established on the area following denudation,

(iii) silviculture treatments to be applied to the area,

(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and

(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,

(c) [Repealed 2003-31-2.]

(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests and Range Act* (consolidated 2006) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to do the following:

(a) encourage maximum productivity of the forest and range resources in British Columbia;

(b) manage, protect and conserve the forest and range resources of the government, having regard to the immediate and long term economic and social benefits they may confer on British Columbia;

(c) plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are co-ordinated and integrated, in consultation and co-operation with other ministries and agencies of the government and with the private sector;

(d) encourage a vigorous, efficient and world competitive

(i) timber processing industry, and

(ii) ranching sector

in British Columbia;

(e) assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

Document attached:

Appendix 3: Minister's letter of July 4, 2006

BRITISH COLUMBIA

JUL 0 4 2006

Jim Snetsinger
Chief Forester
Ministry of Forests and Range
3rd Floor, 1520 Blanshard Street
Victoria, British Columbia
V8W 3C8

Dear Jim:

Re: Economic and Social Objectives of the Crown

The *Forest Act* gives you the responsibility for determining Allowable Annual Cuts-decisions with significant implications for the province's economy, communities and environment. This letter outlines the economic and social objectives of the Crown you should consider in determining Allowable Annual Cuts, as required by Section 8 of the *Forest Act*. This letter replaces the July 28, 1994 letter expressing the economic and social objectives of the Crown, and the February 26, 1996 letter expressing the Crown's economic and social objectives for visual resources. The government's objective for visual quality is now stated in the Forest Practices and Planning Regulation of the *Forest and Range Practices Act*.

Two of this government's goals are to create more jobs per capita than anywhere in Canada and to lead the world in sustainable environmental management. The Ministry of Forests and Range supports these objectives through its own goals of sustainable forest and range resources and benefits. In making Allowable Annual Cut determinations, I ask that you consider the importance of a stable timber supply in maintaining a competitive and sustainable forest industry, while being mindful of other forest values.

The interior of British Columbia is in the midst of an unprecedented mountain pine beetle outbreak. Government's objectives for management of the infestation are contained in British Columbia's Mountain Pine Beetle Action Plan. Of particular relevance to Allowable Annual Cut determinations are the objectives of encouraging long-term economic sustainability for communities affected by the epidemic; recovering the greatest value from dead timber before it burns or decays, while respecting other forest values; and conserving the long-term forest values identified in land use plans.

Minister of Forests and Range and Minister Responsible for Housing

Office of the Minister

Mailing Address:
PO Box 9049 Stn Prov Govt
Victoria BC V8W 9E2
Telephone: 250 387-6240
Facsimile: 250 387-1040

Location:
Parliament Buildings
Victoria BC V8V 1X4
e-mail: FOR.Minister@gov.bc.ca

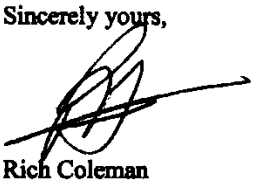
Jim Snetsinger

To assist the province and affected communities in planning their responses to the beetle infestation, it would be best to have realistic assessments of timber volumes that can be utilized economically. Therefore, in determining the best rate of harvest to capture the economic value from beetle-killed timber, I ask that you examine factors that affect the demand for such timber and products manufactured from it, the time period over which it can be utilized, and consider ways to maintain or enhance the mid-term timber supply.

The coast of British Columbia is experiencing a period of significant change and transition. In making Allowable Annual Cut determinations I urge you to consider the nature of timber supply that can contribute to a sustainable coast forest industry, while reflecting decisions made in land and resource management plans.

You should also consider important local social and economic objectives expressed by the public during the Timber Supply Review process, where these are consistent with the government's broader objectives as well as any relevant information received from First Nations.

Sincerely yours,



Rich Coleman
Minister

Appendix B: Timber Supply Analysis

BRITISH COLUMBIA
The Best Place on Earth

File: 12850-20/TFL 19
CLIFF 120886

June 26, 2009

Mr. Mike Davis, R.P.F.
Planning Forester
Western Forest Products Inc.
118 – 1334 Island Highway
Campbell River, British Columbia
V9W 8C9

Dear Mr. Davis:

Thank you for the Tree Farm Licence (TFL) 19 Timber Supply Analysis for Management Plan 10 that you submitted on January 30, 2009.

I have reviewed the report along with Ministry of Forests and Range (MFR) regional, and district staff and Ministry of Environment specialists. As the MFR timber supply forester responsible for reviewing this report, I accept the report subject to the attached note.

Please note that this letter does not mean that the MFR endorses every aspect of the information package and analysis report. During the allowable annual cut (AAC) determination meeting, MFR staff will advise the deputy chief forester of the technical validity of the information and the implications the assumptions. The deputy chief forester will consider this advice as he develops the rationale for his determination of the AAC for TFL 19.

Sincerely,

Doug Layden, R.P.F.
Timber Supply/Geomatics Forester
Forest Analysis and Inventory Branch

Attachment

Ministry of Forests and Range
Forest Analysis and Inventory Branch
Location:
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Victoria BC
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PO Box 9512 Stn Prov Govt
Victoria BC V8W 9C4
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pc: Jim Langridge, Director, Resource Tenures and Engineering Branch
Albert Nussbaum, A/Director, Forest Analysis and Inventory Branch
Bud Koch, Senior Analyst – TFLs, Forest Analysis and Inventory Branch
Jim Brown, Timber Supply Forester, Coast Forest Region
Jill Werk, Stewardship Forester, Campbell River Forest District

Notes on Acceptance of the Timber Supply Analysis Report for TFL 19

Please provide clarification regarding the modelling of the following factors which were of concern to Ministry of Environment. The specific concerns were sent to you by email on June 26, 2009.

- Ungulate Winter Range
- Wildlife Habitat Areas
- Marbled Murrelet
- Red-legged Frogs
- Old-growth Management Areas
- Community Watershed
- Terrain Stability
- Riparian
- Wildlife Tree Patches
- Operability Mapping

WESTERN FOREST PRODUCTS INC.

Tree Farm Licence 19

Timber Supply Analysis

MANAGEMENT PLAN 10

January 2009

Mike Davis, *R.P.F*
Planning Forester
Western Forest Products Inc.

Executive Summary

This analysis examines timber supply projections for Tree Farm Licence 19 located on west-central Vancouver Island.

Woodstock, a pseudo-spatial harvest model, was used to model current management practices for protection and maintenance of ecological values and to estimate the residual timber potential through the year 2256.

After allowances for non-recoverable losses, the modelling of current management practice as set out in the associated Information Package suggests an AAC of 762,152 m^3/year (a 10% reduction) for the term of the Management Plan #10. This represents a reasonable harvest level that accommodates ecological and social concerns in the short and longer terms. The modelling suggests that a minimum of 45,300 ha (32%) of productive forest area will be maintained in old forests (>250 yrs) and a minimum 20,000,000 m^3 of merchantable growing stock will be retained throughout the 250-year planning horizon. These forests are expected to contribute significantly to biodiversity conservation and complement protected areas within and adjacent to the Tree Farm Licence.

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Acknowledgements

Dave Coster, Craig Mistal, and Rene de Jong of Timberline Natural Resource Group prepared the Woodstock model and the various yield tables. At Western Forest Products, Mike Fowler handled data preparation and yield table queries. Peter Kofoed provided valuable guidance and review comments.

1.0 Introduction

1.1 Background

Tree Farm Licence (TFL) 19 is located on the west coast of central Vancouver Island in the vicinity of Gold River and Nootka Sound. This analysis does not include areas recently removed from TFL 19 to create two woodlots with a total AAC of 10,000 m^3; nor does it include the area that will eventually be removed from TFL 19 to create an operating area for BC Timber Sales (BCTS) – see Figure 1. All references to TFL 19 in this document refer to the portion of TFL 19 managed by WFP on an on-going basis (i.e. excludes the BCTS area). The TFL encompasses 171,722 ha of which 75,312 ha is estimated to be available for long term timber production. The TFL was acquired from Pacific Forest Products in 1997. The allowable annual cut (AAC) for this landbase is currently set at 845,947 m^3 per annum.

1.2 Objective

The primary objective of this report is to estimate reasonably achievable timber flows for the consideration of the Provincial Chief Forester in making his determination of Allowable Annual Cut for the term of Management Plan 10. More specifically:

1. The management of non-timber values such as fish and wildlife habitat, biodiversity, recreation, visual quality, and terrain stability is accounted for. Protection of non-timber values will be satisfied by land base removals, yield net downs and/or by maintaining a percentage of the landbase in older stands.
2. Residual timber flow is to be estimated by considering harvestable inventory, growth potential of present and future stands, silvicultural treatments, potential timber losses, operational and legislative constraints.
3. Impacts of declining timber flow on community stability and employment are to be lessened by keeping rates of decline per decade as low as possible without inducing undue impacts on other values or long term timber sustainability.

1.3 Timber Supply Model

Timber supply optimizations were completed with Woodstock software developed by Remsoft. Woodstock is a pseudo-spatial supply model and is described in more detail in the associated Information Package (IP).

The inventory database was current to January 1, 2007 for harvesting depletion and January 1, 2006 for silviculture treatments and assessments. The model was constructed using 50 5-year periods for a total optimization horizon of 250 years.

Analysis units and associated yield curve parameters are described in more detail in the associated Information Package.

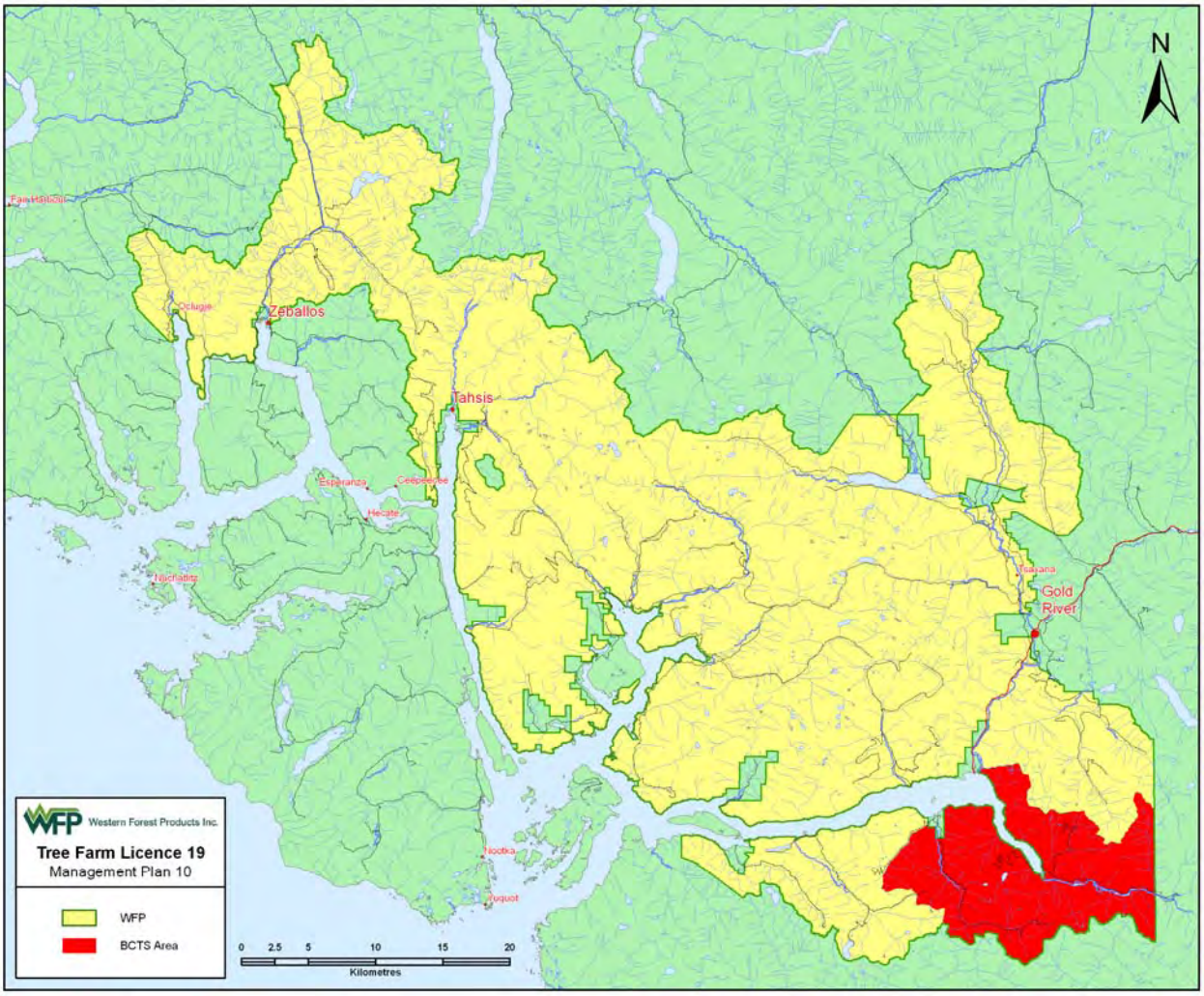

Figure 1 - TFL 19

2.0 Current Management or Base Case

The Base Case or Current Management option includes the following assumptions and modelling parameters that are described in more detail in the associated Information Package (note that as a result of preliminary model runs using the criteria in the original Information Package from February 2008, some modelling parameters have been revised and will be explained in this document):

- Future stand level retention is projected to be in the order of 14% (on an area basis) and have an incremental impact of 4% to the THLB[1] (i.e. 10% is assumed to be located in areas constrained for management of other non-timber resources). Old seral stage targets are maintained based on the *Order Establishing Provincial Non-Spatial Old Growth Objectives* effective June 30, 2004 (NSOG). Mature seral targets are incorporated for the two Special Management Zones within TFL 19.

- Designated wildlife habitat areas such as ungulate winter ranges are not included for timber production. 356 hectares of suitable Marbled Murrelet habitat are removed from the THLB to account for the *Forest Planning and Practices Regulation* (FPPR) section 7(2) notice for the Campbell River District and the strategy in the approved FSP.

- Green-up heights are assigned based on Resource Management Zoning established in the Vancouver Island Land Use Plan.

- The operable land base includes stands accessible to helicopter and conventional cable or ground-based harvesting systems.

- All harvested stands are planted promptly; a 1-year regeneration delay is incorporated into the yield tables (the 1-year regeneration delay was not included in the original IP). Future plantations are assumed to use seed orchard stock. Yield reductions are based on standard OAFs of 15% and 5%. Future medium and poor site Douglas-fir stands in the CWHxm2 subzone are assumed fertilized twice per rotation.

- Visual quality restrictions are based on the VQOs established for the Campbell River Forest District on December 14, 2005 with upper range disturbance assumed. Recreation constraints are applied based on the *Order to Identify Recreation Resource Features for the Campbell River Forest District* dated April 12, 2006. Karst features management is based on the karst vulnerability potential (KVP) identified in the TFL 19 Planning-Level Karst Inventory dated March 31, 2003.

- Minimum harvest age varies by leading species (a change from the original IP) and site productivity and the minimum harvestable volume is 350m^3 per hectare (see Table 1). Both

[1] As the 4% is applied as a yield reduction, growing stock and age class distributions and summaries do not reflect this reserved area or volume.

minimum age and minimum volume requirements must be met before a stand can be harvested. Minor deciduous leading stands are included in the THLB and any volume in these stands contributes to the analysis.

Table 1 – Minimum harvest ages

	Minimum Harvest Age by Leading Species (years)		Minimum Volume (m^3/ha)
Site Productivity	**Douglas fir**	**Other**	
Good	50	60	350
Medium	60	80	350
Poor	70	100	350

- For the first 5-year period of the analysis, a net 300,000 m^3 is added to reflect the awarding of licences to first nations for undercut volume in TFL 19 less the portion of the Hisnit woodlot that remains within TFL 19 until March 31, 2010 (see Table 2). This additional volume in period 1 is a change from the original IP.

Table 2 - Additional Volume for First Period of Analysis

Description	Volume (m^3)
Total TFL 19 undercut volume awarded or in discussion	350,000
Less: TFL 19 undercut volume harvested to October 2008	(17,000)
Less: Estimated WFP harvest in Hisnit woodlot area	(33,000)
Total volume to add to first period of analysis	**300,000**

- Also as the first period of the analysis is 2007-2011 and the new AAC will be determined in early to mid 2009, the harvest volume for the first period is set to reflect two years at the current AAC (845,947 m^3/year) plus 3 years at the new lower harvest level (see Table 3). Subsequent harvest levels are based on changes from the average value for the first period. This additional volume (2 years at the current AAC) is a change from the parameters in the original IP.

Table 3 - First Period Harvest Level

Description	Rounded Volume (m^3)
2 years at current AAC (2 x 845,947 m^3)	1,690,000
plus: 3 years at 93% of 845,947 m^3	2,360,000
plus: 300,000 m^3 from above	300,000
Total volume for first period of analysis	**4,350,000**
Yearly average for first period of analysis	**870,000**

- Recent harvest within the non-conventional portion of the THLB has been approximately 6.0% of the total harvest area whereas it represents approximately 12% of the THLB and contains approximately 17% of the current THLB volume. The level of performance in the non-conventional THLB is not anticipated to increase significantly in the near future. Therefore, a 50,000 m^3/year constraint is applied in the timber supply model. This value represents approximately 6% of the initial harvest level. This is an additional constraint added since the original IP was submitted.

- Woodstock is set up to maximize harvest volume over the first half of the 250-year analysis period subject to maintaining a relatively stable (± 5%) growing stock on the THLB over the final 150 years.

The Base Case flow is presented in Table 4 and Figure 2. All harvest volume figures are net of non-recoverable losses of 6,335 m^3/year.

Table 4 - Base Case Harvest Levels

Period	Start Year	End Year	Harvest Volume (m^3)
1	2007	2011	870,000
2	2012	2016	753,000
3	2017	2021	699,800
4	2022	2026	650,400
5	2027	2031	604,400
6 - 14	2032	2076	561,700
15 - 17	2077	2091	595,700
18 - 50	2092	2256	650,500

The optimization suggests that immediate declines in AACs need to be initiated and maintained for the next 25-30 years. A decline of about 14% per decade will allow for an orderly transition to the mid-term harvest level estimated to be about 561,700 m^3/year. A few decades after the 561,600 m^3/year level is reached, AACs are expected to increase as stands planted today with higher yielding seed orchard stock reach harvestable ages. Yield gains through tree planting and particularly tree improvement to date are expected to eventually contribute to a long-term harvest level (LTHL) of approximately 650,500 m^3/year. The total volume harvested over the 250 years is roughly 159.4 million m^3.

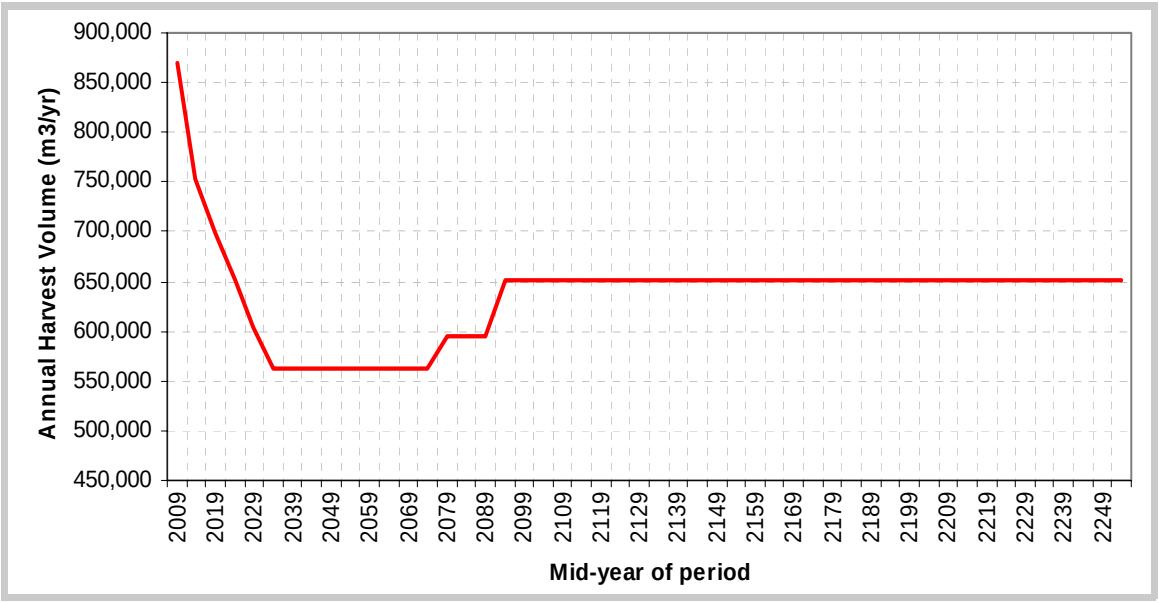

Figure 2 - Base Case Harvest Schedule 2007-2256

Figure 3 indicates the contribution from each of the four different age classes used to define the analysis units to the total harvest volume by period. As expected, old growth stands contribute the greatest proportion of volume in the first 6 periods (30 years). In the following 30 years current managed stands provide the greatest volume. Starting in period 13 (61-65 years into the future) future managed stands provide the majority of the harvest volume.

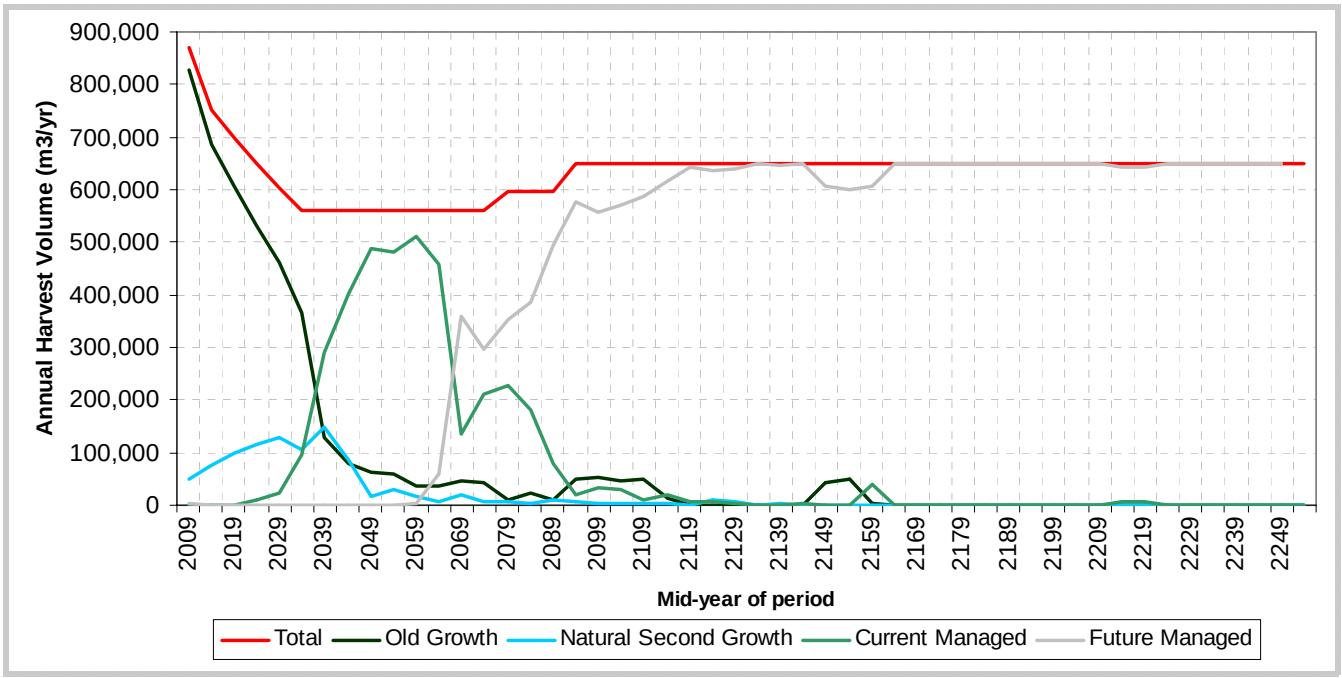

Figure 3 – Analysis Units age classes' contribution to Base Case harvest

Age class distributions are examined in Figure 4 and Figure 5. Note that the age classes are offset from standard age classes due to the Woodstock model being constructed with 5-year periods with the mid-point of the period being set at ages that are multiples of 5. This also explains why the areas in each age class differ from those shown in Table 5 of the Information Package. Generally the youngest age class remains stable through the simulation; it is slightly higher in the first time period (2007) due to the presence of NSR lands whereas in future time periods the model "regenerates" harvested stands immediately. Within the productive forest the oldest age class initially declines by about one-fifth and then increases as younger reserved timber ages into the old growth age class (see Figure 4). Zero to sixty-two year old stands increase initially until a relatively balanced age class distribution is achieved on the timber harvesting land base (THLB) (refer to Figure 5).

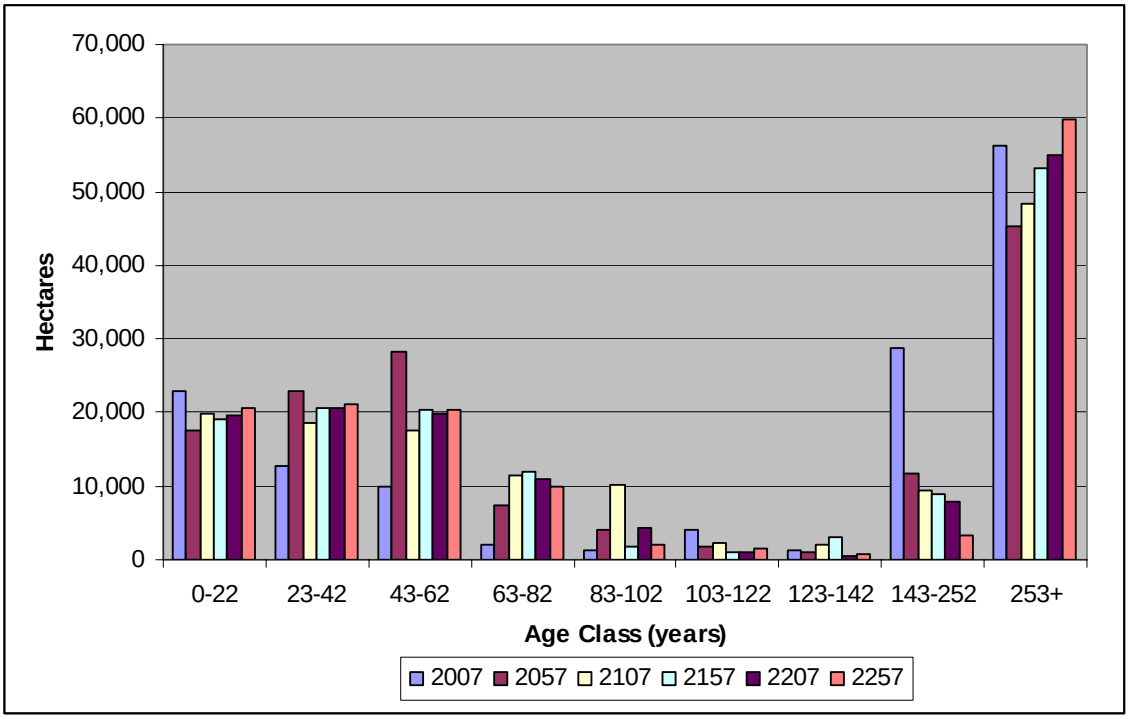

Figure 4 - Age class distribution on productive forest area

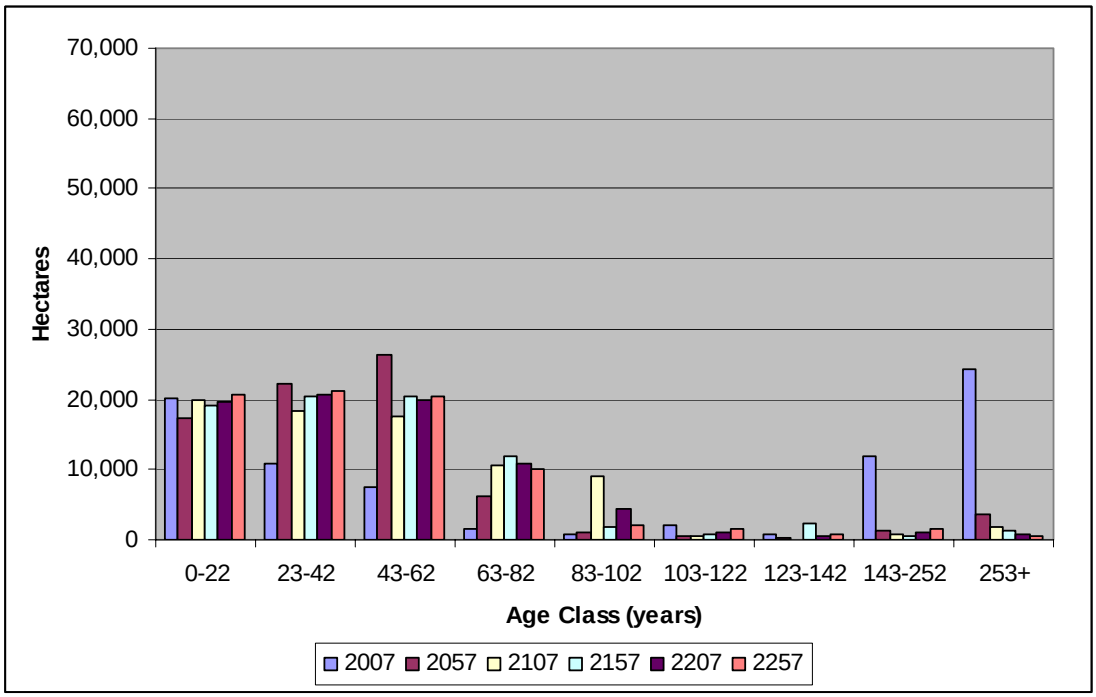

Figure 5 - Age class distribution on timber harvesting land base

Figure 6 illustrates harvestable (i.e. meets minimum harvest age criteria) and gross growing stock levels for the THLB. Growing stock declines until the transition to second growth harvesting is completed and then rises as tree improvement gains take effect. Growing stock on the THLB declines by 21% through the transition to second growth and then climbs back to approximately

90% of current levels and at no time through the simulation does growing stock fall below 20 million cubic metres.

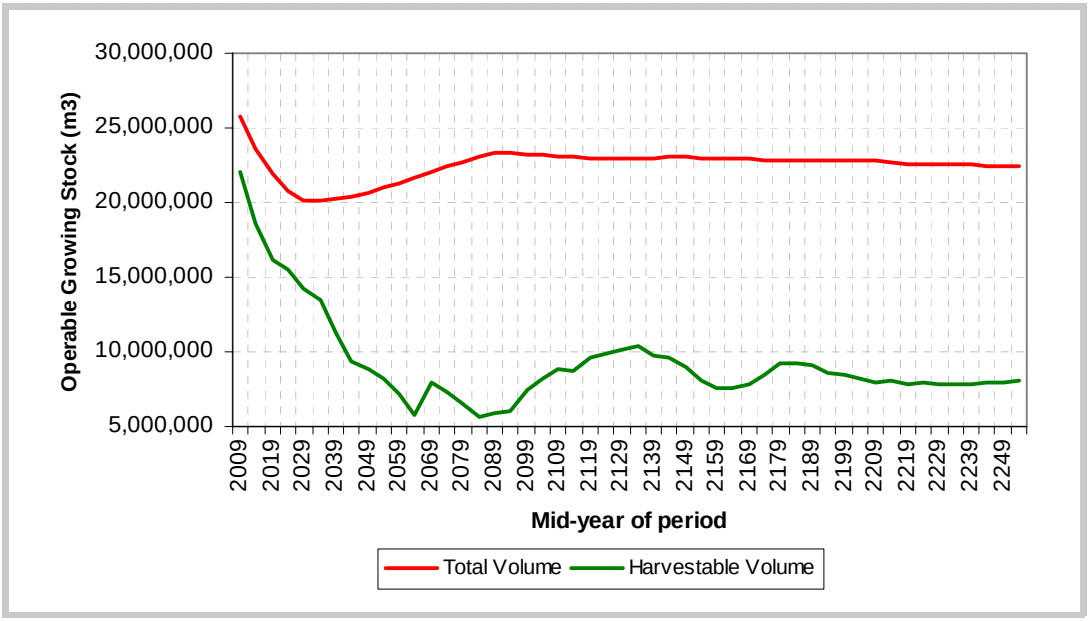

Figure 6 -THLB Growing stock

Figure 7 provides average statistics for timber harvested through the optimization. As expected, mean age of stands harvested declines rapidly as the transition to second growth harvesting occurs and by 2062 averages 80 years.

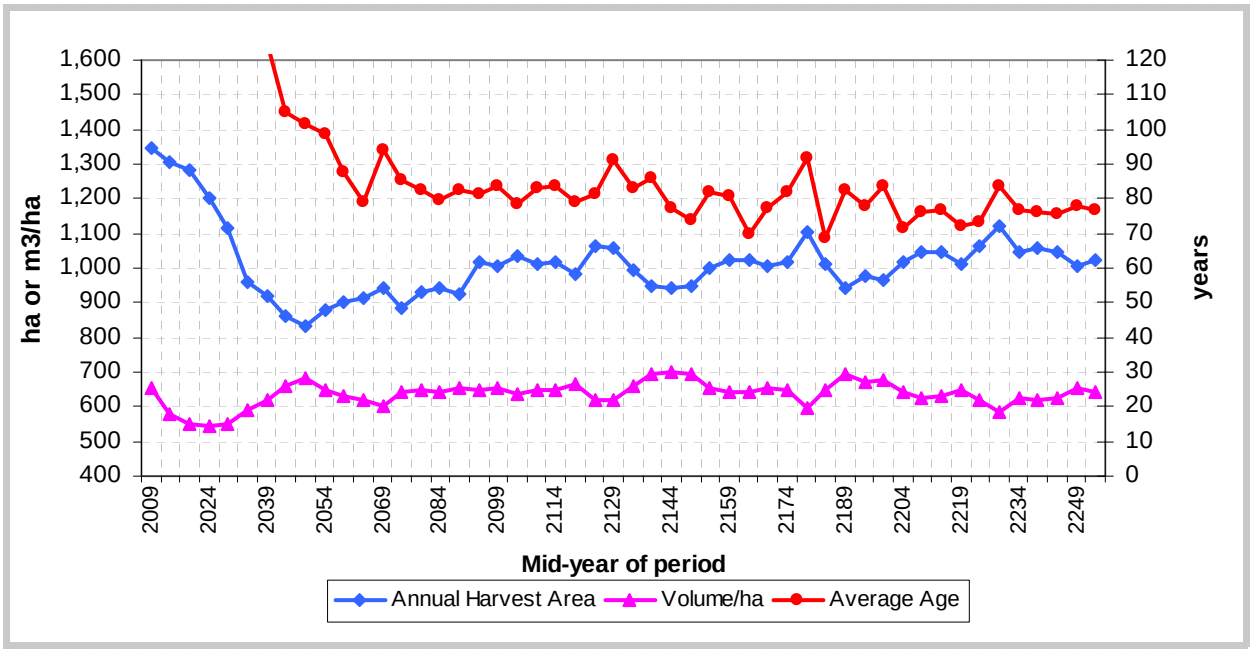

Figure 7 - Harvest Statistics 2001 – 2250

Annual area harvested declines for the next few decades in conjunction with the proposed decline in harvest levels. Once the transition to second growth harvesting is completed, annual area harvested fluctuates between 900 to 1100 hectares per annum. Merchantable volume/hectare remains relatively stable through the simulation at around 640 m^3/ha.

The minimum harvest age modelled for Douglas fir leading stand on good sites is 50 years. All other stands must be at least 60 to 100 years old depending on site quality (see Table 1). Concern was raised by the MoFR with the minimum age of 50 years and a request was made to report the contribution of stands less than 60 years old. Figure 8 indicates the contribution of stands less than 60 years old to total annual harvest volume.

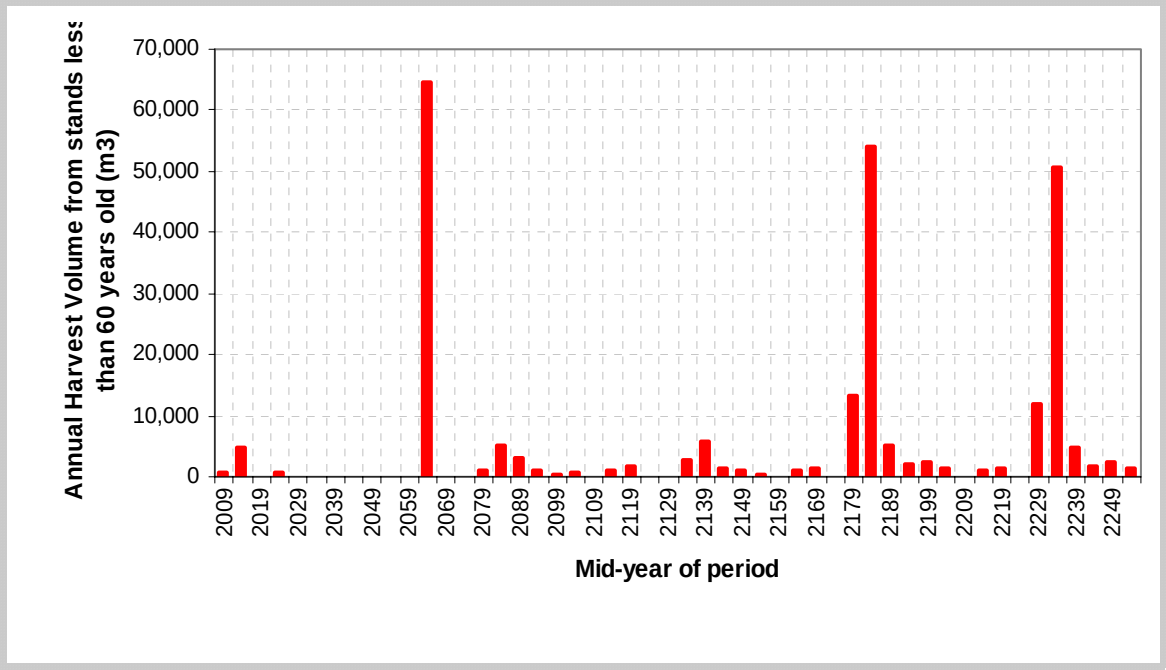

Figure 8 - Volume Contribution from Stands less than 60 years old

These young stands provide little volume in the short term. The largest contribution occurs in period 12 (2062-2066) when they contribute 64,488 m^3/year or approximately 11.4% of the total volume. Subsequent peaks occur in period 36 (2182-2186) and 46 (2232-2236) when these young stands supply 8.3% and 7.7% of the annual volume respectively. Otherwise, on average these stands generally provide less than 1% of the annual volume.

3.0 Alternate Harvest Flows

Table 5, Table 6, Figure 9 and Figure 10 examine alternate flow scenarios.

Table 5 and Figure 9 represent an attempt to maintain the current harvest level for the first 10 years (2 periods). Note that the drop in the second period is due to the removal of the undercut volume accounted for in the first period. The results indicate that, compared to the Base Case, an additional 1.1 million m3 can be harvested over the next 25 years with a total of approximately 2.0 million m3 less being harvested over the following 50 years. Over the entire 250 years, the overall harvest volume is 800,000 m^3 less. The lower harvest levels in the mid-term are required to allow the total operable inventory to recover to levels capable of supporting the long term harvest level.

Table 5 - Harvest levels with maintaining current AAC for 10 years

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Maintain current AAC
1	2007	2011	870,000	906,000
2	2012	2016	753,000	846,000
3	2017	2021	699,800	760,700
4	2022	2026	650,400	684,000
5	2027	2031	604,400	615,000
6	2032	2036	561,700	552,800
7 - 14	2037	2076	561,700	513,700
15 - 17	2077	2091	595,700	595,500
18 - 50	2092	2256	650,500	650,500

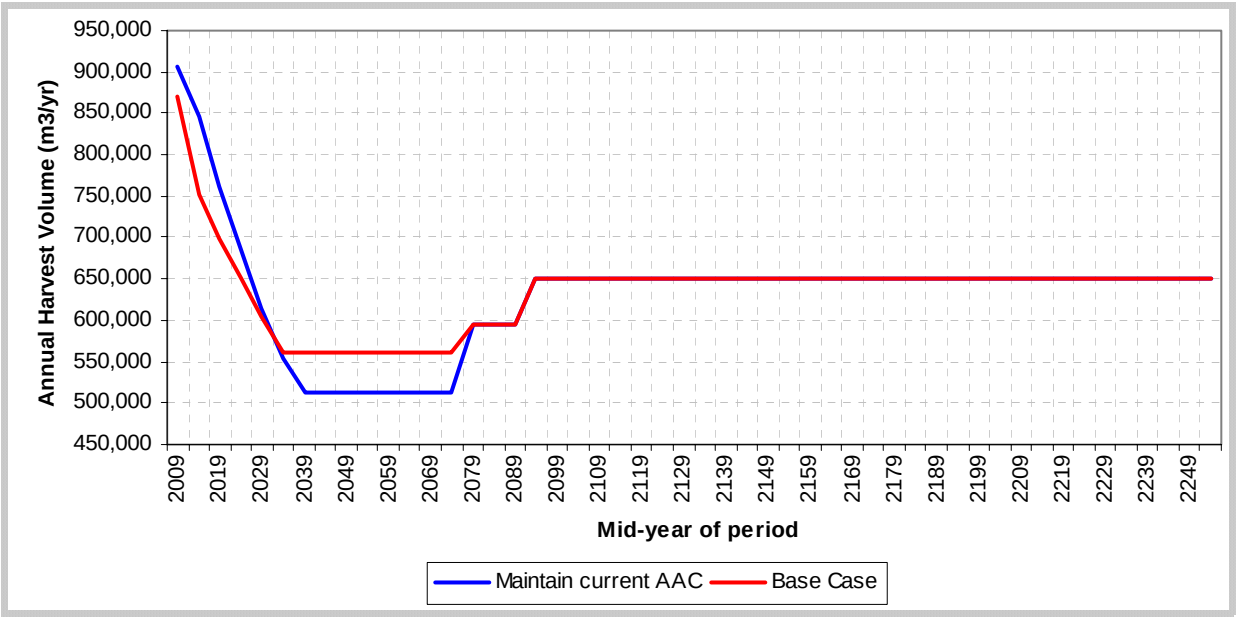

Figure 9 – Harvest levels with maintaining current AAC for 10 years

Table 6 and Figure 10 show the impact of immediately dropping to a non-declining even flow (NDEF) harvest level. This run results in approximately 3.6 million m^3 less (~2.3%) being harvested over the 250 year planning horizon, with 2.4 million m^3 being in the first 20 years. The large drop in short term harvest levels would have dramatic social and economic impacts. While this immediate drop eliminates a mid-term timber supply decline, the long term harvest level of 623,400 m3/year is approximately 27,100 m3/year (4.1%) lower than achieved in the Base Case.

Table 6 – Harvest levels with non-declining even flow

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	NDEF
1	2007	2011	870,000	623,400
2	2012	2016	753,000	623,400
3	2017	2021	699,800	623,400
4	2022	2026	650,400	623,400
5	2027	2031	604,400	623,400
6 - 14	2032	2076	561,700	623,400
15 - 17	2077	2091	595,700	623,400
18 - 50	2092	2256	650,500	623,400

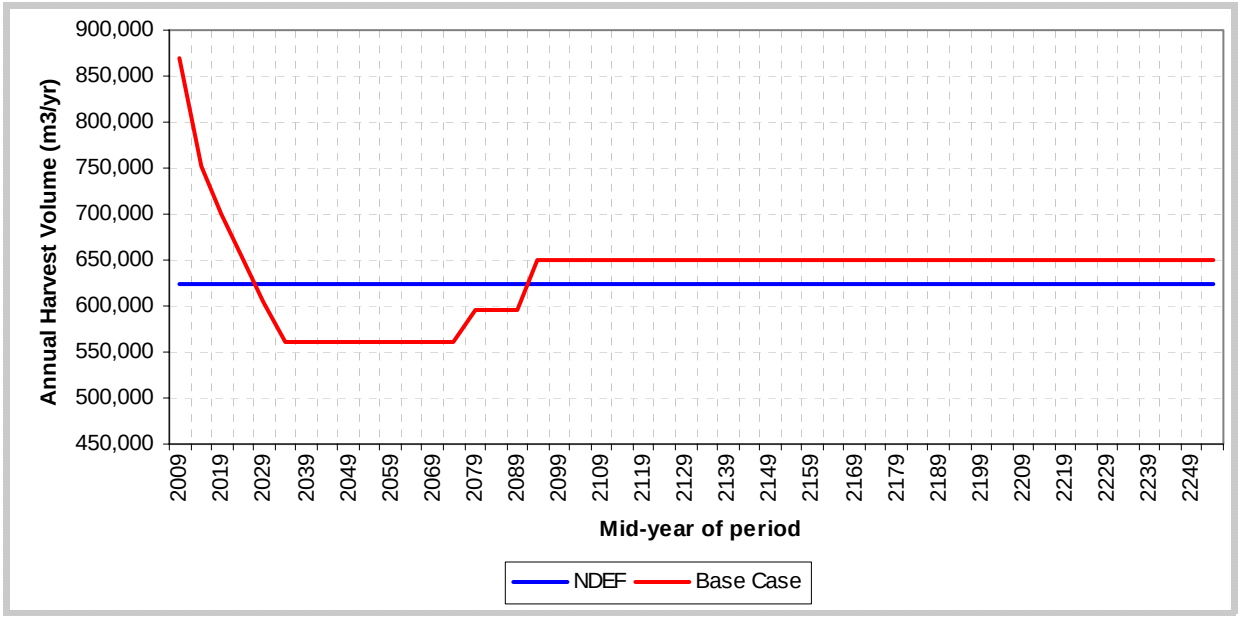

Figure 10 – Harvest levels with non-declining even flow

4.0 Sensitivity Analyses

Sensitivity analysis provides a measure of the upper and lower bounds of the Base Case harvest forecast, reflecting the uncertainty of assumptions made in the Base Case. By developing and testing a number of sensitivity issues, it is possible to determine which variables most affect results. This in turn facilitates the management decisions that must be made in the face of uncertainty. As Woodstock was used as an optimization tool to generate the Base Case, it is expected that the results will be sensitive to any changes to the inputs. The issue is how sensitive – more or less than changes to the inputs?

To allow meaningful comparison of sensitivity analyses, they are performed using the Base Case option and varying only the assumption being evaluated.

In general, sensitivities with negative impacts were run with the goal of keeping the short term rate of decline as close as possible to the rate of decline in the Base Case; mid and long term harvest level goals were not considered. Where impacts were positive, flow request adjustments were made to (1) raise the medium term flow, and optionally (2) lessen the short term decline slope.

Sensitivity issues are summarized in Table 7. The timber supply impacts are illustrated in Sections 4.1 through 4.13.

Table 7 – Current Management Sensitivity Analyses

Issue	Sensitivity level tested	Section
Operability	Remove non-conventional areas	4.1
	Include economically marginal areas	4.2
Growth and Yield	Natural stands yields overestimated by 10%	4.3
	Natural stands yields underestimated by 10%	4.4
	Managed stands yields overestimated by 10%	4.5
	Managed stands yields underestimated by 10%	4.6
	Globally reduce SIBEC Site Index estimates by 3m	4.7
	Use Timberline NRG Potential Site Index estimates	4.8
Minimum Harvest Ages	Increase minimum ages by 10 years and volumes by 100 m^3/ha	4.9
Visual Quality	Reduce the percent disturbed within each VQO polygon	4.10
Tree Improvement	Remove benefits of genetic gain and fertilizing	4.11
Western Forest Strategy	Impact of implementing use of retention silviculture system	4.12
Summary	Summary of sensitivity impacts	4.13

4.1 Remove non-conventional areas

The MP #9 analysis base option included no constraints on rate of harvest from areas classified as helicopter accessible ("heli areas"). At that time plans were to harvest significant volumes from heli areas

In the MP #10 heli areas were included in the landbase but their harvest contribution was restricted to 50,000 m^3 per year to reflect recent performance (from 2001 to 2005 approximately 6.3% of the harvest area was classified as non-conventional). This sensitivity tests the impacts of removing these heli areas from the landbase. These areas represent approximately 12% of the THLB and contain approximately 17% of the current THLB volume (approximately 4.9 million m^3).

In theory harvest levels would be 50,000 m^3/year lower than the Base Case with the removal of the heli areas due to this being their contribution in the Base Case. The question is how to distribute this loss of volume – uniformly or variably? These results (Table 8, Figure 11) indicate one possible result where the impact of this reduced volume is minimized in the short term. This creates a mid-term impact larger than 50,000 m^3/year and a long term impact of 53,600 m^3/year. The total volume harvested over the 250 years is 12.9 million m^3 (~8%) less than the Base Case – slightly greater than 50,000 m^3/year overall.

Table 8 – Harvest levels with heli stands removed

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Heli Stands Removed
1	2007	2011	870,000	865,300
2	2012	2016	753,000	740,900
3	2017	2021	699,800	681,100
4	2022	2026	650,400	626,100
5	2027	2031	604,400	575,500
6	2032	2036	561,700	529,000
7	2037	2041	561,700	486,200
8 - 11	2042	2061	561,700	446,800
12 - 14	2062	2076	561,700	506,900
15 - 17	2077	2091	595,700	596,900
18 - 50	2092	2256	650,500	596,900

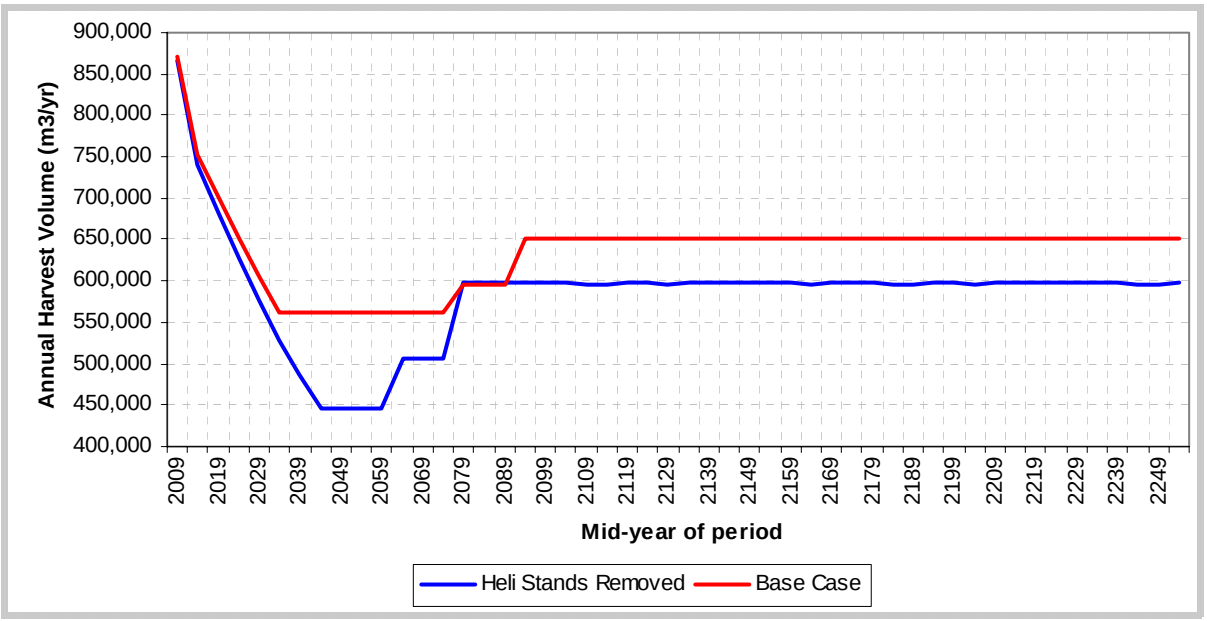

Figure 11 – Harvest levels with heli stands removed

As recent performance in the heli operable stands has been reflected in the Base Case (i.e. an annual restriction on volume sourced from these stands), the removal of this portion of the THLB (12%) has a small impact in the short term. The impact is greatest in the mid-term as there is insufficient growing stock to maintain a higher harvest level and meet the objective of a stable growing stock on the THLB in the long-term. This indicates that the harvest levels achieved in the Base Case are sensitive to the inclusion of the heli operable stands.

There is uncertainty that all heli areas will be harvested (due to economic considerations) – to the extent that this occurs there will be some downward pressure on mid and long term harvest levels. Note that 6.9% of harvest area in 2001 to 2006 has been from inoperable and economically marginal areas (outside the analysis THLB), providing a buffer (offset) for additional areas that may be removed from the THLB for OGMAs, further WHAs etc.

4.2 Include economically marginal areas

The Base Case excludes stands identified as economically marginal. This sensitivity tests the impact of including these stands in the THLB. The total THLB area added is 4,418 ha of which 374 ha is conventional yarding and 4,044 ha is helicopter yarding. The total volume added is 1.78 million m^3.

Due to the 50,000 m^3/year heli restriction being maintained the additional heli area and volume has no impact. The additional conventional yarding area and volume results in a further 310,000 m^3 being harvested over the 250 years – all in the mid and long term (Table 9, Figure 12). Essentially in times of higher timber values these marginal areas provide more operational flexibility to locate the AAC but their inclusion in the THLB should not result in a higher AAC.

Table 9 – Harvest levels with marginal stands added

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Marginal Stands added
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6 - 14	2032	2076	561,700	561,700
15 - 17	2077	2091	595,700	599,600
18 - 50	2092	2256	650,500	652,000

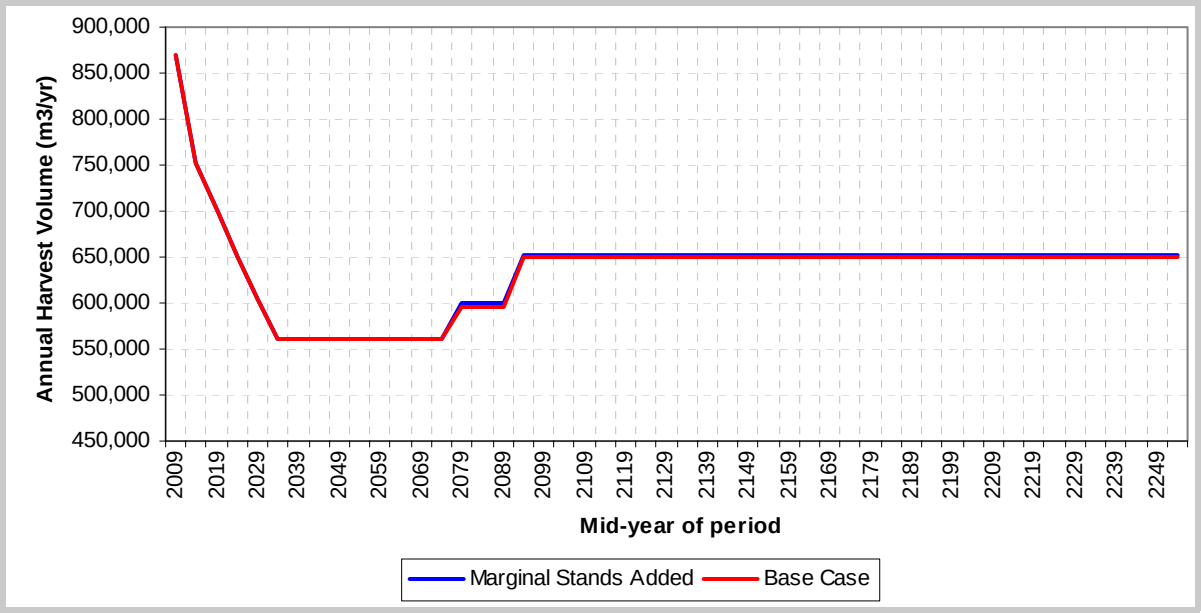

Figure 12 - Harvest levels with marginal stands added

4.3 Natural stands yields overestimated by 10%

The sensitivity of timber supply to natural stands (old growth and older second growth) volume estimates was tested by decreasing (this Section) and increasing (Section 4.4) these volumes by 10%. The volumes in these stands are estimated from the Vegetation Resource Inventory (VRI) attributes and the Ministry of Forests and Range (MoFR) Variable Density Yield Prediction system (VDYP).

The reduced yields result in approximately 2.6 million m^3 less inventory on the THLB today when compared to the Base Case. It also reduces the volume of growth on the second growth stands impacted in this sensitivity. Table 10 and Figure 13 indicate the results of trying to minimize the short term impact of these reduced volumes. The total volume harvested in the 250 years is reduced by approximately 2.8 million m^3 with the greatest impact being in the first 50 years (as this is when the majority of the volume harvested is from these natural stands – refer to Figure 3).

Table 10 – Harvest levels with reduced natural stands yields

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Natural Stands Yields Reduced
1	2007	2011	870,000	860,300
2	2012	2016	753,000	728,300
3	2017	2021	699,800	662,200
4	2022	2026	650,400	602,000
5	2027	2031	604,400	547,300
6	2032	2036	561,700	497,400
7	2037	2041	561,700	452,100
8	2042	2046	561,700	444,600
9 - 11	2047	2061	561,700	544,600
12 - 14	2062	2076	561,700	551,400
15 - 17	2077	2091	595,700	595,500
18 - 50	2092	2256	650,500	650,500

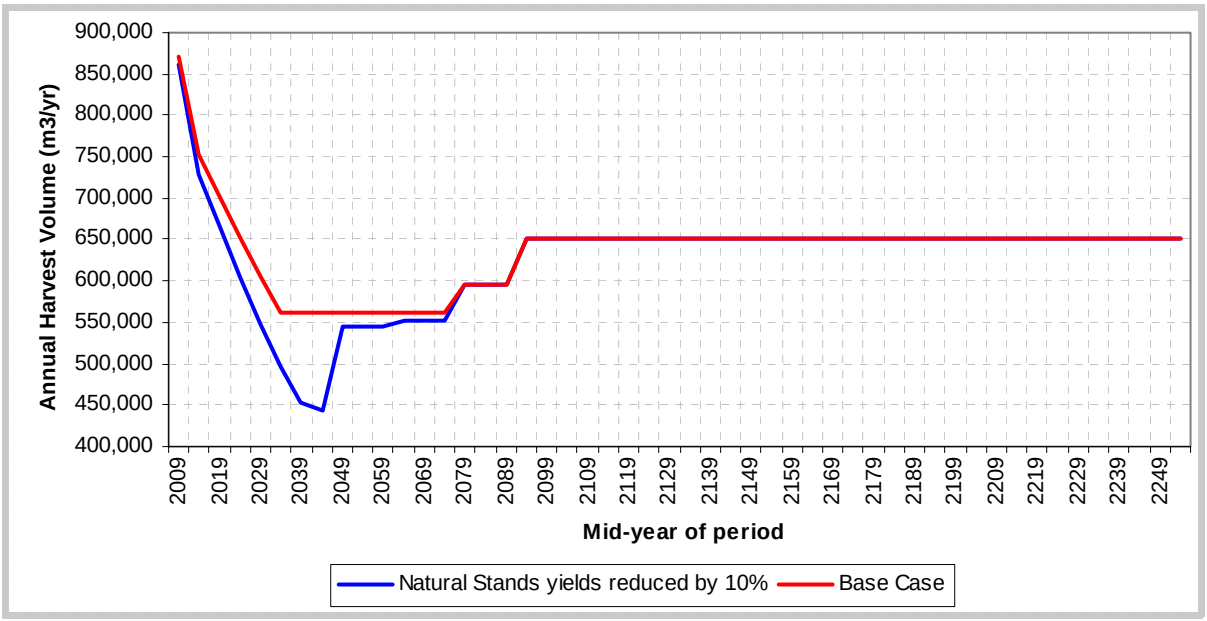

Figure 13 – Harvest levels with reduced natural stands yields

Minimizing the impact in the short term has a significant impact on the mid-term as the inventory is drawn down faster and the current managed stands can not provide adequate volume to maintain harvest levels at or near the Base Case levels.

4.4 Natural stands yields underestimated by 10%

This sensitivity adds 2.6 million m^3 to the current inventory and increases the total harvest in the first 80 years by 3.2 million m^3. The additional volume is in the short and mid term when natural stands are providing the majority of the volume. Long term harvest levels are marginally lower than the Base Case as stands are harvested at slightly younger ages on average due to maximization of the short and mid-term harvest levels somewhat at the expense of the long term.

Table 11 – Harvest levels with increased natural stands yields

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Natural Stands Yields Increased
1	2007	2011	870,000	875,500
2	2012	2016	753,000	766,600
3	2017	2021	699,800	722,200
4	2022	2026	650,400	678,300
5	2027	2031	604,400	637,200
6 - 11	2032	2061	561,700	598,600
12 - 14	2062	2076	561,700	645,200
15 - 17	2077	2091	595,700	645,200
18 - 50	2092	2256	650,500	645,200

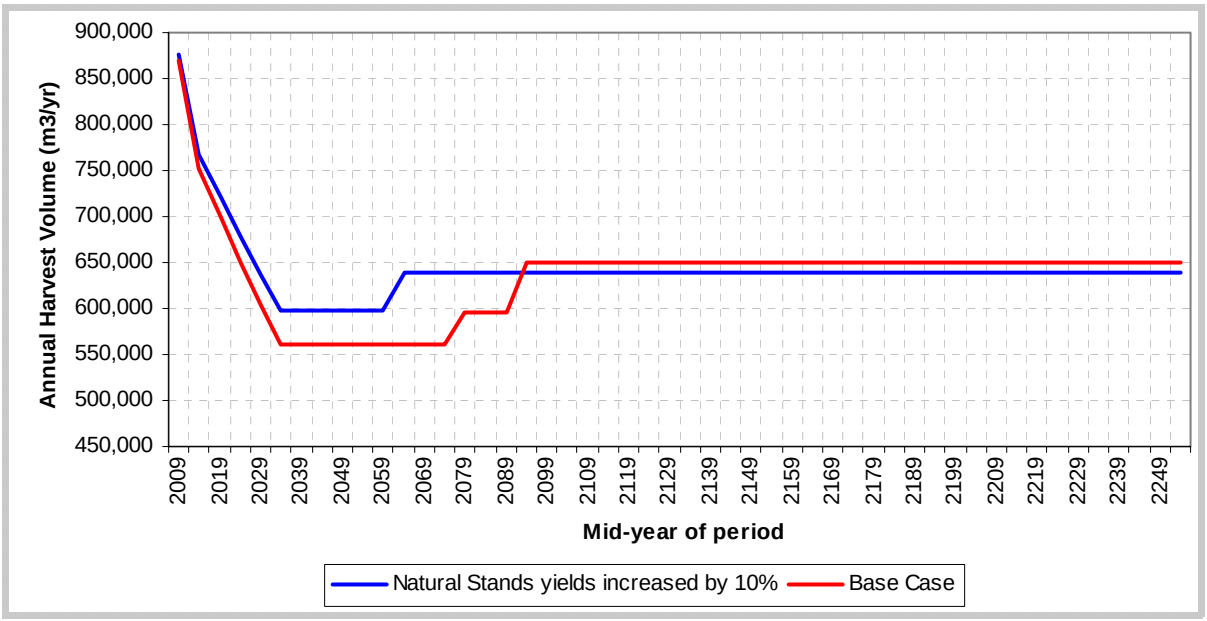

Figure 14 – Harvest levels with increased natural stands yields

There is general comfort with the overall volume estimates for old-growth natural stands. Similar average volumes for the mature productive forest are reported in the current inventory (see areas and volumes in table 5 and Table 7 of the IP), the previous inventory and MoFR audits (553 m^3/ha, 562 m^3/ha, and 556 m^3/ha respectively).

Volume estimates for younger natural stands (current ages 46 to 120 years) appear low. One small unquantified contributing factor is the utilization limits used to generate the volume

estimates. The volume in these stands was generated using VDYP. Operationally for these stands the minimum DBH for utilization is 12.5 cm whereas the VDYP volume estimates are based on a 17.5 cm minimum; VDYP does not accept the smaller DBH utilization limit. This discrepancy results in a slight timber supply underestimation.

An additional factor is that impacts of completed fertilization have not been included. Since 1980 approximately 8,400 ha of nitrogen fertilization has occurred, mostly on Douglas fir leading stands aged 21-40 years at time of application. Much of the fertilized area is in young natural stands (with the rest in the current managed age range). Increased yields from these fertilization treatments are estimated to be between 100,000 m^3 and 200,000 m^3. The higher estimate assumes an average response of 25 m3/ha and the lower estimate assumes no response from the hemlock component in the fertilized stands. This additional volume would be available in the mid-term when timber supply is at its lowest levels.

4.5 Managed stands yields overestimated by 10%

The sensitivity of timber supply to managed stands (younger second growth and future stands) volume estimates was tested by decreasing (this Section) and increasing (Section 4.6) these volumes by 10%. The volumes in these stands are estimated from attributes and assumptions detailed in the Information Package (see Section 8.8 of the IP) and the MoFR's Table Interpolation Program for Stand Yields (TIPSY).

Table 12 and Figure 15 indicate that the first 6 periods (30 years) of the Base Case harvest schedule can be achieved even with managed stand yields reduced by 10%. This is logical as managed stands do not provide any significant volume to the Base Case harvest levels until period 6 (see Figure 3). This run results in approximately 13.2 million m3 (8.3%) less harvest than in the Base Case over the 250 year planning horizon. The long term harvest level is 9.5% less than in the Base Case.

Table 12 – Harvest levels with reduced managed stands yields

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Managed Stands Yields Reduced
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6	2032	2036	561,700	561,700
7	2037	2041	561,700	521,900
8 - 14	2042	2076	561,700	516,600
15 - 17	2077	2091	595,700	516,600
18 - 50	2092	2256	650,500	588,700

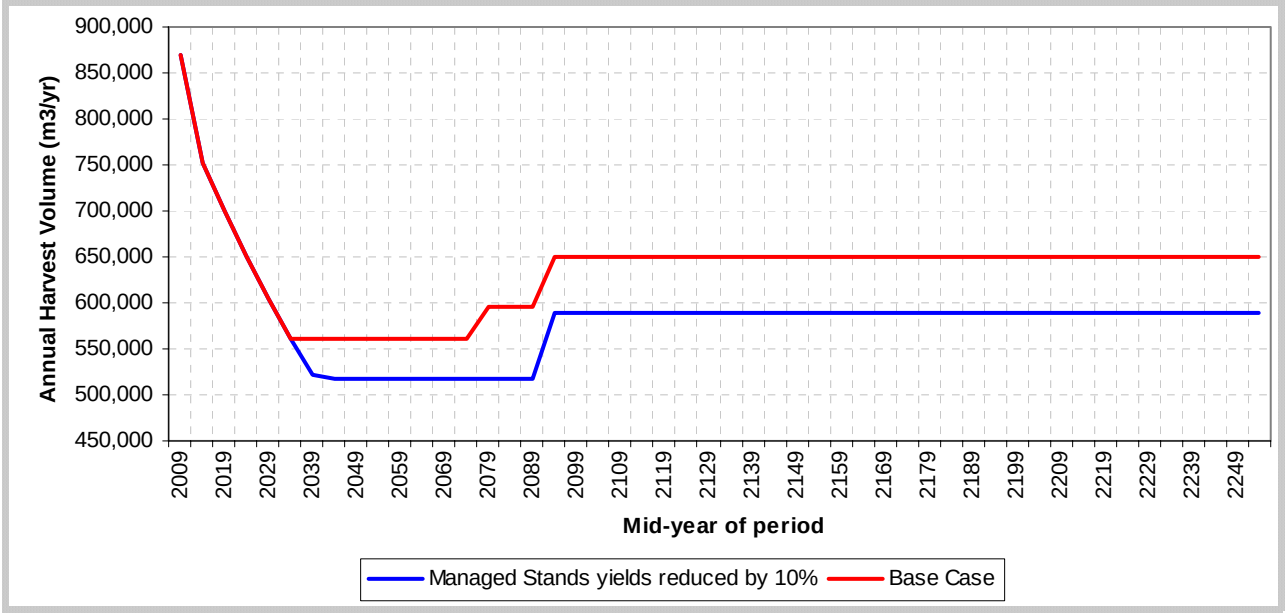

Figure 15 – Harvest levels with reduced managed stands yields

4.6 Managed stands yields underestimated by 10%

With managed stands yields increased by 10%, this sensitivity adds inventory volume in the critical mid-term. This additional inventory supports an additional 3.9 million m^3 of harvest between 2047 and 2091 (periods 9 to 17). The long term harvest level is 51,900 m^3/year (8.0%) higher than the Base Case results (see Table 13 and Figure 16). The long term harvest level is less than 10% higher as there is sufficient inventory to maintain higher harvest levels in the mid term that results in stands being harvested, on average, at younger ages in the long term with the corresponding reduction in yield.

Table 13 – Harvest levels with increased managed stands yields

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Managed Stands Yields Increased
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6 – 8	2032	2046	561,700	561,700
9 - 11	2047	2061	561,700	592,800
12 - 14	2062	2076	561,700	692,800
15 - 17	2077	2091	595,700	702,400
18 - 50	2092	2256	650,500	702,400

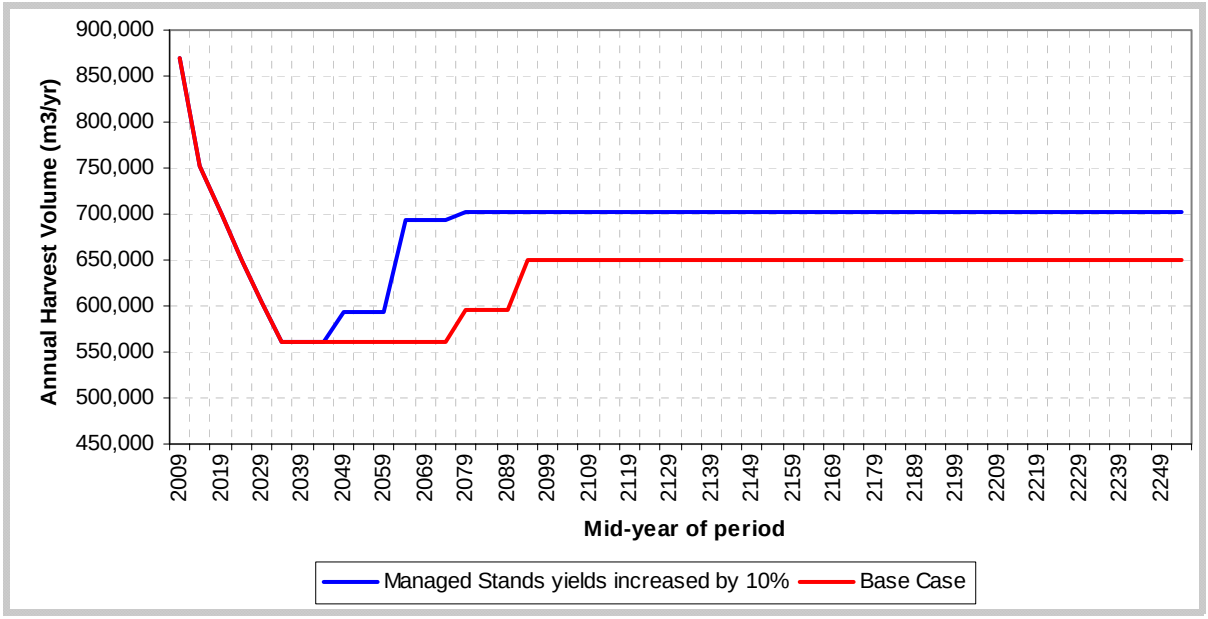

Figure 16 – Harvest levels with increased managed stands yields

4.7 Globally reduce SIBEC Site Index estimates by 3m

This sensitivity is run at the request of the MoFR's Forest Analysis and Inventory Branch. Normally the use of Terrestrial Ecosystem Mapping (TEM) and the associated SIBEC site index estimates depends on an accuracy assessment having been done for the TEM. As no such assessment has been done for the TFL 19 TEM, this sensitivity is run to approximate the use of adjusted inventory (VRI) site indices for managed stands. It is widely understood from past studies that site index estimates based on old growth stands significantly underestimate the growth of managed stands.

The lower site indices result in an 890,000 m^3 (3.1%) reduction in operable inventory at the beginning of the analysis and reduce managed stands yields by approximately 20-25% on average. These reduced yields create timber supply shortages in the mid and long term (when comparing against the Base Case). The short term is impacted to a lesser degree but reduced harvest levels are necessary to transition down to the lower mid-term harvest levels. In the short term (first 20 years) 600,000 m^3 less is harvested; in the mid-term (21-100 years) 6.2 million m^3 less is harvested; and in the long term (101-250 years) 20.8 million m^3 less is harvested. Overall, there is 27.6 million m^3 (17.3%) less harvested. The long term harvest level is approximately 21.3% less than the Base Case level.

Table 14 – Harvest levels with yields based on reduced SIBEC values

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Reduced SIBEC Estimates
1	2007	2011	870,000	860,300
2	2012	2016	753,000	728,300
3	2017	2021	699,800	662,200
4	2022	2026	650,400	602,000
5	2027	2031	604,400	547,300
6 - 8	2032	2046	561,700	497,400
9 - 11	2047	2061	561,700	500,800
12 - 14	2062	2076	561,700	512,000
15 - 17	2077	2091	595,700	512,000
18 - 50	2092	2256	650,500	512,000

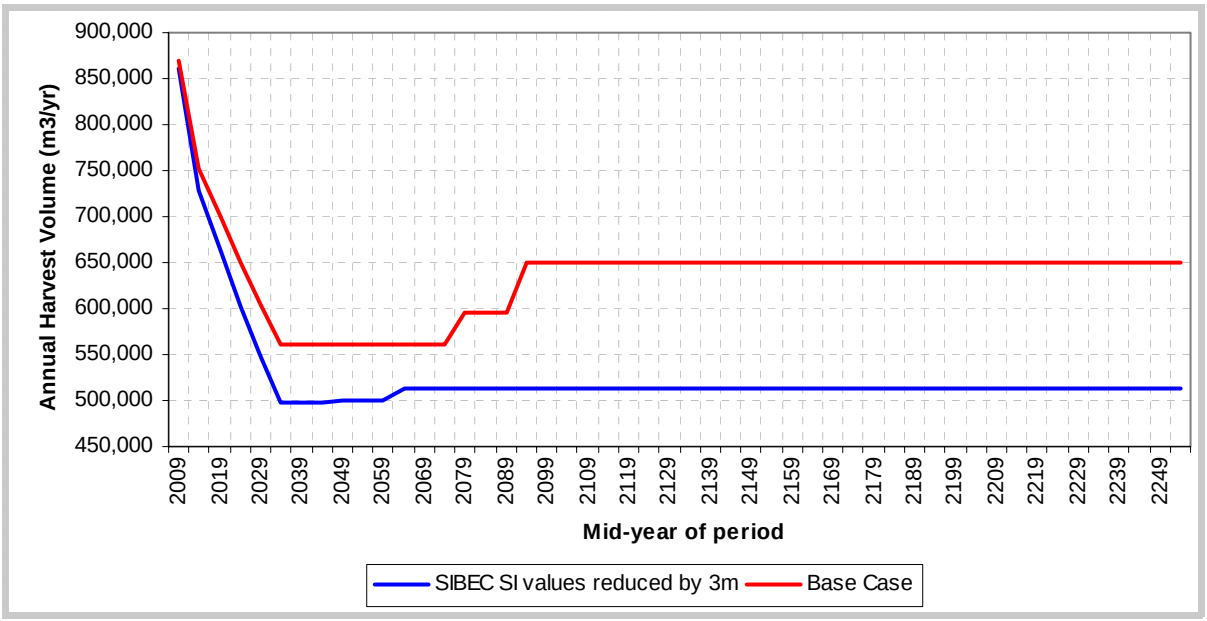

Figure 17 – Harvest levels with yields based on reduced SIBEC values

4.8 Use Timberline Preliminary Site Index (PSI) estimates

Timberline Natural Resource Group has completed 25 Site Index Adjustment (SIA) projects on management units across BC including 11 coastal units, two of which were WFP's TFL 6 and TFL 37. The data gathered in the coastal SIA projects provides Timberline with a data set that can be used to predict estimates of site productivity of managed stands in ecologically similar areas. These site index estimates were labelled as "preliminary site index". The average PSI for hemlock in the CWHvm1 was about 10% higher than the SIBEC estimate. This accounts for the majority of the difference between the two overall average estimates. See Appendix G of the IP for more details.

Some PSI estimates are lower than SIBEC estimates (see Appendix H of the IP for some comparisons) and a large proportion of the current managed stands happen to be composed of species located in those variants where the PSI estimates are lower. When compared to the Base Case this creates a brief timber supply shortfall in the mid-term (periods 7 and 8). Afterwards the overall higher site productivity estimates from the PSI allows long term harvest levels to be approximately 8% higher than that of the Base Case (very similar to the results of increasing managed stands yields by 10% - see Section 4.6). This results in approximately 11.3 million m^3 (~7%) more being harvested over the 250 years.

Table 15 – Harvest levels with yields based on PSI values

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	PSI Estimates
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6	2032	2036	561,700	561,700
7 - 8	2037	2046	561,700	521,900
9 - 11	2047	2061	561,700	558,100
12 - 14	2062	2076	561,700	658,100
15 - 17	2077	2091	595,700	703,200
18 - 50	2092	2256	650,500	703,200

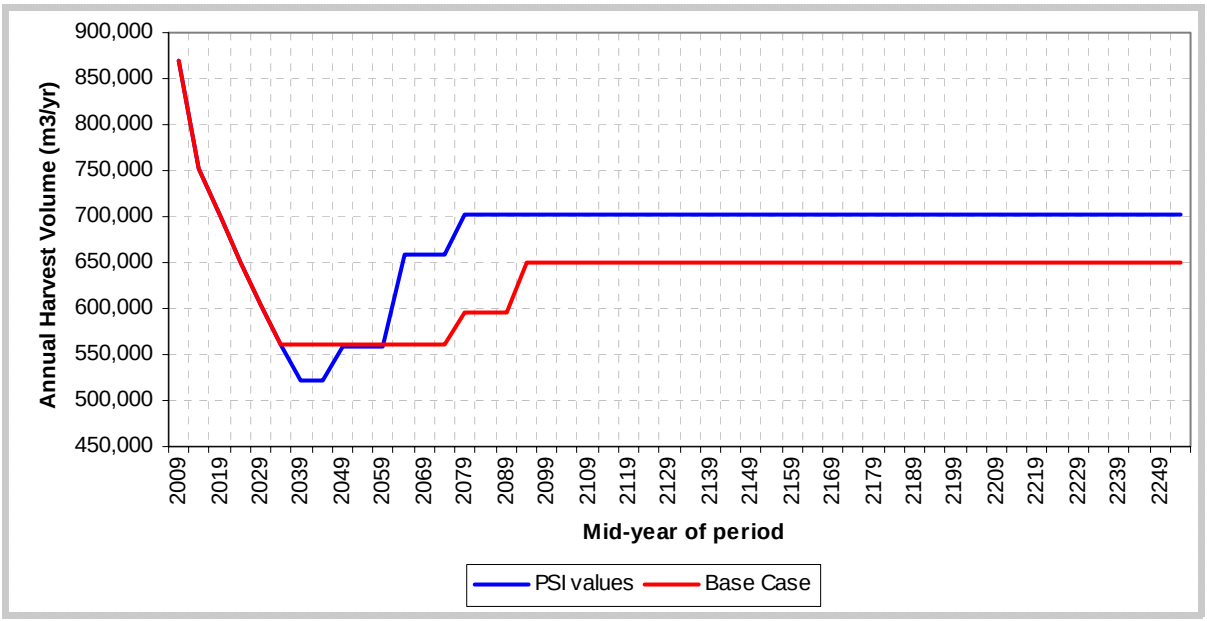

Figure 18 – Harvest levels with yields based on PSI values

The Timberline approach for assigning SIBEC site indexes was conservative. SIBEC values were assigned to each site series in the Terrestrial Ecosystem Mapping (TEM) within the THLB based on the leading species for current and future stands. Within the CWHvm1 and CWHvm2 variants, the TEM did not distinguish between Site Series 01 and Site Series 06 and classified these areas as Site Series 01. The yields for analysis units within these two variants were generated using an arithmetic average of the SIBEC values for these two site series (i.e. the presence of the 01 and 06 series were assumed equal).

Table 16 – SIBEC values for Site Series 01 within CWHvm1 and CWHvm2

Site Series	Hw Site Index (SIBEC)	
	CWHvm1	CWHvm2
01	27.7 m	28.0 m
06	25.2 m	24.0 m
Average	26.5 m	26.0 m

A summary of TEM data for the productive forest in TFL 39 and TFL 44 shows the site series 06 to be approximately 9% of the total for 01 and 06 in the CWHvm1 and 6% in the CWHvm2. Using these percentages to calculate weighted averages for TFL 19 results in 27.5 m for CWHvm1 (+1.0 m) and 27.8 m for CHWvm2 (+1.8 m). Approximately 34% of the TFL 19 operable productive forest is estimated to be in the CWHvm1 01 site series and 17% in the CWHvm2 01 site series. Applying these adjustments would increase the average SIBEC site index from 23.9 m to 24.6 m and increase managed stand yields. Additional managed stand yields would provide greater timber supply in the mid and long term and would partially alleviate the mid-term “trough” present in the Base Case.

4.9 Increase minimum ages by 10 years and volumes by 100 m^3/ha

To test the impact of minimum harvest age criteria on timber supply, the minimum ages are increased by 10 years and the minimum volume is increased by 100 m^3/ha to 450 m^3/ha.

These changes remove approximately 2.5 million m^3 (~11%) of available inventory from the forest at the beginning of the analysis. For the majority of the older second growth stands (natural stands) the minimum volume per hectare is the limiting factor and the increased minimum volume used in this sensitivity creates a timber supply shortage (relative to the Base Case) in the short and medium term: approximately 900,000 m^3 less is harvested in the short term (~6%) and approximately 3.9 million m^3 less is harvested in the mid term (~8.4%). For the majority of managed stands (current and future) the minimum age is the limiting factor; therefore, in the longer term the minimum ages become the limiting factor. The long term average harvest age increases by about 8 years. This longer effective rotation age generates higher yields but less area meets the minimum age criteria in any given year with the net effect being a slightly lower (~0.8%) long term harvest level. Overall this sensitivity results in approximately 5.6 million m^3 (~3.5%) less harvest than the Base Case (Table 17, Figure 19).

Table 17 – Harvest levels with older minimum harvest ages

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Older MHA
1	2007	2011	870,000	855,200
2	2012	2016	753,000	715,700
3	2017	2021	699,800	643,500
4	2022	2026	650,400	578,500
5	2027	2031	604,400	520,000
6	2032	2036	561,700	467,400
7 - 8	2037	2046	561,700	420,000
9 - 11	2047	2061	561,700	469,500
12 - 14	2062	2076	561,700	551,400
15 - 17	2077	2091	595,700	595,500
18 - 50	2092	2256	650,500	645,300

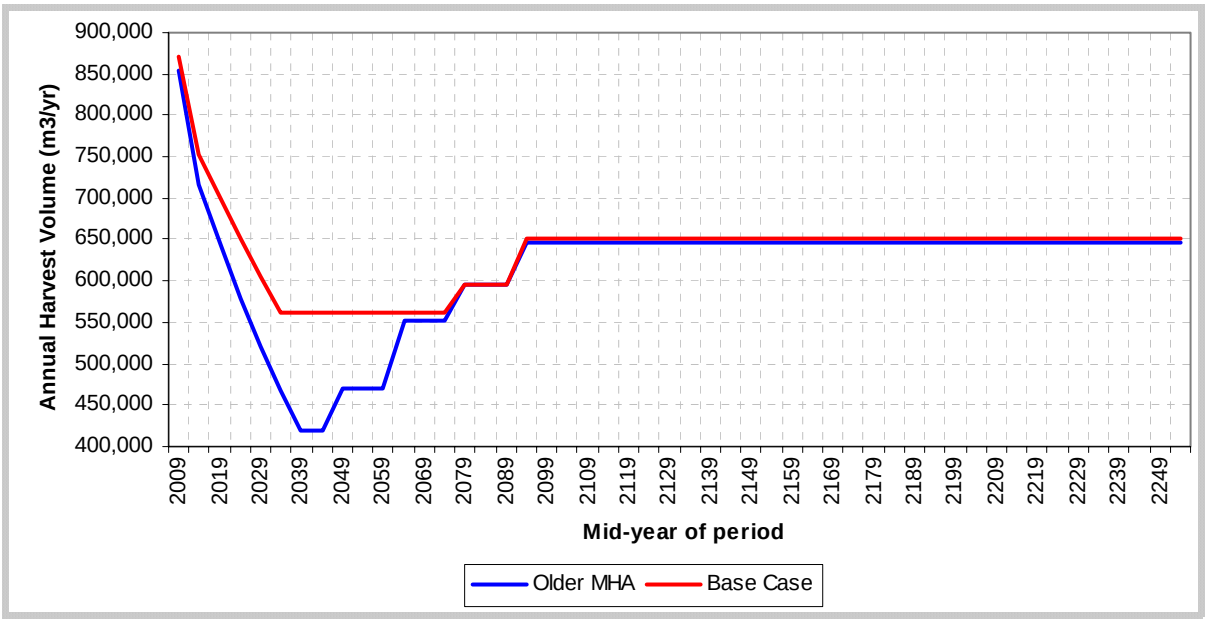

Figure 19 – Harvest levels with older minimum harvest ages

A minimum harvestable age of 60 years (and 350 m^3/ha) was used in the previous two analyses (MP #8 and MP #9). The minimum harvest ages used in this analysis (see Table 1) were selected to reflect the expectation that stands on poorer sites take longer to reach an economically viable condition (DBH and height distributions) than a similar stand on a better site. Short and mid-term timber supply is sensitive to minimum harvest ages. This is a consequence of the low yields from the young natural stands (see discussion in Section 4.4) – the harvest eligibility of these stands is delayed significantly when 450 m3/ha minimum volume is required. Long term timber supply is unaffected as the future managed stand yields are great enough that the 10 year delay can be accommodated and the higher minimum volume requirement is already met.

4.10 Reduce the percent disturbed within each VQO polygon

To test the sensitivity of timber supply to the assumptions used for managing visual quality objectives (VQO), this sensitivity uses the mid-point of the disturbance range for each VQO class rather than the upper limit as in the Base Case (Table 18). The model was set such that no more than the applicable listed percentage of each VQO polygon could be occupied by stands less than 15 years old (i.e. visually effective green-up (VEG) is reached in 15 years). An alternative approach would be to hold the maximum disturbance percentage the same but lengthen the time to reach VEG to say 20 years.

Table 18 – Maximum disturbance by VQO class

VQO	Maximum disturbance %	
	Base Case	Sensitivity
Modification (M)	25%	20%
Partial Retention (PR)	15%	10%
Retention (R)	5%	2.5%

Table 19 and Figure 20 indicate the results of this sensitivity. Short term harvest levels are unaffected as there is sufficient inventory outside the visually sensitive areas to maintain the Base Case harvest levels. Commencing in 2037 (period 7) the more restrictive visual quality management assumptions (relative to the Base Case) begin having a timber supply impact. This impact continues until 2076 (period 14) with approximately 1.6 million m^3 less harvested over that 40 year period. The reduced harvest level over this period allows inventory to accumulate such that harvest levels basically equal to the Base Case are possible for a short time between 2077 and 2091 (periods 15 – 17). In the long term the more restrictive VQO assumptions reduce the harvest level by 5,000 m^3/year or approximately 0.8%. Over the 250 years approximately 2.4 million m3 (~1.5%) less volume is harvested.

Table 19 – Harvest levels with more restrictive visual quality management

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	VQOs more restrictive
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6	2032	2036	561,700	561,700
7 - 14	2037	2076	561,700	521,900
15 - 17	2077	2091	595,700	595,500
18 - 50	2092	2256	650,500	645,500

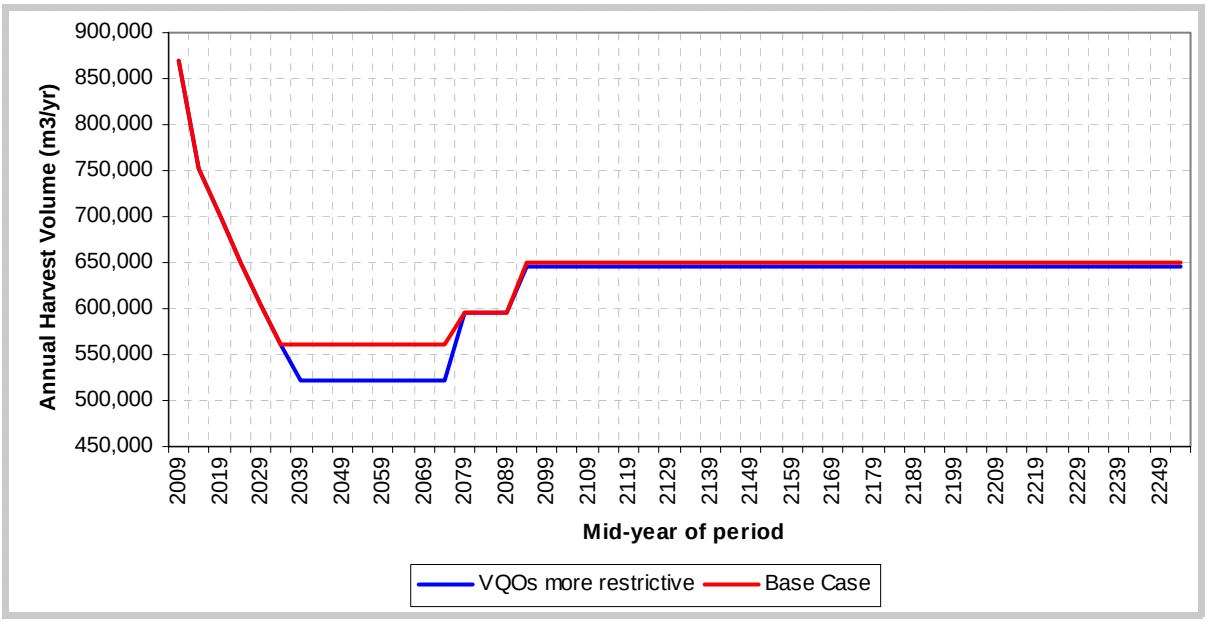

Figure 20 – Harvest levels with more restrictive visual quality management

Visual impact assessments are used to guide cutblock design in order to mitigate the visual impact of cutblocks and roads. The screening effect of strategically located stand level retention can be used to effectively reduce the visual impact of cutblocks. The forthcoming implementation of the Western Forest Strategy (see Section 4.12) aligns well with this visual management strategy.

4.11 Remove benefits of genetic gain and fertilizing

The Base Case includes yields from tree improvement (genetic gain that varies by the age of the managed stand) and two fertilization applications (at age 40 and 50) to future stands on medium and poor sites in the CWHxm2 (a total of approximately 2,000 ha). This sensitivity tests the impact on timber supply if these silviculture activities to improve yields do not occur.

Table 20 and Figure 21 indicate that in the short term these silviculture activities are not contributing to timber supply. This is logical as natural stands are providing almost the entire harvest volumes for the first 25 years (5 periods) and the yields from these stands are not influenced by genetic gain or fertilization. Lower harvest levels are required starting in 2037 (period 7) due to reduced yields from current managed stands (no genetic gain) and little remaining natural stands inventory. In the long term, the lack of genetic gain and fertilization generates harvest levels about 8.9% lower than the Base Case. Overall approximately 10.1 million m3 (~6.4%) less is harvested over the 250 years.

Table 20 - Harvest levels with no genetic gain or fertilization

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	No genetic gain or fert.
1	2007	2011	870,000	870,000
2	2012	2016	753,000	753,000
3	2017	2021	699,800	699,800
4	2022	2026	650,400	650,400
5	2027	2031	604,400	604,400
6	2032	2036	561,700	561,700
7 - 11	2037	2061	561,700	549,000
12 - 14	2062	2076	561,700	551,400
15 - 17	2077	2091	595,700	592,300
18 - 50	2092	2256	650,500	592,300

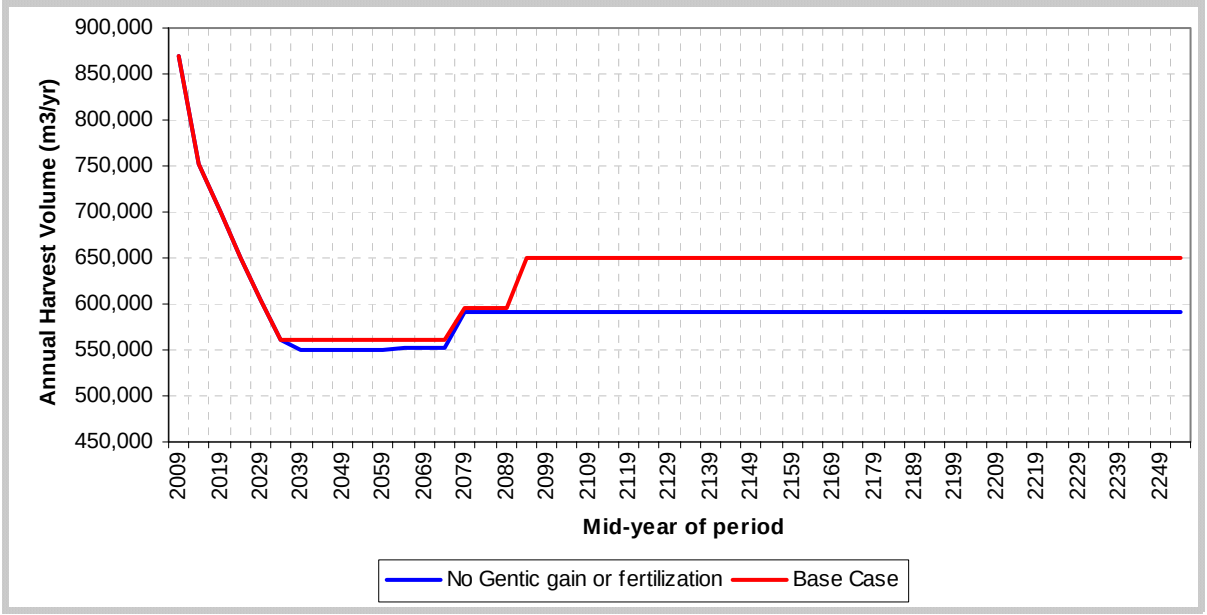

Figure 21 - Harvest levels with no genetic gain or fertilization

4.12 Impact of implementing use of retention silviculture system

Western Forest Products is in the process of developing and implementing a Forest Strategy. The first component of the strategy is a program for conserving biodiversity on the company's tenures. The approach is to vary the use of retention systems and the amount of stand level retention by Resource Management Zones of the Vancouver Island Land Use Plan and by ecosection and variant. It is being phased in over the next few years. As past practice is clearcut and clearcut-with-reserves the estimated impact (area and volume) of this strategy is not included in the Base Case. It is expected that the strategy will be implemented during Management Plan #10 such that preliminary impacts can be reflected in the Base Case associated with the next timber supply analysis.

Applying the retention system requirements to the Ecosection/VILUP Zone/BEC variant combinations present within TFL 19 results in an average overall stand level retention requirement of 5.6% for TFL 19. This sensitivity analysis reduces current stand yields by 3% to reflect the area retained to meet these retention targets. This assumes the other 2.6% is already accounted for by all other netdowns. In this sensitivity analysis, future stand yields are reduced by 5% to reflect the area retained (3%) and the impact of trees retained in the first harvest entry on growth and yield of the future stands (2%).

Table 21 and Figure 22 indicate that short term timber supply is affected by these reduced yields. Approximately 600,000 m^3 (~4.1%) less volume is harvested in the first 20 years (4 periods). Approximately 1.4 million m3 (~2.9%) less is harvested over the following 80 years. The long term harvest level is 33,600 m^3/year (~5.2%) lower than the Base Case. In total over the 250 years, 7.0 million m^3 (~4.4%) less is harvested.

Table 21 - Harvest levels with Western Forest Strategy assumptions

Period	Start Year	End Year	Annual Harvest Volume (m^3)	
			Base Case	Western Forest Strategy
1	2007	2011	870,000	860,000
2	2012	2016	753,000	728,300
3	2017	2021	699,800	662,200
4	2022	2026	650,400	602,000
5	2027	2031	604,400	547,300
6 - 11	2032	2061	561,700	547,300
12 - 14	2062	2076	561,700	551,400
15 - 17	2077	2091	595,700	595,500
18 - 50	2092	2256	650,500	616,900

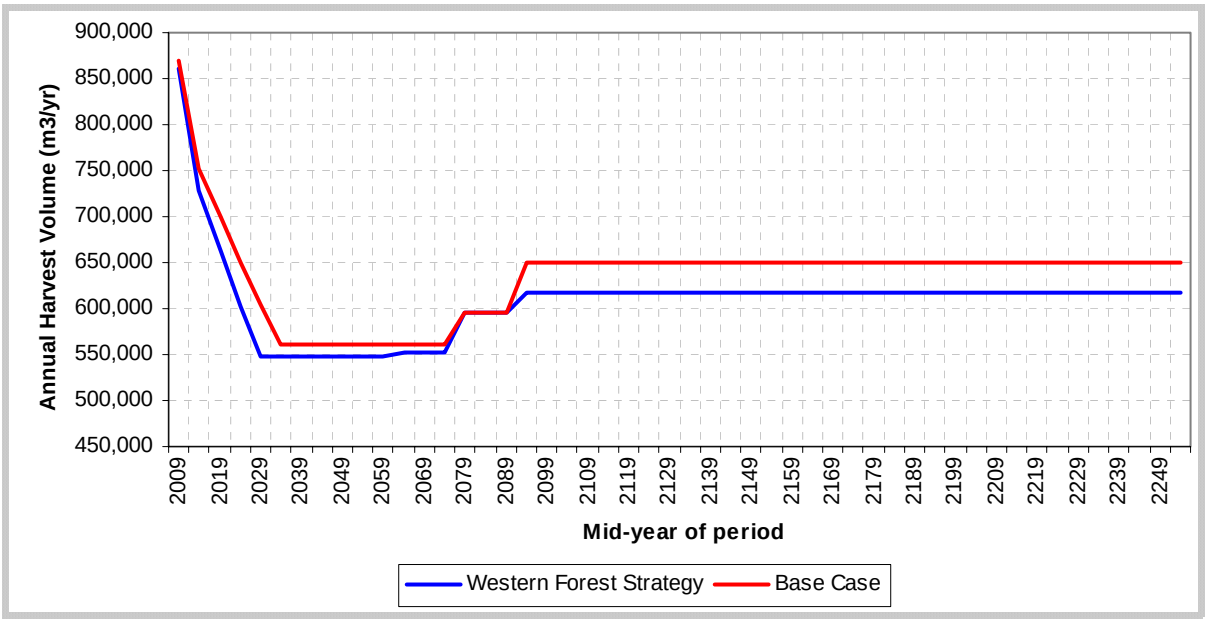

Figure 22 - Harvest levels with Western Forest Strategy assumptions

4.13 Summary of sensitivity impacts

Table 22 provides a summary of the impacts of the sensitivity issues explored. Impacts shown indicate the aggregate differences over the time periods indicated and are rounded to the nearest tenth of a percent.

Table 22 – Summary of sensitivity analyses harvest impacts

		Harvest Interval (years)		
		1 – 20	21 – 100	101 - 250
Base Case total net harvest level (m^3)		14,866,245	46,991,885	97,577,051
Issue tested	**Sensitivity**	**Percentage Impact**		
Operability	Remove non-conventional areas	-2.0%	-9.8%	-8.2%
	Include economically marginal areas	0.0%	+0.2%	+0.2%
Growth and Yield	Natural stands yields reduced by 10%	-4.1%	-4.6%	0.0%
	Natural stands yields increased by 10%	+2.3%	+6.2%	-1.8%
	Managed stands yields reduced by 10%	0.0%	-8.3%	-9.5%
	Managed stands yields increased by 10%	0.0%	+10.2%	+8.0%
	Globally reduce SIBEC Site Index estimates by 3m	-4.1%	-13.3%	-21.3%
	Use Timberline Preliminary Site Index estimates	0.0%	+7.2%	+8.1%
Minimum Harvest Ages	Increase minimum ages by 10 years and volumes by 100 m^3/ha	-6.1%	-8.4%	-0.8%
Visual Quality	Reduce the percent disturbed within each VQO polygon	0.0%	-3.6%	-0.8%
Tree Improvement	Remove benefits of genetic gain and fertilizing	0.0%	-3.0%	-9.0%
Western Forest Strategy	Impact of implementing use of retention silviculture system	-4.1%	-2.9%	-5.2%

5.0 Base Case Evolution

This section provides some details for other Base Case options that were reviewed and considered before deciding upon the option described in Section 2.0.

All options reviewed were created with these general assumptions:

1. Decline in "even" steps to the mid-term harvest level and do not allow any further declines once the mid-term harvest level is reached.
2. Achieve a long-term even-flow harvest level that is approximately the same as the growth on the THLB (i.e. the volume of growing stock on the THLB is stable in the long-term).
3. Maximize volume harvested over the entire planning horizon. To reduce model solving times, a 100 year (20 periods) planning horizon was used to do these comparisons. 250 year runs are used for the final analyses.

5.1 Original Information Package Base Case

The original IP anticipated an initial decline of 3.8% and limiting future periodic declines to 5% per 5 year-period. In addition, the minimum harvest criteria was 50 years old and 350 m^3/ha for all analysis units. No allowance was contemplated for undercut volume as described in Section 2.0 nor was a helicopter operability constraint envisioned as described in Section 2.0. Figure 23 shows the results of this scenario.

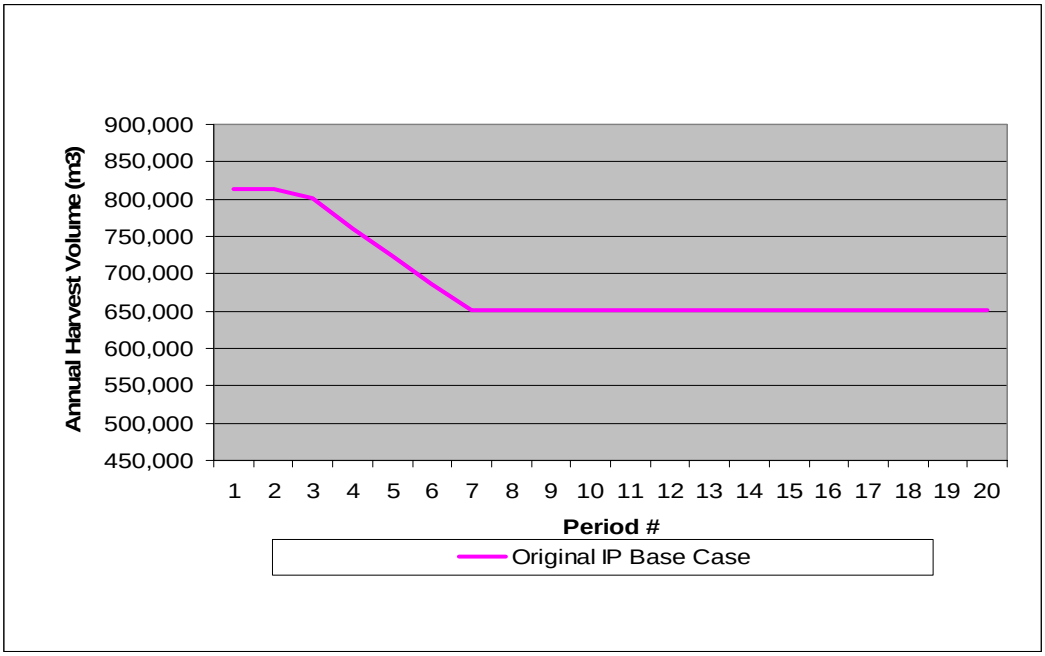

Figure 23 - Original Information Package Base Case Schedule

5.2 Revised Minimum Harvest Criteria and addition of Undercut volume

The revised IP introduced the varying minimum harvest age criteria described in Section 2.0. The Base Case option described in the revised IP still anticipated an initial decline of 3.8% and limiting future periodic declines to 5% per 5 year-period. Additionally, in order to account for undercut volume from a previous cut control period and WFP's short-term access to a portion of the Hisnit woodlot, a net 300,000m3 is added to the harvest level for the first period. Figure 24 indicates the harvest volume results of this run.

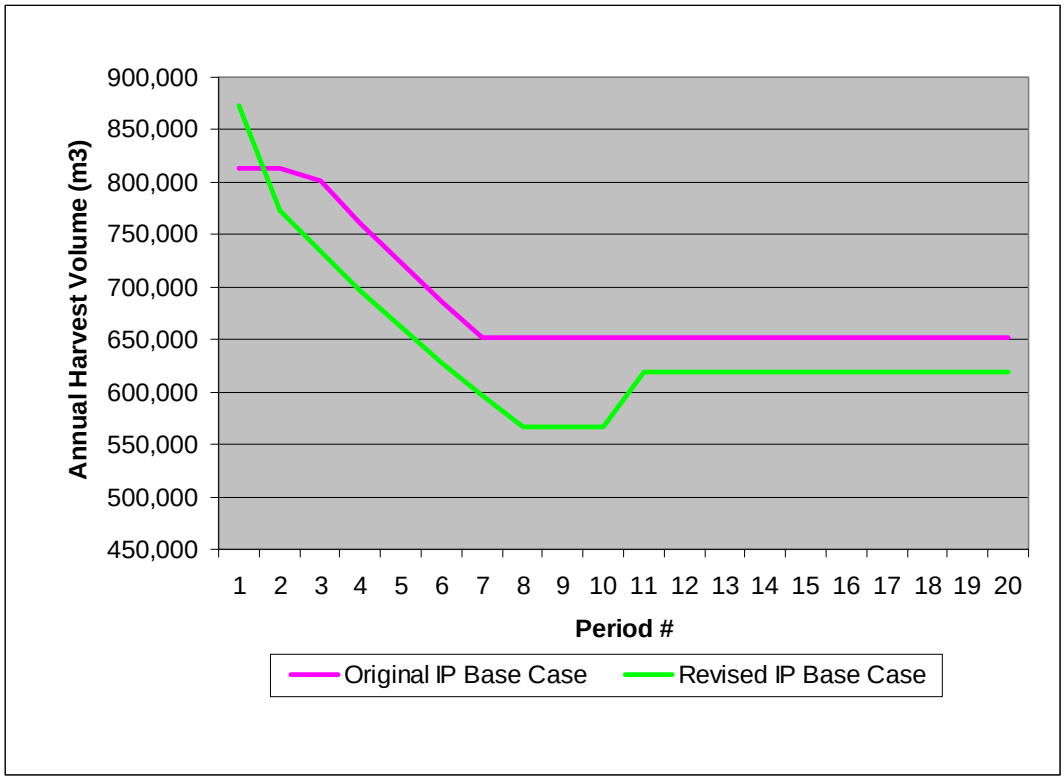

Figure 24 - Revised Minimum Harvest Criteria and addition of Undercut volume Schedule

This run required harvest levels to decline by 5% per period until period 8 (2042-2046). Limiting the decline to period 7 (2037-2041) resulted in an infeasible solution due to the requirements for a stable growing stock and even-flow harvest level in the long term (i.e. there is not enough growing stock to maintain a higher harvest level through the mid-term). The minimum harvest level achieved in this run (~566,600 m^3/year) was used as criteria for judging other possible base case options.

5.3 Addition of helicopter volume restriction

The revised IP included a harvest rule that limits the volume accessed from stands classified as helicopter in the operability inventory to 50,000 m^3/year (see section 10.4.3 of the revised IP). This additional constraint resulted in an infeasible solution when limiting harvest volume declines to 5% per 5-year period as used above; therefore, the harvest flow objective listed in the IP can

not be achieved. By allowing the declines to be 6% per period starting after period 2 the solution indicated in Figure 25 was achieved.

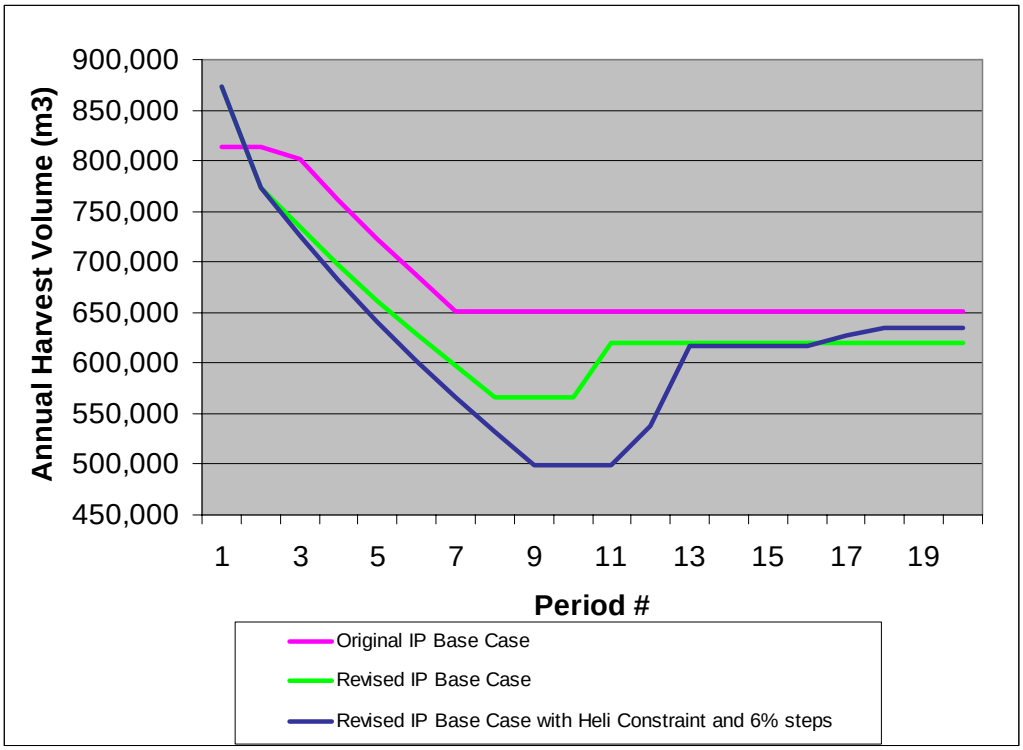

Figure 25 - Addition of heli constraint

This run required harvest levels to decline by 6% per period until period 9 (2047-2051). Limiting the decline to period 8 (2042-2046) resulted in an infeasible solution due to the requirements for a stable growing stock and even-flow harvest level in the long term (i.e. there is not enough growing stock to maintain a higher harvest level through the mid-term). Note that the long-term harvest level is slightly higher in this scenario as more growing stock is available as a result of the lower harvest levels in the mid-term.

5.4 Heli constraint and faster decline

In order to try to raise the mid-term harvest level, runs were made with a faster decline in the short-term: 7% per period rather than the 6% used above. Figure 26 shows the results of two different possible scenarios using this 7% decline criteria.

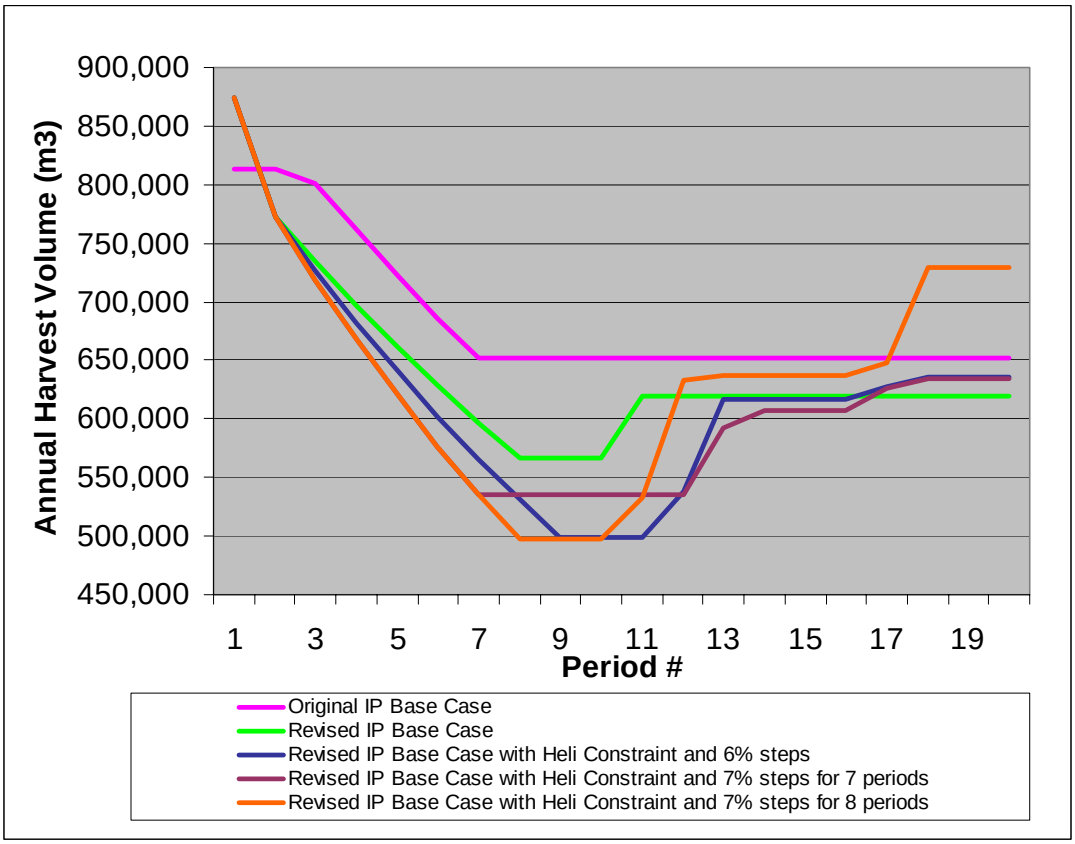

Figure 26 - Alternative step down rates

Again note that the long-term harvest level is higher in these scenarios as more growing stock is available as a result of the lower harvest levels in the mid-term. However the minimum harvest level achieved when the decline is allowed for 8 periods is approximately the same as when a 6% periodic decline was used – this run sacrifices short and mid-term harvest levels to achieve a higher long-term harvest level. When a 7% periodic decline is allowed for 7 periods a higher harvest level in the mid-term is achieved at the expense of the long-term. With the uncertainties associated with such long-term projections this is the preferable approach. Trying to restrict the 7% periodic decline to 6 periods resulted in an infeasible solution.

5.5 Final Base Case

Finally, with the timber supply model being built to start in 2007 yet the AAC determination will be made in early to mid 2009, the harvest volume for the first period is set to reflect two years at the current AAC (845,947 m^3/year) plus 3 years at the lower new harvest level. Subsequent harvest levels are based on changes from the average value for the first period. This is a change from the assumptions in the IP.

All runs discussed above had the harvest level in period 2 set at 95% of the harvest level in period 1 after accounting for the 300,000 m^3 of undercut volume. As the results of the above runs indicated that harvest levels should decline in the order of 7% per period, this scenario was

constructed to assume a 7% decline from the current AAC for 3 years in period 1 and then 7% per subsequent period. Again the harvest level in period 2 was set to account for the 300,000 m^3 of undercut volume included in period 1. Figure 27 indicates the results of this run as compared to all the previously discussed runs.

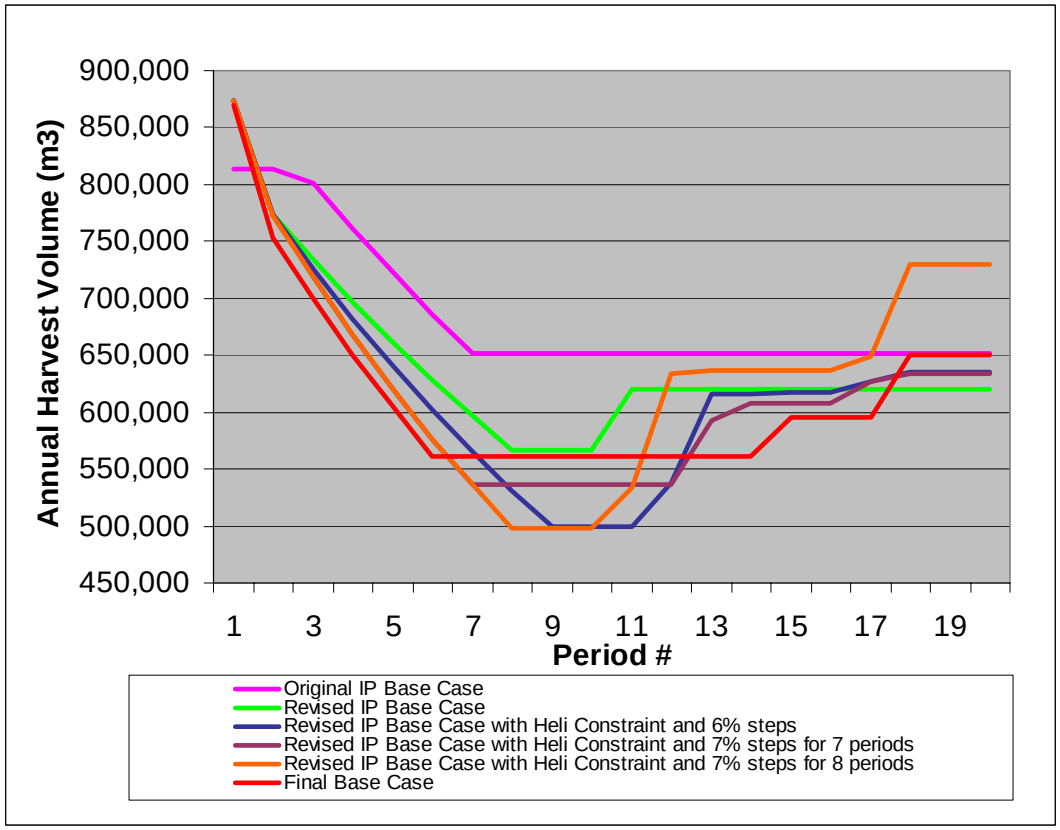

Figure 27 - Base Case Options Reviewed

The final base case provides for an orderly reduction to a mid-term harvest level that is approximately the same as the assumptions in the revised IP (although for a significantly longer time – 9 periods instead of 3) and achieves a long-term harvest level approximately equal to the original IP assumptions. This scenario balances short and long-term harvest levels without a mid-term harvest level significantly below the level achieved with the revised IP assumptions.

6.0 Recommendation

6.1 Allowable Annual Cut

Based on the analysis, it is proposed that the AAC for TFL 19 (excluding the BCTS area) be 762,152 m^3 for the next five years. This represents approximately a 10% reduction from the current AAC. This harvest may be maintained for the five years and then reduced by 26% over the next 25 years.

The recommended AAC differs somewhat from the 7% decline in harvest level indicated in the Base Case. The Base Case indicated a reduction in harvest levels of approximately 14 - 15% over the next 10 years. Given recent and current economic conditions in the forest industry and the downward pressures revealed by the sensitivities it seems appropriate to reduce harvest levels more in the first half of the next decade rather than the last half. This slightly reduced cut will provide more flexibility in both the short and mid-term to plan the annual harvest. Also, if the uncertainties associated with the sensitivities are found to warrant a lower mid-term harvest level the reduced short term harvest levels assist in making the transition to the lower mid-term harvest levels. If addressing the uncertainties leads to a higher mid-term harvest level, reduced short term harvest levels lessen the depth of the mid-term "trough".

The recommended AAC has been reduced from that implied in the earlier MP #9 analysis because of changes in assumptions and results of the sensitivity analyses. These factors include:

- A THLB that is 3% smaller than in the MP #9 analysis
- A maximum harvest of 50,000 m^3/year from areas classified as accessible by helicopter. This reflects recent practice. No restriction was applied in the MP #9 base case.
- Older minimum harvest ages for medium and poor site second-growth hemlock stands than in the earlier analysis
- On average lower site indexes for managed stands than those applied in the MP #9 analysis.

The recommendation is consistent with the approach of moving in a regular manner towards current estimates of medium-term and long-term harvest projections.

Appendix C: Accepted Timber Supply Analysis Information Package

MJD

BRITISH COLUMBIA
The Best Place on Earth

File: 12850-20/TFL 19
CLIFF 115998

September 16, 2008

Mr. Mike Davis, R.P.F.
Planning Forester
Western Forest Products Inc.
118 – 1334 Island Highway
Campbell River, British Columbia
V9W 8C9

Dear Mr. Davis:

Thank you for the Tree Farm Licence 19 Timber Supply Analysis Information Package (IP) that you submitted February 4, 2008.

I have extensively reviewed the document along with Ministry of Forests and Range (MFR) branch, regional, and district staff, and Ministry of Environment specialists. As the MFR timber supply forester responsible for reviewing this IP, I accept the document for use in the timber supply analysis for TFL 19 subject to the attached conditions and notes.

Please note that this letter does not mean that the MFR endorses every aspect of the IP. During the AAC determination meeting, MFR staff will advise the deputy chief forester of the technical validity of the information and the implications the assumptions. The deputy chief forester will consider this advice as he develops the rationale for his determination of the AAC for TFL 19.

Yours truly,

Doug Layden, R.P.F.
Timber Supply / Geomatics Forester
Forest Analysis and Inventory Branch

Attachment

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Notes and Conditions on Acceptance of Information Package for TFL 19

The following are items that must be addressed in the timber supply analysis for TFL 19.

Site productivity sensitivity analysis

Please add a sensitivity analysis where the site indices are reduced by 3 metres for existing managed and future stands.

An accuracy assessment has not been done for the terrestrial ecosystem mapping (TEM) of TFL 19. This would normally be required before the TEM can be used for the base case. In the case of TFL 19 the adjusted inventory site indices are clearly too low based on a comparison with site indices from nearby units. I believe that SIBEC provides the best available information of site productivity on TFL 19. In order to use SIBEC site indices you have to use the TEM. The requested sensitivity analysis will allow the uncertainty associated with the TEM to be evaluated.

Minimum merchantability standards

For the base case please report the projected volume scheduled for harvesting by period coming from stands between 50 and 60 years of age and between 350 and 450 cubic metres per hectare.

Also I would prefer that for the base case you use the minimum harvest ages that you say you are considering in your email of September 5, 2008 rather than those proposed in the information package; namely 50 years for good sites in the CWHxm2 variant (Fd stands) and 60 years for all others.

While it is difficult to predict the minimum merchantability standards that will apply in the future, in the IP you state that "little activity has occurred in stands between 50 and 60 years." This indicates to me that there is some uncertainty around the minimum criteria that you proposed in the IP. The requested information will allow the significance of the less restrictive criteria to be evaluated.

WESTERN FOREST PRODUCTS INC.

Tree Farm Licence 19

Timber Supply Analysis Information Package

In Preparation of

MANAGEMENT PLAN 10

Submitted to the Ministry of Forests and Range
Forest Analysis & Inventory Branch
Victoria, BC

October 2008

Mike Davis, R.P.F
Planning Forester
Western Forest Products Inc.

Acknowledgements

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- Pat Bryant and Paul Bavis of WFP for their advice and comments on several of the inputs for the analysis and possible approaches to take in the analysis; and
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1 INTRODUCTION

This Information Package provides a summary of data, assumptions, and modelling procedures to be used in the Timber Supply Analysis for Western Forest Products' (WFP) Tree Farm Licence (TFL) 19 Management Plan (MP) #10. The analysis will not include areas recently removed from TFL 19 to create two woodlots with a total AAC of 10,000 m^3; nor will it include the area that will eventually be removed from TFL 19 to create an operating area for BC Timber Sales (BCTS) – see Figure 1 - TFL 19. All references to TFL 19 in this document refer to the portion of TFL 19 managed by WFP on an on-going basis (i.e. excludes the BCTS area).

The timber supply analysis will be conducted using Remsoft's spatial planning system Woodstock–Stanley (www.remsoft.com). Woodstock is the aspatial component of the suite and addresses the majority of the model objectives and constraints. Woodstock performs a similar function as the Ministry of Forests and Range's FSSIM model whereby management zones and constraints are defined, yield curves incorporated and applied to an aggregated area file. The primary difference between Woodstock and FSSIM is that Woodstock is capable of using either optimization or sequential simulation in developing a harvest forecast.

Stanley, the spatial component of the suite, applies the Woodstock harvest forecast to specific polygons on the land base. Stanley will aggregate individual polygons into suitable harvest units (blocks) based on specified minimum, maximum and target block sizes. The model will also enforce green-up and adjacency requirements as it schedules the harvest spatially.

For this analysis, optimization will be used in Woodstock to develop the base case harvest schedule. The optimization will be subject to a number of harvest constraints including the requirement to produce a long-term sustainable harvest forecast.

WFP will complete the timber supply analysis to estimate timber harvest over a 250-year planning horizon (in five-year planning periods) based on the current harvestable land base, existing old forest timber volumes, and regenerating forest growth rates. The harvest forecast will project the timber supply impacts of current environmental protection and management practices including operational requirements of the Forest and Range Practices Act (FRPA), approved Forest Stewardship Plans (FSPs), orders, other regulations and guidelines with significance to timber supply. Sensitivity analyses will be used to investigate the expected impacts of different management scenarios, and to examine the relative importance of variations in assumptions. These may include the removal of area from the timber harvesting land base (THLB), imposing forest-cover harvest constraints, or changes in growth & yield (G&Y) estimates.

The timber supply forecast will attempt to achieve the long-term harvest potential, and minimize the rate of change during the transition from the current level of harvest to the mid- and long-term sustainable levels. Due to the large proportion of area in older age classes within the TFL and a shortage of maturing age classes, it is expected that the majority of the harvest in the short- and medium-term will be concentrated in mature and over-mature stands.

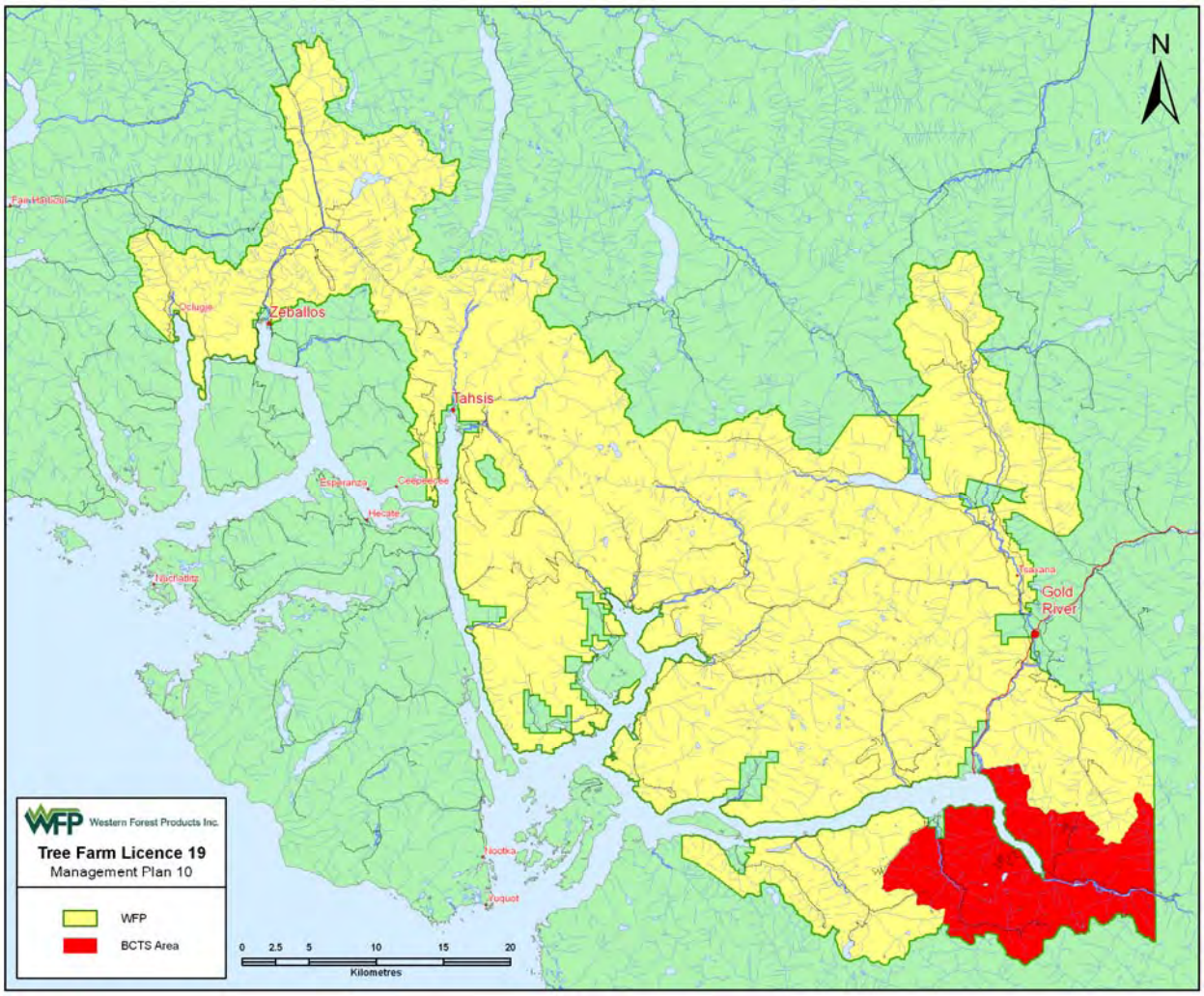


Figure 1 - TFL 19.

2 PROCESS

2.1 Overview

The information package was submitted for review to the Ministry of Forests and Range (MoFR) Timber Supply Forester at Forest Analysis and Inventory Branch and was accepted subject to a few conditions. This revised and approved package will guide the timber supply analysis and, with the timber supply analysis report, will be appended to MP #10. These in turn will be considered by the Chief Forester in determining the new Allowable Annual Cut (AAC) for TFL 19. This revised document incorporates the conditions of acceptance by MoFR and reflects the removal of the BCTS management area from the landbase for the purposes of the timber supply analysis.

2.2 Growth and Yield

Yield tables for existing stands will be divided into four groups based on age. Existing mature stands greater than age 120 years will have existing volumes estimated with VDYP 6.6d. These generated volumes will remain static (flat line) throughout the analysis, as the assumption for these stands is that growth net decay is zero. Stands that are less than age 121 years and greater than age 45 years will have existing and projected volumes estimated with VDYP. Existing stands less than age 46 years will be split into two categories based on age and will have yields estimated and projected with TIPSY version 4.1c. Current stands aged 11 years to 45 years will be differentiated from younger stands (1 to 10 years of age) for which genetic gains are expected. TIPSY yield projections will be assigned to existing not satisfactorily restocked (NSR) areas and simulated harvest areas according to their expected management regime.

3 TIMBER SUPPLY FORECASTS/OPTIONS/SENSITIVITY ANALYSES

3.1 Overview

This section describes the management scenarios to be included in the timber supply analysis. The details, assumptions, and sensitivities of each are also described.

3.2 Current Management Option

The current management option (or the "Base Case") represents the present operational requirements and management practices on the TFL. The forecast of current management incorporates existing land use designations, including Resource Management Zones[1], and current regulations and guidelines including the Forest and Range Practices Act and the Nootka Forest Stewardship Plan. This option is used as the basis for analysing various timber supply projections.

Current management on TFL 19 includes:

- The operable land base of forested area accessible using conventional (Oc) and helicopter (Oh) harvesting methods.
- Silviculture to meet free growing requirements is carried out on all regenerated stands. All harvested areas are planted.
- Known tree improvement gains will be applied to existing stands ≤ 10 years old and future regenerated stands.
- Visual quality objectives (VQOs) are modelled based on the VQOs established for the Campbell River Forest District on December 14, 2005 with upper range disturbance assumed.
- Recreation constraints are applied based on the *Order to Identify Recreation Resource Features for the Campbell River Forest District* dated April 12, 2006.
- Karst features management based on the karst vulnerability potential (KVP) identified in the TFL 19 Planning-Level Karst Inventory dated March 31, 2003.
- Green-up heights for cutblock adjacency are assigned based on Resource Management Zones established in the Vancouver Island Higher Level Plan. Special and General zones have a 3m green-up requirement while Enhanced zones have a 1.3m green-up height.
- Future Wildlife Tree and other stand-level retention within the THLB is accounted for by a blanket percent volume reduction in the timber supply model.
- Biodiversity and Landscape Units – old seral stage targets are applied to each biogeoclimatic variant within each landscape unit based on the *Order Establishing Provincial Non-Spatial Old Growth Objectives* effective June 30, 2004 (NSOG). Mature seral targets are incorporated for the two Special Management Zones within TFL 19.
- Established Ungulate Winter Ranges (UWRs) and Wildlife Habitat Areas (WHAs) are removed from the THLB.

[1] Vancouver Island land Use Plan (VILUP) Resource Management Zones and Resource Management Zone objectives approved by Government in December 2000.

- 356 hectares of suitable Marbled Murrelet habitat are removed from the THLB to account for the *Forest Planning and Practices Regulation* (FPPR) section 7(2) notice for the Campbell River District and the strategy in the approved FSP.
- Minimum harvest age varies by leading species and site productivity and the minimum harvestable volume is 350m^3 per hectare. Both minimum age and minimum volume requirements must be met before a stand can be harvested.
- Minor deciduous leading stands are included in the THLB and any volume in these stands contributes to the analysis.

The total area of TFL 19 managed by WFP has declined by 20,270 ha during MP #9. Most of this change results from the removal of the remaining private land (2,007 ha) from the TFL effective January 31, 2007 and agreement on an area to eventually be removed from the TFL and be managed by BC Timber Sales as a result of the Forest Revitalization Act (2003). This latter area totals approximately 16,500 ha. Smaller areas were removed in 2001 (private land) and in 2004 (Schedule B crown land).

The area available to WFP for timber production (the THLB) has declined by 15,254 ha from 94,702 ha listed in MP #9 to 79,448 ha for MP #10. In effect, the MP #9 THLB was 4,627 ha lower due to the area described as "inferred area net-down for recreation". The effective THLB decrease of 10,627 ha (15,254 – 4,627) is largely attributable to:

- The decrease in the total area of TFL 19 (removal of private land from the TFL and BCTS area agreement);
- More productive forest area (classified as non-productive in the previous inventory) classified as non-commercial and inoperable; and
- The establishment of revised Ungulate Winter Ranges (UWRs) and of Wildlife Habitat Areas (WHAs).

Table 1 - TFL 19 land base: MP #10 compared to MP #9

	MP #10	MP #9	Difference
Total Area (ha)	171,722	191,992	-20,270
THLB Area (ha)	79,448	94,702	-15,254

The Forest Revitalization Act has resulted in allocations of the TFL 19 AAC to B.C. Timber Sales (BCTS), First Nations and woodlots as well as to Western Forest Products Inc. The current AAC allocations are summarized in Table 2.

Table 2 – TFL 19 Current (October 2008) AAC Allocations

	Current AAC Allocations (m^3) (October 2008)
BCTS	65,253
First Nations	12,152
WFP	833,795
Total	**911,200**

Within TFL 19, a management area has been defined for the BCTS allocation and areas have been removed from the TFL for the woodlot allocation of 10,000 m^3 (refer to Figure 1 and to Table 3). It is

expected that the BCTS defined management area will be removed from TFL 19 in the near future and it is not being included in the timber supply analysis.

Table 3 – TFL 19 Current Management Areas

	Total Area (ha)	THLB (ha)
BCTS Area	16,452	5,795
Remaining Area	171,722	79,448
Total	**188,174**	**85,243**

3.3 Sensitivity Analyses

Sensitivity analyses will be conducted for the current management option to examine the potential impact of uncertainty in several key attributes. These may include the removal of operable areas from the THLB, imposing forest-cover harvest constraints, or changes in growth & yield estimates.

Sensitivities for the base case will include:

1) Operability: Operability classes have been developed that reflect current harvesting methods, timber quality, terrain stability, and economic accessibility. The purpose of this analysis is to examine potential timber supply impacts of both reduced access to more difficult areas and of improved economic conditions by including operability classes that are currently not economic to harvest. Sensitivity analyses will model the impacts of:

    - Removing the non-conventional area (Oh – 9,156 ha), and;
    - Including areas that are considered economically marginal (Oce – 341 ha and Ohe – 3,835 ha).

2) Volume: The impact on harvest forecasts of over- or under-estimating the yields for all stands will be tested by adjusting

    i) all natural stands (age 46 plus) by ±10%, and

    ii) all regenerated stands (stands currently less than 46 years and future stands) by ±10%.

3) Site Productivity: Site indices for natural (currently aged 46 years plus) stands are assigned using the forest inventory database. For existing managed (currently aged less than 46 years) and future stands, site indices are based on the MoFR SIBEC database.

    i) As the SIBEC values are assigned based on terrestrial ecosystem mapping (TEM) and the TEM for TFL 19 has not been subject to an accuracy assessment, a sensitivity analysis will be done where the SIBEC values are globally reduced by 3m. The intent of this sensitivity analysis is to approximate the use of inventory site indices for managed stands. In many areas forest inventory site indices have been shown to underestimate site productivity for managed stands. This sensitivity analysis will give an indication of the timber supply impacts of such underestimates.

ii) The Potential Site Index (PSI) estimates compiled by Timberline Natural Resource Group are higher on average than the SIBEC estimates and will be used in a separate sensitivity analysis (see Section 8.2).

4) Harvest Age: The effect of rotation length will be tested by increasing both the minimum harvest age by 10 years and the minimum volume by 100 m^3/ha.

5) Visual Quality: Current management incorporates constraints from VQOs established by the Campbell River Forest District in December 2005. A sensitivity analysis will be used to examine the impacts of varying the percentage of area below Visually Effective Green-up (VEG) to the mid-range percent disturbance limit recommended for the VQO class (see Section 10.3.2).

6) Silviculture Opportunities: The current management option includes expectations of incremental silviculture such as fertilizing and genetically improved stock. Excluding these treatments from future activities will assess the impacts of these expectations.

7) Silviculture Systems: Current management is based on the use of clearcut and clearcut-with-reserves silviculture systems. A sensitivity analysis will examine the potential impacts of implementing WFP's Forest Strategy, in particular variable retention systems.

3.4 Alternate Harvest Flow

The harvest level in the current management option will adjust each period (5 years) in the first part of the run towards the estimated Long Term Harvest Level (LTHL) and will attempt to change at a rate that does not exceed 10% of the initial harvest per decade. The results of the base case will determine potential alternate harvest flows. One option will be to continue the initial harvest as long as possible while avoiding later reductions of more than 10% of the initial harvest per decade.

During preparation of the timber supply analysis, the need for further sensitivity analyses or harvest flows may become apparent. If warranted, additional analyses will be included in the final timber supply analysis for consideration by the Chief Forester.

Table 4 – Summary of Current Management and Sensitivity Analyses

Issue Tested	Proposed Options / Sensitivity Analysis	
	Title	**Reason for Analysis and Range to be tested**
To project the timber supply based on current management practices, performance, operational requirements and currently enforced guidelines while meeting the objective of maintaining a timber supply which is not excessively variable over time and which maintains the long-term productivity of the TFL.	**Current Management Option**	Current Management Option includes the following: • Conventional and helicopter harvesting • Visual Quality based on government established VQOs • Recreation constraints based on government established features • Karst potential constraints based on TFL inventory • WTRA – 4% volume net down to reflect WTRA requirements and to account for riparian management area and other stand level retention • Riparian reserves based on FRPA requirements • Silviculture practices as described in Section 8.8. • Landscape Unit biodiversity targets for old seral based on Non-Spatial Old Growth Order • UWR & WHA (established and draft) excluded;
	(1) Operability	The impact on the harvest flow of including different operability classes in the THLB will be evaluated by (current management practices for all): • Removing non-conventional areas. • Including economically marginal areas.
	(2) Volumes	The impact on the harvest flow of varying stand yields will be evaluated by: • Varying existing natural stand volumes ±10%; and, • Varying regenerated stand volumes ±10%.
	(3) Site Productivity	The impact on the harvest flow of varying site indices will be evaluated by: ▪ Reducing SIBEC values globally by 3m; and, ▪ Using managed and future second growth Site Indices (SI 50) based on the Potential Site Indices compiled by Timberline.
	(4) Harvest Age	Increasing both the minimum harvest age by 10 years and the minimum harvest volume for the stand by 100 m3/ha will assess the effect of harvestability limits.
	(5) Visual Quality	The effects on varying the percent disturbed limit to the mid range.
	(6) Silviculture Opportunities	The impact of not fertilizing or using genetically improved stock in the future will be assessed.
	(7) Silviculture Systems	The potential impacts of implementing the use of the retention silviculture system as detailed in WFP's Forest Strategy will be evaluated.
	(8) Alternative Harvest Flow	The implications on timber supply associated with varying the rate of decline towards the long term harvest level (LTHL).

4 HARVEST MODEL

4.1 Woodstock/Stanley

The TFL 19 timber supply analysis including harvest level and forest inventory projections will be developed using Remsoft's spatial planning system Woodstock (www.remsoft.com).

Woodstock is a pseudo-spatial timber supply model that projects harvesting activities across a land base over a specific period of time. These models are referred to as pseudo-spatial because the data used to create the model has spatial components to it; however, the harvest schedules produced by these models are not spatially explicit. It is possible to bring spatial context into this type of model by applying constraints to spatial attributes of the land base such as landscape units or watersheds; however harvest schedules produced using these types of models report the timing of the harvest of different types of stands as opposed to specific polygons harvested in each period. For these reasons it is not possible to explicitly model spatial management objectives such as cutblock size, adjacency and green-up requirements, or patch size targets using this type of model.

Woodstock uses optimization to establish a harvest schedule that incorporates objectives such as visual quality, biodiversity, wildlife habitat with the objective of timber harvest. In Woodstock, harvest volume is maximized subject to the maintenance of other values on the land base.

Stanley, the spatial component of the Remsoft modelling suite, will be used for the 20-year spatial feasibility analysis ("20 Year Plan"). Stanley applies the Woodstock harvest forecast to specific polygons on the land base. Individual polygons are aggregated into suitable harvest units (cutblocks) based on specified minimum, maximum and target block sizes. Stanley can also enforce green-up and adjacency requirements as it schedules the harvest spatially.

5 FOREST COVER INVENTORY

5.1 Vegetation Resources Inventory

Management Plan #9 included a statement that completion of a new forest cover inventory was planned. A Vegetation Resource Inventory (VRI) project was initiated in 2000. Phase I (forest cover polygon boundaries delineated and attributes estimated using aerial photography) was completed in 2002. Phase II (ground sampling) occurred in 2002 and 2003 and the Net Volume Adjustment Factor (NVAF) sampling was carried out in 2003 and 2004. The last component, the statistical adjustment, was completed and reported on by J.S. Thrower & Associates (now part of Timberline Natural Resource Group) in early 2006, with a revision of the report for minor typographical errors in January 2007.

The VRI project was funded by the Forest Investment Account (FIA).

The forest cover has been updated for silvicultural treatments and assessments to the end of 2005 and for harvest depletion to the end of 2006. Table 5 indicates the current age class distribution of the forested land base of TFL 19.

Table 5 – Age Class Distribution

Age Class	Age (years)	Productive Forest (ha)	THLB (ha)
0	0	4,807	3,930
1	1-20	16,280	14,409
2	21-40	12,529	10,546
3	41-60	11,797	9,221
4	61-80	2,382	1,683
5	81-100	1,048	665
6	101-120	4,307	2,106
7	121-140	1,374	735
8	141-250	28,877	11,788
9	>250	56,366	24,365
Total		**139,767**	**79,448**

5.2 VRI Attribute Adjustments

Standard adjustment methods were used to adjust volume but non-standard methods were used for the age and height adjustment. The median age of the ground plots were used instead of the average age to provide more robust age estimates in old-growth stands. Using the median rather than the average age had little impact on site index and volume since these two variables are rather insensitive to a variation in age in old-growth stands. Non-standard top height trees (O and X trees) were used when no standard top height tree (T, L, and S trees) information existed. This significantly increased the number of valid height observations. Height adjustment ratios using the extra information were compared to the ratios based on the standard information only and shown to be similar in magnitude. The non-standard method

therefore had little impact on the polygon-level height estimates. Using the extra information however provided more precise estimates and therefore a higher level of confidence that the average height in each stratum was reliable.

The results have been reviewed by the MoFR, Forest Analysis & Inventory Branch and approved for use in the TFL 19 MP #10 timber supply analysis.

6 DESCRIPTION OF LAND BASE

6.1 Overview

This section describes the TFL 19 land base and the methods used to determine the portion of the land base that contributes to timber harvesting (THLB). Some portions of the productive land base, while not contributing to harvest, are crucial in meeting the demands for non-timber resource sustainability. Areas within all tables in this section may not sum due to rounding.

6.2 Timber Harvesting Land Base Determination

The THLB and the total long-term land base in TFL19 are presented in Table 6 – areas are reported for both Schedule A (Timber Licences within the TFL) and Schedule B (Crown land) land classes. Mature volume (stands ≥ 121 years old) estimates are indicated in Table 7. Areas and volumes have been compiled from a stand database constructed for the preparation of this information package.

For MP #9, in 2001, the total area of reductions amounted to 101,917 ha (if the inferred net-down for recreation is applied), then equal to 53% of the total area. For MP #10 the reductions are 92,303 ha, which is 54% of the total area.

The following sections show total area classified in each category noted in Table 6 – and serve to summarise the area deducted from the land base in the order the categories appear in Table 6 (i.e. overlapping constraints are addressed in a hierarchy).

The new forest inventory (VRI) used in this analysis affects some of the area reductions compared to those reported for MP #9. In particular the classification of areas as non-forest, non-productive forest and non-commercial forest is different. The resulting productive forest area is substantially higher than that reported in the MP #9 analysis. This additional area classified as productive forest is largely netted out as inoperable (refer to Section 6.8).

6.3 Total Area

The total area of the TFL is 171,722 ha. The total area in 2001 was 191,992 ha. The net decrease of 20,270 ha is due to the deletion of areas (primarily private land) from the TFL and the agreement on a management area for BCTS due to the Forest Revitalization Act (2003).

Table 6 – Timber harvesting land base for TFL 19[1]

Classification	Schedule A (ha)	Schedule B (ha)	Total (ha)
Total Area	**4,518**	**167,204**	**171,722**
Less: Non-Forest	91	16,195	16,286
Less: Non-Productive Forest	145	15,523	15,698
Total Productive Forest	**4,282**	**135,485**	**139,767**
Less Reductions to Total Productive Forest:			
Non-Commercial Brush	13	933	946
Riparian Reserves	254	3,519	3,773
Inoperable / Inaccessible	831	47,676	48,507
Wildlife Habitat Reserves	475	3,779	4,254
Road Right of Way	81	2,081	2,162
Karst	0	475	475
Recreation	1	203	204
Total Reductions to Productive Forest	**1,654**	**58,665**	**60,319**
Current Timber Harvesting Land Base	**2,628**	**76,820**	**79,448**
Less: Allowance for future WTRA (4%)	105	3,073	3,178
Less: Future Roads, Trails and Landings	28	930	958
Total Long Term Land Base	**2,495**	**72,817**	**75,312**

[1] Portion of TFL 19 that will be managed by WFP on an on-going basis (i.e. excludes BCTS management area)

Table 7 - Timber harvesting land base (mature volume) for TFL 19[1]

Classification	Schedule A (m^3)	Schedule B (m^3)	Total (m^3)
Total Volume	**1,468,845**	**46,472,481**	**47,941,326**
Less: Non-Forest	0	0	0
Less: Non-Productive Forest	0	0	0
Total Productive Forest	**1,468,845**	**46,472,481**	**47,941,326**
Less Reductions to Total Productive Forest:			
Non-Commercial Brush	614	64,776	65,390
Riparian Reserves	131,782	1,240,281	1,372,063
Inoperable / Inaccessible	338,328	20,268,098	20,606,426
Wildlife Habitat Reserves	357,311	2,243,546	2,600,857
Road Right of Way	3,997	131,900	135,897
Karst	0	186,041	186,041
Recreation	0	64,219	64,219
Total Reductions to Productive Forest	**832,032**	**24,198,861**	**25,030,893**
Total Reduced Land base	**636,813**	**22,273,621**	**22,910,434**
Less: Volume Reductions (WTRA – 4%)	25,473	890,945	916,418
Current Timber Harvesting Land Base	**611,340**	**21,382,676**	**21,994,016**

[1] Portion of TFL 19 that will be managed by WFP on an on-going basis (i.e. excludes BCTS management area)

6.4 Non-Forest

The non-forest portion of TFL 19 includes area where merchantable tree species are largely absent. Most of this area is in alpine, rocks and slides, and wet areas (Table 8).

Table 8 - Non-forest area in TFL 19

Description	Gross Non-forest Area (ha)	Total Area Reduction (ha)
Alpine	2,296	2,296
Rock and slides	11,262	11,262
Swamp, Marsh, Creek, River, Lake	2,421	2,421
Dump, Camps and Sort	64	64
Classified Roads and Pits	71	71
Hydro and Telephone RoW	172	172
TOTAL	**16,286**	**16,286**

6.5 Non-Productive Forests

TFL 19 includes 15,698 ha of non-productive land (Table 9). These largely alpine forest areas also contain brush (shrubs) and grass.

Table 9 – Non-productive area in TFL 19

Description	Gross Non-productive Area (ha)	Total Area Reduction (ha)
Non-productive	15,698	15,698

6.6 Non-commercial Cover

Approximately 946 ha of TFL19 is classified as non-commercial cover (Table 10). Most of this area is occupied by brush.

Table 10 - Non-commercial area

Description	Gross Non-commercial Area (ha)	Total Area Reduction (ha)
Brush	946	946

6.7 Riparian Reserves

Detailed riparian features mapping is ongoing for TFL 19 through cutblock development. Operational stream inventories associated with development planning have been conducted since 1988 and reconnaissance (1:20,000) fish and fish habitat inventory projects to RIC standards were completed between 1999 and 2002. These inventories provide information on fish distribution, fish habitat, and habitat restoration opportunities.

This detailed information provided the basis for estimating riparian classes and hence reserve areas for watercourses. A review of cutblocks harvested over the past ten years indicated that within-block retention within the riparian management zone has been minimal and it is not expected to change in the future. The approach employed in the timber supply analysis was to utilise the available stream classification in the GIS to apply reserves to known fish bearing streams, in accordance to specifications in the Forest and Range Practices Act. A non-spatial allowance for retention within riparian management zones and streams not mapped at 1:20,000 (generally narrow and not expected to contain fish) is incorporated with the volume reduction for wildlife tree retention (see Section 10.3.5).

Table 11 - Riparian Reserve Zones

Riparian Feature Class	Feature Size	Riparian Reserve width from FRPA (metres)
Double Line Streams (ha)		
S1	493	50
S2	103	30
Single Line streams (km)		
S1	36	50
S2	205	30
S3	291	20
S4	3	0
S5	793	0
S6	3,023	0
Lakes and Wetlands (ha)		
L1	1,385	**10**
W1	96	**10**
W2	10	**10**
W3	132	**0**
W5	15	**10**

Double line streams – Within the GIS all double-lined streams (i.e. polygons) are assigned a riparian reserve based on their classification.

Operationally, riparian reserve zones are established using slope distance; these zones are modelled using horizontal distance. Therefore the area of riparian reserve zones is slightly overestimated in the GIS data used in the timber supply analysis. This additional unquantifiable area also helps account for retention within riparian management zones and streams not mapped at 1:20,000.

Table 12 - Riparian Reserves in TFL 19

Description	Gross Riparian Reserve Area (ha)	Total Area Reduction (ha)
S1	1,407	1,370
S2	1,384	1,335
S3	1,060	905
L1	117	105

Description	Gross Riparian Reserve Area (ha)	Total Area Reduction (ha)
W1	71	40
W2	10	9
W5	12	9
TOTAL	**4,061**	**3,773**

6.8 Inoperable/Inaccessible

Operability classes have been developed for TFL 19 that reflect the harvesting system, timber quality, terrain stability, and economic accessibility. Some of the operability criteria were based on attributes from the previous forest inventory. Significantly more productive forest area is classified as inoperable compared to that for MP #9. A large part of the difference is area classified as productive in the VRI, but considered non-productive in the previous inventory (approximately 4,500 ha out of the total difference of 8,000 ha). Updating the operability mapping to reflect the current forest inventory (VRI) may change the operability classification somewhat, however changes are expected to largely be in areas of marginal economics.

Three major categories are recognized:

Inoperable (I) - This includes areas not available for timber harvesting due to being physically inaccessible, of low productivity and/or unmerchantable. Physical inoperability relates to the presence of a physical barrier or terrain constraint leaving access virtually impossible. Low productivity and/or unmerchantable relates to stands that do not produce wood volumes or quality that is economical to harvest and manage under an even-aged silviculture system regardless of market conditions.

Marginal (Oce/Ohe) - Timber harvesting under normal market conditions is not justified given costs of harvesting and the expected value of the timber. Oce refers to conventional harvesting areas and Ohe refers to helicopter logging areas that could be logged and managed under an even-aged silviculture system profitably should markets improve sufficiently.

Operable (Oc/Oh) - Areas that are classified as operable for the timber supply analysis. Oc refers to conventional harvesting areas and Oh refers to helicopter logging areas.

Of the net inoperable land base, 4,418 ha are currently classified as Oce/Ohe and 44,089 ha are currently classified as I. The total area excluded from the productive forest land base for operability reasons is 48,507 ha (see Table 13).

Table 13 - Inoperable area (ha) by class

Description	Gross Inoperable Area (ha)	Total Area Reduction (ha)
I – Physically Inoperable/ low productivity/unmerchantable	72,563	44,089
Oce – Operable for conventional logging with economic constraints removed	430	374

Description	Gross Inoperable Area (ha)	Total Area Reduction (ha)
Ohe – Operable for heli-logging with economic constraints removed	4,616	4,044
TOTAL	**77,609**	**48,507**

Harvest areas by operability class and within terrain classes IV and V have been reported during MP #9. The results for the years 2001 to 2006 are summarized in Table 14 and Table 15.

Table 14 - TFL 19 Harvest Area for 2001 to 2006 by Operability Class

Operability Class	% of Harvest Area	% of THLB
Conventional (Oc)	87.1%	87.9%
Non-conventional (Oh)	6.0%	12.1%
Marginal (Oce & Ohe)	1.6%	0%
Inoperable	5.3%	0%
Total	**100.0%**	**100.0%**

Table 15 - TFL 19 Harvest Area for 2001 to 2006 on Class IV and Class V Terrain

Terrain and Slope Classes	% of Harvest Area	% of THLB
Class IV < 80%	21.9%	17.8%
Class IV > 80%	3.3%	4.1%
Class V < 80%	2.1%	2.4%
Class V > 80%	0.4%	0.5%
Total	**27.7%**	**24.8%**

6.9 Forest Regeneration

Inventories maintained by the previous Licensee indicated areas of potentially poor regeneration associated with harsh geoclimatic conditions and biotic damage, largely within inoperable areas. The area within the operable land base subject to harsh geoclimatic conditions was small and operational foresters believe these areas are widely-scattered, small patches and therefore appropriately accounted for within operational adjustment factors. Definable areas of failed regeneration due to brush or wildlife browsing have not been realized and are no longer anticipated within the THLB. WFP does not consider this classification applicable to TFL 19 and has not included it within the inventory files.

6.10 Wildlife Habitat

Revised Ungulate Winter Ranges (UWRs) for Columbian black-tailed deer and Roosevelt elk were approved in December 2004 (U-1-014). The original 73 UWRs had a total area of 6,231 ha (excluding 648 ha in Provincial Parks). Two UWRs were amended slightly on January 30, 2006 to accommodate adjacent cutblocks. With the deletion of the private land from the TFL, a total of 163 ha of UWR was

removed from the TFL. A total of 189 ha of replacement UWR has been identified within TFL 19 and was legally established on November 9, 2007. These replacement UWRs are included in the data set for the analysis and will be excluded from the THLB.

Six Wildlife Habitat Areas (WHAs) have been approved in TFL 19. Five of these for the Queen Charlotte Goshawk were approved in December of 2004 and the sixth for the Keen's Long-eared Myotis was approved in April of 2000. The WHAs have a total area of 689 ha.

Marbled Murrelet habitat capability inventories have been developed for northern and western portions of Vancouver Island. Collaboration between WFP and the Ministry of Environment (MoE) is proceeding on defining and refining draft Marbled Murrelet WHAs within TFL 19. A total of 813 ha of draft WHAs are included in the data set to account for managing Marbled Murrelet habitat within TFL 19. The inclusion of these draft WHAs in no way gives them any legal status but is merely the current best estimate of spatially accounting for the FPPR section 7 notice and the approved strategy in the FSP for Marbled Murrelet habitat.

Area reductions of 4,254 ha for wildlife habitat exceeds the 2,467 ha allowed for in MP #9. The difference is due to the establishment of UWR areas equivalent to Ew2 areas (cover class constraint) applied in MP #9 and the establishment of WHAs.

Wildlife Tree Retention Areas (WTRA) and other stand-level retention will be handled through a volume reduction of 4% in the timber supply analysis as described in Section 10.3.5.

Table 16 - Wildlife areas

Description	Gross Wildlife Area (ha)	Total Area Reduction (ha)
Ungulate Winter Range	5,880	3,550
Wildlife Habitat Area - Established	689	348
Wildlife Habitat Area - Draft	831	356
TOTAL	**7,382**	**4,254**

6.11 Recreation Feature Inventory and Karst Potential

On April 12, 2006, a Government Actions Regulation (GAR) Order was established to identify Recreation Resource Features for the Campbell River Forest District. Many of the TFL 19 polygons in the Order correspond to areas identified in the TFL 19 recreation features inventory, with the majority located in areas that are non-forested or non-productive forest.

It is recognized that as operational planning proceeds some harvesting may occur in these areas. Most of the productive forest area in the GAR Order polygons is netted-down as inoperable or for karst (see following paragraph). Additional 100% netdowns are applied to the GAR Order polygons where the corresponding recreation features in the TFL 19 inventory have a very high or high significance and a high or moderate sensitivity, resulting in 162 ha (approximately 10%) of the 1,558 ha of productive forest in the GAR Order polygons remaining in the THLB.

A Planning Level Karst Inventory of TFL 19 was completed in March 2003. Funding was primarily from Forest Renewal BC (FRBC) and the Forest Investment Account (FIA). The impact of protecting karst features on timber supply is uncertain. To date, little area has been reserved during operational planning to protect karst features. Estimates of impacts will improve as operational planning proceeds in karst areas. In the meantime, for this analysis, karst polygons rated as very high and high vulnerability will be netted down at 100%. This is representative of possible impacts as it is recognized that areas may be reserved in lower vulnerability classes and that not all areas will need to be reserved in very high and particularly high vulnerability classes. This is also consistent with the Campbell River Forest District GAR *Order to Identify Karst Resource Features* of May 30, 2007.

These more specific directions on defining areas of recreation value have resulted in lower area reductions than in MP #9 (679 ha compared to 4,627 ha).

Table 17 – Karst and Recreation areas

Description	Karst Vulnerability Potential	Gross Recreation Area (ha)	Total Area Reduction (ha)
Karst	VH	315	71
Karst	H	612	404
Recreation		4,415	204
TOTAL			**679**

6.12 Cultural Heritage Resources

An archaeological overview assessment for the Nootka and Kyuquot Sound areas including TFL 19 was completed by Arcas Consulting Archaeologists Ltd. in 1998 and was updated in early 2007 by Baseline Archaeological Services Ltd.. This overview deals with archaeological sites and resources and indicates where past human activities are likely to have occurred. This assessment is used in operational planning. Areas with high potential of past activities are subject to field reconnaissance and inventory.

Some recently harvested cutblocks have had numerous culturally modified trees (CMTs) inventoried within the harvest boundaries (e.g. cutblocks near Galiano Bay on Tlupana Inlet). The vast majority of the CMTs were harvested under Site Alteration Permits issued under the Heritage Conservation Act with no areas being reserved specifically to manage CMTs. No explicit reductions for cultural heritage resources have been made to the inventory file as management of the most common features such as CMTs are addressed by already-accounted-for reserves for riparian protection or wildlife tree retention.

6.13 Deciduous Stands

Table 18 shows the area of stands defined as deciduous leading in the inventory. This represents about 0.65% of the THLB. These are included in the THLB and these minor deciduous volumes will be included in modelled timber flows.

Table 18 - Area of Deciduous forest types

Inventory Type Group	Net Deciduous Area (ha)
Pure deciduous	48
Deciduous leading	470
TOTAL	**518**

6.14 Roads, Trails and Landings

6.14.1 Existing Roads

Existing roads are excluded from the timber harvesting land base. This reduction is due to the combination of classified and unclassified roads. Classified roads are those that are mapped as forest cover polygons distinctly separate from adjacent polygons. Unclassified roads have been mapped as lineal features. For the purposes of determining the total area of unclassified roads, all mainlines are assumed to occupy a 13 metre wide unproductive width; all other unclassified roads are assumed to occupy a 10 metre wide unproductive width. As all trails and the majority of the landings are rehabilitated and restocked immediately following logging, the associated area reduction is thought insignificant. Table 19 summarizes the areas of existing roads in the TFL.

Table 19 - Existing roads

Description	Gross Road Area (ha)	Total Area Reduction (ha)
Existing road	2,372	2,162

Further road development and a larger allowance for main roads (13m width compared to 10m) have increased the reduction for existing roads from the 1,948 ha in the MP #9 analysis.

6.14.2 Future Roads

A projected road system was developed as part of the operability classification for TFL 19. This road system was digitized into the GIS in conjunction with the operability classification, which allowed for the same approach used with existing roads to predict area summaries. The area available for timber production will be reduced when the model harvests these polygons.

Table 20 indicates the area of future roads in the TFL that have yet to be developed.

Road development during MP #9 has reduced this allowance from that applied in MP #9.

Table 20 - Future roads

Description	Gross Road Area (ha)	Total Area Reduction (ha)
Future road	1,194	958

7 INVENTORY AGGREGATION

7.1 Overview

This section describes the delineation of the TFL land base and definition of stand types needed to complete the timber supply analysis. The TFL area is categorized in a hierarchy of different management zones to allow for a variety of forest cover constraints (e.g., biodiversity). Stand types are grouped in analysis units (AU) based on similar leading species, history and productivity. Areas within all tables in this section may not sum due to rounding.

7.2 Management Zones

Unique forest cover objectives will be modelled through the different management zones. Landscape Units, Special Management Zone (SMZ) and Resource Management Zone (RMZ) are delineated in the data and may be used to report seral stage distributions and other ecological parameters for selected sensitivity analyses (Table 21 and Table 22).

Table 21 - Management zones and landscape units

Mgmt Zone	Mgmt Unit	Landscape Unit	Seral[1] Stage	Productive Forest (ha)	Management Considerations (from Vancouver Island Summary Land Use Plan)
EMZ 24	Burman	Burman *Low BEO*	Early	2,552	***Enhanced Forestry Zone*** suited for enhanced silviculture, as well as limited enhanced timber harvesting; due consideration and integration of riparian and wildlife values associated with Burman River corridor into Strathcona Park; integration of biodiversity, recreation and scenic values.
			Mid	534	
			Mature	725	
			Old	5,324	
			Total	**9,135**	
EMZ 18	Eliza	Eliza *Low BEO*	Early	932	***Enhanced Forestry Zone,*** particularly suited for enhanced timber harvesting in suitable areas (e.g. areas which are not visually sensitive), as well as enhanced silviculture on most productive sites; emphasis on scenic values along coast, and integration of associated recreation/tourism opportunities; objectives for biodiversity are to be integrated at the basic stewardship; adaptive road engineering/deactivation efforts are indicated to maintain terrain and watershed integrity.
			Mid	1,242	
			Mature	178	
			Old	2,672	
			Total	**5,024**	

[1] Early seral is <40 years old; Mid seral is 40-80 years old in CWH zone and 40-120 years old in MH zone; Mature seral is 81-250 years old in CWH zone and 121-250 years old in MH zone; Old seral is >250 years old.

Mgmt Zone	Mgmt Unit	Landscape Unit	Seral Stage	Productive Forest (ha)	Management Considerations (from Vancouver Island Summary Land Use Plan)
GMZ 22	Gold	Gold *High BEO*	Early	7,493	***General Management Zone***, with high fish, wildlife and biodiversity values, as well as significant timber values; landscape level development of riparian recovery plan for the Gold-Muchalat-Oktwanch-Nimpkish riparian corridor recommended.
			Mid	6,993	
			Mature	9,537	
			Old	15,160	
			Total	**39,184**	
EMZ 23	Kleeptee	Kleeptee *Low BEO*	Early	2,694	***Enhanced Forestry Zone***, suited for enhanced timber harvesting and silviculture, while maintaining fish and wildlife, as well as watershed integrity; basic level of biodiversity conservation; integration of coastal scenic and recreation values.
			Mid	845	
			Mature	4,193	
			Old	5,703	
			Total	**13,435**	
SMZ 11	Schoen-Strathcona	Gold *High BEO*	Early	721	***Special Management Zone***, the focus should be on maintenance of old growth biodiversity and habitat values, as well as backcountry recreation potential and maintenance of viewsheds around Victoria and Warden Peaks; this SMZ should become a focal area for old growth retention at the landscape level.
			Mid	333	
			Mature	9	
			Old	1,076	
			Total	**2,139**	
EMZ 19	Tahsis	Tahsis *Low BEO*	Early	4,316	***Enhanced Forestry Zone,*** with opportunity for enhanced timber harvesting, as well as enhanced silviculture on most productive sites; emphasis on integration of visual values along coastline; objectives for biodiversity are to be integrated at the basic stewardship level; adaptive road engineering/ deactivation efforts are indicated to maintain terrain and watershed integrity.
			Mid	2,622	
			Mature	5,115	
			Old	7,993	
			Total	**20,046**	
EMZ 21	Tlupana	Tlupana *Intermediate BEO*	Early	8,766	***Enhanced Forestry Zone***, with significant opportunity for enhanced timber harvesting and silviculture, while maintaining high fish, wildlife and intermediate biodiversity values; integration of scenic/recreation/tourism values along coastline.
			Mid	1,977	
			Mature	15,877	
			Old	10,732	
			Total	**37,353**	
SMZ 6	Woss-Zeballos	Zeballos *Low BEO*	Early	64	This ***Special Management Zone*** should become a focal area for old growth biodiversity conservation; focus should also be on maintenance of recreation opportunities associated with lakes and alpine/subalpine, and maintenance of scenic values associated with recreation sites and access corridors.
			Mid	40	
			Mature	46	
			Old	2,122	
			Total	**2,272**	
GMZ 16	Zeballos	Zeballos *Low BEO*	Early	2,914	***General Management Zone***, with lower biodiversity conservation objectives; sensitive development of timber values on unstable terrain
			Mid	1,586	
			Mature	460	
			Old	6,220	
			Total	**11,180**	
GRAND TOTAL				**139,768**	

Table 22 - Area by landscape unit and BEC variant

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)[1]	Non Contributing Area		THLB Area	
				ha	%	ha	%
Burman	CWH vm 1	Early	2,127	143	7%	1,984	93%
		Mid	477	77	16%	400	84%
		Mature	476	52	11%	424	89%
		Old	2,908	1,143	39%	1,765	61%
	CWH vm 1 Total		5,988	1,415	24%	4,573	76%
	CWH vm 2	Early	285	19	7%	266	93%
		Mid	37	31	84%	6	16%
		Mature	65	48	74%	17	26%
		Old	1,986	1,104	56%	882	44%
	CWH vm 2 Total		2,373	1,202	51%	1,171	49%
	MH mm 1	Early	3	0	0%	3	100%
		Mid	5	5	100%	0	0%
		Mature	180	115	64%	65	36%
		Old	353	269	76%	84	24%
	MH mm 1 Total		541	389	72%	152	28%
	MH mmp1	Mature	1	1	100%	0	0%
		Old	8	8	100%	0	0%
	MH mmp1 Total		9	9	100%	0	0%
Burman Total			***8,911***	***3,015***	***34%***	***5,896***	***66%***
Eliza	CWH vm 1	Early	786	88	11%	698	89%
		Mid	1,192	111	9%	1,081	91%
		Mature	161	55	34%	106	66%
		Old	1,994	859	43%	1,135	57%
	CWH vm 1 Total		4,133	1,112	27%	3,020	73%
	CWH vm 2	Early	105	7	6%	98	94%
		Mid	2	1	50%	1	50%
		Mature	17	17	100%	0	0%
		Old	603	324	54%	279	46%
	CWH vm 2 Total		726	348	48%	378	52%
	MH mm 1	Old	69	64	93%	5	7%
	MH mm 1 Total		69	64	93%	5	7%
Eliza Total			***4,928***	***1,524***	***31%***	***3,403***	***69%***

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)[1]	Non Contributing Area		THLB Area	
				ha	%	ha	%
Gold	CWH vm 1	Early	4,613	442	10%	4,171	90%
		Mid	4,282	634	15%	3,648	85%
		Mature	2,078	1,162	56%	916	44%
		Old	3,445	1,875	54%	1,570	46%
	CWH vm 1 Total		14,418	4,113	29%	10,305	71%
	CWH vm 2	Early	2,528	121	5%	2,407	95%
		Mid	676	226	33%	450	67%
		Mature	3,304	2,232	68%	1,072	32%
		Old	7,112	3,576	50%	3,536	50%
	CWH vm 2 Total		13,620	6,155	45%	7,465	55%
	CWH xm 2	Early	220	42	19%	178	81%
		Mid	1,888	279	15%	1,609	85%
		Mature	1,551	1,033	67%	518	33%
		Old	311	287	92%	24	8%
	CWH xm 2 Total		3,970	1,641	41%	2,329	59%
	MH mm 1	Early	372	11	3%	361	97%
		Mid	147	114	78%	33	22%
		Mature	2,361	1,944	82%	417	18%
		Old	5,088	3,199	63%	1,889	37%
	MH mm 1 Total		7,968	5,268	66%	2,700	34%
	MH mmp1	Mature	122	122	100%	0	0%
		Old	59	59	100%	0	0%
	MH mmp1 Total		181	181	100%	0	0%
Gold Total			***40,157***	***17,358***	***43%***	***22,799***	***57%***
Kleeptee	CWH vm 1	Early	1,710	125	7%	1,586	93%
		Mid	608	117	19%	491	81%
		Mature	1,424	556	39%	868	61%
		Old	2,460	931	38%	1,529	62%
	CWH vm 1 Total		6,202	1,728	28%	4,474	72%
	CWH vm 2	Early	805	41	5%	764	95%
		Mid	42	18	43%	24	57%
		Mature	1,725	1,032	60%	694	40%
		Old	2,352	1,414	60%	938	40%
	CWH vm 2 Total		4,924	2,505	51%	2,419	49%
	CWH xm 2	Early	42	5	11%	37	89%
		Mid	141	17	12%	124	88%
		Mature	366	234	64%	132	36%
		Old	35	8	22%	27	78%
	CWH xm 2 Total		584	264	45%	321	55%
	MH mm 1	Early	7	0	6%	6	94%
		Mid	26	26	99%	0	1%
		Mature	659	574	87%	86	13%
		Old	830	755	91%	75	9%
	MH mm 1 Total		1,522	1,355	89%	167	11%
Kleeptee Total			***13,232***	***5,851***	***44%***	***7,381***	***56%***

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)[1]	Non Contributing Area		THLB Area	
				ha	%	ha	%
Tahsis	CWH vm 1	Early	3,066	329	11%	2,737	89%
		Mid	2,218	297	13%	1,922	87%
		Mature	3,460	1,115	32%	2,345	68%
		Old	3,837	1,803	47%	2,034	53%
	CWH vm 1 Total		12,581	3,544	28%	9,037	72%
	CWH vm 2	Early	937	66	7%	866	93%
		Mid	259	97	37%	162	63%
		Mature	1,329	780	59%	549	41%
		Old	2,949	2,055	70%	894	30%
	CWH vm 2 Total		5,468	2,998	55%	2,471	45%
	MH mm 1	Early	52	5	9%	48	91%
		Mid	62	61	98%	1	2%
		Mature	276	256	93%	20	7%
		Old	1,092	989	91%	104	9%
	MH mm 1 Total		1,482	1,310	88%	172.0	12%
	MH mmp1	Mid	1	1	100%	0	0%
		Mature	5	5	100%	0	0%
		Old	22	22	100%	0	0%
	MH mmp1 Total		27	27	100%	0	0%
Tahsis Total			***19,559***	***7,879***	***40%***	***11,680***	***60%***
Tlupana	CWH vm 1	Early	7,217	659	9%	6,558	91%
		Mid	1,647	335	20%	1,312	80%
		Mature	9,499	4,119	43%	5,380	57%
		Old	3,987	1,427	36%	2,560	64%
	CWH vm 1 Total		22,350	6,540	29%	15,810	71%
	CWH vm 2	Early	1,025	105	10%	920	90%
		Mid	154	125	81%	29	19%
		Mature	5,142	3,395	66%	1,747	34%
		Old	4,778	3,014	63%	1,764	37%
	CWH vm 2 Total		11,099	6,639	60%	4,460	40%
	MH mm 1	Early	28	27	96%	1	4%
		Mid	51	51	100%	0	0%
		Mature	1,132	1,057	93%	75	7%
		Old	1,873	1,750	93%	123	7%
	MH mm 1 Total		3,084	2,885	94%	199	6%
	MH mmp1	Early	1	1	100%	0	0%
		Mature	12	12	100%	0	0%
		Old	13	13	100%	0	0%
	MH mmp1 Total		26	26	100%	0	0%
Tlupana Total			***36,559***	***16,090***	***44%***	***20,469***	***56%***

Landscape Unit	BEC	Seral Stage	Productive Forest (ha)[1]	Non Contributing Area		THLB Area	
				ha	%	ha	%
Zeballos	CWH vm 1	Early	2,129	159	7%	1,970	93%
		Mid	1,406	197	14%	1,209	86%
		Mature	348	49	14%	299	86%
		Old	3,321	1,599	48%	1,721	52%
	CWH vm 1 Total		7,204	2,004	28%	5,200	72%
	CWH vm 2	Early	618	58	9%	560	91%
		Mid	99	74	75%	25	25%
		Mature	79	63	80%	16	20%
		Old	3,949	2,281	58%	1,668	42%
	CWH vm 2 Total		4,745	2,476	52%	2,269	48%
	MH mm 1	Early	24	24	98%	0	2%
		Mid	44	44	99%	0	1%
		Mature	69	56	82%	13	18%
		Old	996	706	71%	290	29%
	MH mm 1 Total		1,134	830	73%	304	27%
	MH mmp1	Early	0	0	100%	0	0%
		Mid	0	0	100%	0	0%
		Mature	1	1	100%	0	0%
		Old	12	9	78%	3	22%
	MH mmp1 Total		13	10	80%	3	20%
Zeballos Total			***13,095***	***5,320***	***41%***	***7,775***	***59%***
GRAND TOTAL			**136,441**	**57,037**	**42%**	**79,403**	**58%**

[1] All existing roads and Non-commercial brush are excluded in area totals.

7.3 Analysis Units

The forested area in the THLB is aggregated into groups of similar stands to produce growth and yield information needed to model timber supply. For existing stands, analysis units are based on biogeoclimatic subzone/variant (subzone), site productivity class, age class, and leading species. These grouping are described in more detail in the following sections.

"Base" refers to analysis units in the THLB for the base option. "Marginal" refers to the additional areas classified for the sensitivity that includes marginal lands (Oce and Ohe – refer to Section 6.8)

7.3.1 Subzone assignment

Subzones were assigned using the TFL 19 Terrestrial Ecosystem Mapping (TEM). Each polygon in the THLB was assigned to one of four analysis unit level subzones. Resultant polygons with missing subzones were assigned the subzone with the largest representative area for that particular forest cover polygon (this only affected 30 ha). MHmmp1 was combined with MHmm1 to limit the number of unique combinations (Table 23).

Table 23 – Analysis Units Subzones

	Area (ha)		
Subzone	**Base AUs**	**Marginal AUs**	**Total**
CWHvm1	52,439	1,008	53,447
CWHvm2	20,656	2,158	22,814
MHmm1	3,704	1,008	4,712
CWHxm2	2,649	2	2,651
Total	**79,448**	**4,176**	**83,624**

7.3.2 Productivity class assignment

SIBEC site index estimates were attached to each forest cover (for_pid) / subzone resultant polygon. Area weighted-average Fd and Hw SIBEC site index was calculated for each forest cover / subzone resultant polygon based on the component site series within each resultant polygon. Site productivity classes were developed by WFP based on the range and distribution of 3 m site index estimate classes within each subzone (Figure 2, Figure 3, and Table 24). SIBEC site index values for Hw are used in the CWHvm1, CWHvm2, and MHmm1 subzones and Fd is used in the CWHxm2 subzone. Note that the total areas within each subzone indicated in Figure 2 and Figure 3 include the two woodlots now removed from TFL 19 and the BCTS management area as well as the WFP portion of TFL 19.

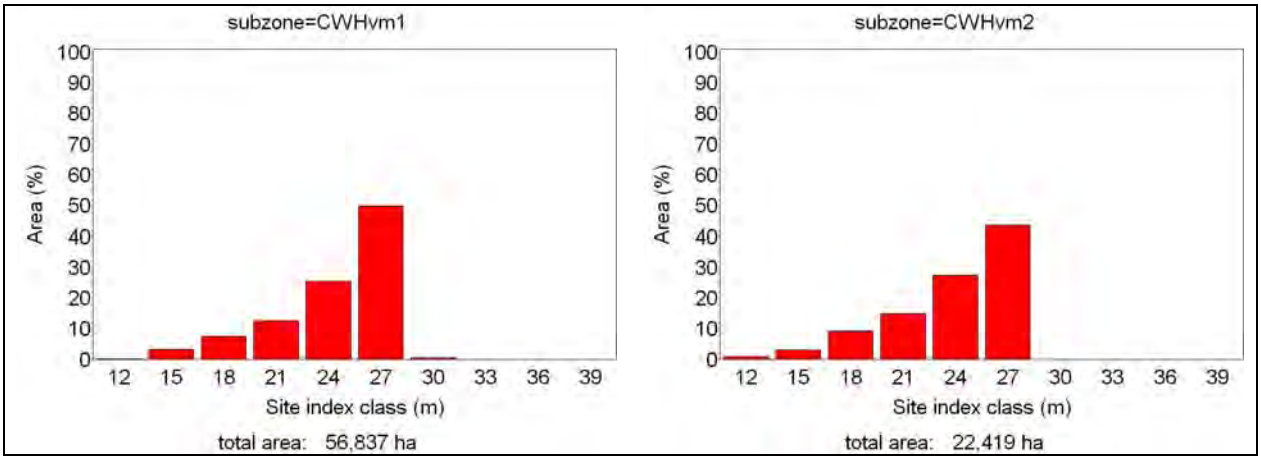


Figure 2 – Site Indices for CWHvm1 and CWHvm2

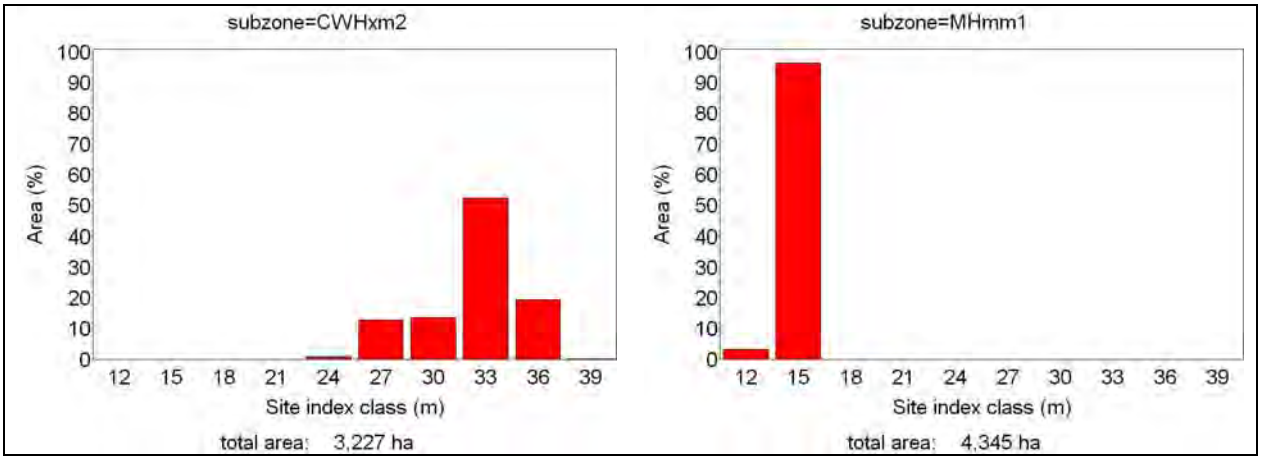


Figure 3 – Site Indices for CWHxm2 and MHmm1

Table 24 –Site Productivity Classes by Subzone – Base AUs

	Productivity class						
	good		medium		poor		
Subzone	SI class (m)	Area (ha)	SI class (m)	Area (ha)	SI class (m)	Area (ha)	Total Area (ha)
CWHvm1	≥ 27	25,318	21-24	20,876	< 21	6,245	52,439
CWHvm2	≥ 27	8,745	21-24	8,951	< 21	2,960	20,656
CWHxm2	≥ 36	579	30-33	1,884	< 30	185	2,649
MHmm1					All	3,704	3,704
Total Area		**34,642**		**31,711**		**13,095**	**79,448**

7.3.3 Species group assignment

Each polygon was assigned to one of six species groups based on the leading species in the inventory label. Sufficiently restocked polygons missing an inventory label (approx. 1,335 ha) were assigned to a leading species group based on management practices within each subzone: Hw for CWHvm1/vm2, Fd for CWHxm2 and Ba for MHmm1.

Table 25 – Species Groups

Species group	Base area (ha)	Marginal area (ha)	Total area (ha)
Hw	47,275	2,006	49,281
Fd	9,909	0	9,909
Cw	8,183	542	8,725
Yc	5,113	1,165	6,278
Other	2,185	394	2,579
Ba	2,754	0	2,754
Total	**75,419**	**4,107**	**79,526**

Other includes Dr, Pl, Mb, and Ss

Recently harvested (projected age=0 years) and NSR polygons are excluded from this summary (4,029ha in the base area and 69 ha in the marginal area) but are assigned to future yield curves based on subzone and productivity class (see Section 8.8.2).

7.3.4 Age class assignment

Each polygon was assigned an age class based on maturity and management era (Table 26). Existing managed stands less than or equal to 10 years of age in the base area were put into separate analysis units to isolate the use of genetically improved stock during this management era in the timber supply model.

Table 26 – Age Classes

Age class	Adjusted age range (years)	Base area (ha)	Marginal area (ha)
Mature natural	≥121	36,875	3,976
Immature natural	46-120	10,355	55
Existing managed $_{>10 \text{ years}}$	11-45	20,994	76
Existing managed $_{\leq 10 \text{ years}}$	1-10	7,196	n/a
Future	0 (+ NSR polygons)	4,029	69

7.3.5 Analysis unit assignment for timber supply model

Polygons in the timber harvesting land base were assigned to existing analysis units defined by the unique combination of subzone, site productivity class, age class, and leading species. Analysis unit / species combinations representing less than 100 ha were combined into the 'Other' species analysis unit

within the same combination of subzone, site productivity class, and age class. Also, productivity classes were combined within subzone / age class / leading species analyses units in the marginal area representing less than 100 ha (affects 123 ha in total). This resulted in 111 existing analysis units in the base area, and an additional 29 existing analysis units in the marginal area. (Appendix A – Appendix C).

Future analysis units for each polygon were defined by the unique combination of subzone, and site productivity class. Also, productivity classes were combined within subzone analyses units in the marginal area representing less than 100 ha (affects 123 ha in total). This resulted in 10 future analysis units in the base area, and an additional 10 future analysis units in the marginal area. (Appendix D).

7.3.6 Analysis unit codes

A 5-character code identifies the land base area (base or marginal), subzone, productivity class, species group and age class for each analysis unit (Table 27).

Table 27 – Analysis Units Legend

First Character *Land base area*	Second Character *Subzone*	Third Character *Productivity Class*	Fourth Character *Leading Species*	Fifth Character *Age Class*
B Base M Marginal	1 CWHxm2 2 CWHvm1 3 CWHvm2 4 MHmm1/mmp	G Good M Medium P Poor A All	B Balsam C Cedar F Fir H Hemlock O Other Y Cypress	1 1 -10 years 2 11 – 45 years 3 46 – 120 years 4 121+ years 5 Future stands

For example, the code B2GH2 identifies the Base/CWHvm1/Good Site/Hemlock leading/age 11-45 analysis unit.

8 GROWTH AND YIELD

8.1 Overview

This section describes the approach used to develop yield tables for managed and natural stands. The general approach is to develop yield tables for existing and future stands, thus specific yield tables are developed for:

1) Existing natural mature stands.
2) Existing natural immature stands.
3) Existing managed stands.
4) Future managed stands.

Table 28 describes the different input parameters for the different sets of yield tables.

Table 28 - Modelling overview

	Existing Natural Mature Stands	Existing Natural Immature Stands	Existing Managed Stands	Future Stands
Inputs				
Model	Batch VDYP (6.6d) (Flatline)	Batch VDYP (6.6d)	Batch TIPSY (4.1)	Batch TIPSY (4.1)
Age Class	121+ years	46 - 120 years	1 - 45 years	All
Current Area (ha)	36,875	10,355	28,190	4,029
Proportion of THLB	47%	13%	35%	5%
Outputs SIBEC scenario				
Average Culm MAI	N/A	5.6 m^3/ha/yr	9.6 m^3/ha/yr	9.2 m^3/ha/yr
Average Culm Age	N/A	89 years	82 years	86 years
Average Volume at Culm Age	N/A	440 m^3/ha	743 m^3/ha	707 m^3/ha
Outputs PSI scenario				
Average Culm MAI	N/A	5.6 m^3/ha/yr	10.1 m^3/ha/yr	10.0 m^3/ha/yr
Average Culm Age	N/A	89 years	80 years	82 years
Average Volume at Culm Age	N/A	440 m^3/ha	780 m^3/ha	774 m^3/ha

8.2 Site Index

Site index estimates for existing immature natural stands are from the adjusted inventory database.

Site index estimates for existing and future managed stands are based on the SIBEC database. A site index was assigned to each site series in the Terrestrial Ecosystem Mapping (TEM) within the THLB, based on the current-leading species in the inventory for existing managed stands. Site index for future managed stands was based on the expected future leading species on that site series. This was done for both the SIBEC estimate (to generate yield tables for the base case) and potential site index (PSI) estimates (to generate yield tables for a PSI scenario).

In MP #9, the site indexes used for managed stands, were estimated by averaging SIBEC and TFL 37 site indexes by site series. The result was an average site index of 26, substantially higher than the SIBEC estimates (average of 23.9) to be used in the MP #10 base case.

SIBEC estimates for TFL 19 were compared to site index data collected from random sampling in other coastal management units including TFL 6, 37, 46, 47, and 54 (SIA projects). High elevation data from permanent and temporary sample plots on TFL 39 and 44 was also reviewed.

Potential site index (PSI) estimates were developed from these existing data by Timberline to reflect the local conditions on TFL 19. Expert opinion was used to fill data gaps or inconsistencies and to ensure that expected site productivity trends were applied across species, subzone variant, site series, and soil moisture and nutrient regimes. See Appendix G: Timberline Memo Re: SIBEC and PSI Estimates for TFL 19 for the Timberline document.

PSI estimates average 25.4 m across the THLB compared to an average of 23.9 using SIBEC. Refer to Appendix H: SIBEC and PSI Estimates for Major Site Series in TFL 19 for a comparison of SIBEC and PSI values for significant site series in TFL 19.

A significant difference between PSI and SIBEC estimates is for western hemlock in the CWHvm1/03 site series (approximately 13% of the net land base). This site series has been sampled to improve the Hw site index estimate. Preliminary results support the lower SIBEC site index estimate in the CWHvm1/03 site series.

Notwithstanding the results of the sampling, the PSI estimates will be included as a sensitivity of higher (on average) site indexes for managed and future stands (refer to Section 3.3).

8.3 Utilization Levels

The utilization level is 12.5 cm for all existing stands less than 46 years old and for future stands. Stump height for these stands is 30 cm and top diameter inside bark (DIB) is 10 cm. Utilization level for immature and mature natural stands is 17.5 cm, with stump height of 30 cm and top DIB of 15 cm (Table 29). Operationally stands aged 46 to 120 years are utilized to the same minimum DBH as listed for the younger managed stands; however, volumes for these stands are being calculated using VDYP and VDYP does not accept the smaller DBH standards for TFL 19.

Table 29 - Utilization levels

Species Group	Utilization			Firmwood Standard
	Minimum DBH (cm)	Stump Height (cm)	Top DIB (cm)	
Managed Conifers (1 - 45 yrs, future)	12.5	30.0	10.0	50%
Immature (46 – 120 yrs)	17.5	30.0	10.0	50%
Mature (121+ yrs)	17.5	30.0	15.0	50%

8.4 Decay, Waste, and Breakage

The default decay, waste, and breakage factors for TFL19 within VDYP 6.6d were used for existing natural stands.

8.5 Operational Adjustment Factors (OAFs)

An OAF1 of 15% and OAF2 of 5% were used for yield tables generated with TIPSY.

8.6 Volume Deductions

A volume deduction of 4% will be used to model stand-level retention in the THLB – for more detail see Section 10.3.5. This reduction will occur when individual stands are harvested during modelling. Yield curves are left unaltered.

Deciduous volumes existing in pure or mixed stands have not been removed from the volume calculations. Pure deciduous stands represent only 63 ha and deciduous-leading stands represent 528 ha.

8.7 Yield Tables for Unmanaged Stands

8.7.1 Existing Mature Stand Volumes

The timber volume in existing mature stands (those ≥ 120 years) was determined for each analysis unit by calculating the area-weighted average adjusted inventory volumes (Table 30).

Table 30 - Existing mature volume

Analysis Unit	THLB Area (ha)	Weighted Avg Age (years)	Weighted Avg Volume/ha (m^3/ha)	Analysis Unit Volume (m^3)
B1GO4	58	222	667	38,395
B1MF4	203	182	676	136,929
B1MH4	105	178	702	73,811
B1MO4	31	251	511	16,028
B1PF4	89	183	582	51,915

Analysis Unit	THLB Area (ha)	Weighted Avg Age (years)	Weighted Avg Volume/ha (m^3/ha)	Analysis Unit Volume (m^3)
B2GB4	587	313	985	577,602
B2GC4	998	339	639	638,270
B2GF4	208	233	740	154,212
B2GH4	3,858	300	801	3,088,979
B2GY4	204	324	506	103,483
B2MB4	126	269	958	120,508
B2MC4	3,029	303	572	1,732,170
B2MF4	808	230	632	510,846
B2MH4	4,522	286	655	2,962,139
B2MY4	701	309	459	322,151
B2PC4	1,675	282	370	619,003
B2PF4	466	205	522	243,413
B2PH4	1,572	240	483	759,031
B2PO4	163	186	264	43,061
B2PY4	813	326	326	265,405
B3GB4	234	323	874	204,678
B3GC4	269	310	611	164,577
B3GH4	3,766	316	772	2,908,969
B3GO4	11	210	493	5,398
B3GY4	390	333	446	173,930
B3MB4	121	320	978	118,107
B3MC4	653	301	560	365,437
B3MH4	4,065	303	658	2,674,251
B3MO4	33	197	592	19,379
B3MY4	1,458	315	438	639,058
B3PC4	320	315	408	130,471
B3PF4	91	186	385	34,919
B3PH4	937	290	511	479,357
B3PO4	1	254	683	901
B3PY4	1,143	310	360	411,056
B4PB4	151	319	700	105,414
B4PC4	101	337	553	55,953
B4PH4	2,495	315	631	1,574,808
B4PO4	15	163	408	6,195
B4PY4	403	322	403	162,321
Total Base	**36,873**	**295**	**616**	**22,692,530**
M1PO4	2	185	603	1,141
M2GO4	49	317	634	30,868
M2MC4	131	340	402	52,695
M2MH4	195	319	639	124,427
M2MO4	101	286	424	42,996
M2PC4	129	343	321	41,505
M2PH4	160	294	442	70,660
M2PO4	0	178	416	66
M2PY4	123	301	361	44,459
M3GH4	269	314	583	156,537
M3GO4	21	328	449	9,497
M3GY4	105	314	393	41,140
M3MC4	162	291	400	64,905
M3MH4	579	299	559	323,199

Analysis Unit	THLB Area (ha)	Weighted Avg Age (years)	Weighted Avg Volume/ha (m^3/ha)	Analysis Unit Volume (m^3)
M3MO4	15	231	843	12,832
M3MY4	294	300	370	108,505
M3PC4	119	307	378	45,100
M3PH4	195	301	452	87,993
M3PO4	11	182	418	4,558
M3PY4	329	314	348	114,348
M4PH4	609	308	521	317,120
M4PO4	63	272	506	31,901
M4PY4	315	294	353	111,462
Total Marginal	**3,976**	**306**	**464**	**1,837,914**
Grand Total	**40,849**	**296**	**601**	**24,530,444**

8.7.2 Natural Immature Stand Volumes

For existing natural immature stands, an analysis unit was assigned to every forest cover polygon based on criteria defined in Section 7.3. The adjusted height and adjusted age was used to generate the yield tables for each individual polygon using VDYP 6.6d. Raw yield table output from VDYP was shifted left or right so the yield table volume matched the adjusted volume in the inventory at the adjusted age (Figure 4). Yield tables for each analysis unit were calculated as the area-weighted average of the component polygon-level yield tables. Average input to VDYP for existing natural immature stands are listed in Table 31.

The area-weighted yield curves for each natural immature analysis unit are listed and shown in Appendix A: Natural Immature Yield Tables.

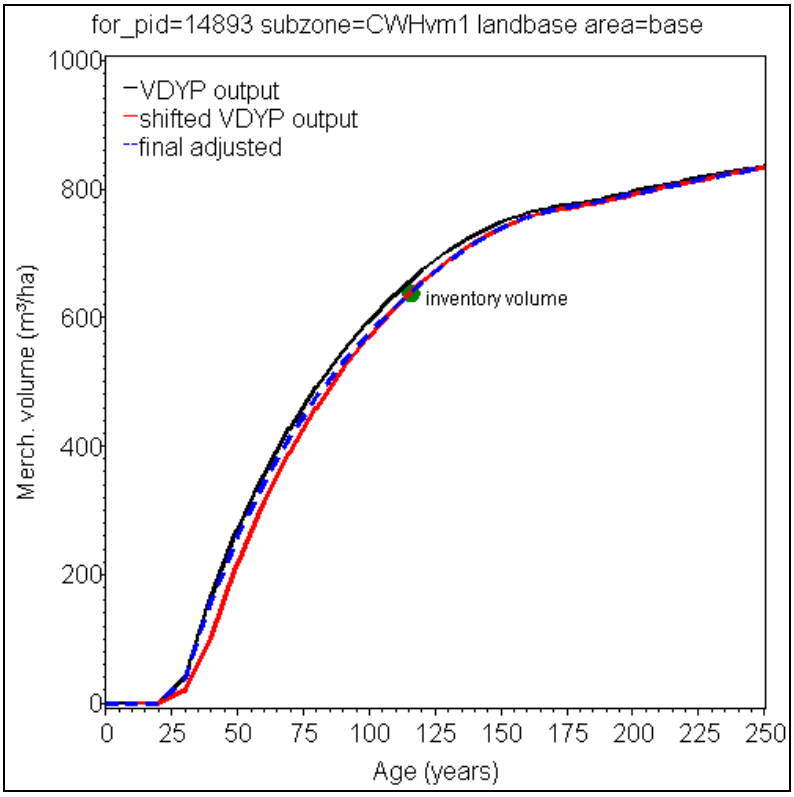


Figure 4 – Example of VDYP output shift

Table 31 - Average VDYP inputs for existing natural immature stands

Existing AU	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	% Spp 1	% Spp 2	% Spp 3	% Spp 4	% Spp 5	% Spp 6	Stk Cls	Avg. SI (spp1)	Avg. Crn Cls	Area (ha)
B1GF3	Fd	Hw	Pl	Dr			68.9	31.0	0.1	0.0			0	37.8	57.4	437
B1GO3	Hw	Fd	Cw	Dr			50.3	30.4	13.1	6.3			0	38.5	53.7	34
B1MF3	Fd	Hw	Cw	Pl	Dr	Ba	68.4	26.8	2.5	1.1	0.8	0.4	0	30.8	49.5	868
B1MH3	Hw	Fd	Cw	Dr	Pl	Ba	53.1	34.2	8.4	2.0	1.9	0.4	0	29.9	51.8	155
B1MO3	Pl	Fd	Dr	Hw			38.0	31.7	17.9	12.4			0	24.1	45.2	41
B1PF3	Fd	Pl	Hw	Cw	Pw	Ba	51.8	23.6	21.9	2.5	0.1	0.1	0	18.2	41.6	61
B1PO3	Pl	Hw	Fd	Cw	Pw	Ba	33.1	28.5	28.2	7.1	3.0	0.1	0	19.4	42.5	30
B2GF3	Fd	Hw	Cw	Dr	Ba	Pl	70.4	26.3	2.0	1.0	0.3	0.1	0	34.0	51.8	2,315
B2GH3	Hw	Fd	Cw	Ba	Dr	Yc	56.7	19.3	15.3	6.7	1.4	0.5	0	28.2	54.4	2,334
B2GO3	Dr	Hw	Mb	Fd	Cw	Ss	77.2	12.5	3.7	2.9	2.1	1.6	0	26.2	56.3	308
B2MC3	Cw	Hw	Fd	Ba	Dr		48.8	34.7	13.9	1.3	1.3		0	21.1	45.4	101
B2MF3	Fd	Hw	Cw	Pl	Dr	Ba	57.9	30.1	10.5	0.9	0.6	0.1	0	26.0	47.6	605
B2MH3	Hw	Fd	Cw	Ba	Dr	Pl	56.8	19.6	18.8	2.2	1.9	0.6	0	23.9	50.6	1,657
B2MO3	Dr	Pl	Fd	Hw	Cw	Yc	41.7	21.9	16.5	13.6	6.2	0.1	0	19.7	53.1	65
B2PC3	Cw	Fd	Hw	Pl			43.6	24.1	22.7	9.6			0	16.6	43.3	123
B2PF3	Fd	Hw	Cw	Pl	Pw	Yc	46.9	29.9	17.6	4.9	0.6	0.1	0	21.7	44.4	213
B2PH3	Hw	Fd	Cw	Ba	Pl	Yc	47.8	24.6	21.6	2.6	2.6	0.8	0	18.4	48.7	416
B2PO3	Pl	Fd	Hw	Cw			61.1	32.1	5.1	1.6			0	15.1	37.2	30
B3GH3	Hw	Fd	Ba	Cw	Hm	Yc	41.4	16.7	16.0	11.4	7.9	6.6	0	20.5	42.3	180
B3GO3	Fd	Hw	Ba	Yc	Cw	Hm	52.7	29.0	7.5	4.8	3.5	2.5	0	22.3	41.1	55
B3MH3	Hw	Fd	Cw	Yc	Pl	Ba	52.1	29.2	11.3	4.4	1.5	1.5	0	20.4	33.0	108
B3MO3	Fd	Hw	Yc	Ba	Cw	Hm	50.7	15.0	13.9	8.0	6.6	5.8	0	20.5	49.3	44
B3PO3	Hw	Fd	Cw	Pl	Yc	Ba	36.8	31.0	19.3	7.5	3.4	2.0	0	15.8	46.6	142
B4PO3	Hw	Fd	Yc	Ba	Hm	Cw	52.2	28.1	9.9	4.9	3.6	1.4	0	21.2	39.4	32
M2AO3	Hw	Fd	Cw	Dr	Ba	Hm	45.1	28.1	25.0	1.4	0.2	0.1	0	19.3	44.5	25
M3AO3	Hw	Fd	Cw	Yc	Ba	Hm	47.1	21.8	14.1	9.7	4.6	2.6	0	17.8	47.9	12
M4PO3	Hw	Ba	Yc	Fd	Hm	Cw	45.3	21.3	20.3	6.8	5.1	1.3	0	18.1	40.0	18

8.8 Yield Tables for Managed Stands

8.8.1 Existing Managed Stand Volumes

Silviculture assumptions for existing managed stands included a plantation regeneration method for all stands, species composition from the inventory database, establishment density as 10% higher than the free-to-grow density estimates (to account for mortality in the TIPSY model). These silviculture assumptions and SIBEC estimates were used as input into Batch TIPSY 4.1 (Table 33). Genetic gain for Fd, Hw, Cw, Yc, and Ss was applied to stands ≤10 years old. A second set of existing managed yield tables were generated using PSI estimates for a sensitivity analysis.

Yield tables were first calculated for each component site series within a forest cover polygon. The yield table for the forest cover polygon was calculated as the area-weighted average of the component site series-level yield tables. The yield table for the analysis unit was calculated as the area-weighted average of the component forest cover polygon-level yield tables.

8.8.1.1 Stocking density

The 6,893 ha of Free Growing stands in the TFL 19 silviculture file were summarized by subzone / variant for average total stems per ha. The overall average stems per ha and the % of area in the lower stocking class (800 to 1,500 sph) are reported in Table 32.

Table 32 – Free Growing stands

Subzone/variant	Total ha	Average sph (total)	% area with 800-1,500 sph
CWHxm2	89	2,246	23.2%
CWHvm1	5,167	3,167	12.2%
CWHvm2	1,597	3,715	4.6%
MHmm1	40	5,013	0%

TIPSY does not directly model planted stands with natural in-growth. Most of the current managed area has been planted and includes substantial natural in-growth. The Free Growing summaries indicate that there is a variation in stocking; much of the area is well stocked, and some of the area has a lower stocking. Hence the current natural stands are modelled (refer to Table 33) in TIPSY as a combination of:

- Most of the area (75% to 95%) as if planted at 2,000 or 3,000 sph to reflect an average of greater than 2,000 or 3,000 sph (a majority of the area planted combined with substantial in-growth).
- A smaller percentage of the area (5% to 25%) as if planted to 1,000 sph to represent the reduced amount of in-growth in these areas.

Genetic gain for Fd, Hw, Cw, Yc, and Ss was applied to stands ≤10 years old. Records of WFP's Nootka Region (predominately TFL 19 and FL A19231) sowing requests were summarized for the 10 year period from 1996 to 2005. Average genetic (volume) gains by species, reduced to allow for natural regeneration, are shown in Table 33.

8.8.1.2 *Fertilization*

Since 1980, nitrogen fertilization (post-establishment) has occurred on 8,419 ha in TFL 19: 7,495 ha with a single application and 924 ha with two applications. The fertilization treatments have mostly occurred on stands where Douglas fir is the leading species or is a significant component. The stand age has varied, with 61% of the initial application in stands aged 21 to 40 years of age.

In the last four years (2002 to 2006) an average of 534 ha has been fertilized annually as a first application and a further 231 ha annually as a second application. The fertilization program has been contingent on government funding programs and is expected to continue, mostly as second applications in the next few years.

Fertilization will not be incorporated into the yield tables for current stands (much of it occurred in the "younger natural" stands). The impacts of this management effort will be discussed in the sensitivity analysis of yield projections as it will make a contribution to medium-term (in 10 to 50 years) timber supply for TFL 19.

Average TIPSY inputs for existing managed stands are given in Table 34.

Table 33 - Existing managed assumptions

Subzone	Regime no.	Regime %	Regen method	Density at FTG	Input density	Genetic gain (applied to ≤ 10 years AUs only)				
						Fd	Hw	Cw	Yc	Ss
CWHxm2	1	75	P	2000	2200	5	2.3	0.9	6.2	0.5
CWHxm2	2	25	P	1000	1100	5	2.3	0.9	6.2	0.5
CWHvm1	1	85	P	3000	3300	5	2.3	0.9	6.2	0.5
CWHvm1	2	15	P	1000	1100	5	2.3	0.9	6.2	0.5
CWHvm2	1	95	P	3000	3300	5	2.3	0.9	6.2	0.5
CWHvm2	2	5	P	1000	1100	5	2.3	0.9	6.2	0.5
MHmm1	1	95	P	3000	3300	5	2.3	0.9	6.2	0.5
MHmm1	2	5	P	1000	1100	5	2.3	0.9	6.2	0.5

Table 34 - Area-weighted average TIPSY inputs for existing managed stands

Existing AU	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	% Spp 1	% Spp 2	% Spp 3	% Spp 4	% Spp 5	% Spp 6	SIBEC (m)	PSI (m)	Area (ha)
B1GO1	Fd	Hw	Cw	Bg	Pw		51.3	37.4	8.1	3.0	0.2		29.0	31.3	7
B1GO2	Fd	Hw	Dr	Cw	Ss	Bg	64.0	29.7	3.0	2.5	0.7	0.1	34.0	34.2	35
B1MF2	Fd	Hw	Dr	Pl	Cw	Pw	60.9	27.4	6.9	3.7	0.7	0.3	33.1	32.6	321
B1MO1	Fd	Hw	Cw	Pw	Bg	Dr	52.8	36.3	5.0	4.4	1.4	0.2	27.8	28.4	89
B1MO2	Hw	Fd	Cw	Dr	Ba		55.6	30.0	8.1	5.9	0.4		24.6	26.4	45
B1PO1	Fd	Pw	Hw				80.0	12.0	8.0				27.7	27.8	0
B1PO2	Fd	Hw	Cw	Ss			57.3	36.9	5.6	0.1			23.9	25.1	5
B2GB2	Ba	Hw	Cw	Yc			55.4	39.9	4.3	0.4			24.6	25.5	198
B2GC1	Cw	Hw	Ba	Fd	Dr	Ss	54.9	29.5	8.2	6.2	1.0	0.1	23.2	25.8	143
B2GC2	Cw	Hw	Ba	Fd	Ss	Yc	46.7	37.0	7.5	6.6	1.8	0.4	22.9	25.0	240
B2GF2	Fd	Hw	Cw	Dr	Ss	Pl	60.6	33.0	4.8	1.2	0.2	0.2	35.6	34.2	2,436
B2GH1	Hw	Cw	Ba	Fd	Yc	Ss	69.2	13.5	9.9	6.0	1.0	0.4	26.6	27.6	1,513
B2GH2	Hw	Fd	Ba	Cw	Ss	Yc	60.3	13.3	12.5	12.2	1.1	0.7	26.8	27.9	8,605
B2GO1	Ba	Hw	Fd	Cw	Dr	Yc	35.5	27.7	18.4	13.2	2.7	2.6	29.7	29.8	159

Existing AU	Spp 1	Spp 2	Spp 3	Spp 4	Spp 5	Spp 6	% Spp 1	% Spp 2	% Spp 3	% Spp 4	% Spp 5	% Spp 6	SIBEC (m)	PSI (m)	Area (ha)
B2GO2	Dr	Hw	Fd	Cw	Ss	Ba	74.0	16.2	3.7	3.4	1.9	0.8	27.1	28.2	125
B2MB2	Ba	Hw	Cw	Yc			50.0	30.0	20.0	0.1			22.9	24.8	112
B2MC1	Cw	Hw	Ba	Fd	Yc	Tw	50.1	35.5	6.4	5.1	2.3	0.5	20.5	23.4	317
B2MC2	Cw	Hw	Fd	Ba	Dr	Yc	51.1	37.8	10.0	0.8	0.2	0.2	21.1	23.6	214
B2MF1	Fd	Hw	Cw	Dr	Ss	Pw	55.0	22.9	16.4	3.6	1.2	0.8	33.4	31.8	93
B2MF2	Fd	Hw	Cw	Dr	Pl	Pw	58.7	28.9	9.8	1.5	1.0	0.2	34.5	32.2	571
B2MH1	Hw	Cw	Fd	Ba	Yc	Pw	66.6	17.2	7.7	6.8	1.4	0.3	23.1	25.6	1,772
B2MH2	Hw	Cw	Fd	Ba	Yc	Dr	56.4	18.9	14.6	8.0	1.0	1.0	24.1	26.2	4,571
B2MO1	Ba	Hw	Cw	Fd	Yc	Tw	36.4	25.1	13.9	11.5	10.4	2.9	20.5	24.0	66
B2MO2	Dr	Hw	Fd	Cw			67.9	15.9	8.4	7.9			22.8	25.7	14
B2PH1	Hw	Cw	Ba	Fd	Yc	Ss	71.5	15.5	4.9	4.8	3.2	0.2	17.5	23.4	300
B2PH2	Hw	Cw	Fd	Ba	Dr	Yc	59.6	19.4	9.7	9.5	1.2	0.6	18.0	23.7	163
B2PO1	Cw	Hw	Fd	Yc	Ba	Hm	42.2	28.6	10.3	10.0	7.9	1.1	18.1	22.0	64
B2PO2	Hw	Cw	Fd	Ba	Pl	Yc	32.3	29.1	19.9	11.9	6.2	0.7	19.6	22.7	20
B3GB1	Ba	Hw	Yc	Cw	Hm	Ss	48.6	34.7	10.9	3.9	1.2	0.7	23.8	22.4	272
B3GB2	Ba	Hw	Yc	Cw	Fd		58.0	38.1	2.0	1.5	0.5		23.7	22.4	407
B3GF2	Fd	Hw	Cw	Dr	Ba		56.6	39.6	2.4	1.1	0.3		29.4	30.2	122
B3GH1	Hw	Ba	Cw	Yc	Fd	Yc	65.9	23.5	6.0	3.2	1.0	0.4	26.2	24.8	958
B3GH2	Hw	Ba	Cw	Fd	Yc	Hm	57.2	26.6	6.8	6.3	2.9	0.1	26.2	24.9	1,583
B3GO1	Cw	Ba	Hw	Yc	Fd	Tw	32.3	28.1	20.4	18.1	1.0	0.1	20.3	22.0	53
B3GO2	Cw	Ba	Hw	Yc	Pl	Fd	59.6	37.4	2.5	0.3	0.1	0.0	20.0	21.7	23
B3MB1	Ba	Hw	Yc	Cw	Fd	Hm	45.8	33.0	12.2	5.9	1.6	1.5	20.5	20.4	208
B3MB2	Ba	Hw	Yc	Cw			50.7	28.7	18.5	2.2			21.3	20.8	103
B3MH1	Hw	Ba	Yc	Cw	Fd	Hm	63.7	20.3	8.2	6.2	1.1	0.5	23.7	23.1	696
B3MH2	Hw	Ba	Cw	Fd	Yc	Dr	54.1	23.7	11.2	7.4	3.4	0.2	23.7	23.2	814
B3MO1	Hw	Cw	Ba	Yc	Fd	Tw	29.2	25.4	17.9	15.0	11.3	1.2	21.5	23.0	18
B3MO2	Yc	Hw	Ba	Cw	Fd		34.5	30.8	17.6	11.4	5.7		19.1	20.9	86
B3PH1	Hw	Ba	Cw	Yc	Fd	Hm	61.9	16.0	9.8	9.6	2.0	0.5	17.7	20.0	131
B3PO1	Ba	Hw	Yc	Hm	Cw	Fd	42.3	21.2	15.5	10.3	7.0	3.6	16.6	18.4	50
B3PO2	Hw	Ba	Cw	Yc	Fd	Pw	44.0	28.4	15.3	7.5	4.2	0.6	18.3	20.2	79
B4PB1	Ba	Hw	Yc	Hm	Cw	Fd	72.4	10.5	9.8	5.4	1.7	0.2	13.5	15.9	236
B4PO1	Hw	Ba	Yc	Hm	Cw	Bp	40.6	33.6	16.7	4.2	3.5	1.4	15.4	17.5	52
B4PO2	Hw	Ba	Yc	Cw	Fd	Hm	39.7	29.6	14.2	11.4	5.1	0.0	14.7	17.1	102
M2AO1	Hw	Cw	Ba	Fd	Yc	Hm	66.8	16.6	9.2	4.3	2.7	0.3	20.7	24.7	45
M3AO1	Hw	Ba	Yc	Cw	Fd	Hm	65.9	15.5	7.2	7.1	3.2	1.1	22.1	21.9	30
M4PO1	Hw	Ba	Fd	Yc	Cw	Hm	48.4	32.4	13.0	6.0	0.2	0.1	14.9	16.3	1

The area-weighted yield curves for each existing managed analysis unit are listed and shown in Appendix B: Existing Managed Yield Tables (SIBEC option) and Appendix C: Existing Managed Yield Tables (PSI option).

8.8.2 Future Stand Volumes

Ecologically-based silviculture strategies for future stands were developed by Western Forest Products staff based on current practice (Table 35). Other TIPSY inputs were standard OAFs (OAF1=15%, OAF2=5%) and utilization limit of 12.5 cm.

Stand density is represented by planting at 1500 sph to reflect both the continued practice to plant almost all harvested areas and the substantial natural in-growth experienced on many sites.

Species and stocking levels are portrayed at this broad average level to simplify modelling. It is recognized that this includes a range of specific prescriptions that for example might include establishment of alder on a small % of the landbase or a greater reliance on natural regeneration in some areas.

Projections of Genetic Worth (GW) were developed from WFP's Saanich Forestry Centre seed inventory, development plans and the Forest Genetics Council business plan for 2006/2007. GW is projected to increase somewhat over the period from 2008-2012 to 2018-2028. Average values by species and elevation zone (subzone / variant) listed in Table 35 will be applied to future managed stands.

Two sets of yield tables were generated; one for the base case which used SIBEC estimates for input into Batch TIPSY 4.1 (Appendix D: Future Managed Yield Tables (SIBEC option)), and a second set of future managed yield tables were generated using PSI estimates for a sensitivity analysis (Appendix E: Future Managed Yield Tables (PSI option)). Table 36 shows area-weighted average site index inputs for each analysis unit.

The base management option includes nitrogen fertilization of the CWHxm2 medium and poor site analysis units. The yield tables include fertilizer applications at 40 and 50 years of age (Appendix F: Future Managed Yield Tables (Fertilization options)). The impact will be relatively small as the total area involved is approximately 2,000 ha.

The area-weighted yield curves for each future managed analysis unit are listed and shown in Appendix D: Future Managed Yield Tables (SIBEC option), Appendix E: Future Managed Yield Tables (PSI option) and Appendix F: Future Managed Yield Tables (Fertilization options).

Table 35 - Silviculture strategies for future stands

Subzone	Site class	Regen method	Regen delay (years)	Planting density (sph)	Sp p 1	Sp p 2	Sp p 3	Pct 1	Pct 2	Pct 3	Genetic gain			
											Fd	Hw	Cw	Yc
CWHxm2	G	P	0	1500	Fd	Cw	Hw	60	20	20	14	15	8	N/A
CWHxm2	M	P	0	1500	Fd	Cw	Hw	60	20	20	14	15	8	N/A
CWHxm2	P	P	0	1500	Fd	Cw	Hw	50	30	20	14	15	8	N/A
CWHvm1	G	P	0	1500	Hw	Fd	Cw	50	30	20	14	15	8	N/A
CWHvm1	M	P	0	1500	Hw	Cw	Ba	60	20	20	N/A	15	8	N/A
CWHvm1	P	P	0	1500	Hw	Cw	Ba	50	30	20	N/A	15	8	N/A
CWHvm2	G	P	0	1500	Hw	Ba	Yc	50	30	20	N/A	9	N/A	20
CWHvm2	M	P	0	1500	Hw	Ba	Yc	50	30	20	N/A	9	N/A	20
CWHvm2	P	P	0	1500	Hw	Yc	Ba	50	30	20	N/A	9	N/A	20
MHmm1	P	P	0	1500	Ba	Hm	Yc	40	30	30	N/A	N/A	N/A	20

Table 36 - Area-weighed average TIPSY site index inputs for future managed stands

Future AU	SIBEC (m)	PSI (m)	Area (ha)
B1GF5	35.1	34.7	579
B1MF5	32.6	32.3	1,884
B1PF5	27.2	27.8	185
B2GH5	26.8	28.0	25,316
B2MH5	23.3	25.8	20,873
B2PH5	17.5	23.2	6,245
B3GH5	26.2	24.8	8,745
B3MH5	23.2	22.9	8.951
B3PH5	17.4	19.6	2,960
B4PB5	13.3	15.5	3,704
M1PF5	27.9	29.0	2
M2AH5	21.4	24.9	70

Future AU	SIBEC (m)	PSI (m)	Area (ha)
M2GH5	25.8	26.5	50
M2MH5	21.2	24.9	473
M2PH5	17.0	23.3	416
M3AH5	21.6	21.7	42
M3GH5	26.0	24.3	397
M3MH5	22.2	22.1	1,059
M3PH5	17.2	19.2	660
M4PB5	12.9	15.0	1,008

8.8.3 Regeneration Delay

The regeneration delay refers to the average time between harvesting and establishment of the next rotation. The average regeneration delay as reported in TFL 19 Annual Reports through until 2004 has decreased until it is now approximately 1.5 years.

Nearly all harvested area is planted and prompt establishment after harvesting has continued to be practiced in the TFL. Planted seedlings are typically one year old. Hence the regeneration delay from harvest until germination of the next crop of planted trees is generally less than 1 year. Also, early seedling growth is assisted by the currently common practice in TFL 19 of fertilization at time of planting.

A one year regeneration delay is appropriate for future managed stands and is incorporated into the yield tables that will be used in the analyses. Note that the yield tables in Appendices D, E and F do not reflect a 1-year regen delay as the tables in the appendices were generated when no regeneration delay was proposed. The yield tables in the Woodstock model will reflect a 1-year regeneration delay and will simply be interpolations of the tables in Appendices D, E and F.

8.8.4 Species Conversion

A small amount of non-productive brush type (NP BR) is converted on a yearly basis within the TFL. This occurs in small patches and is usually contiguous to or surrounded by productive forest land. These areas are site prepared in conjunction with the harvested area and planted. As the area converted on a yearly basis is difficult to quantify but thought insignificant, it will not be explicitly modelled but a slight positive impact on future timber supply may be realized operationally.

8.8.5 Not Satisfactorily Restocked (NSR) Areas

The data set prepared for the analysis includes 4,098 ha, described as not regenerated (NSR). Of this “NSR” area 4,029 ha are in the base case timber harvesting land base with the remainder in marginal areas. The “NSR” area is significantly larger than in operational records as it includes areas planted that did not have a regeneration survey as of 2005 and areas planted in 2006. NSR areas will be regenerated to the appropriate future Analysis Unit.

Table 37 - NSR area

	Total Area (ha)
Base option area	4,029
Marginal area	69

Total	***4,098***

9 NON-RECOVERABLE LOSSES

9.1 Overview

Windthrow, insects, disease and fire can cause catastrophic losses of whole stands of trees. Over the long-term the probability of losses to such natural causes can be predicted. Where losses occur in merchantable stands some of the dead or dying timber may be salvageable. When modelling timber supply, unsalvaged losses are added to the desired harvest forecast and then subtracted from the forecast upon completion of the modelling exercise.

The analysis will model 6,335 m^3/year of non-recoverable losses.

9.2 Windthrow

Historically, windthrow has occurred mainly in relatively small areas. Records for the twelve year period from 1993 to 2004 show an average of 13.4 ha or 9,595 m^3 a year of windthrow in the TFL of which 3,260 m^3 is recovered through salvage. Non-recoverable losses from windthrow are therefore estimated at 6,335 m^3/year.

9.3 Insects and Disease

The forests of TFL 19 have been relatively free of major insect or disease infestations and therefore no losses are associated. There have been no major catastrophic outbreaks causing significant unsalvaged mortality or volume losses. The main active agents have been various defoliators and bark beetles. The last defoliator outbreak was in the mid-70's by western black-headed budworm (*Acleris gloverana*) in stands above 600m near Zeballos. Douglas fir and mountain pine beetle caused pockets of mortality in the mid-60's around Gold River.

Hemlock dwarf mistletoe is widespread throughout merchantable sized stands. Sanitation treatments of advanced regeneration are sometimes required to prevent the spread in newly regenerated western hemlock stands. Usually regenerated stands are not impacted significantly by hemlock dwarf mistletoe.

Root diseases sometimes result in small pockets of mortality. These losses are assumed accounted for by standard operational adjustment factors (OAFs) applied to yield curves. Impacts of laminated root rot (*Phellinus weirii*) are less than observed in other areas. Additional OAF allowances are not applied.

9.4 Fire

The risk of loss of timber due to fire is low within the TFL. The bulk of the TFL has a wet climate characterized by cool, wet summers and fire suppression has been efficient; hence the likelihood of losses to forest fire is small.

10 INTEGRATED RESOURCE MANAGEMENT

10.1 Overview

The intent of this section is to give an overview of the resource inventories available and being used for the timber supply review. The section also describes other resource management information that is being utilized for planning within TFL 19.

10.2 Forest Resource Inventory

Table 38 summarizes the forest resource inventories currently being maintained for the TFL.

Table 38 - Forest resource inventory status

Item	Status	MOF Acceptance Date	Plan
Vegetation Resource Inventory (VRI)	Initiated in 2000. The last component, the statistical adjustment was completed by the Timberline natural Resource Group in early 2006.		Inventory revisions updated annually.
Ecosystems	Mapping completed by Madrone Consulting Ltd (Nov 00).		
Terrain Stability	Completed in 1997 by Terence Lewis et al.		
Karst	Planning-Level Karst Inventory of TFL 19 completed March 31, 2003 by Terra Firma Geoscience Services. Included refinements to the planning-level karst inventory procedures (RISC 2003).		
Recreation Inventory	Recreation inventory completed in 2000 by Jeremy Webb of Recreation Resources Limited. Basis for the TFL 19 portion of the GAR Order to identify Recreation Resource Features for the Campbell River Forest District.	GAR Order Established April, 2006	
Visual Landscape Inventory	Completed by Recreation Resources Limited (Jeremy Webb) in 2000. Basis for the TFL 19 portion of the GAR Order to establish Scenic Areas and Visual Quality Constraints for the Campbell River Forest District.	GAR Order Established December, 2005	

Ungulate Winter Ranges (UWRs)	Revised UWRs for Columbian black tailed deer and Roosevelt elk (U-1-014). Plus replacement UWRs for those removed with deletion of private land from TFL 19.	Approved December 2004. Replacement UWRs established November 2007	
Wildlife Habitat Areas (WHAs)	Six WHAs established – five for Queen Charlotte Goshawks and one for Keen's Long-eared Myotis.	Established December 2004 and April 2000	Draft Marbled Murrelet WHAs defined – refinement and establishment expected in 2008
Item	**Status**	**MOF Acceptance Date**	**Plan**
Old Growth Management areas (OGMAs)	Preliminary draft OGMAs – need further work before review and establishment.		
Stream Classification	Operational stream inventories. Reconnaissance (1:20,000) fish and fish habitat inventories to RIC standards – completed in 1999 and 2002.		On-going with operational planning.
Archaeological	Archaeological Overview Assessment completed by Arcas in 1998. Updated in early 2007 by Baseline Archaeological Services Ltd. Site-specific maps and description on file (held in confidence at request of First Nations).	Undertaken by the Campbell River Forest District	Used in operational planning
Operability	Completed by WFP in 1999.	October 2000	

10.3 Forest Cover Requirements

10.3.1 Forest Cover Objectives - Rationale

The rationale for each forest cover objective reported in the timber analysis is described below. The rationales are based on the unique attributes of the TFL.

10.3.2 Visual Quality

The District Manager of the Campbell River Forest District in a Government Actions Regulation Order established Visual Quality Objectives (VQOs) for the Forest District on December 14, 2005. This includes VQOs in TFL 19.

Visual Quality Objectives to be modelled in the timber supply analysis are Retention (R), Partial Retention (PR) and Modification (M). The amount of area that can be disturbed (i.e. has not achieved visually effective green-up) is 5%, 15% and 25% for each VQO respectively. These levels are set at the upper end of the % disturbance range for use in timber supply analyses as visual landscape design during cutblock layout has become common practice in sensitive viewscapes. A sensitivity analysis in which these percentages are reduced to the mid-point of the range for each VQO (2.5%, 10% and 20% respectively) will indicate the sensitivity of timber supply to management of visual quality objectives and the design of cutblocks within visually sensitive areas.

A 5 m visually effective green-up (VEG) height is proposed for TFL 19. As Woodstock uses volume over age curves for yield tables, an age surrogate of 15 years old (3 periods) will be established to represent VEG height for each analysis unit.

Table 39 outlines the management assumptions for dealing with visual quality within the TFL. The areas reported are based on the recently completed inventory.

Table 39 – Visual Quality Management Assumptions

Visual Quality Objective	Productive Forest	THLB Area	Disturbance %
M	32,306	17,577	25%
PR	20,609	12,810	15%
R	1,277	895	5%

10.3.3 Adjacent Cutblock Green-up

A 3 metre green-up height in General and Special Resource Management Zones is proposed for areas without visual quality objectives. A 10 year (2 periods) age surrogate will be used within the model to represent the 3 m height. This is a reasonable approximation (on average) with prompt planting, planting of improved seedlings and fertilization at time of planting in some areas. Work elsewhere has shown that early height growth for western hemlock has been underestimated – refer to section 8.4.2 in the TFL 44 MP #4 Information Package. The Woodstock model applies cover class constraints by period. The analysis will use five-year periods to coincide with the five-year interval for AAC determinations. Ten years is more appropriate than fifteen years for the 3m requirement. As Woodstock does not have the capability to spatially model adjacency requirements, a proxy will be used: a maximum of 25% of the THLB within a zone but outside of VQO polygons will be able to be less than 10 years old. No green-up requirements will be modelled in the Enhanced Resource Management Zones (outside of VQO polygons) as the approved FSP contains a result/strategy that in addressing objective #7 of the VILUP Higher Level Plan Order effectively eliminates green-up in these zones (due to the maximum 40 hectare cutblock size limit being removed and no alternate limit specified by the VILUP order).

10.3.4 Landscape Level Biodiversity

Biodiversity Emphasis Options (BEOs) and Landscape Units were designated through the *Order Establishing Provincial Non-Spatial Old Growth Objectives* effective June 30, 2004 (NSOG order). This order is in effect until Old Growth Management Areas (OGMAs) are spatially determined through Landscape Unit planning. As OGMAs are not yet established within TFL 19, an old seral stage cover constraint will be applied based on the designations in the NSOG order. For the forest types within TFL 19, old forest is defined as stands >250 years old. The old seral target is based on the combination of BEO, BEC variant, and the natural disturbance type (NDT) of the variant.

Landscape units with a Low BEO will have the old seral target drawn down to 1/3 for the first rotation (80 years). The target for the end of the second rotation (160 years) will be 2/3 of the full target, with the full old seral target being achieved by the end of the third rotation (240 years). Intermediate and High BEO landscape units will be subject to the full target constraint throughout the planning period. Table 40

indicates the landscape biodiversity constraints that will be applied for old seral forest. For a breakdown of the current forest age by landscape unit and variant, see Table 22.

Table 40 – Landscape biodiversity assumptions

Landscape Unit	BEO	BEC Variant	NDT	Area (ha)		Old Seral constraint (% of productive)		
				Productive	THLB	1st rotation	After 2nd rotation	After 3rd rotation
Burman	Low	CWHvm1	1	5,998	4,573	4.3	8.7	13
		CWHvm2	1	2,373	1,171	4.3	8.7	13
		CWHxm2	2	0	0	N/A	N/A	N/A
		MHmm1	1	541	152	6.3	12.7	19
		MHmmp1	5	9	0	0	0	0
Eliza	Low	CWHvm1	1	4,133	3,020	4.3	8.7	13
		CWHvm2	1	726	378	4.3	8.7	13
		MHmm1	1	69	5	6.3	12.7	19
Gold	High	CWHvm1	1	14,418	10,305	19	19	19
		CWHvm2	1	13,620	7,465	19	19	19
		CWHxm2	2	3,970	2,329	13	13	13
		MHmm1	1	7,968	2,700	28	28	28
		MHmmp1	5	181	0	0	0	0
Kleeptee	Low	CWHvm1	1	6,202	4,474	4.3	8.7	13
		CWHvm2	1	4,924	2,419	4.3	8.7	13
		CWHxm2	2	584	321	3	6	9
		MHmm1	1	1,522	167	6.3	12.7	19
Tahsis	Low	CWHvm1	1	12,581	9,037	4.3	8.7	13
		CWHvm2	1	5,468	2,471	4.3	8.7	13
		MHmm1	1	1,482	172	6.3	12.7	19
		MHmmp1	5	27	0	0	0	0
Tlupana	Intermediate	CWHvm1	1	22,350	15,810	13	13	13
		CWHvm2	1	11,099	4,460	13	13	13
		MHmm1	1	3.084	199	19	19	19
		MHmmp1	5	26	0	0	0	0
Zeballos	Low	CWHvm1	1	7,204	5,200	4.3	8.7	13
		CWHvm2	1	4,745	2,269	4.3	8.7	13
		MHmm1	1	1,134	304	6.3	12.7	19
		MHmmp1	5	13	3	0	0	0

10.3.5 Reductions to Reflect Volume Retention in Cutblocks

Where feasible and wildlife objectives can be met, WTRA are located in constrained areas such as riparian reserves, inoperable stands or unstable slopes. In order to capture those WTRA located in harvestable areas a volume reduction will be implemented in the timber supply model. A review of 9 years of harvested cutblocks (1997-2005) in the TFL indicated that total stand-level retention was averaging about 14% (see Appendix I: Results of Review of 1997-2005 Harvested Cutblocks). As per the FSP, future WTRA retention is expected to average 7%. The remaining 7% is expected to be retained but be classified as some other type of stand-level retention (e.g. riparian management areas). Assuming 75% of the total stand-level retention is in constrained areas (based on the *Forest Practices Code Timber Supply Impact Analysis*) a volume reduction of 3.5% (0.25 x 14%) is recommended for use to account for operable area in stand-level retention. The deduction is rounded up for precaution to 4%. It is expected that this retention level will also address gully management areas left around non-fish bearing streams and account for basal area retention in riparian management zones and other areas.

10.3.6 Community Watersheds

The Village of Tahsis draws its water supply from McKelvie Creek, a designated community watershed draining into the Tahsis River. Due to the small size of this watershed (2112ha total area within TFL 19; 1145ha of productive forest; 483ha of THLB) issues surrounding water quality will mainly be dealt with at an operational level. A cover constraint will be applied so no more than 5% of the productive area within the watershed will be covered with stands less than 5 years old.

10.3.7 Higher Level Plans

The order establishing Resource Management Zones and Resource Management Zone objectives within the area covered by the Vancouver Island Land Use Plan came into effect as of December 1, 2000. Each Special Management Zone (SMZ) established by the order has an objective of maintaining mature seral forest over one quarter to one third of the forested area of the SMZ; the final target is to be established through landscape unit planning which has not yet been completed for TFL 19.

There are portions of two SMZ's within TFL 19 – SMZ 6 (Woss-Zeballos) and SMZ 11 (Schoen-Strathcona). For this analysis, a constraint will be incorporated that maintains 25% of the productive forest land base in the mature and/or old seral stage within these SMZ's.

10.4 Timber Harvesting

10.4.1 Minimum Harvestable Age

Minimum harvestable ages are simply minimum criteria for use in the timber supply model. While harvesting may occur in stands at or below the minimum requirements, in order to meet forest level objectives (i.e. maintaining overall timber flows) many stands will not be harvested until well past the minimum timber production ages because consideration of other resource values may take precedence or timber may be in ample supply.

Minimum harvestable ages were selected based on leading species and site productivity (see Table 41). The minimum volume was selected to be 350m^3 per hectare. Both minimum age and minimum volume requirements must be met before a stand can be harvested; this results in several analysis units not being eligible until older than the minimum age in order that the minimum volume requirement is met. These minimum harvest criteria will be used in the new analysis, and sensitivity analysis will investigate the impacts of using higher minimums. A minimum harvestable age of 60 years was used in the previous two analyses. Operational planners indicate that little activity has occurred in stands aged between 50 and 60 years but that they expect to be harvesting Douglas fir stands in this age range on better sites in the near future. The timber supply analysis will report on the volume harvested in stands less than 60 years old. These minimum harvest ages were selected to reflect the expectation that stands on poorer sites take longer to reach an economically viable condition (DBH and height distributions) than a similar stand on a good site.

Table 41 - Minimum Harvest Ages

	Minimum Harvest Age by Leading Species (years)		Minimum Volume (m^3/ha)
Site Productivity	**Douglas fir**	**Other**	
Good	50	60	350
Medium	60	80	350
Poor	70	100	350

10.4.2 Initial Harvest Rate

The strategy is to gradually adjust harvest levels towards the best estimate of the Long Term Harvest Level (LTHL) for the forest.

The harvest level for the first five-year period of the analysis will initially be set at 813,800 m^3, 3.8% lower than the current AAC of 845,947 m^3. This is consistent with the change in harvest in the second period of the MP #9 analysis. For the first period, 300,000 m^3 will be added to reflect the awarding of licences to first nations for undercut volume in TFL 19 and the portion of the Hisnit woodlot that remains within TFL 19 until March 31, 2010. A total of 350,000 m^3 of undercut volume has been or will be awarded to first nations of which approximately 17,000 m^3 has been logged as of October 2008. For simplicity the entire Hisnit woodlot has been removed from the data set for the analysis eventhough a portion remains within TFL 19 until March 31, 2010. WFP estimates that this area will provide 33,000 m^3 of harvest to WFP in the first period of the analysis. Table 42 summarizes this additional volume to be scheduled in the first period of the analysis.

Table 42 - Additional Volume for First Period of Analysis

Description	**Volume (m^3)**
Total TFL 19 undercut volume awarded or in discussion	350,000
Less: TFL 19 undercut volume harvested to October 2008	(17,000)
Less: Estimated WFP harvest in Hisnit woodlot area	(33,000)
Total volume to add to first period of analysis	**300,000**

It should be noted that the undercut volume is attributable to the entire TFL and as such a portion should be allocated to the BCTS management area.

This “initial harvest rate” provides a starting point for the analysis. However, the timber harvesting land base and other assumptions have changed since the MP #9 analysis. Therefore, the initial harvest level may subsequently be adjusted to achieve harvest flow objectives over the entire planning period. For all subsequent periods, harvest level changes will be based on an initial harvest rate that does not include the undercut volume.

10.4.3 Harvest Rules

The analysis will be undertaken with the model Woodstock, using optimization to project harvest schedules. With optimization, the model determines harvest order to achieve the defined objective. This is different from a simulation approach where rules are specified for harvest priority.

Harvest constraints will, however, be applied to model a gradual transition from old-growth harvest to second-growth harvest and to reflect performance within the non-conventional portion of the THLB. Recent harvest numbers and short-term plans indicate low levels of second-growth harvest in TFL 19. Second-growth harvest in the base case option will commence at approximately 5% of the total harvest and will gradually increase over time until the transition to second-growth harvest is largely complete (small volumes of old-growth harvest may continue because of the scheduling impacts of cover class constraints).

As discussed in section 6.8 recent harvest within the non-conventional portion of the THLB has been approximately 6.0% of the total harvest area whereas it represents approximately 12% of the THLB. The level of performance in the non-conventional THLB is not anticipated to increase significantly in the near future. Therefore, a 50,000 m^3/year constraint will be applied in the timber supply model. This value represents approximately 6.1% of the initial harvest level.

10.4.4 Silviculture Systems

The majority of the TFL is currently harvested using clearcut and clearcut with reserves silviculture systems. The retention silviculture system (group retention) has been used on a small number of cutblocks. There is no significant selection or partial cutting with dispersed retention occurring at this time.

WFP is currently reviewing its Forest Strategy. Included in this is a program for conserving biodiversity on company tenures. The approach is to vary the use of retention systems and the amount of stand level retention by Resource Management Zones of the Vancouver Island Land Use Plan and by ecosection and is being phased in over the next few years.

In Enhanced Management Zones the retention system will be used for 30% of the harvested area in the high wind environment of the northwest coast of Vancouver Island (Nahwitti Lowlands and the northern portion of the Windward Island Mountains Ecosection), and 50% of the harvested area in other Ecosections (60% in drier variants – CWHdm, xm, mm1). The minimum long-term stand-level retention target is 10% (15% in drier variants – CWHdm, xm, mm1).

In General Management Zones the retention system will be used for 40% of the harvested area in the high wind environment of the northwest coast of Vancouver Island (Nahwitti Lowlands and the northern portion of the Windward Island Mountains Ecosection), and 60% of the harvested area in other Ecosections (70% in drier variants – CWHdm, xm, mm1). The minimum long-term stand-level retention target is 15% (20% in drier variants – CWHdm, xm, mm1).

In Special Management Zones the VILUP Higher Level Plan Order specifies: “applying a variety of silvicultural systems, patch sizes and patch shapes across the zone, subject to a maximum cutblock size of 5 ha if clearcut, clearcut with reserves or seed tree silvicultural systems are applied, and 40 ha if shelterwood, selection or retention silvicultural systems are applied.” A minimum of 20% long-term stand-level retention is recommended for SMZs in the Western Forest Strategy based on both social and biological criteria.

This retention is long-term - it must remain for at least one rotation. TFL 19 is roughly split two-thirds in the northern portion of the Windward Island Mountains Ecosection and one-third in the Northern Island Mountains Ecosection. Applying the above retention system requirements to the Ecosection/VILUP Zone/BEC variant combinations present within TFL 19 results in an average overall stand level retention requirement of 5.6% for TFL 19.

A sensitivity analysis will be done where current stand yields are further reduced by 3% to reflect the area retained to meet the retention targets discussed above. This assumes the other 2.6% is already accounted for by all other netdowns. In this sensitivity analysis, future stand yields will be further reduced by 5% to reflect the area retained (3%) and the impact of trees retained in the first harvest entry on growth and yield of the future stands (2%).

10.4.5 Harvest Flow Objectives

Harvest projections will reflect a balance of the following objectives:

- Gradually adjust harvest levels towards the best estimate of the long-term harvest level;
- Limit harvest reductions per decade to no more than 10% unless greater reductions are necessitated by timberland reallocation to higher land use; and
- Achieve a stable long-term harvest level.

11 Glossary

Allowable Annual Cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres per year.
Analysis Unit (AU)	A grouping of forest types – for example, by biogeoclimatic zone, site productivity, leading tree species, and age - done to simplify analysis and the generation of timber yield tables.
Base case harvest forecast (Current Management Option)	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animal and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic zones and variants (BEC)	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested cutblocks must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested.
Forest inventory	An assessment of timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and wildlife habitat.
Forest and Range Practices Act	Legislation that governs forest and range practices and planning, with a focus on ensuring management of all forest values.
Forest type	The classification or label given to a forest stand, usually based on tree species composition.

11 Glossary

Free-growing	An established seedling of an acceptable species that is free from growth-inhibiting brush, weeds and excessive tree competition.
Geographic Information System (GIS)	A geographic information system, also known as a geographical information system or geospatial information system, is a system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the Earth.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually expressed as a specific height) - to ensure maintenance of water quality, wildlife habitat, soil stability, or aesthetics – before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The potential flow of timber harvest over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and a set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Inoperable areas	Areas defined as unavailable for timber harvest for terrain-related or economic reasons. Operability can change over time as a function of changing harvesting technology and economics.
Integrated resource management (IRM)	The identification and consideration of all resource values, including social, economic and environmental needs in resource planning and decision-making.
Karst features	Karst is a distinctive topography that develops as a result of the dissolving action of water on carbonate bedrock (usually limestone, dolomite or marble). Karst features include fluted rock surfaces, vertical shafts, sinkholes, sinking streams, springs, complex sub-surface drainage systems and caves.

11 Glossary

Landscape-level biodiversity	The *Landscape Unit Planning Guide* and the *Order Establishing Provincial Non-Spatial Old Growth Objectives* provide objectives for maintaining biodiversity at the landscape level and stand level. At the landscape level, objectives are provided for the maintenance of old growth.
Landscape unit	A planning area based on topographic or geographic features, that is appropriately sized (up to 100,000ha), and designed for application of landscape-level biodiversity objectives.
Long-term harvest level	A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.
Management assumptions	Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specifications for minimum harvestable ages, utilization levels, and integrated resource management and silviculture and pest management programs.
Model	An abstraction and simplification of reality constructed to help understand an actual system. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help management activities.
Natural disturbance type (NDT)	An area that is characterized by a natural disturbance regime, such as wildfires and wind, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more old forests.
Non-recoverable losses	The volume of timber killed or damaged annually by natural causes (e.g. fire, wind, insects and disease) that is not harvested.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

11 Glossary

Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Riparian habitat	The stream bank and flood plain area adjacent to streams or water bodies.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed and the results are compared to a baseline or the base case.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground).
Site Index by Biogeoclimatic Ecosystem Classification site series (SIBEC)	Site index estimates for tree species according to site units of the Biogeoclimatic Ecosystem Classification system of British Columbia.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
TIPSY (Table Interpolation Program for Stand Yields)	A BC Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Timber harvesting land base (THLB)	Crown forest land within the TFL where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and harvesting technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Ungulate	A hoofed herbivore, such as a deer.

11 Glossary

VDYP (Variable Density Yield Prediction model)	An empirical yield prediction system supported by the BC Forest Service designed to predict average yields and provide forest inventory over large areas (e.g. TFLs). It is intended for use in unmanaged natural stands of pure or mixed species composition.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds (basins).
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for wildlife.

APPENDICES

Appendix A: Natural Immature Yield Tables

Appendix B: Existing Managed Yield Tables (SIBEC option)

Appendix C: Existing Managed Yield Tables (PSI option)

Appendix D: Future Managed Yield Tables (SIBEC option)

Appendix E: Future Managed Yield Tables (PSI option)

Appendix F: Future Managed Yield Tables (Fertilization options)

Appendix G: Timberline Memo Re: SIBEC and PSI Estimates for TFL 19

Appendix H: SIBEC and PSI Estimates for Major Site Series in TFL 19

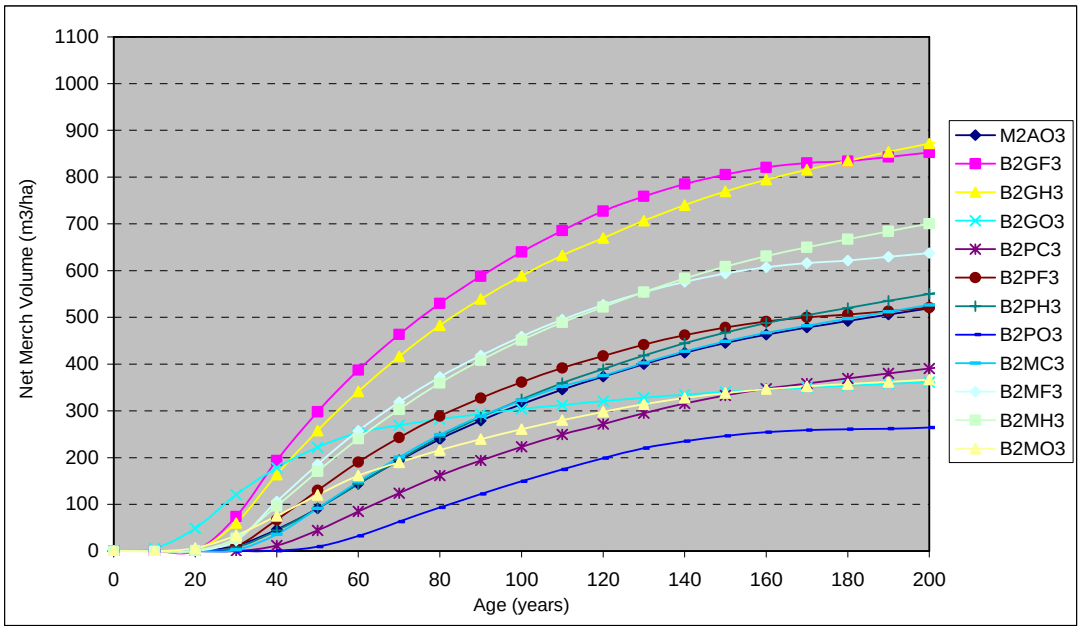
Appendix I: Results of Review of 1997-2005 Harvested Cutblocks

Appendix A: Natural Immature Yield Tables

Net Merchantable Volume Yield Curves

Natural Immature Stands within the CWHvm1 Subzone

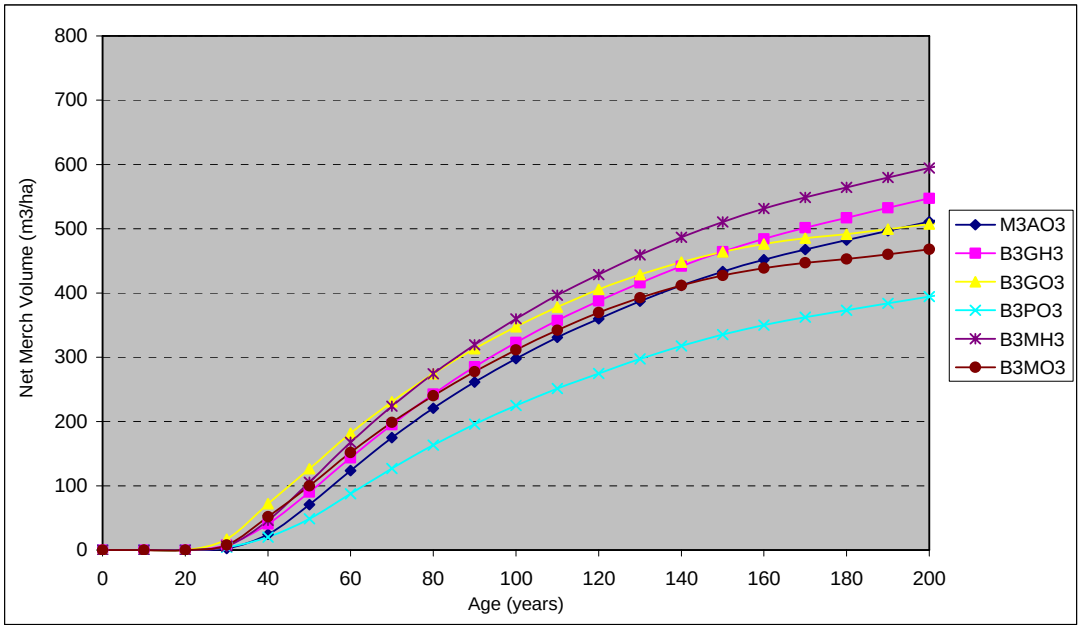
	Analysis Units											
Age	**M2AO3**	**B2GF3**	**B2GH3**	**B2GO3**	**B2PC3**	**B2PF3**	**B2PH3**	**B2PO3**	**B2MC3**	**B2MF3**	**B2MH3**	**B2MO3**
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	6	0	0	0	0	0	0	0	0
20	1	0	1	49	0	0	0	0	0	0	1	6
30	12	74	60	121	0	11	8	0	2	23	27	34
40	46	194	163	178	12	67	44	0	36	106	96	76
50	91	298	258	222	44	130	91	9	91	186	170	120
60	144	387	342	253	85	190	143	32	148	257	240	161
70	194	463	416	269	124	243	196	63	201	319	303	190
80	240	530	483	282	162	289	244	93	249	372	359	216
90	279	588	539	294	194	327	286	122	288	419	408	239
100	314	640	589	304	223	361	325	149	322	459	451	261
110	346	686	633	313	249	391	359	175	352	495	489	280
120	373	727	670	321	272	418	389	199	375	527	522	298
130	400	759	707	328	295	442	418	220	402	554	554	314
140	424	785	740	334	316	462	445	235	427	576	583	328
150	445	806	769	340	333	478	468	246	449	594	609	338
160	463	821	794	345	347	491	488	254	467	607	631	346
170	478	830	816	350	359	500	504	259	482	616	650	353
180	492	834	835	354	369	506	520	261	497	622	667	357
190	506	843	854	358	380	513	535	262	512	629	684	362
200	520	853	872	361	391	521	550	264	527	638	700	367
210	532	862	889	365	401	528	564	267	540	646	716	372
220	544	871	905	368	413	535	577	270	557	653	730	377
230	556	879	919	371	425	542	589	272	573	661	743	382
240	567	887	933	374	437	548	601	275	588	667	756	386
250	577	894	946	376	449	554	612	277	603	674	767	390
260	580	895	951	378	451	557	616	278	606	676	772	392
270	582	896	956	379	452	558	620	280	607	677	776	393
280	584	897	960	381	454	559	623	281	609	678	779	395
290	586	897	963	382	455	559	625	282	610	679	782	396
300	588	898	966	383	457	560	628	283	612	679	784	398
310	589	898	968	384	458	560	630	283	613	680	786	399
320	590	898	970	385	459	561	631	284	614	680	788	400
330	591	898	972	386	460	561	633	284	614	681	790	400
340	592	898	973	386	461	561	634	283	615	681	791	401
350	592	898	974	387	462	561	635	284	615	681	792	401



Net Merchantable Volume Yield Curves

Natural Immature Stands within the CWHvm2 Subzone

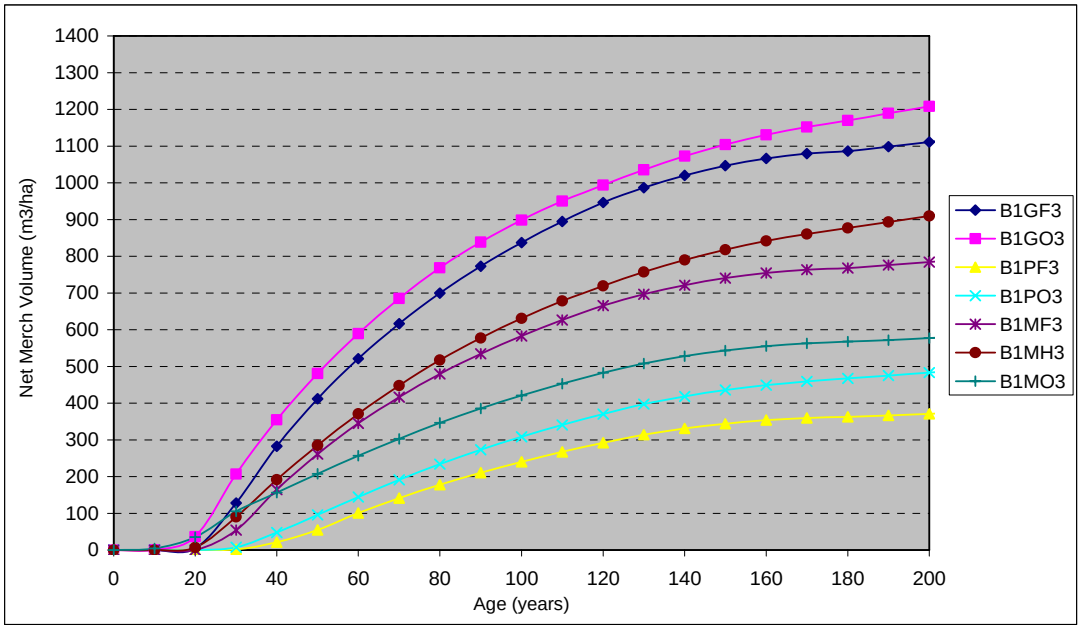
	Analysis Units					
Age	**M3AO3**	**B3GH3**	**B3GO3**	**B3PO3**	**B3MH3**	**B3MO3**
0	0	0	0	0	0	0
10	0	0	0	0	0	0
20	0	0	0	0	0	0
30	2	8	17	4	6	8
40	24	41	72	20	46	52
50	71	90	127	49	106	100
60	124	143	182	88	168	152
70	175	195	231	127	224	199
80	221	243	274	163	274	240
90	261	285	313	196	319	277
100	298	323	347	225	360	311
110	331	357	378	251	396	342
120	360	387	406	275	429	370
130	387	416	429	298	459	392
140	412	442	448	318	487	412
150	433	464	464	335	511	427
160	452	484	476	350	531	439
170	468	501	485	362	549	447
180	482	517	492	373	564	453
190	497	533	499	384	580	460
200	511	547	507	394	595	468
210	524	561	514	404	608	475
220	536	574	522	414	621	483
230	548	586	528	423	633	490
240	559	598	534	432	645	497
250	570	609	540	440	655	504
260	574	614	543	443	660	506
270	577	619	545	446	664	508
280	580	623	547	448	668	509
290	583	626	549	450	671	511
300	586	630	551	452	674	512
310	588	633	552	453	677	513
320	590	636	554	455	679	514
330	592	638	555	456	681	515
340	594	640	556	457	683	516
350	595	642	557	458	684	517



Net Merchantable Volume Yield Curves

Natural Immature Stands within the CWHxm2 Subzone

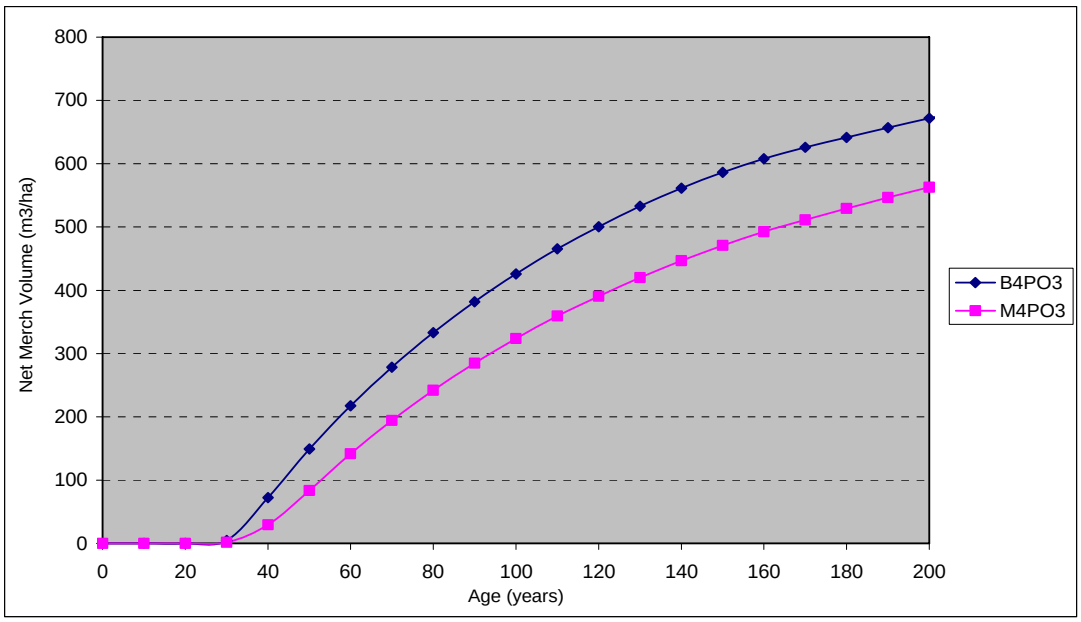
	Analysis Units						
Age	**B1GF3**	**B1GO3**	**B1PF3**	**B1PO3**	**B1MF3**	**B1MH3**	**B1MO3**
0	0	0	0	0	0	0	0
10	0	1	0	0	0	0	4
20	4	36	0	0	0	7	35
30	128	207	2	8	54	90	105
40	282	354	21	48	165	192	157
50	412	481	55	96	261	285	208
60	521	590	101	145	345	371	257
70	616	685	142	191	417	448	303
80	700	769	178	234	479	517	346
90	773	838	211	273	534	577	385
100	837	898	240	308	583	631	421
110	895	950	267	341	627	678	453
120	946	994	292	371	666	719	483
130	987	1036	314	397	696	757	508
140	1020	1073	331	419	721	790	528
150	1047	1104	344	436	741	818	543
160	1066	1131	354	449	755	841	555
170	1080	1152	360	460	764	861	563
180	1086	1170	363	467	768	877	568
190	1099	1189	367	475	776	893	572
200	1111	1208	371	483	784	909	577
210	1124	1225	376	491	793	924	583
220	1135	1242	380	498	801	938	588
230	1147	1257	384	505	808	951	593
240	1158	1271	388	512	816	964	597
250	1168	1284	391	518	822	975	601
260	1169	1288	393	521	823	979	604
270	1170	1290	394	523	824	983	606
280	1171	1292	395	525	825	986	607
290	1171	1293	397	527	825	989	608
300	1171	1294	397	529	826	991	609
310	1171	1294	398	530	826	993	610
320	1171	1294	399	531	826	995	611
330	1171	1293	399	532	826	996	611
340	1171	1292	399	533	826	997	612
350	1171	1291	399	533	826	997	612



Net Merchantable Volume Yield Curves

Natural Immature Stands within the MHmm1 Subzone

	Analysis Units	
Age	**B4PO3**	**M4PO3**
0	0	0
10	0	0
20	0	0
30	5	2
40	72	29
50	149	84
60	217	142
70	278	194
80	333	242
90	382	285
100	426	324
110	465	359
120	500	390
130	533	420
140	561	447
150	586	471
160	608	492
170	626	511
180	641	529
190	657	547
200	672	563
210	685	578
220	698	592
230	709	606
240	720	619
250	730	631
260	735	637
270	740	643
280	744	648
290	748	653
300	751	658
310	753	662
320	756	665
330	758	669
340	760	672
350	761	675

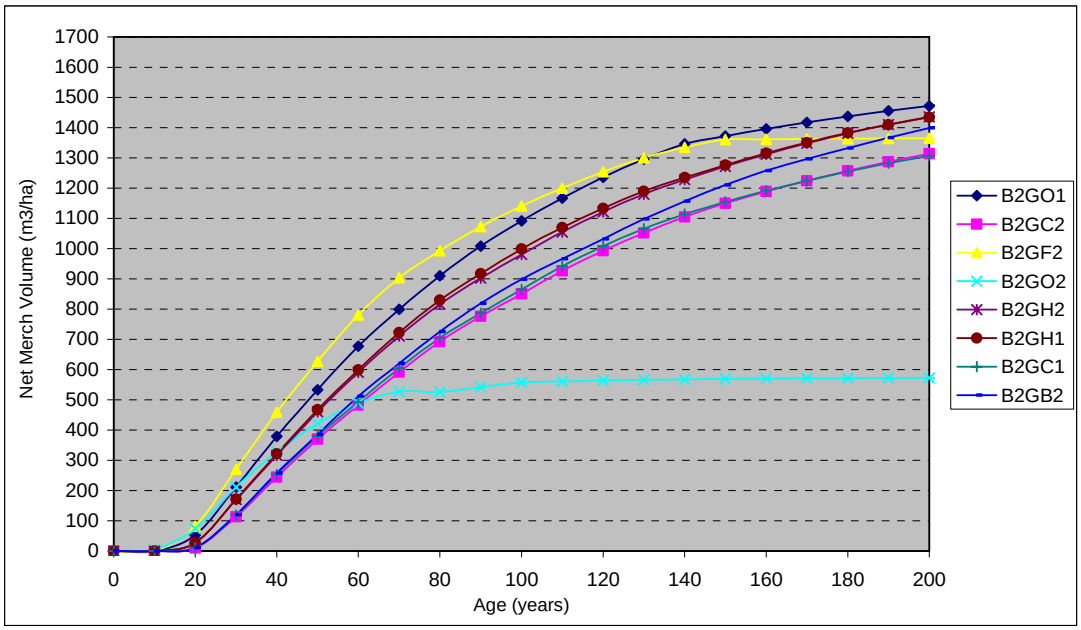


Appendix B: Existing Managed Yield Tables (SIBEC option)

Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (SIBEC scenario, good productivity)

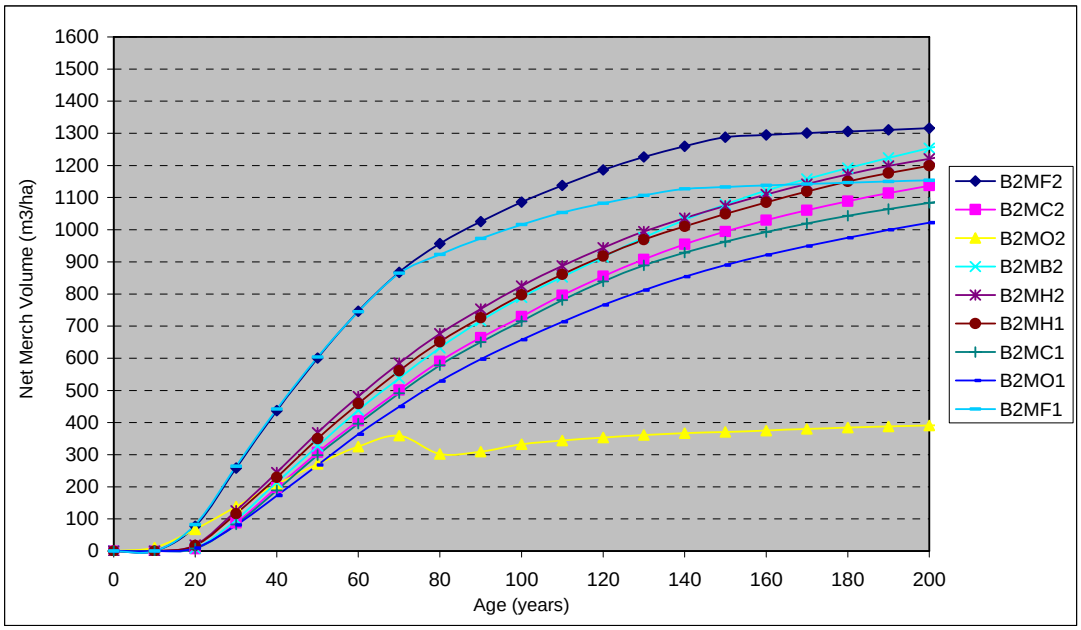
	Analysis Units							
Age	**B2GO1**	**B2GC2**	**B2GF2**	**B2GO2**	**B2GH2**	**B2GH1**	**B2GC1**	**B2GB2**
0	0	0	0	0	0	0	0	0
10	0	0	0	5	0	0	0	0
20	53	10	82	74	28	27	11	10
30	212	113	270	212	170	172	119	120
40	379	245	459	328	317	322	253	258
50	534	370	628	421	461	468	380	385
60	678	483	780	489	591	599	494	512
70	799	592	903	527	711	723	605	621
80	910	693	993	526	816	830	705	725
90	1008	776	1072	542	902	917	787	819
100	1092	851	1141	558	981	999	865	899
110	1167	926	1200	561	1055	1069	942	966
120	1236	993	1254	564	1121	1133	1008	1032
130	1295	1052	1300	566	1180	1190	1066	1097
140	1346	1105	1335	568	1228	1235	1114	1157
150	1372	1150	1360	569	1271	1277	1155	1211
160	1396	1189	1362	570	1312	1315	1192	1258
170	1418	1224	1363	571	1348	1351	1225	1297
180	1437	1257	1364	572	1381	1383	1255	1333
190	1456	1287	1365	572	1410	1410	1282	1367
200	1471	1314	1366	572	1436	1434	1307	1399
210	1486	1340	1366	572	1460	1455	1332	1428
220	1498	1367	1367	573	1482	1476	1358	1456
230	1508	1391	1367	573	1503	1494	1381	1480
240	1518	1414	1368	573	1522	1512	1403	1500
250	1527	1435	1368	573	1540	1528	1424	1520
260	1534	1453	1368	573	1557	1543	1441	1538
270	1542	1470	1368	573	1571	1556	1457	1555
280	1547	1486	1368	573	1581	1565	1472	1571
290	1552	1501	1368	573	1590	1573	1486	1586
300	1552	1501	1368	573	1590	1573	1486	1586
310	1552	1501	1368	573	1590	1573	1486	1586
320	1552	1501	1368	573	1590	1573	1486	1586
330	1552	1501	1368	573	1590	1573	1486	1586
340	1552	1501	1368	573	1590	1573	1486	1586
350	1552	1501	1368	573	1590	1573	1486	1586



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (SIBEC scenario, medium productivity)

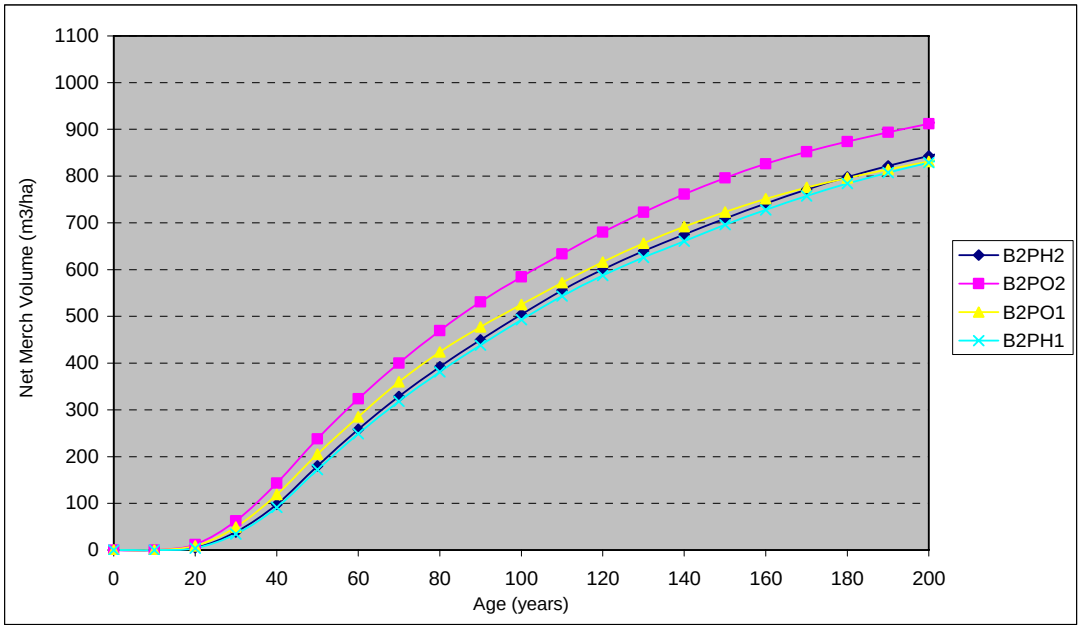
	Analysis Units								
Age	**B2MF2**	**B2MC2**	**B2MO2**	**B2MB2**	**B2MH2**	**B2MH1**	**B2MC1**	**B2MO1**	**B2MF1**
0	0	0	0	0	0	0	0	0	0
10	0	0	11	0	0	0	0	0	0
20	77	7	68	8	19	17	8	9	82
30	258	88	138	98	125	116	83	81	264
40	437	197	207	214	245	229	189	173	442
50	601	307	271	326	368	349	298	267	603
60	746	405	325	438	481	459	397	363	745
70	867	501	359	538	585	561	491	449	864
80	957	590	302	632	676	651	579	528	923
90	1025	664	310	717	753	726	650	597	972
100	1086	730	333	790	825	798	715	657	1016
110	1138	796	344	853	888	861	781	713	1054
120	1186	855	354	915	944	918	839	766	1082
130	1227	908	362	975	995	969	889	812	1107
140	1260	954	367	1030	1036	1010	929	853	1127
150	1288	995	371	1079	1074	1049	963	890	1133
160	1295	1030	375	1122	1110	1085	993	921	1138
170	1301	1061	380	1158	1142	1119	1020	949	1142
180	1306	1089	384	1192	1172	1150	1043	975	1146
190	1311	1114	388	1224	1198	1176	1064	999	1150
200	1316	1137	391	1254	1221	1199	1084	1021	1153
210	1320	1161	394	1281	1243	1220	1103	1043	1156
220	1324	1184	396	1308	1264	1240	1123	1063	1158
230	1327	1206	396	1332	1282	1258	1140	1081	1159
240	1330	1227	396	1352	1299	1275	1157	1098	1161
250	1332	1246	396	1372	1315	1290	1172	1114	1163
260	1333	1262	396	1390	1330	1304	1186	1127	1163
270	1334	1277	396	1407	1343	1316	1198	1140	1163
280	1334	1292	396	1424	1352	1325	1210	1151	1163
290	1334	1305	396	1438	1361	1333	1221	1160	1163
300	1334	1305	396	1438	1361	1333	1221	1160	1163
310	1334	1305	396	1438	1361	1333	1221	1160	1163
320	1334	1305	396	1438	1361	1333	1221	1160	1163
330	1334	1305	396	1438	1361	1333	1221	1160	1163
340	1334	1305	396	1438	1361	1333	1221	1160	1163
350	1334	1305	396	1438	1361	1333	1221	1160	1163



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (SIBEC scenario, poor productivity)

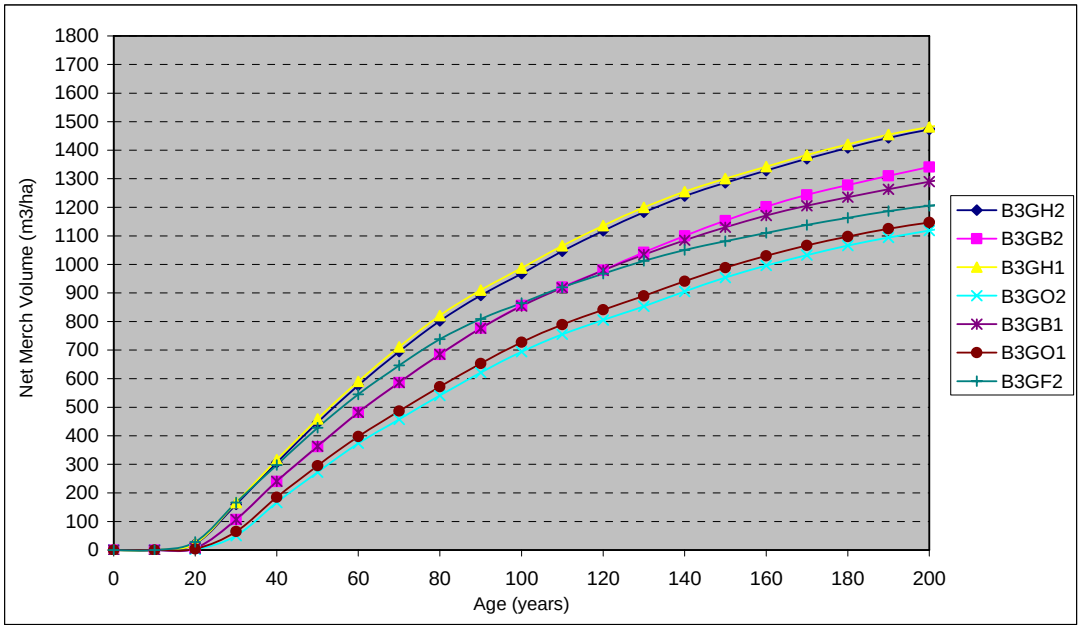
	Analysis Units			
Age	**B2PH2**	**B2PO2**	**B2PO1**	**B2PH1**
0	0	0	0	0
10	0	0	0	0
20	5	12	9	4
30	39	63	49	34
40	98	143	119	91
50	180	238	205	172
60	258	324	285	249
70	329	400	360	318
80	392	470	424	381
90	450	531	478	438
100	504	585	525	493
110	556	634	572	543
120	600	680	616	587
130	640	723	657	626
140	675	762	692	661
150	709	796	723	696
160	742	826	751	728
170	771	852	776	758
180	798	874	796	784
190	822	894	814	808
200	843	912	831	829
210	863	930	848	849
220	883	948	866	868
230	897	964	881	882
240	911	980	897	896
250	924	996	912	909
260	936	1010	925	921
270	946	1023	937	932
280	956	1034	949	941
290	964	1043	959	949
300	964	1043	959	949
310	964	1043	959	949
320	964	1043	959	949
330	964	1043	959	949
340	964	1043	959	949
350	964	1043	959	949



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (SIBEC scenario, good productivity)

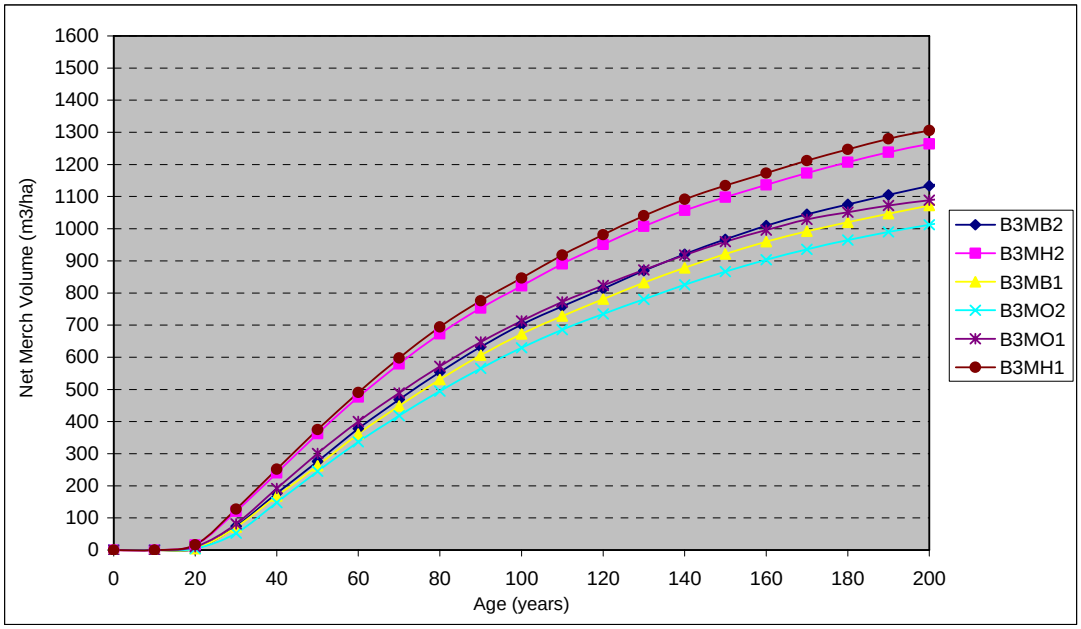
	Analysis Units						
Age	**B3GH2**	**B3GB2**	**B3GH1**	**B3GO2**	**B3GB1**	**B3GO1**	**B3GF2**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	22	6	23	2	7	4	29
30	160	107	166	50	107	65	166
40	307	240	316	166	241	185	297
50	447	362	459	273	363	295	428
60	576	482	590	374	482	397	545
70	695	587	712	458	587	487	647
80	802	685	821	541	686	572	739
90	892	777	910	621	776	653	809
100	968	856	987	694	854	727	865
110	1046	921	1065	755	919	790	920
120	1117	980	1136	806	979	841	968
130	1182	1042	1200	854	1034	890	1013
140	1239	1100	1255	906	1084	941	1050
150	1286	1153	1300	954	1130	989	1082
160	1329	1202	1342	996	1171	1030	1111
170	1370	1243	1383	1032	1206	1066	1138
180	1408	1278	1420	1066	1235	1098	1163
190	1443	1310	1454	1094	1263	1125	1187
200	1472	1341	1481	1118	1290	1147	1206
210	1499	1371	1507	1143	1315	1170	1222
220	1524	1398	1531	1169	1338	1193	1238
230	1547	1424	1553	1194	1360	1215	1252
240	1568	1445	1574	1218	1378	1236	1265
250	1588	1464	1594	1240	1394	1255	1276
260	1607	1481	1612	1258	1408	1272	1287
270	1625	1496	1628	1274	1422	1287	1297
280	1641	1511	1643	1289	1434	1301	1307
290	1654	1526	1654	1303	1445	1314	1316
300	1654	1526	1654	1303	1445	1314	1316
310	1654	1526	1654	1303	1445	1314	1316
320	1654	1526	1654	1303	1445	1314	1316
330	1654	1526	1654	1303	1445	1314	1316
340	1654	1526	1654	1303	1445	1314	1316
350	1654	1526	1654	1303	1445	1314	1316



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (SIBEC scenario, medium productivity)

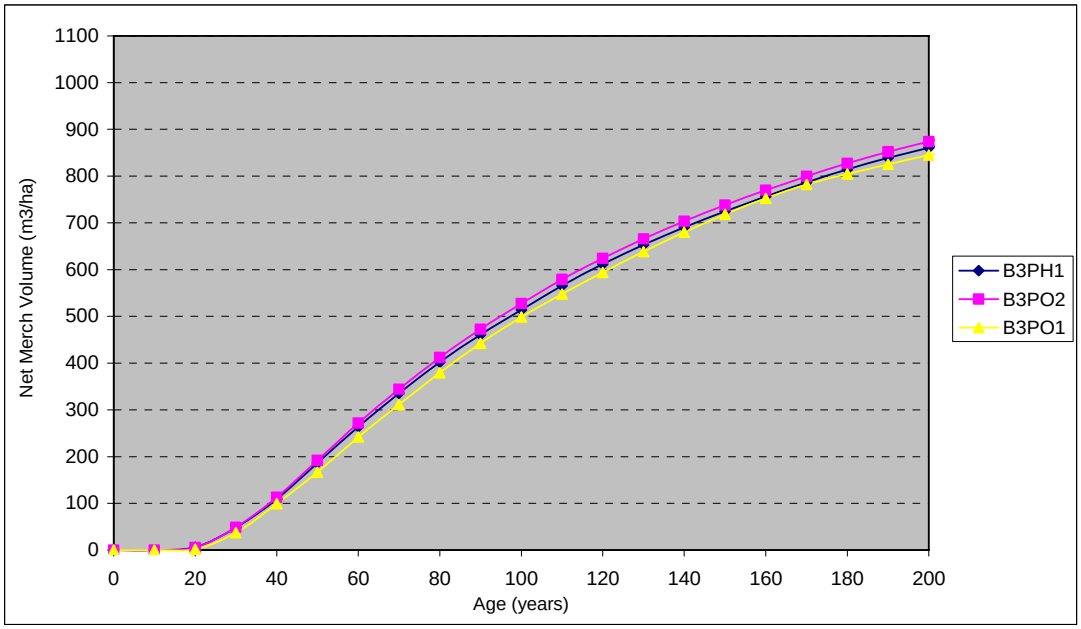
	Analysis Units					
Age	**B3MB2**	**B3MH2**	**B3MB1**	**B3MO2**	**B3MO1**	**B3MH1**
0	0	0	0	0	0	0
10	0	0	0	0	0	0
20	4	16	4	4	10	17
30	74	120	72	52	82	128
40	177	240	168	148	192	251
50	276	362	263	245	300	375
60	378	476	361	337	400	491
70	468	579	448	418	489	598
80	554	673	531	495	572	695
90	633	753	607	565	647	776
100	701	822	673	629	713	847
110	758	890	728	685	772	918
120	813	951	781	735	823	982
130	870	1007	832	780	872	1041
140	920	1057	879	826	918	1091
150	967	1098	921	867	959	1134
160	1009	1137	960	904	996	1173
170	1045	1173	992	936	1029	1212
180	1076	1207	1020	965	1052	1247
190	1105	1238	1047	990	1072	1280
200	1133	1264	1072	1012	1089	1305
210	1161	1288	1097	1034	1106	1329
220	1186	1310	1120	1056	1122	1352
230	1211	1331	1142	1077	1136	1373
240	1231	1350	1161	1097	1149	1394
250	1250	1368	1177	1116	1162	1413
260	1266	1385	1192	1133	1173	1431
270	1282	1400	1205	1148	1183	1448
280	1296	1414	1218	1163	1193	1463
290	1311	1426	1230	1176	1201	1475
300	1311	1426	1230	1176	1201	1475
310	1311	1426	1230	1176	1201	1475
320	1311	1426	1230	1176	1201	1475
330	1311	1426	1230	1176	1201	1475
340	1311	1426	1230	1176	1201	1475
350	1311	1426	1230	1176	1201	1475



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (SIBEC scenario, poor productivity)

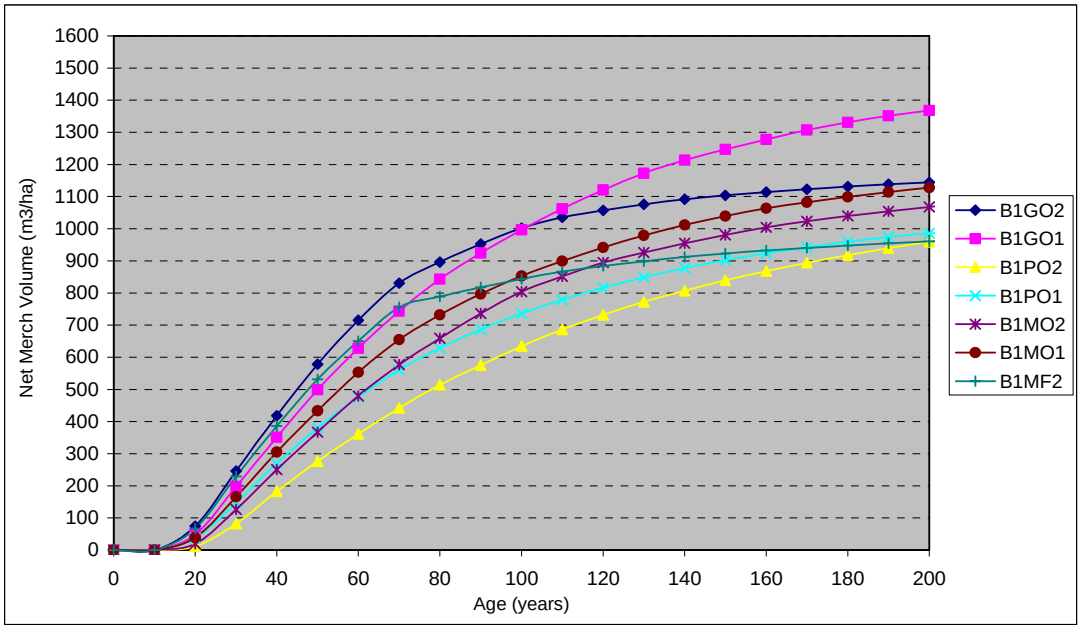
	Analysis Units		
Age	**B3PH1**	**B3PO2**	**B3PO1**
0	0	0	0
10	0	0	0
20	6	5	2
30	48	49	37
40	109	113	99
50	186	192	167
60	264	272	242
70	335	344	311
80	402	412	379
90	461	472	442
100	514	528	498
110	566	579	548
120	612	624	594
130	653	666	639
140	690	703	680
150	725	738	718
160	757	770	752
170	787	800	782
180	814	827	805
190	839	852	825
200	861	874	845
210	881	894	864
220	899	914	882
230	916	931	898
240	931	946	913
250	946	961	926
260	960	975	938
270	972	987	949
280	983	999	959
290	993	1008	969
300	993	1008	969
310	993	1008	969
320	993	1008	969
330	993	1008	969
340	993	1008	969
350	993	1008	969



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHxm2 Subzone (SIBEC scenario)

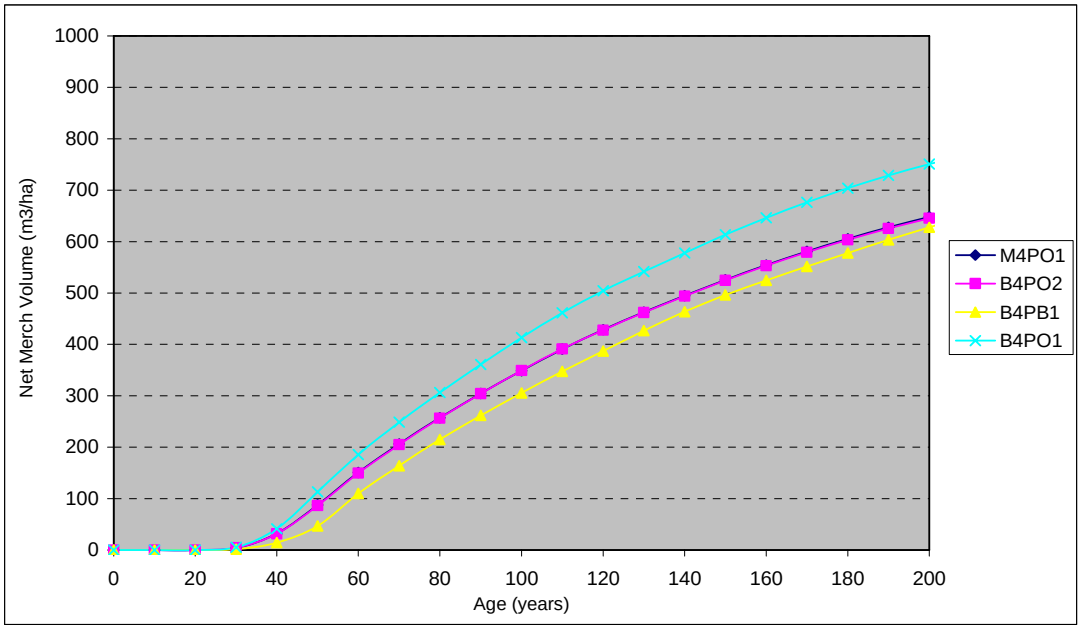
	Analysis Units						
Age	**B1GO2**	**B1GO1**	**B1PO2**	**B1PO1**	**B1MO2**	**B1MO1**	**B1MF2**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	74	48	11	37	20	39	67
30	246	197	82	148	126	166	229
40	418	351	182	270	250	305	386
50	578	499	276	380	367	434	531
60	715	628	361	476	480	553	650
70	831	743	442	560	577	655	756
80	896	843	514	629	659	732	789
90	953	924	576	687	736	797	818
100	1001	997	634	736	804	853	844
110	1036	1062	686	779	851	899	866
120	1057	1121	732	817	895	941	884
130	1076	1172	772	849	926	979	899
140	1092	1213	807	877	954	1012	912
150	1104	1247	839	902	981	1039	923
160	1114	1278	868	923	1005	1063	932
170	1123	1307	894	942	1024	1082	940
180	1131	1331	918	960	1040	1099	948
190	1139	1351	940	974	1054	1114	955
200	1144	1368	959	986	1068	1128	960
210	1149	1384	977	991	1081	1139	965
220	1153	1399	993	996	1093	1149	969
230	1156	1411	1007	1000	1104	1158	972
240	1156	1423	1018	1004	1114	1166	972
250	1156	1434	1028	1008	1121	1172	972
260	1157	1444	1036	1010	1128	1178	972
270	1157	1453	1043	1012	1135	1183	972
280	1157	1459	1050	1014	1141	1187	972
290	1157	1464	1056	1016	1146	1191	972
300	1157	1464	1056	1016	1146	1191	972
310	1157	1464	1056	1016	1146	1191	972
320	1157	1464	1056	1016	1146	1191	972
330	1157	1464	1056	1016	1146	1191	972
340	1157	1464	1056	1016	1146	1191	972
350	1157	1464	1056	1016	1146	1191	972



Net Merchantable Volume Yield Curves

Existing Managed Stands within the MHmm1 Subzone (SIBEC scenario)

	Analysis Units			
Age	**M4PO1**	**B4PO2**	**B4PB1**	**B4PO1**
0	0	0	0	0
10	0	0	0	0
20	0	0	0	0
30	4	5	2	5
40	32	32	14	42
50	88	86	47	113
60	151	149	110	186
70	206	205	164	249
80	257	256	215	306
90	305	304	262	361
100	349	349	306	413
110	391	391	348	462
120	428	428	387	504
130	463	462	427	542
140	495	494	464	578
150	526	525	496	613
160	554	553	525	646
170	581	579	552	676
180	605	603	578	704
190	628	625	604	729
200	648	645	628	751
210	667	664	651	771
220	685	682	671	790
230	700	698	691	805
240	713	712	710	819
250	727	726	727	833
260	739	738	743	843
270	750	750	754	852
280	760	760	766	860
290	770	770	776	869
300	770	770	776	869
310	770	770	776	869
320	770	770	776	869
330	770	770	776	869
340	770	770	776	869
350	770	770	776	869

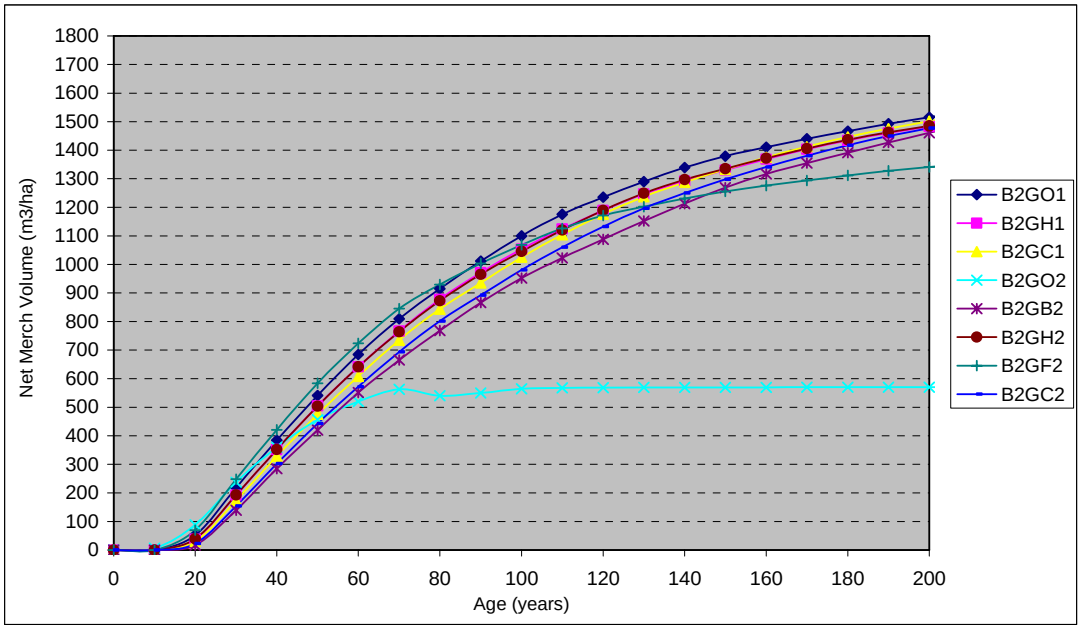


Appendix C: Existing Managed Yield Tables (PSI option)

Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (PSI scenario, good productivity)

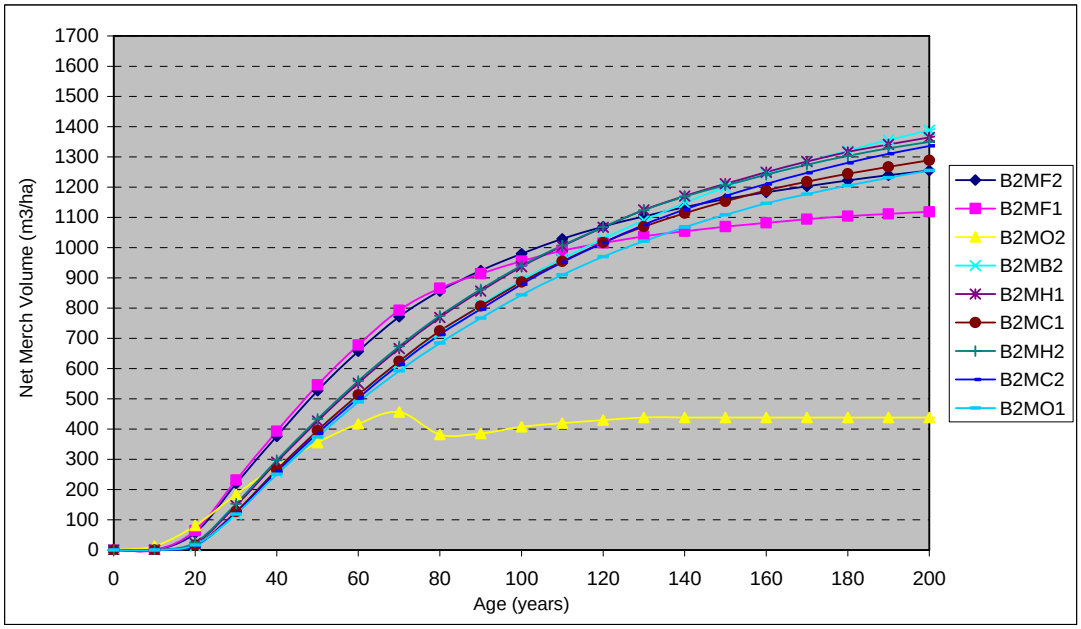
	Analysis Units							
Age	**B2GO1**	**B2GH1**	**B2GC1**	**B2GO2**	**B2GB2**	**B2GH2**	**B2GF2**	**B2GC2**
0	0	0	0	0	0	0	0	0
10	0	0	0	6	0	0	0	0
20	52	38	31	89	17	40	70	23
30	218	192	173	238	140	193	248	154
40	384	352	328	360	285	352	421	303
50	541	504	475	457	420	504	584	443
60	685	642	609	520	551	642	724	572
70	810	767	735	563	665	764	845	694
80	915	878	843	540	769	873	929	802
90	1012	971	936	550	866	965	1003	893
100	1100	1054	1025	565	953	1046	1069	981
110	1175	1124	1104	568	1023	1120	1126	1061
120	1236	1189	1176	569	1088	1189	1172	1132
130	1290	1246	1237	569	1152	1249	1202	1196
140	1339	1291	1287	570	1213	1297	1230	1250
150	1379	1331	1333	570	1268	1335	1255	1298
160	1411	1368	1375	570	1317	1371	1276	1341
170	1439	1403	1412	570	1355	1406	1294	1381
180	1467	1435	1446	570	1391	1437	1311	1417
190	1493	1460	1476	570	1426	1463	1328	1449
200	1515	1483	1502	570	1461	1485	1341	1477
210	1537	1503	1529	570	1492	1506	1353	1505
220	1557	1522	1555	570	1520	1526	1363	1532
230	1567	1540	1578	570	1543	1545	1373	1556
240	1577	1555	1593	570	1563	1560	1373	1579
250	1584	1568	1607	570	1582	1574	1373	1597
260	1592	1580	1620	570	1599	1588	1374	1613
270	1599	1591	1631	570	1616	1599	1374	1628
280	1604	1598	1641	570	1632	1607	1374	1640
290	1609	1605	1650	570	1647	1615	1374	1651
300	1609	1605	1650	570	1647	1615	1374	1651
310	1609	1605	1650	570	1647	1615	1374	1651
320	1609	1605	1650	570	1647	1615	1374	1651
330	1609	1605	1650	570	1647	1615	1374	1651
340	1609	1605	1650	570	1647	1615	1374	1651
350	1609	1605	1650	570	1647	1615	1374	1651



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (PSI scenario, medium productivity)

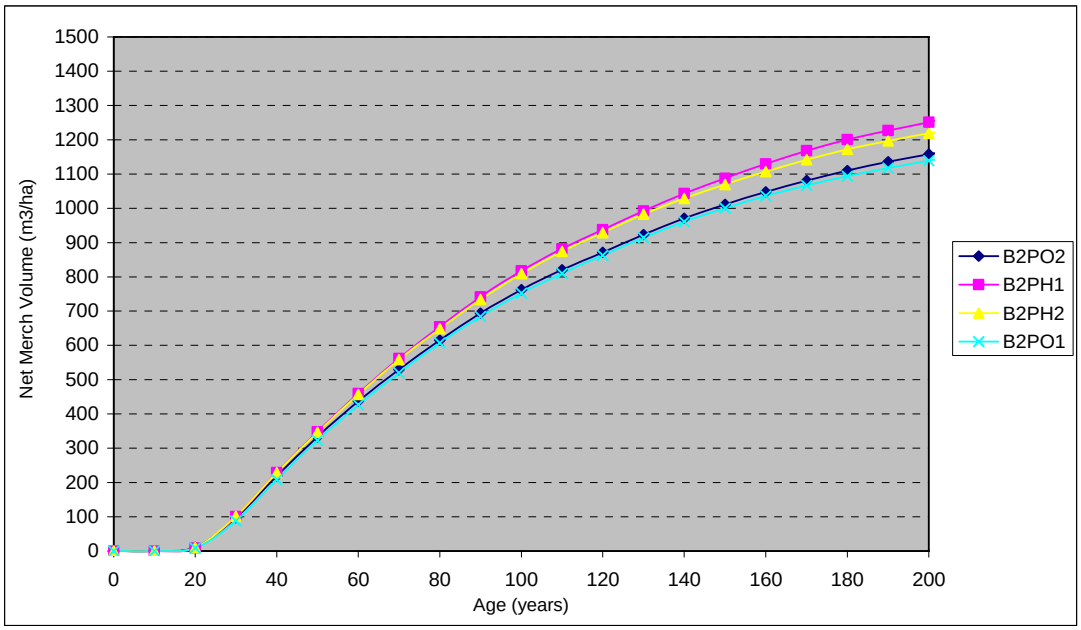
	Analysis Units								
Age	**B2MF2**	**B2MF1**	**B2MO2**	**B2MB2**	**B2MH1**	**B2MC1**	**B2MH2**	**B2MC2**	**B2MO1**
0	0	0	0	0	0	0	0	0	0
10	0	0	13	0	0	0	0	0	0
20	57	64	81	14	22	16	25	15	17
30	220	231	184	119	147	127	153	123	119
40	376	393	278	257	291	265	297	259	251
50	527	547	355	385	427	395	434	386	374
60	658	678	417	508	551	514	559	503	489
70	772	793	457	617	666	625	673	614	592
80	856	865	382	717	769	724	775	713	684
90	924	914	385	810	857	807	862	797	767
100	980	955	408	893	937	886	940	879	844
110	1029	990	420	963	1005	955	1008	951	910
120	1070	1015	429	1029	1067	1017	1068	1016	970
130	1103	1037	438	1090	1125	1069	1124	1075	1021
140	1134	1054	438	1148	1171	1114	1169	1126	1067
150	1160	1069	438	1200	1211	1153	1206	1171	1109
160	1183	1082	438	1246	1249	1189	1241	1211	1146
170	1203	1094	438	1285	1285	1218	1274	1247	1177
180	1222	1104	438	1321	1316	1244	1303	1280	1205
190	1240	1112	438	1356	1342	1268	1328	1310	1231
200	1255	1119	438	1388	1365	1288	1350	1336	1255
210	1268	1123	438	1419	1386	1310	1370	1362	1273
220	1281	1127	438	1447	1406	1331	1390	1388	1290
230	1292	1130	438	1471	1426	1350	1409	1412	1304
240	1295	1132	438	1492	1444	1366	1426	1433	1317
250	1298	1134	438	1512	1459	1381	1441	1452	1330
260	1300	1135	438	1531	1474	1395	1455	1470	1341
270	1303	1137	438	1548	1487	1408	1468	1486	1352
280	1304	1138	438	1565	1496	1418	1477	1499	1361
290	1306	1139	438	1580	1504	1428	1485	1511	1370
300	1306	1139	438	1580	1504	1428	1485	1511	1370
310	1306	1139	438	1580	1504	1428	1485	1511	1370
320	1306	1139	438	1580	1504	1428	1485	1511	1370
330	1306	1139	438	1580	1504	1428	1485	1511	1370
340	1306	1139	438	1580	1504	1428	1485	1511	1370
350	1306	1139	438	1580	1504	1428	1485	1511	1370



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm1 Subzone (PSI scenario, poor productivity)

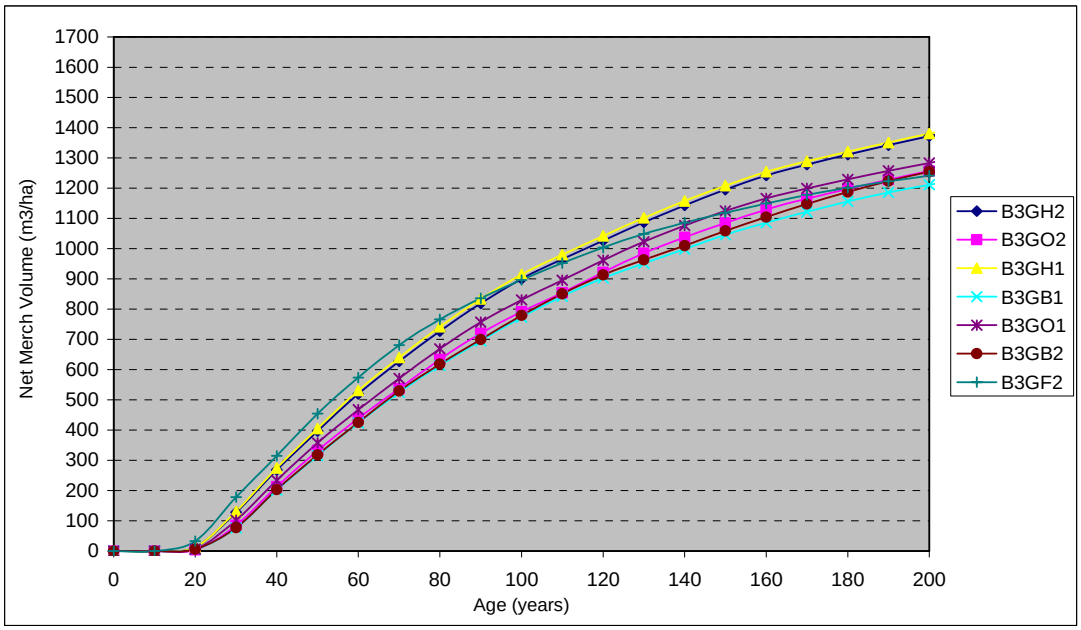
	Analysis Units			
Age	**B2PO2**	**B2PH1**	**B2PH2**	**B2PO1**
0	0	0	0	0
10	0	0	0	0
20	11	9	10	9
30	97	101	101	88
40	219	229	229	208
50	333	348	346	323
60	437	460	457	426
70	529	562	558	520
80	615	655	649	607
90	694	742	734	684
100	763	818	809	752
110	820	882	874	810
120	872	937	929	862
130	923	993	983	914
140	971	1043	1029	961
150	1011	1088	1069	1000
160	1048	1130	1107	1036
170	1081	1168	1142	1067
180	1110	1201	1172	1094
190	1135	1227	1197	1118
200	1158	1251	1219	1139
210	1180	1274	1240	1161
220	1202	1297	1261	1183
230	1223	1318	1280	1201
240	1241	1337	1298	1219
250	1256	1356	1315	1234
260	1269	1373	1330	1248
270	1280	1386	1343	1260
280	1291	1396	1353	1271
290	1301	1406	1363	1282
300	1301	1406	1363	1282
310	1301	1406	1363	1282
320	1301	1406	1363	1282
330	1301	1406	1363	1282
340	1301	1406	1363	1282
350	1301	1406	1363	1282



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (PSI scenario, good productivity)

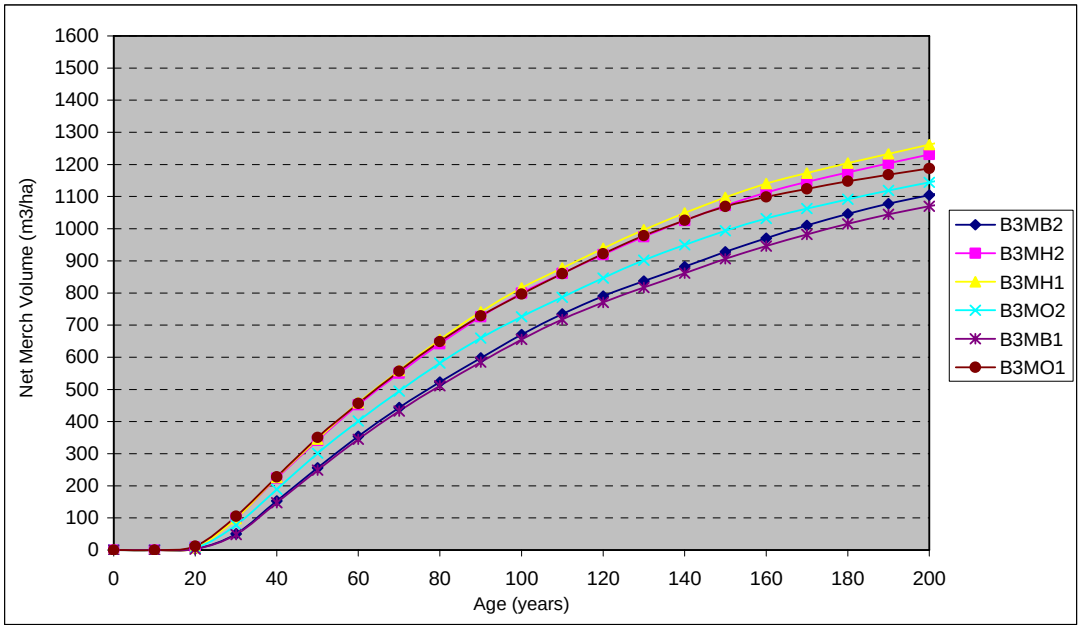
	Analysis Units						
Age	**B3GH2**	**B3GO2**	**B3GH1**	**B3GB1**	**B3GO1**	**B3GB2**	**B3GF2**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	13	4	13	6	6	6	33
30	128	85	131	77	102	77	178
40	268	213	274	202	234	203	315
50	396	333	405	316	358	318	454
60	520	439	531	423	468	426	574
70	628	537	640	525	570	529	681
80	727	633	741	613	669	618	766
90	819	720	834	695	757	700	836
100	900	792	914	773	830	779	897
110	965	854	980	842	896	851	952
120	1027	922	1042	902	962	913	1004
130	1087	985	1102	952	1023	963	1049
140	1143	1037	1157	998	1076	1010	1086
150	1195	1085	1208	1046	1125	1059	1118
160	1242	1129	1254	1085	1166	1104	1149
170	1278	1165	1288	1122	1199	1148	1177
180	1311	1198	1320	1156	1229	1187	1202
190	1342	1228	1351	1186	1257	1224	1223
200	1372	1257	1380	1211	1284	1254	1241
210	1401	1284	1408	1232	1309	1280	1258
220	1427	1313	1434	1252	1336	1304	1272
230	1451	1338	1457	1271	1359	1327	1287
240	1471	1360	1475	1288	1378	1349	1301
250	1487	1382	1490	1305	1398	1370	1314
260	1502	1403	1505	1320	1416	1389	1325
270	1516	1423	1519	1334	1433	1407	1334
280	1530	1443	1533	1346	1450	1422	1340
290	1542	1462	1545	1356	1466	1435	1345
300	1542	1462	1545	1356	1466	1435	1345
310	1542	1462	1545	1356	1466	1435	1345
320	1542	1462	1545	1356	1466	1435	1345
330	1542	1462	1545	1356	1466	1435	1345
340	1542	1462	1545	1356	1466	1435	1345
350	1542	1462	1545	1356	1466	1435	1345



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (PSI scenario, medium productivity)

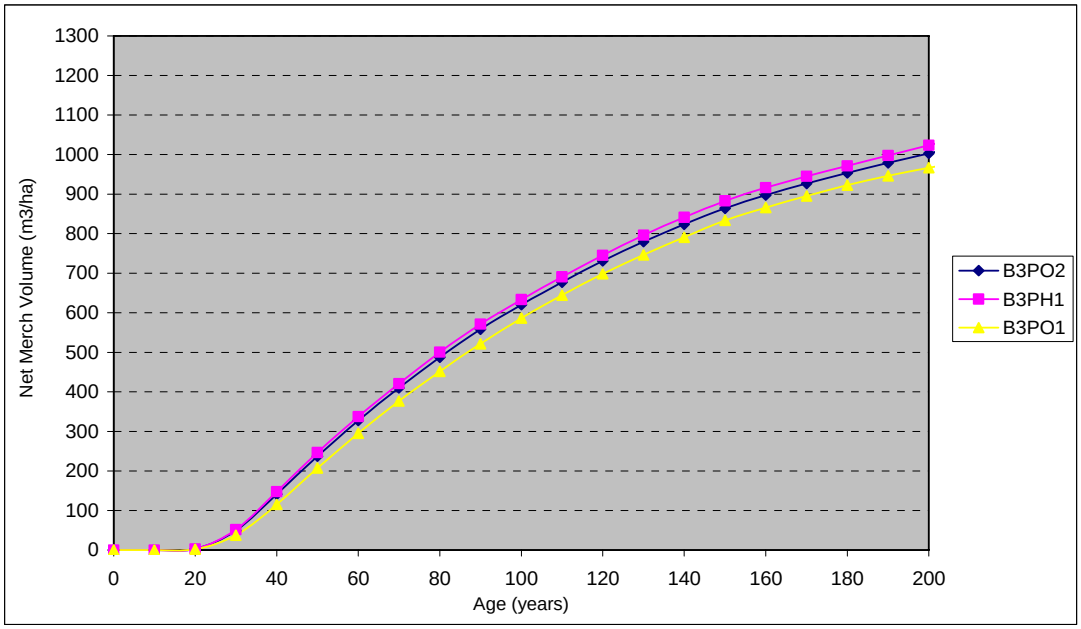
	Analysis Units					
Age	**B3MB2**	**B3MH2**	**B3MH1**	**B3MO2**	**B3MB1**	**B3MO1**
0	0	0	0	0	0	0
10	0	0	0	0	0	0
20	3	9	7	7	3	12
30	51	99	98	78	48	105
40	153	223	226	189	147	228
50	256	341	346	301	249	350
60	354	452	459	402	345	456
70	443	550	559	495	432	557
80	523	642	655	582	511	649
90	598	726	741	659	585	729
100	670	800	815	726	656	797
110	735	861	877	787	718	860
120	790	920	939	846	771	922
130	837	975	996	902	817	978
140	882	1025	1049	950	861	1026
150	928	1072	1098	994	907	1069
160	970	1113	1140	1031	946	1099
170	1010	1146	1173	1063	982	1124
180	1046	1175	1204	1092	1015	1148
190	1078	1204	1233	1119	1045	1168
200	1105	1231	1262	1144	1070	1187
210	1129	1257	1289	1171	1091	1206
220	1152	1282	1315	1197	1112	1223
230	1174	1304	1338	1221	1131	1238
240	1195	1323	1357	1242	1150	1253
250	1215	1340	1374	1262	1167	1267
260	1234	1355	1390	1280	1184	1279
270	1252	1369	1404	1296	1199	1289
280	1267	1382	1418	1312	1213	1299
290	1280	1395	1431	1326	1225	1308
300	1280	1395	1431	1326	1225	1308
310	1280	1395	1431	1326	1225	1308
320	1280	1395	1431	1326	1225	1308
330	1280	1395	1431	1326	1225	1308
340	1280	1395	1431	1326	1225	1308
350	1280	1395	1431	1326	1225	1308



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHvm2 Subzone (PSI scenario, poor productivity)

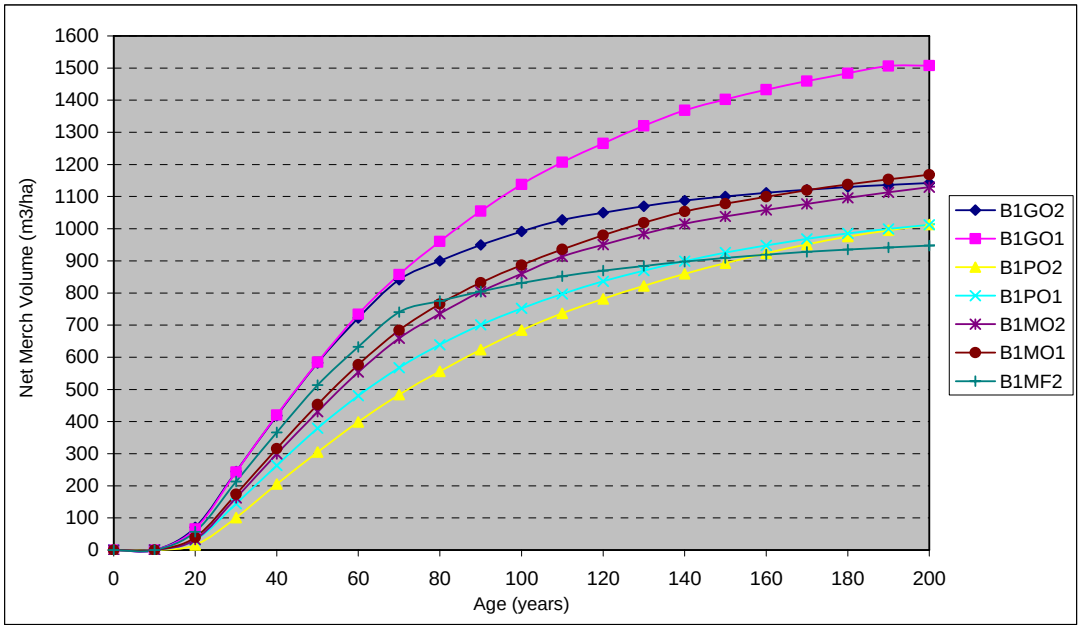
	Analysis Units		
Age	**B3PO2**	**B3PH1**	**B3PO1**
0	0	0	0
10	0	0	0
20	3	3	2
30	49	51	37
40	141	148	115
50	237	246	207
60	328	337	295
70	410	421	377
80	488	500	452
90	558	571	522
100	621	633	586
110	677	691	645
120	731	745	698
130	780	796	746
140	824	841	791
150	864	883	833
160	898	916	866
170	927	945	895
180	954	971	923
190	979	998	946
200	1003	1023	967
210	1027	1048	985
220	1049	1072	1003
230	1070	1094	1020
240	1089	1114	1036
250	1106	1132	1051
260	1121	1147	1065
270	1135	1162	1077
280	1147	1175	1088
290	1159	1187	1098
300	1159	1187	1098
310	1159	1187	1098
320	1159	1187	1098
330	1159	1187	1098
340	1159	1187	1098
350	1159	1187	1098



Net Merchantable Volume Yield Curves

Existing Managed Stands within the CWHxm2 Subzone (PSI scenario)

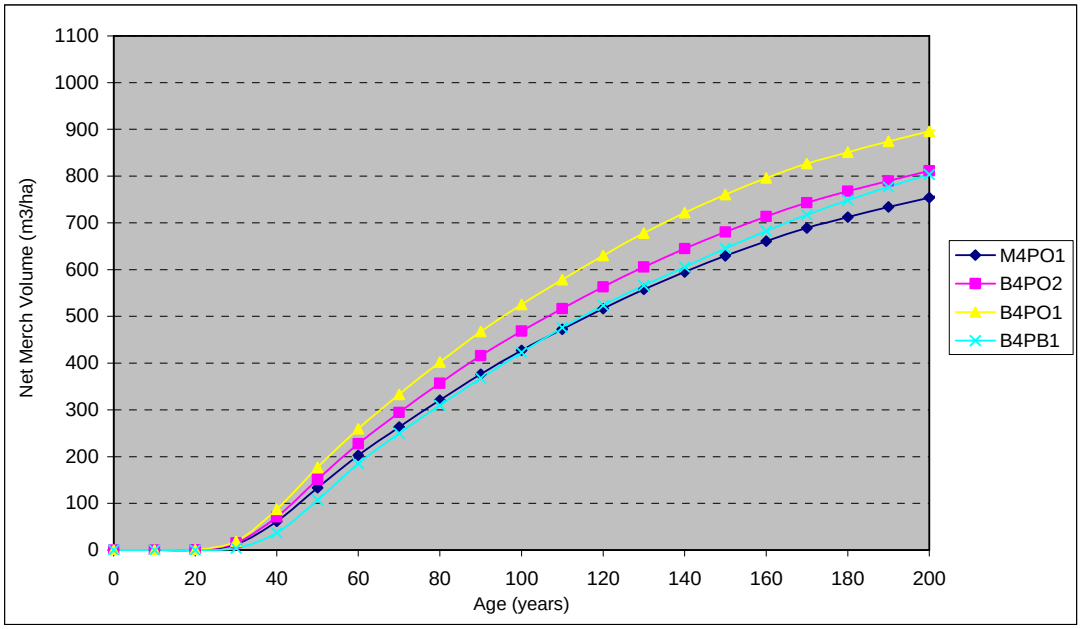
	Analysis Units						
Age	**B1GO2**	**B1GO1**	**B1PO2**	**B1PO1**	**B1MO2**	**B1MO1**	**B1MF2**
0	0	0	0	0	0	0	0
10	0	0	0	0	1	0	0
20	71	66	16	31	33	39	57
30	244	243	101	144	162	174	214
40	418	421	205	263	299	316	366
50	583	585	305	380	431	453	514
60	723	734	399	480	554	577	633
70	841	858	484	568	659	684	741
80	900	961	556	639	735	766	775
90	949	1055	624	701	804	832	805
100	992	1138	685	752	860	887	831
110	1027	1207	737	797	914	936	852
120	1050	1265	781	836	950	980	869
130	1070	1320	822	869	984	1019	884
140	1087	1369	859	899	1015	1053	897
150	1100	1402	893	926	1038	1078	909
160	1112	1432	924	948	1059	1100	919
170	1121	1459	951	968	1077	1120	928
180	1130	1484	976	986	1096	1138	936
190	1136	1506	995	999	1114	1154	942
200	1142	1508	1013	1012	1129	1168	947
210	1148	1509	1030	1023	1141	1180	953
220	1148	1509	1042	1027	1152	1188	953
230	1148	1509	1053	1031	1162	1195	953
240	1148	1509	1064	1035	1170	1202	953
250	1148	1509	1075	1038	1179	1208	953
260	1148	1509	1084	1041	1187	1214	953
270	1148	1509	1092	1043	1194	1219	953
280	1148	1509	1099	1045	1200	1224	953
290	1148	1509	1104	1046	1206	1224	953
300	1148	1509	1104	1046	1206	1224	953
310	1148	1509	1104	1046	1206	1224	953
320	1148	1509	1104	1046	1206	1224	953
330	1148	1509	1104	1046	1206	1224	953
340	1148	1509	1104	1046	1206	1224	953
350	1148	1509	1104	1046	1206	1224	953



Net Merchantable Volume Yield Curves

Existing Managed Stands within the MHmm1 Subzone (PSI scenario)

	Analysis Units			
Age	**M4PO1**	**B4PO2**	**B4PO1**	**B4PB1**
0	0	0	0	0
10	0	0	0	0
20	1	1	1	0
30	12	15	19	4
40	61	71	87	37
50	133	151	177	107
60	203	228	259	185
70	263	295	333	250
80	321	357	402	310
90	376	416	468	368
100	427	468	525	423
110	473	517	578	476
120	517	563	630	524
130	558	606	678	566
140	595	645	722	605
150	629	681	761	645
160	661	714	796	683
170	689	743	827	717
180	712	768	851	748
190	734	790	874	777
200	754	812	896	804
210	774	831	917	825
220	792	851	938	845
230	810	870	953	864
240	826	887	968	881
250	842	905	982	898
260	857	921	995	915
270	871	936	1007	931
280	883	950	1018	946
290	895	962	1027	960
300	895	962	1027	960
310	895	962	1027	960
320	895	962	1027	960
330	895	962	1027	960
340	895	962	1027	960
350	895	962	1027	960



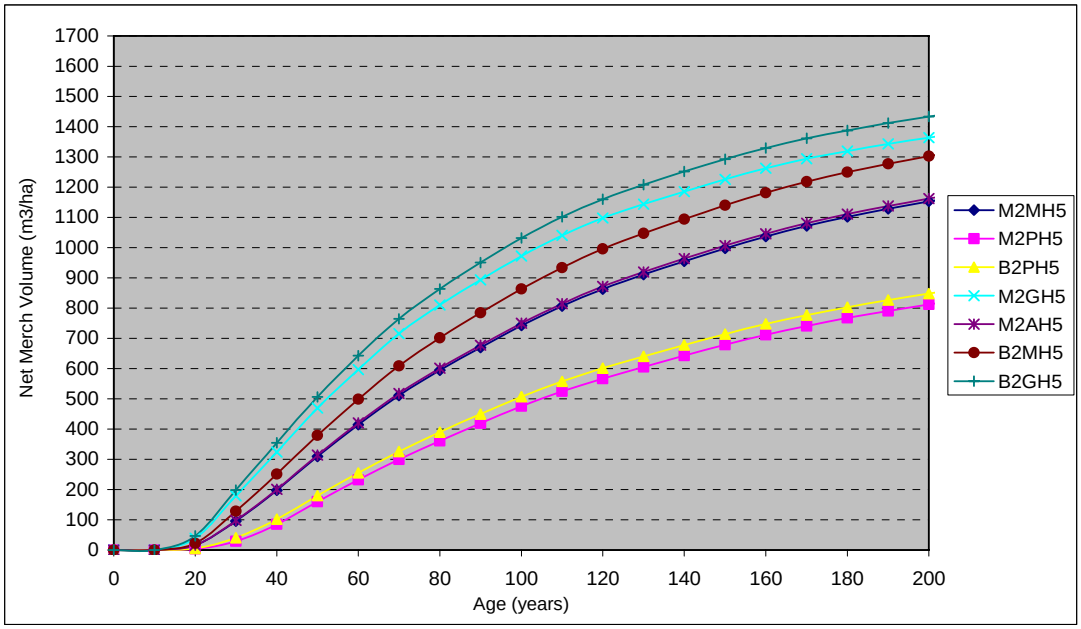
Appendix D: Future Managed Yield Tables (SIBEC option)

Note that the yield tables in this appendix do not reflect a 1-year regen delay as the tables were generated when no regeneration delay was proposed. The corresponding yield tables in the Woodstock model will reflect a 1-year regeneration delay and will simply be interpolations of the tables in this appendix.

Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHvm1 Subzone (SIBEC scenario)

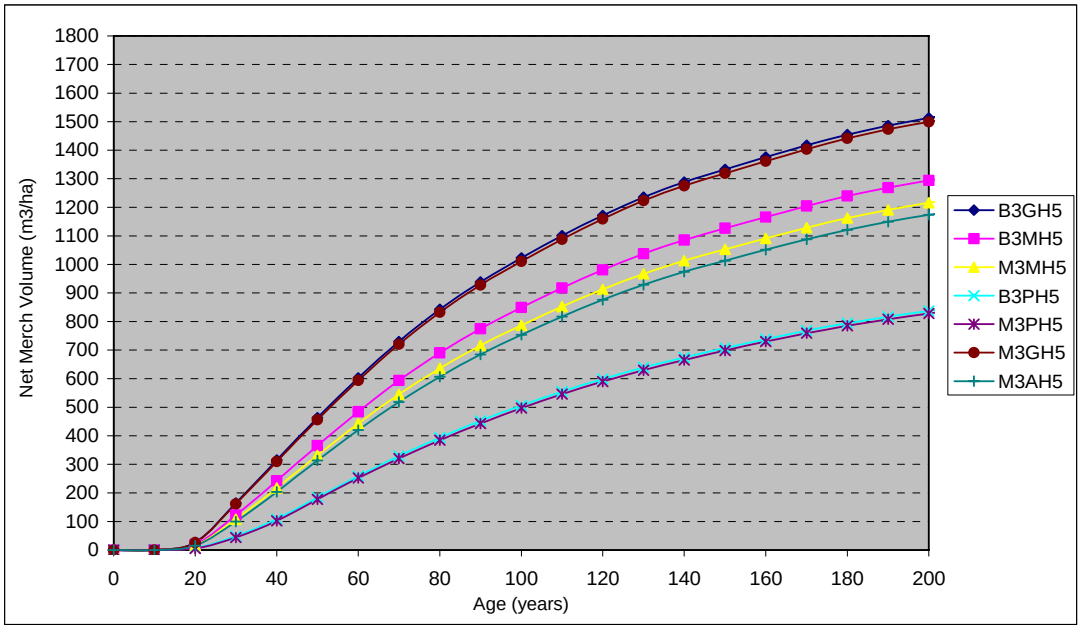
	Analysis Units						
Age	**M2MH5**	**M2PH5**	**B2PH5**	**M2GH5**	**M2AH5**	**B2MH5**	**B2GH5**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	16	4	6	39	16	23	47
30	96	29	41	179	98	128	199
40	197	85	102	324	201	251	355
50	309	160	180	469	314	379	507
60	415	232	255	597	420	499	643
70	511	299	326	715	518	609	764
80	595	361	390	811	602	702	863
90	670	419	450	894	677	784	951
100	742	476	507	972	750	863	1032
110	806	525	558	1040	815	934	1101
120	863	567	602	1098	871	996	1160
130	911	605	641	1144	919	1048	1208
140	955	643	678	1185	964	1094	1252
150	998	679	714	1226	1007	1140	1293
160	1037	712	747	1262	1046	1181	1329
170	1072	741	777	1294	1081	1218	1361
180	1102	767	803	1319	1111	1249	1387
190	1129	791	827	1343	1138	1277	1412
200	1153	812	848	1364	1162	1302	1433
210	1175	832	868	1384	1184	1325	1454
220	1195	848	884	1403	1204	1347	1472
230	1213	864	900	1420	1222	1366	1488
240	1230	878	916	1436	1239	1384	1504
250	1246	893	930	1449	1255	1401	1517
260	1260	905	943	1459	1270	1416	1524
270	1272	916	954	1467	1281	1428	1530
280	1282	926	964	1474	1291	1438	1536
290	1292	936	974	1481	1301	1449	1541
300	1292	936	974	1481	1301	1449	1541
310	1292	936	974	1481	1301	1449	1541
320	1292	936	974	1481	1301	1449	1541
330	1292	936	974	1481	1301	1449	1541
340	1292	936	974	1481	1301	1449	1541
350	1292	936	974	1481	1301	1449	1541



Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHvm2 Subzone (SIBEC scenario)

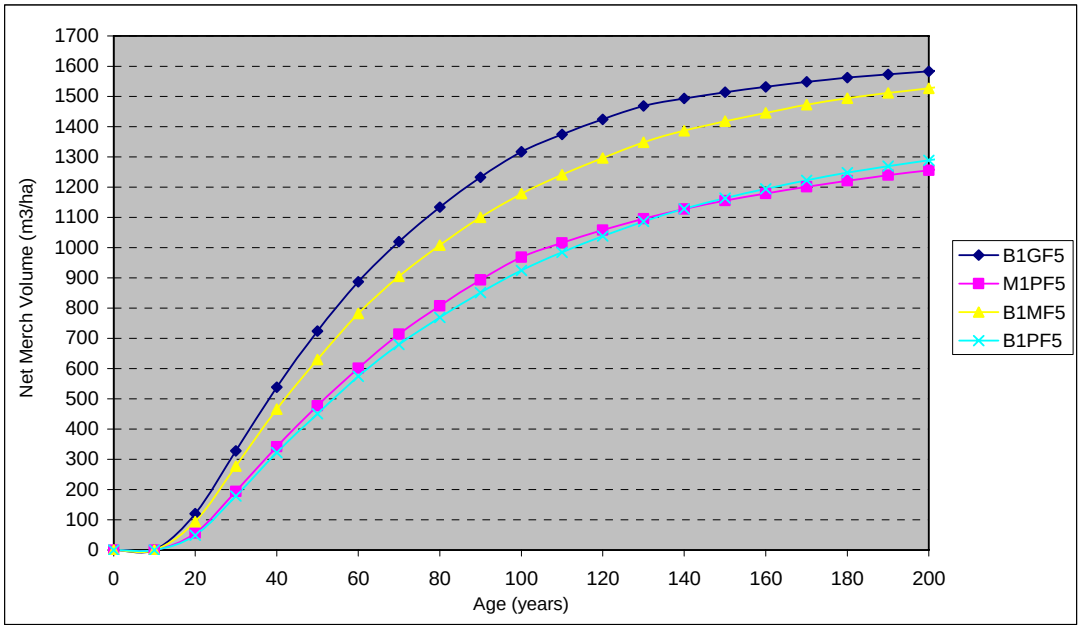
	Analysis Units						
Age	**B3GH5**	**B3MH5**	**M3MH5**	**B3PH5**	**M3PH5**	**M3GH5**	**M3AH5**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	27	19	17	7	6	26	15
30	165	123	108	49	43	161	100
40	315	243	217	109	103	310	203
50	463	366	332	184	178	456	314
60	603	485	443	259	252	594	420
70	730	593	545	329	321	720	519
80	843	690	636	394	385	832	607
90	939	774	716	452	443	928	685
100	1023	849	787	506	497	1011	754
110	1100	917	852	555	546	1088	818
120	1172	981	913	599	589	1159	876
130	1235	1037	967	639	629	1223	929
140	1288	1085	1013	674	665	1275	974
150	1333	1126	1053	707	699	1319	1014
160	1376	1166	1091	738	730	1361	1051
170	1417	1204	1128	768	759	1403	1088
180	1455	1239	1162	794	785	1441	1121
190	1486	1269	1191	817	808	1473	1150
200	1513	1294	1216	837	829	1499	1174
210	1536	1316	1237	856	847	1522	1195
220	1560	1338	1258	874	865	1546	1216
230	1581	1357	1277	889	880	1567	1234
240	1601	1375	1295	904	895	1587	1252
250	1620	1393	1312	917	909	1605	1269
260	1637	1409	1327	930	921	1622	1284
270	1653	1424	1342	942	933	1639	1299
280	1667	1438	1355	953	944	1653	1311
290	1678	1448	1365	962	953	1663	1321
300	1678	1448	1365	962	953	1663	1321
310	1678	1448	1365	962	953	1663	1321
320	1678	1448	1365	962	953	1663	1321
330	1678	1448	1365	962	953	1663	1321
340	1678	1448	1365	962	953	1663	1321
350	1678	1448	1365	962	953	1663	1321



Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHxm2 Subzone (SIBEC scenario)

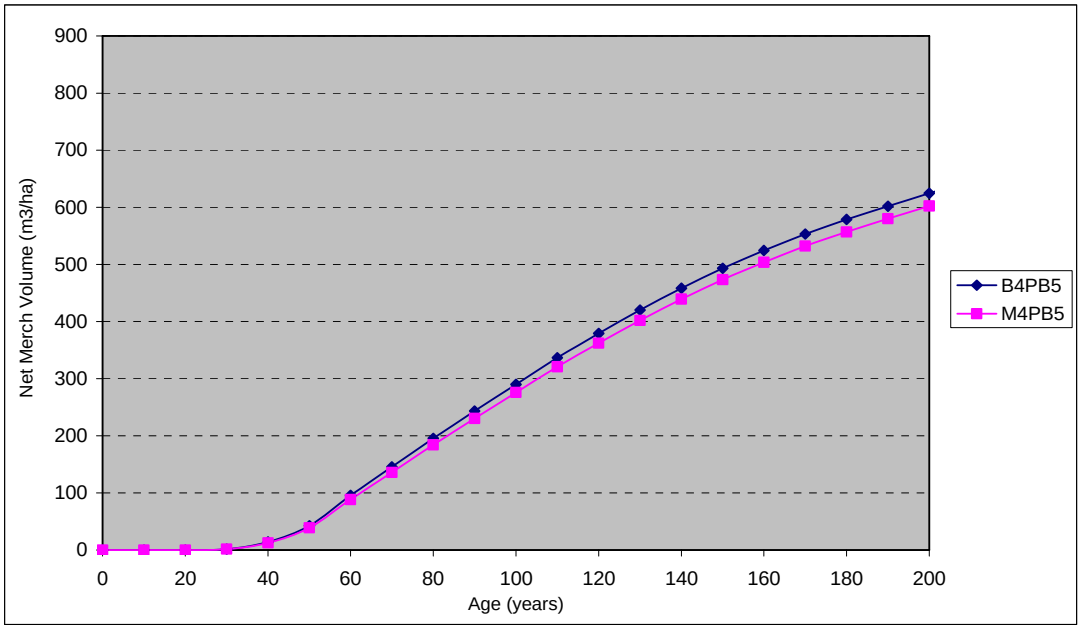
	Analysis Units			
Age	**B1GF5**	**M1PF5**	**B1MF5**	**B1PF5**
0	0	0	0	0
10	1	0	0	0
20	120	56	94	49
30	328	194	277	178
40	539	342	466	323
50	724	478	630	450
60	887	602	782	574
70	1020	714	904	680
80	1134	808	1008	769
90	1233	893	1100	851
100	1317	968	1179	925
110	1375	1016	1241	985
120	1424	1058	1297	1038
130	1469	1095	1348	1086
140	1493	1128	1386	1128
150	1514	1156	1418	1164
160	1531	1179	1446	1195
170	1548	1201	1472	1222
180	1562	1221	1494	1248
190	1573	1240	1512	1269
200	1583	1255	1527	1289
210	1594	1271	1544	1308
220	1594	1286	1545	1318
230	1594	1299	1547	1327
240	1595	1310	1548	1335
250	1595	1320	1549	1342
260	1595	1329	1550	1348
270	1595	1338	1551	1353
280	1596	1346	1552	1359
290	1596	1353	1553	1363
300	1596	1353	1553	1363
310	1596	1353	1553	1363
320	1596	1353	1553	1363
330	1596	1353	1553	1363
340	1596	1353	1553	1363
350	1596	1353	1553	1363



Net Merchantable Volume Yield Curves

Future Managed Stands within the MHmm1 Subzone (SIBEC scenario)

	Analysis Units	
Age	**B4PB5**	**M4PB5**
0	0	0
10	0	0
20	0	0
30	2	2
40	14	13
50	42	39
60	96	89
70	146	136
80	195	184
90	243	231
100	290	276
110	336	321
120	379	362
130	420	402
140	458	439
150	493	473
160	524	504
170	553	532
180	579	557
190	602	580
200	625	602
210	646	624
220	666	643
230	686	663
240	703	680
250	719	696
260	733	710
270	745	721
280	756	732
290	766	742
300	766	742
310	766	742
320	766	742
330	766	742
340	766	742
350	766	742



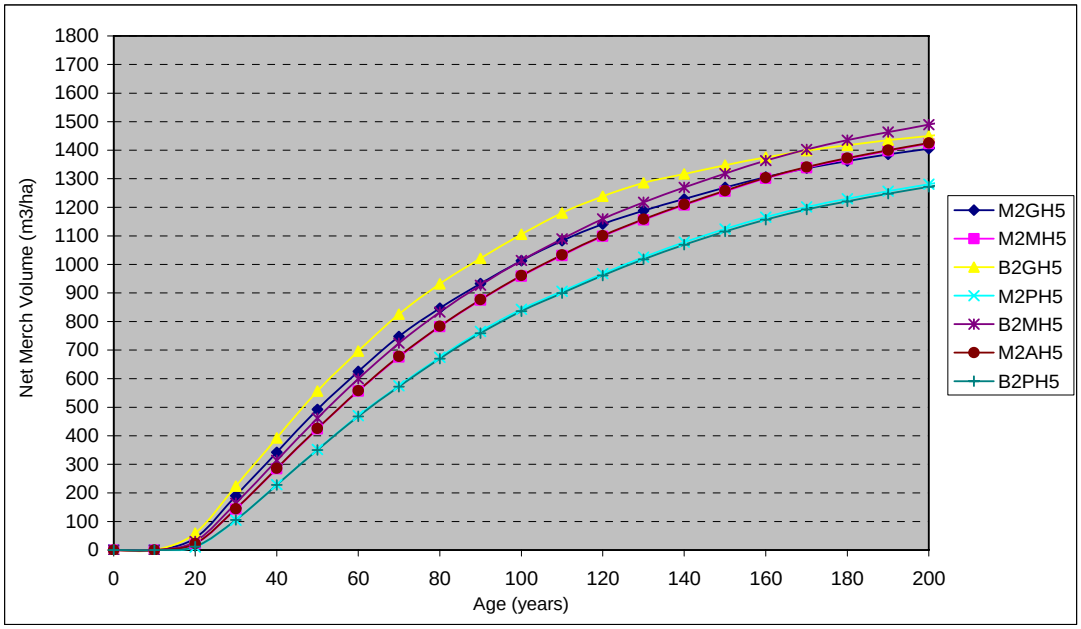
Appendix E: Future Managed Yield Tables (PSI option)

Note that the yield tables in this appendix do not reflect a 1-year regen delay as the tables were generated when no regeneration delay was proposed. The corresponding yield tables in the Woodstock model will reflect a 1-year regeneration delay and will simply be interpolations of the tables in this appendix.

Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHvm1 Subzone (PSI scenario)

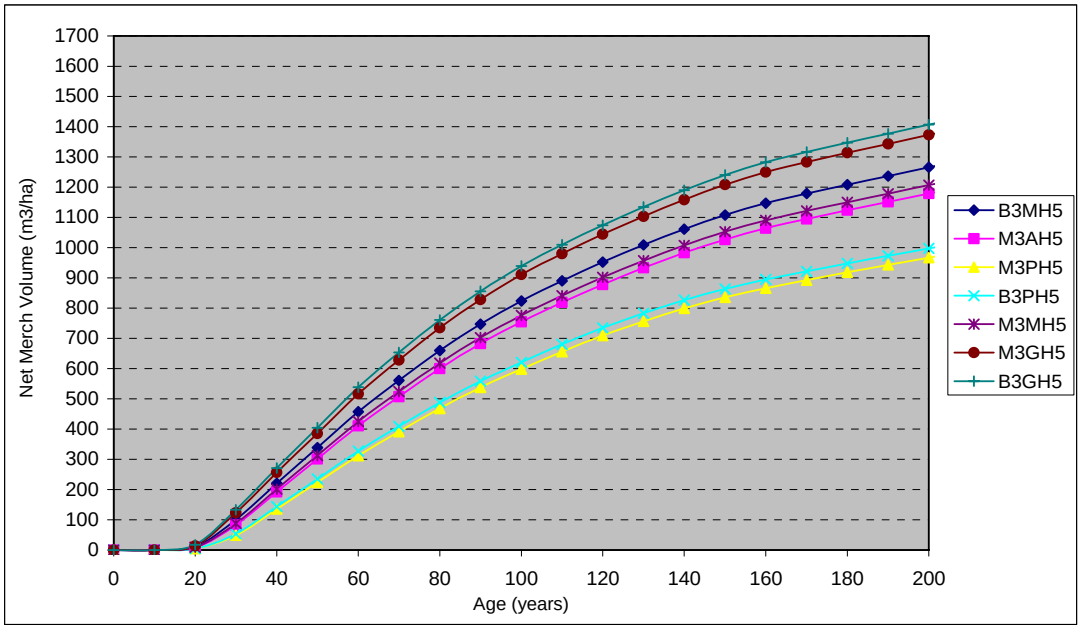
	Analysis Units						
Age	**M2GH5**	**M2MH5**	**B2GH5**	**M2PH5**	**B2MH5**	**M2AH5**	**B2PH5**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	42	22	59	11	30	22	12
30	190	143	224	105	164	144	106
40	342	285	393	229	314	287	228
50	493	424	557	352	462	426	350
60	625	556	697	470	599	558	468
70	748	676	826	575	724	678	572
80	847	782	932	675	833	784	670
90	932	875	1021	766	927	877	759
100	1013	959	1106	843	1014	961	836
110	1083	1031	1180	906	1090	1033	900
120	1141	1098	1238	968	1159	1100	961
130	1188	1156	1286	1025	1217	1158	1018
140	1229	1207	1317	1078	1269	1210	1069
150	1269	1256	1347	1124	1318	1258	1115
160	1306	1301	1375	1166	1364	1303	1157
170	1337	1338	1398	1201	1402	1341	1192
180	1362	1370	1417	1230	1435	1372	1221
190	1386	1397	1435	1257	1464	1400	1248
200	1405	1423	1450	1281	1489	1425	1272
210	1426	1448	1466	1307	1515	1451	1298
220	1445	1472	1480	1331	1537	1474	1322
230	1462	1493	1493	1353	1558	1496	1342
240	1478	1514	1505	1374	1577	1516	1363
250	1491	1531	1515	1392	1594	1533	1381
260	1500	1545	1522	1405	1607	1547	1393
270	1509	1556	1528	1417	1618	1558	1405
280	1516	1566	1534	1429	1627	1568	1417
290	1523	1577	1539	1440	1637	1579	1428
300	1523	1577	1539	1440	1637	1579	1428
310	1523	1577	1539	1440	1637	1579	1428
320	1523	1577	1539	1440	1637	1579	1428
330	1523	1577	1539	1440	1637	1579	1428
340	1523	1577	1539	1440	1637	1579	1428
350	1523	1577	1539	1440	1637	1579	1428



Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHvm2 Subzone (PSI scenario)

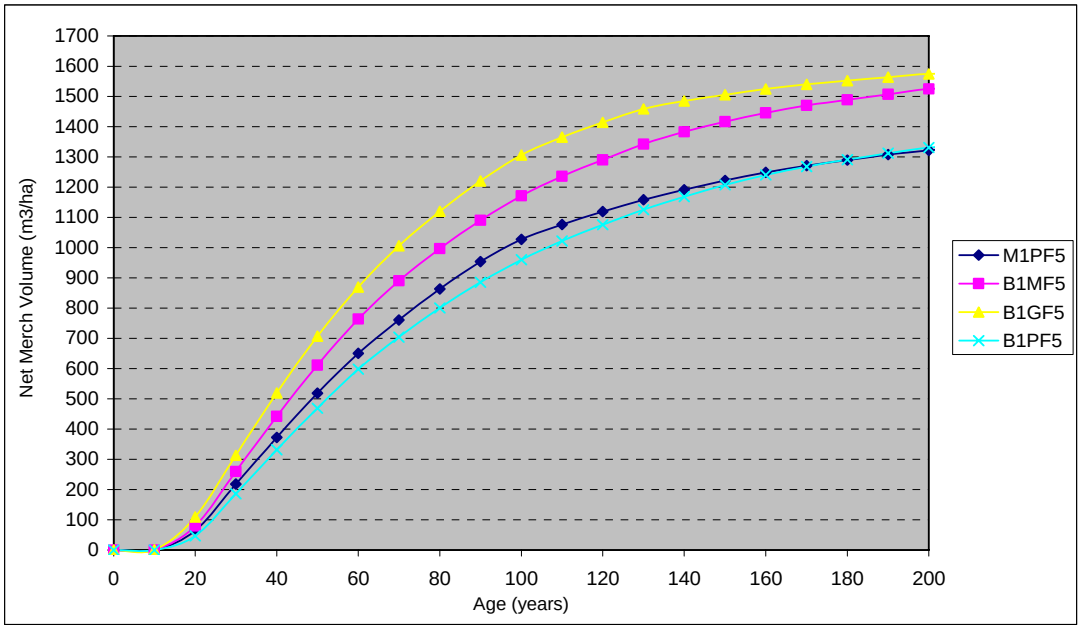
	Analysis Units						
Age	**B3MH5**	**M3AH5**	**M3PH5**	**B3PH5**	**M3MH5**	**M3GH5**	**B3GH5**
0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
20	11	8	4	5	9	14	18
30	100	83	49	53	88	123	133
40	221	193	136	144	201	257	271
50	339	301	224	235	313	385	405
60	458	411	312	327	425	516	538
70	561	507	392	409	524	628	653
80	659	600	468	488	618	735	761
90	747	682	537	559	703	829	856
100	824	755	598	621	776	911	939
110	890	819	656	680	841	980	1010
120	952	878	709	734	901	1044	1074
130	1009	933	757	783	957	1103	1135
140	1061	983	799	826	1007	1158	1190
150	1108	1027	835	864	1052	1208	1240
160	1147	1064	866	895	1090	1250	1282
170	1179	1095	893	922	1121	1283	1316
180	1208	1124	919	948	1150	1314	1347
190	1237	1152	943	973	1178	1343	1377
200	1266	1179	967	997	1207	1373	1407
210	1292	1205	990	1020	1233	1401	1434
220	1318	1230	1012	1043	1258	1428	1461
230	1339	1251	1031	1062	1279	1449	1482
240	1357	1269	1049	1081	1296	1465	1499
250	1373	1285	1065	1097	1313	1481	1516
260	1388	1300	1080	1111	1328	1497	1532
270	1403	1314	1093	1125	1342	1511	1546
280	1416	1327	1105	1137	1355	1525	1560
290	1427	1338	1115	1147	1366	1537	1572
300	1427	1338	1115	1147	1366	1537	1572
310	1427	1338	1115	1147	1366	1537	1572
320	1427	1338	1115	1147	1366	1537	1572
330	1427	1338	1115	1147	1366	1537	1572
340	1427	1338	1115	1147	1366	1537	1572
350	1427	1338	1115	1147	1366	1537	1572



Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHxm2 Subzone (PSI scenario)

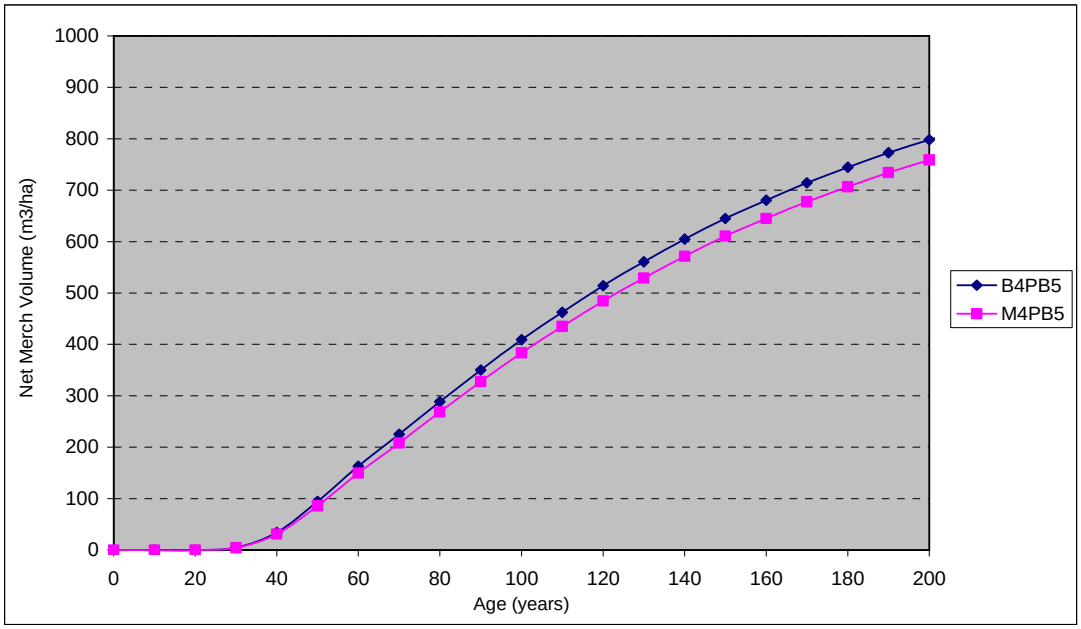
	Analysis Units			
Age	**M1PF5**	**B1MF5**	**B1GF5**	**B1PF5**
0	0	0	0	0
10	0	0	1	0
20	64	80	110	47
30	218	260	313	187
40	372	442	519	332
50	518	611	707	469
60	650	763	869	599
70	761	891	1006	704
80	864	997	1120	801
90	954	1090	1220	886
100	1028	1171	1306	960
110	1076	1235	1365	1022
120	1120	1291	1414	1076
130	1158	1343	1459	1125
140	1191	1383	1485	1168
150	1222	1416	1506	1207
160	1248	1445	1524	1240
170	1271	1470	1540	1268
180	1290	1489	1552	1291
190	1307	1507	1563	1313
200	1322	1524	1574	1331
210	1336	1526	1575	1341
220	1351	1527	1575	1351
230	1365	1528	1575	1360
240	1377	1530	1575	1369
250	1389	1531	1575	1377
260	1399	1532	1575	1384
270	1409	1533	1576	1390
280	1416	1533	1576	1396
290	1425	1534	1576	1401
300	1425	1534	1576	1401
310	1425	1534	1576	1401
320	1425	1534	1576	1401
330	1425	1534	1576	1401
340	1425	1534	1576	1401
350	1425	1534	1576	1401



Net Merchantable Volume Yield Curves

Future Managed Stands within the MHmm1 Subzone (PSI scenario)

	Analysis Units	
Age	**B4PB5**	**M4PB5**
0	0	0
10	0	0
20	0	0
30	5	5
40	34	31
50	95	86
60	163	150
70	226	208
80	289	269
90	350	327
100	409	384
110	462	435
120	514	485
130	561	529
140	605	571
150	645	610
160	681	645
170	714	677
180	744	707
190	773	734
200	798	759
210	820	781
220	841	801
230	861	821
240	877	837
250	891	851
260	905	865
270	917	877
280	928	888
290	939	899
300	939	899
310	939	899
320	939	899
330	939	899
340	939	899
350	939	899



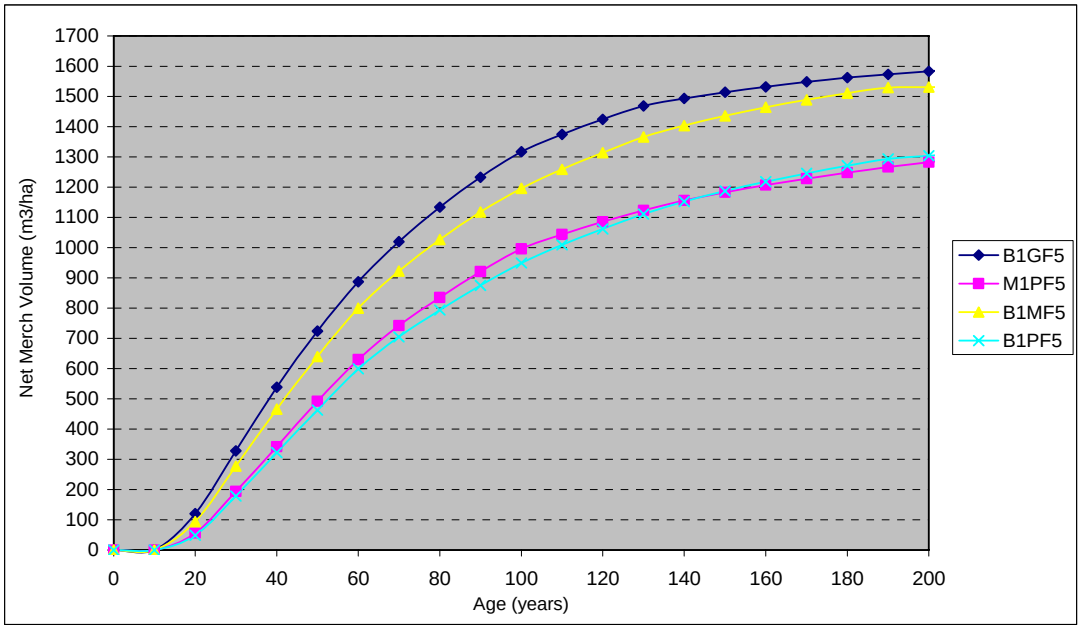
Appendix F: Future Managed Yield Tables (Fertilization options)

Note that the yield tables in this appendix do not reflect a 1-year regen delay as the tables were generated when no regeneration delay was proposed. The corresponding yield tables in the Woodstock model will reflect a 1-year regeneration delay and will simply be interpolations of the tables in this appendix.

Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHxm2 Subzone (SIBECfert scenario)

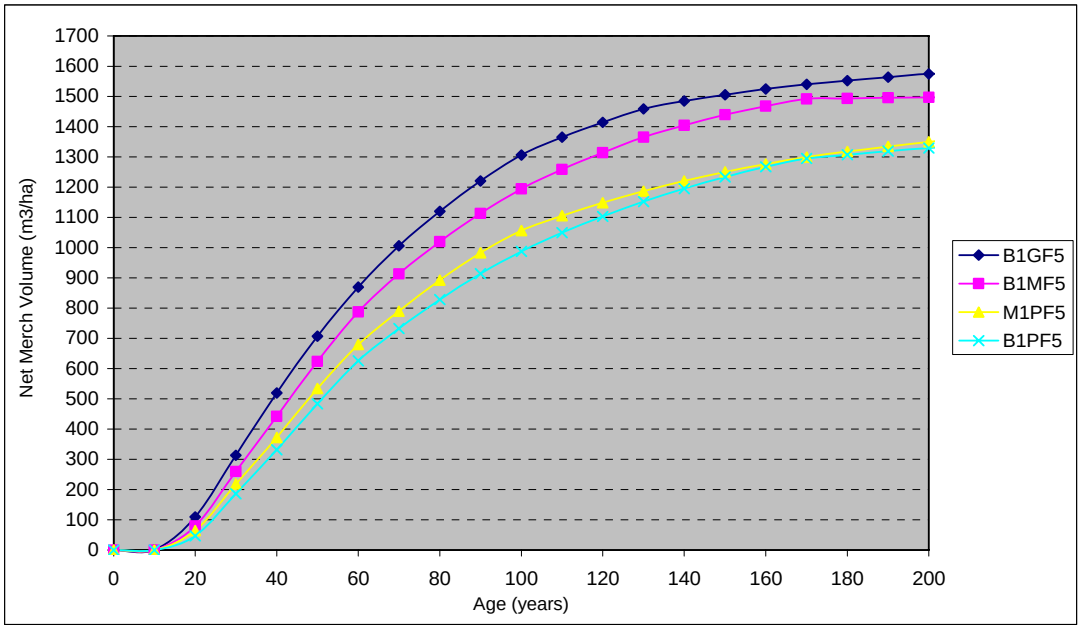
	Analysis Units			
Age	**B1GF5**	**M1PF5**	**B1MF5**	**B1PF5**
0	0	0	0	0
10	1	0	0	0
20	120	56	94	49
30	328	194	277	178
40	539	342	466	323
50	724	492	639	463
60	887	630	800	599
70	1020	742	923	705
80	1134	835	1026	793
90	1233	921	1118	875
100	1317	996	1196	949
110	1375	1044	1259	1009
120	1424	1086	1314	1062
130	1469	1123	1366	1111
140	1493	1156	1404	1152
150	1514	1183	1436	1187
160	1531	1206	1464	1218
170	1548	1228	1489	1246
180	1562	1248	1510	1271
190	1573	1266	1529	1293
200	1583	1282	1531	1304
210	1594	1297	1533	1314
220	1594	1312	1534	1324
230	1594	1324	1535	1332
240	1595	1336	1537	1340
250	1595	1347	1538	1348
260	1595	1356	1539	1354
270	1595	1364	1540	1360
280	1596	1372	1540	1365
290	1596	1379	1541	1369
300	1596	1379	1541	1369
310	1596	1379	1541	1369
320	1596	1379	1541	1369
330	1596	1379	1541	1369
340	1596	1379	1541	1369
350	1596	1379	1541	1369



Net Merchantable Volume Yield Curves

Future Managed Stands within the CWHxm2 Subzone (PSIfert scenario)

	Analysis Units			
Age	**B1GF5**	**B1MF5**	**M1PF5**	**B1PF5**
0	0	0	0	0
10	1	0	0	0
20	110	80	64	47
30	313	260	218	187
40	519	442	372	332
50	707	624	534	484
60	869	787	680	626
70	1006	914	790	732
80	1120	1020	893	828
90	1220	1113	983	914
100	1306	1195	1057	988
110	1365	1258	1105	1050
120	1414	1314	1149	1103
130	1459	1366	1187	1153
140	1485	1405	1220	1195
150	1506	1439	1250	1234
160	1524	1468	1277	1267
170	1540	1491	1299	1294
180	1552	1493	1318	1307
190	1563	1495	1335	1319
200	1574	1497	1350	1329
210	1575	1498	1364	1339
220	1575	1499	1379	1349
230	1575	1501	1392	1358
240	1575	1502	1405	1366
250	1575	1503	1416	1374
260	1575	1504	1426	1381
270	1576	1505	1435	1387
280	1576	1505	1444	1393
290	1576	1506	1452	1399
300	1576	1506	1452	1399
310	1576	1506	1452	1399
320	1576	1506	1452	1399
330	1576	1506	1452	1399
340	1576	1506	1452	1399
350	1576	1506	1452	1399



Appendix G: Timberline Memo Re: SIBEC and PSI Estimates for TFL 19

Timberline Natural Resource Group

Suite 401, 958 West 8th Ave.,
Vancouver, BC V5Z 1E5
Tel (604) 733-0731
Fax (604) 733-0634
www.timberline.ca

MEMO

DATE: June 29, 2007
TO: Patrick Bryant, Mike Davis, and Peter Kofoed
FROM: Tara McCormick
RE: SIBEC Estimates for TFL 19

1. Terms of Reference

In November 2006, Western Forest Products Ltd. (Western) contacted Timberline Natural Resource Group Ltd. (TNRG)[1] seeking options to incorporate the best available site index estimates for the upcoming Timber Supply Review (TSR) for Tree Farm Licence (TFL) 19, and to provide recommendations to improve the estimates across the TFL for future TSRs. Following a preliminary review of background information, TNRG and Western decided that the Ministry of Forests and Range (MoFR) Site Index Biogeoclimatic Ecosystem Classification (SIBEC)[2] estimates provided the best available, and MoFR-approved, site productivity information for the upcoming TSR.

Patrick Bryant *RPF*, Peter Kofoed *RPF*, and Mike Davis *RPF* were the company contacts for Western. The TNRG team included Tara McCormick *BSc*, Guillaume Thérien *PhD*, and Hamish Robertson *RPF*. Minor revisions were made to the original version submitted April 19th to incorporate suggestions and clarify questions identified by Western.

2. Background

Growth and yield practitioners in British Columbia generally recognize that the site index estimates of old, natural stands do not accurately reflect the potential height growth that can be achieved in managed, second-growth stands regenerating on the same sites. The site index of these old stands has often been negatively impacted by non-site factors including past suppression, cumulative height growth damage, and application bias of the site index equations in very old stands. In managed stands, where non-site factors are minimized through management practices, we expect that site index will better reflect the potential productivity of the site. Application of under-estimated site indices to future managed stands in timber supply analysis results in inaccurate predictions of stand volume, which ultimately leads to under-stating the sustainable harvest in TSR. This under-estimation in current inventories has been repeatedly confirmed in studies completed across the province.[3,4,5] In December 2002, the MoFR released the second approximation SIBEC estimates for use in base case timber supply analyses to help improve estimates of managed stand site index.[6]

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[1] J.S. Thrower & Associates Ltd., Timberline Inventory Consultants Ltd., and GeoSpatial Consulting Inc. merged operations in May 2006 to become Timberline Natural Resource Group (TNRG).
[2] MoFR SIBEC website: http://www.for.gov.bc.ca/hre/sibec/
[3] TNRG has completed 25 Site Index Adjustment (SIA) projects on management units across BC including 11 coastal units, two of which were Western's TFL 6 and TFL 37.
[4] Nigh, G.D. 1998. Site index adjustments for old-growth stands based on veteran trees B.C. Min. For., Res. Br., Victoria, B.C. Work. Pap. 36.
[5] Nussbaum, A.F. 1998. Site index adjustments for old-growth stands based on paired plots. B.C. Min. For., Res. Br., Victoria, B.C. Work Pap. 37.
[6] Mah, S and G. Nigh. 2003. SIBEC site index estimates in support of forest management in British Columbia. Tech. Rep. 04. B.C. Min. For. Res. Br. Victoria, BC. Available from website: http://www.for.gov.bc.ca/hfd/pubs/docs/tr/tr004.htm

In the last TSR, Western incorporated interim site productivity estimates for managed stands derived from MoFR first approximation SIBEC estimates and SIA results from TFL 37.[1,2] Western has reviewed available site index sources in preparation for the upcoming TSR, and has decided to use the updated SIBEC estimates to develop managed stand yield tables.[2]

3. Memo Objectives

This document outlines the methods used to assign SIBEC estimates to the TFL 19 land base, summarizes the results, compares the proposed SIBEC estimates to other sources of site index, and provides recommendations for future refinements.

4. Methods

4.1. TFL 19 Dataset

Western provided TNRG with a TFL 19 resultant dataset created from the overlay of the Terrestrial Ecosystem Mapping (TEM) and Vegetation Resources Inventory (VRI).[3] These inventories were completed on the TFL in 2000 and 2001, respectively.[4,5] TNRG attached the operability layer to the VRI/TEM resultant and provided an average elevation, derived from the Digital Elevation Model (DEM), to each resultant polygon. Non-forested and non-productive polygons identified in the VRI (based on DESCRIPTOR_ attribute) were excluded (Table 1). The population of interest for the SIBEC assignment was the productive forested land base (PFLB) where TEM information was available, and included 171,646 ha (Table 1). Data summaries provided in this memo distinguish the operable (approximation of timber harvesting land base) and inoperable areas within the forested land base.

Table 1. Netdown to the productive forested land base on TFL 19

Land base/ Descriptor	Area (ha)	Excluded Area (ha)	% TFL	% Forested
Entire TFL	191,696		100%	
Non-Productive & Non-Forested (VRI)		19,017	10%	
A		2,998	2%	
BRUSH		1,121	1%	
CAMP		46	0%	
CLEAR		2	0%	
CUTBK		3	0%	
HIWAY		42	0%	
HYDRW		195	0%	
LAKE		1,550	1%	
OUTLD		2	0%	
PIT		42	0%	
RIVER		796	0%	
ROAD		7	0%	
ROCK		11,641	6%	
SLIDE		447	0%	
SORT		21	0%	
SWAMP*		82	0%	

[1] Province of British Columbia. 1997. Site index estimates by site series for coniferous tree species in British Columbia. Site Productivity Working Group, BC Ministry of Forests and Forest Renewal BC. 265 pp.
[2] British Columbia Ministry of Forests. Tree Farm Licence 19 Rationale for Allowable Annual Cut (AAC) Determination. Effective August 1, 2001. 32 pp. + App.
[3] TNRG downloaded the TFL 19 resultant dataset and the operability layer from Western's FTP site on January 23, 2007.
[4] Olympic Resource Management completed Phase I of the VRI on TFL 19 in 2001, based on 1995 aerial photos.
[5] Madrone Consultants Ltd. 2000. Terrestrial Ecosystem Mapping of TFL 19. Final Report. Contract report to Western Forest Products Ltd. Campbell River, BC. 50 pp.

NPFOR*		22	0%	
Productive Forested	172,679		90%	100%
FOR	148,438		77%	86%
FORSN	245		0%	0%
FORWF	42		0%	0%
NSR	83		0%	0%
NSR00	18		0%	0%
NSR04	396		0%	0%
NSR05	991		1%	1%
NSR91	1		0%	0%
NSR99	16		0%	0%
NSRSN	129		0%	0%
NSRWF	41		0%	0%
NSSR0	6		0%	0%
SR	593		0%	0%
SR01	3		0%	0%
SR02	203		0%	0%
SR03	672		0%	0%
SR04	828		0%	0%
SR05	810		0%	0%
SR96	181		0%	0%
SR97	0		0%	0%
SWAMP*	253		0%	0%
NPFOR*	18,834		10%	11%
Null TEM		1,033	0%	0%
Forested with TEM	171,646		90%	99%
Operable	106,440		56%	62%
Inoperable	65,206		34%	38%

* SWAMP and NPFOR attributes represented both productive and non-productive polygons. Hence, only polygons without a species label were assumed non-productive, and were excluded.

Ninety percent (90%) of the operable TFL area is located in the Coastal Western Hemlock (CWH) very wet maritime subzone (CWHvm), with 64% within the submontane variant (CWHvm1) and 26% in the montane variant (CWHvm2). The remaining areas occur in the very dry maritime variant (CWHxm2) and the Mountain Hemlock (MH) windward moist maritime variant (MHmm1) (Table 2). The most important tree species on the TFL, based on the leading species in the current inventory, are western hemlock (Hw), Douglas-fir (Fd), western redcedar (Cw), and yellow cedar (Yc). These four species are leading in 93% of the forested area. Minor areas of amabilis fir (Ba), lodgepole pine (Pl), Sitka spruce (Ss), red alder (Dr), and bigleaf maple (Mb) also exist on the TFL.

Table 2. Area distribution by BGC variant and operability

BGC	Operable Area		Inoperable Area		Total Area	
Variant	(ha)	(%)	(ha)	(%)	(ha)	(%)
CWHxm2	4,910	4%	1,493	2%	6,403	4%
CWHvm1	67,803	64%	17,969	28%	85,772	50%
CWHvm2	27,323	26%	25,540	39%	52,863	31%
MHmm1	6,393	6%	19,048	29%	25,442	15%
MHmmp1	10	0%	1,108	2%	1,118	1%
AT		0%	47	0%	47	0%
All	*106,440*	*100%*	*65,206*	*100%*	*171,645*	*100%*

4.2. SIBEC Estimates

SIBEC estimates were collated from the most up to date provincial SIBEC database for the biogeoclimatic (BGC) subzone variants, site series, and main management species on the TFL (Table 3).[1,1] The MoFR has been developing

[1] SIBEC estimates are available at: http://www.for.gov.bc.ca/hre/sibec/reports/sisuBybgcUnit.xls

the SIBEC program since the early 1990s. The provincial SIBEC database was initially compiled in 1994/95, collating existing data from various sources, and developing the first approximation estimates by site unit. Since the release of these first approximations, SIBEC data and sampling standards have been developed and additional data have been collected to build on the SIBEC database. Second approximation estimates were released in December 2002, and yearly updates occur to the database to reflect new data collection.

The SIBEC database provides average site indices for each site series/tree species combination with a minimum sample size of seven. Site series combinations not meeting this sample size retain the first approximation estimates. Many of the CWHvm1 combinations are populated with more reliable second approximations, as noted by the sample sizes shown in Table 3. Conversely, all SIBEC estimates in the CWHvm2, MHmm2, and CWHxm2 (with the exception of the CWHxm2/01) are based on historical expert knowledge and extrapolated trends from other BGC variants. Low reliability ratings were assigned to the first approximations in the CWHvm2 and MHmm1 in their initial publication; whereas high and medium reliability ratings were given to the SIBEC estimates for the common site series in the CWHxm2.[1]

Table 3. SIBEC estimates (m) for the site series and management species on TFL 19
n=sample size

BGC	Site	%	%	SIBEC					
Variant	Series	OPFLB	PFLB	Hw SI	Hw n	Fd SI	Fd n	Cw SI	Cw n
CWHxm2	01	3%	2%	24.0		32.9	13	24.0	
CWHxm2	02	0%	0%			20.0			
CWHxm2	03	0%	1%			24.0		20.0	
CWHxm2	04	0%	0%			28.0		28.0	
CWHxm2	05	1%	1%			36.0		24.0	
CWHxm2	07	0%	0%			40.0		28.0	
CWHxm2	08	0%	0%					24.0	
CWHxm2	09	0%	0%					24.0	
CWHxm2	11	0%	0%					8.0	
CWHxm2	12	0%	0%	32.0				16.0	
CWHxm2	15	0%	0%					24.0	
CWHvm1	01	34%	25%	27.7	94	35.8	9	22.6	34
CWHvm1	02	1%	1%	8.0		8.0		8.0	
CWHvm1	03	13%	12%	16.0		32.2	9	16.0	
CWHvm1	04	0%	0%	26.2	7	32.0		22.5	10
CWHvm1	05	9%	6%	28.5	35	36.0		24.0	15
CWHvm1	07	1%	1%	32.6	13			24.0	
CWHvm1	09	1%	1%	28.0				24.0	
CWHvm1	10	0%	0%					24.0	
CWHvm1	12	1%	1%	16.0				12.0	
CWHvm1	13	0%	0%					8.0	
CWHvm1	14	0%	0%	21.0	10			19.4	13
CWHvm2	01	17%	18%	28.0				20.0	
CWHvm2	02	1%	2%	8.0		8.0		8.0	
CWHvm2	03	4%	5%	16.0		24.0		16.0	
CWHvm2	05	2%	2%	28.0				24.0	
CWHvm2	07	1%	1%	28.0				24.0	
CWHvm2	09	1%	1%	12.0				12.0	
CWHvm2	11	0%	0%	16.0				16.0	
MHmm1	01	5%	8%	16.0					
MHmm1	02	1%	3%	12.0					
MHmm1	03	0%	0%	12.0					
MHmm1	05	0%	1%	16.0					

[1] Western identified the main management species as Hw, Fd, and Cw.

MHmm1	06	0%	0%	8.0

4.3. Application of SIBEC Estimates to TFL 19

SIBEC estimates were not always available for Hw, Fd, and Cw in each site series because some site series/species combinations are not populated in the provincial database. Where missing values occurred in plausible BGC variant/site series/species combinations, we used the SIBEC estimate from the available species to generate a converted SIBEC estimate for the missing species using the MoFR site index conversion equations.[1,2] Estimates were not generated for Fd or Cw in the MHmm1.

We assigned SIBEC estimates for Hw, Fd, and Cw to each resultant polygon in the PFLB based on the TEM site series delineation. An area-weighted site index was calculated for each forest cover polygon based on the site series proportions in that polygon. SIBEC estimates were not available for alpine tundra (AT), MH parkland (MHmm1p), or for non-productive or non-forested BEC site series.[3] This resulted in a total of 16,547 ha without SIBEC estimates in the PFLB, of which 3,986 ha were operable. Inventory site index should be used for polygons that fall entirely into non-forested/non-productive site series or in AT and MHmmp1 areas. Where non-productive inclusions occur in a "forested" polygon, the null site index of the non-productive site series component is ignored when calculating the weighted average site index. The component areas of productive and non-productive site series were identified within each forest cover polygon (FOR_PID) in the productive forest land base to allow for appropriate yield reductions in the managed stand yield table process (in TFL19_AVG_SIBEC_by_FOR_PID.xls).

TNRG confirmed with the MoFR that specific methods or protocols do not exist for assigning SIBEC to TSR datasets; rather the forest licensees must document their methods and assumptions in the data package for review by MoFR in the TSR process (pers. comm., Shirley Mah *RPF MSc*, MoFR, Research Branch on January 29, 2007).

4.4. Results

Application of SIBEC estimates to all polygons in the PFLB where estimates were available resulted in an average site index of 22.2 m for Hw, 31.2 m for Fd, and 20.2 m for Cw (Table 4). This approach assumes that the three species are growing everywhere; however, it is more appropriate to apply the species estimates solely to areas where they will be planted (*i.e.*, their natural range of sites). For comparative purposes, we applied the respective species estimates only to areas where H (Hw or Hm), Fd, or C (Cw or Cy) were currently leading in the VRI and where SIBEC estimates were available, representing a subset of 135,809 ha (79% of the PFLB) (Table 5). The average was 22.8 m for H, 32.8 m for Fd, and 18.3 m for C in the PFLB. The overall average SIBEC estimate for all species was 23.1 m, which represents a 27% (4.9 m) increase over the current inventory estimate.

[1] Nigh, G.D. and G. Kayahara. 2000. Site index conversion equations for western redcedar and western hemlock. Northwest Sci. 74(2): 146-150.
[2] Nigh, G. D. 1995a. Site index conversion equations for mixed species stands. B.C. Min. For., Res. Br., Victoria, B.C. Res. Rep. 01.
[3] Although the majority of non-productive and non-forested polygons identified in the VRI were netted out of the population of interest (some SWAMP and NONFOR remain), the TEM identified areas of non-productive or non-forested inclusions within forested polygons.

To increase the level-of-comfort that the SIBEC estimates proposed for TFL 19 are reasonable and consistent with other data sources, we compared the computed average SIBEC estimates to site index data collected from random sampling in other coastal management units. The latter site index source was termed "preliminary site index" and represents TNRG's predicted estimate of site productivity of managed stands on TFL 19 based on our data and experience in ecologically similar areas (Table 5).[1] The SIBEC estimates generally reflect the expected productivity across BGC unit and species. The two sources were within 5% overall, with SIBEC estimates being more conservative.

Based on the comparison, the average Hw SIBEC estimate may under-predict the potential productivity in the CWHvm1 by ~10%. A review of the SIBEC estimates by site series illustrates that part of the under-estimate results from the impact of a very conservative first approximation estimate of 16 m for Hw in the CWHvm1/03 (Table 3). This site series represents 13% of the operable PFLB and is likely under-estimated by 5-6 m (*i.e.*, Hw PSI was 22 m for this site series). Western should consider developing a second approximation estimate for this cell of the SIBEC matrix by populating it with 7 to 10 Hw plots. This would be a relatively easy and low-cost improvement.

Table 4. Average SIBEC estimate by species, operability, and BGC variant based on the site series distribution across the PFLB

Operability	BGC Variant	Area (ha)	SIBEC SI (m)		
			Hw	Fd	Cw
Operable	CWHxm2	4,910	24.3	32.7	23.9
	CWHvm1	67,803	24.2	34.3	21.3
	CWHvm2	27,323	23.2	27.2	18.9
	MHmm1	6,403	15.2	NA	NA
	Subtotal		*23.4*	*32.3*	*20.8*
		106,440			
Inoperable	CWHxm2	1,493	22.1	28.7	22.7
	CWHvm1	17,969	21.0	32.7	19.2
	CWHvm2	25,540	22.1	26.0	18.2
	MHmm1	19,048	14.4	NA	NA
	MHmmp1	1,108	NA	NA	NA
	AT	47	NA	NA	NA
	Subtotal	*65,206*	*19.8*	*28.7*	*18.7*
All	CWHxm2	6,403	23.8	31.8	23.6
	CWHvm1	85,772	23.6	34.0	20.8
	CWHvm2	52,863	22.7	26.6	18.6
	MHmm1	25,442	14.6	NA	NA
	MHmmp1	1,118	NA	NA	NA
	AT	47	NA	NA	NA
All	*Total*		*22.2*	*31.2*	*20.2*
		171,645			

NA – SIBEC estimates were not available for these species/variant

[1] TNRG has collated site index data from growth & yield projects completed over the past 15 years. The TNRG site index database consists of 6,888 observations across the province; 1,105 of which were sampled within the CWH, Coastal Douglas Fir (CDF), and MH zones. The majority of these observations are from randomly located SIA plots, thus provide unbiased estimates for the areas where they were sampled.

Table 5. Comparison of inventory (Inv), SIBEC, and preliminary site index (PSI) by species and BGC variant for the operable productive and productive forested land bases for a subset of PFLB area where Hw, Fd, Cw, or Yc are currently leading

BGC Variant	Spc1	Operable PFLB				PFLB			
		Area (ha)	InvSI (m)	SIBEC (m)	PSI (m)	Area (ha)	InvSI (m)	SIBEC (m)	PSI (m)
CWHxm2	Hw	798	25.8	24.1	25.8	1,050	24.4	23.7	25.3
	Fd	3,710	29.3	32.9	32.6	4,535	27.8	32.1	32.0
	Cw	44	17.3	23.7	23.6	59	16.3	23.2	23.1
	Yc	13	9.9	24.1	23.9	13	9.9	24.1	23.8
	All	*4,565*	*28.5*	*31.3*	*31.3*	*5,657*	*27.0*	*30.4*	*30.6*
CWHvm1	Hw	37,316	22.4	24.7	26.8	44,707	21.4	24.3	26.6
	Fd	9,817	28.5	34.5	33.1	12,010	27.2	34.0	32.6
	Cw	8,750	17.2	19.9	23.1	11,450	16.5	19.6	22.9
	Yc	2,836	12.1	18.7	22.6	4,848	11.5	18.4	22.4
	All	*58,719*	*22.1*	*25.3*	*27.1*	*73,015*	*20.9*	*24.7*	*26.7*
CWHvm2	Hw	15,060	18.1	23.9	23.4	23,801	16.8	23.8	23.3
	Fd	707	22.5	26.6	28.1	1,629	20.2	25.7	27.6
	Cw	1,991	15.8	18.1	19.8	3,460	15.2	18.0	19.7
	Hm	1,310	10.8	24.1	23.7	4,182	9.4	24.3	23.8
	Yc	4,761	12.5	17.5	19.5	12,509	11.3	17.1	19.1
	All	*23,829*	*16.5*	*22.2*	*22.4*	*45,582*	*14.6*	*21.6*	*22.0*
MHmm1	Hw	2,780	15.3	15.5	17.4	5,709	14.5	15.2	17.0
	Hm	1,355	8.2	15.0	17.4	5,847	7.5	14.7	16.4
	All	*4,135*	*12.9*	*15.3*	*17.4*	*11,555*	*10.9*	*14.9*	*16.7*
All	Hw	55,686	21.0	24.0	25.4	74,752	19.5	23.4	24.8
	Fd	14,234	28.4	33.7	32.7	18,175	26.7	32.8	32.0
	Cw	10,786	16.9	19.6	22.5	14,969	16.2	19.3	22.1
	Hm	2,933	9.7	19.8	21.0	10,542	8.4	18.8	19.8
	Yc	7,610	12.4	18.0	20.7	17,371	11.4	17.4	20.0
	All	*91,248*	*20.6*	*24.4*	*25.7*	*135,809*	*18.2*	*23.1*	*24.5*

Western should also consider improving the confidence in the CWHvm2 and MHmm1 estimates, which are based on low reliability first approximations. Although the two sources (SIBEC and PSI) predict very similar averages for this variant, we caution that both sources are based on sparse data and extrapolations from other areas. Much of the existing site index data (SIBEC, SIA, Permanent Sample Plots [PSP]) and the resulting professional expertise are focused in lower elevation areas with extensive harvest history (*i.e.,* below 600 m). Few data have been collected in higher elevation areas due to a lack of managed stands with sufficient years above breast height to provide reliable site index estimates through height and age measurements. The scarcity of data and the known declining site index trend with increasing elevation lead to more uncertainty and potential bias in existing high elevation site productivity estimates. Further work is needed to ensure the proposed CWHvm2 estimates reflect the actual potential productivity of managed stands. A more detailed discussion of this issue was provided in the high elevation site index options analysis completed for Western by TNRG.[1]

4.5. Conclusions

Western applied SIBEC estimates to all areas in the productive forest for the timber supply analysis in support of the current TSR on TFL 19. A comparison between the proposed SIBEC estimates and other coastal data sources showed

[1] Timberline Natural Resource Group Ltd. 2007. Site index options analysis for high elevation areas on Western Forest Products Ltd. Tree Farm Licences. Unpublished Report, Project No. WPC-009. April 17, 2007. 13 pp.

that, on average, the SIBEC estimates generally reflect the expected productivity of managed stands on TFL 19. The application of SIBEC provides more reliable site index than inventory-based estimates and should generally lead to more accurate projections of future growth and yield in managed stands; however, Western should improve the confidence in the high elevation estimates which are based on expert opinion rather than data, and do not incorporate an elevation model to account for the decrease in site index with increasing altitude. Increased certainty in the high elevation site productivity estimates will become more important as harvesting activities expand into these areas.

Appendix H: SIBEC and PSI Estimates for Major Site Series in TFL 19

Table 43 - SIBEC and PSI Site Index Comparisons

BEC Variant	Site Series	% of Operable Productive Forest	Western hemlock		Douglas-fir		Western red cedar	
			SIBEC (m)	PSI (m)	SIBEC (m)	PSI (m)	SIBEC (m)	PSI (m)
CWHxm2	01	3%	24.0	25.5	32.9	32.0	24.0	23.1
	05	1%	26.4	30.0	36.0	36.0	24.0	27.4
CWHvm1	01	34%	26.5	26.5	35.8	33.0	23.0	24.1
	02	1%	8.0	16.0	8.0	20.0	8.0	14.1
	03	13%	16.0	23.0	32.2	29.0	16.0	20.8
	05	9%	28.5	32.0	36.0	38.0	24.0	29.3
	07	1%	32.6	33.0	36.7	38.0	24.0	30.3
	09	1%	28.0	33.0	31.6	38.0	24.0	30.3
	12	1%	16.0	24.0	18.2	27.1	12.0	21.7
CWHvm2	01	17%	26.0	24.0	29.3	30.0	20.0	21.7
	02	1%	8.0	12.0	8.0	18.0	8.0	10.3
	03	4%	16.0	19.0	24.0	25.0	16.0	16.9
	05	2%	28.0	29.0	31.6	35.0	24.0	26.5
	07	1%	28.0	30.0	31.6	36.0	24.0	27.4
	09	1%	12.0	19.0	13.8	18.0	12.0	16.9
MHmm1	01	5%	16.0	18.0				16.0
	02	1%	12.0	10.0				8.3

Appendix I: Results of Review of 1997-2005 Harvested Cutblocks

A review of cutblocks harvested between 1997 and 2005 was undertaken to determine the accuracy of the netdowns used in MP #9 when compared to operational results. The GIS data for the cutblocks harvested in these years was overlaid upon the THLB determined for MP #9. The total area harvested within these cutblocks compared very favourably with the strategic estimate (Table 44).

Table 44 – MP #9 THLB Estimate Compared to Actual Harvest Area

Description	Area (ha)
Total area in cutblocks	11,135
MP #9 THLB within cutblocks	9,687
Less 3.25% WTRA allowance	(315)
MP #9 estimate of harvest area	9,372
Actual harvest area	9,511
Difference	139 (1.5%)

The results also indicate that operationally, overall retention was approximately 14% ((11,135-9,511)/11,135)