Golden TSA
Timber Supply Review #4

Timber Supply Analysis Report

(draft: February 20 2009)

Prepared for

Golden DFAM Group

Louisiana - Pacific Canada Ltd.

Downie Timber Ltd.

BC Timber Sales

Prepared by

Reg Davis, RPF
Forsite Consulting Ltd.

Golden TSR 4
Timber Supply Analysis Report

PROFESSIONAL FORESTER CERTIFICATION

This report was prepared by:

____

An original, master hardcopy is signed, stamped and archived at the office of the Forest Analysis and Inventory Branch, Ministry of Forests and Range, Victoria, B.C.

Reg Davis, R.P.F.
Forsite Consultants Ltd.
250-489-4423
rdavis@forsite.ca

More Information on the Timber Supply Review Process

This document was prepared to support an allowable annual cut determination by British Columbia's Chief Forester. To learn more about this process please visit the following website:

http://www.for.gov.bc.ca/hts/

Or contact:

Forest Analysis Branch
Ministry of Forests
P.O. Box 9512, Stn. Prov. Govt.
Victoria, B.C., V8W 9C2
Telephone: (250) 356-5947

Comments and Questions

Input from First Nations and public is an important part of the Timber Supply Review process and you are encouraged to review the information in this document and forward any comments to

Reg Davis, R.P.F.
204-16 11th Avenue South
Cranbrook, B.C.
V1C 2P1

Email: rdavis@forsite.ca
Tel: (250) 489-4423
Fax: (866) 459-6542

If you have any questions or would like further information, please contact Reg Davis, RPF at (250) 489-4423.

Additional copies of this document are available on the web at:

http://www.forsite.ca/GoldenTSR4/

Acknowledgements

Forsite would like to thank each of the parties that contributed to the completion of this document.

Government representatives

Kevin Lavelle (Ministry of Forests and Range (MoFR), Revelstoke), and **Kurt Huettmeyer** (MoFR, Revelstoke) were instrumental in providing government input to ensure modeling was consistent with local realities and provincial policy.

Gordon Neinaber (Victoria, MoFR) provided extensive quality control and guided the process through several reviews performed by MoFR staff in Victoria.

Defined Forest Area Management (DFAM) members

Stuart Frazer represented Louisiana - Pacific Canada Ltd. (Golden) and was the lead licensee on the Golden TSA TSR 4 project.

Dieter Offermann and **Dave Gill** represented Downie Timber Ltd. (Revelstoke) and BC Timber Sales (Okanagan-Columbia), respectively.

All licensees provided local knowledge, data used to develop the Information Package and produce the Golden GIS net landbase file, as well as extensive input into the assumptions used throughout the analysis.

Finally, we thank and acknowledge **Derek De Biasio** of Crane Management Consultants Ltd for the completion of the socio-economic analysis included in this document.

Executive Summary

This document contains a timber supply analysis and socio-economic analysis specific to the Golden Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA.

The previous timber supply review #3 (TSR3) Analysis Report was completed in August 2003, with an associated annual allowable cut (AAC) of 485,000 m3/yr determined starting in June 1, 2004. This AAC volume is currently allocated to Louisiana Pacific Co. Ltd, Downie Timber Ltd., and BC Timber Sales (BCTS).

This current review (TSR4) is working toward a new AAC determination to be in place before July 1, 2009.

The current Golden TSA Timber Supply Data Package provides the detailed, technical information and assumptions regarding current forest management practices, policy and legislation which were used in this analysis. Based on the details in the Information Package, the area in this analysis (Golden TSA and portions of adjacent parks) covers approximately 1,184,611 hectares in the south-eastern corner of British Columbia. The portion of this area considered available for timber production and harvesting under current management practices is called the timber harvesting land base (THLB).

The THLB has been estimated through the analysis of spatial map layers and assumptions detailed in the Data Package Report. Based on these inputs, the current THLB is estimated to be 141,530 hectares.

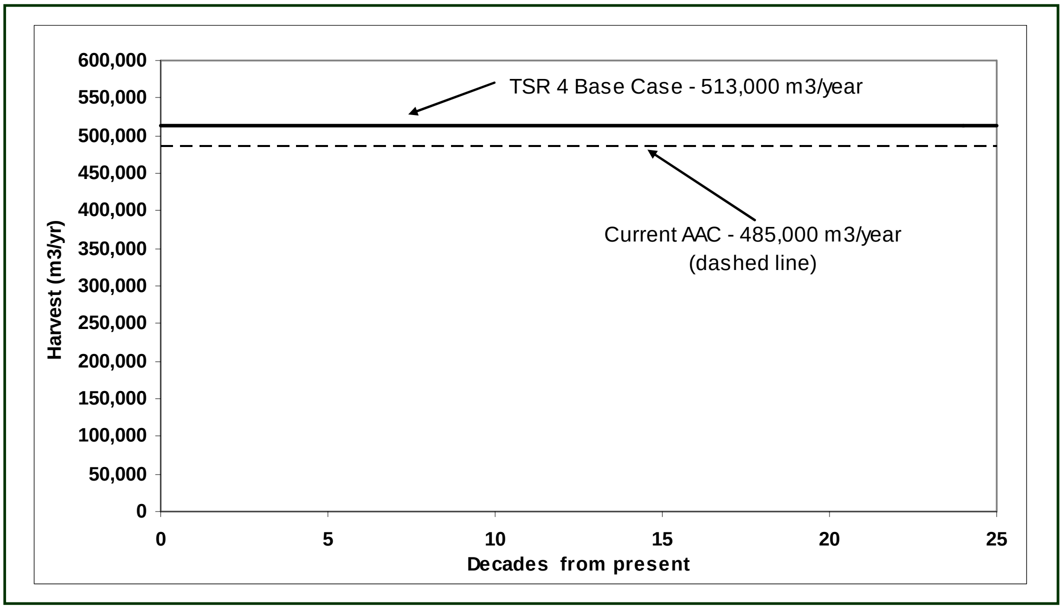
This is a decrease of 8% since the last timber supply review (141,530 ha vs. 153,870 ha). Many other changes affecting forest management and timber supply projections have also occurred. The major changes reflected in the current practice base case are as follows:

- The standing timber volume (or growing stock) is decreased by 1.1% as a result of the VRI Phase 2 inventory adjustment. Long-term productivity levels are also slightly decreased as a byproduct of the inventory adjustment process, due to an overall decrease in heights and increase in ages.
- Volume gains associated with the use of select seed is modeled in managed stand yield curves (20.8% gain for Sx, 12.0% for Pl, 20% for Lw, and 21.1% for Fd). Much smaller gains were modeled in TSR3 (14.07 for Sx, 3.13 for Pl, and 5.73% for Fd).
- Spatially explicit old growth management areas (OGMA) are implemented instead of broad seral constraints for biodiversity, and
- Spatially explicit caribou reserves are implemented instead of old forest cover requirements.
- Ungulate winter range (UWR) is now managed under a new set of objectives (i.e. a new UWR map and forest cover requirements).

The release of this Golden TSA TSR4 Analysis Report is the next step in the TSR4 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this Analysis Report will provide British Columbia's Chief Forester with a large portion of the information that is needed to make an informed AAC determination.

This report focuses on the Base Case Option, which represents current management practices in the Golden TSA. It presents a Base Case harvest flow starting at 513,000 m^3/yr. This flow is maintained at this level for 250 years. This harvest flow is 5.5% higher than the current AAC of 485,000 m^3/yr.

Base Case Harvest Flow



A series of sensitivity analyses were completed to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecasts.

<u>Uncertainties that altered the harvest level in the short-term (next 20 yrs) by at least 3% were:</u>

- changes to existing natural stand yields (+10%), and
- removal of class A seed volume gains, and
- reclassification of the Visual Quality Objectives (VQO) down one VQO class.

<u>Uncertainties that altered the long-term harvest level (decades 9+) by at least 3% were:</u>

- changes to the size of the timber harvesting land base (±10%),
- changes to future managed stand yields (±10%),
- reducing minimum harvest ages by 10 years,
- minimum harvest ages based only on attaining a minimum volume,
- removal of class A seed volume gains,
- adopting TSR3-type UWR requirements, and
- reclassification of the Visual Quality Objectives (VQO) down one VQO class.

Several additional issues were analyzed:

A **Non-spatial Reserves Option** based on the application of seral percentage requirements for biodiversity and caribou habitat, rather than the spatially-explicit (mapped) biodiversity and caribou no-harvest reserves.

A **North versus South Timber Supply Option** based on assuming a sustained harvest in each of the north and the south portions of the TSA.

A **Mountain Pine beetle Option**, based on assuming a mountain pine beetle epidemic, with as much salvage of pine-infested stands as possible along with catastrophic losses in the remaining, non-salvaged stands.

When implementing the forest management requirements specified under the Non-spatial Reserves Option the harvest flow is 537,000 m^3/yr in decades 1 through 25. Relative to the base case, this represents an increase of 4.7% in the short- and long-term. This indicates that the “spatializing” of the biodiversity and caribou guidelines was a net downward pressure on the timber harvest.

When a sustained flow is maintained in both the north and in the south of the TSA the harvest flow for the TSA is 513,000 m^3/yr in decades 1 to 8, decreasing to 511,000 m^3/yr in decades 9 to 11, and then decreasing to 510,500 m^3/yr thereafter. Relative to the base case, this represents no change in the short- and mid-term and -0.5% in the long term. This indicates that even flows could be sustained in both portions of the TSA. No attempt was made to correlate these timber flows with quota allocations or geographic operating areas.

In the Mountain Pine Beetle Option the harvest flow 513,000 m^3/yr in decades 1 to 7, falling to 495,000 m^3/yr in decades 8 to 12, increasing to 503,000 m^3/yr in decades 13 to 16, increasing to 513,000 m^3/yr in decades 17 onwards. Relative to the base case, this represents no change in the short-term, and a decrease of 1.3% in the long-term. The results indicate that salvaging of mountain pine beetle killed timber could be accommodated within the current AAC, and would not require an AAC uplift.

A socio-economic assessment of the importance of the forest industry to the Golden TSA and the province was also completed. Based on facts and data collected, it was concluded that the base case harvest forecast of 513,000 m3 (which extends for the whole planning period) could annually generate the following key economic impacts.

- estimated 545 PYs of total employment and $26.4 million of employment income in the Golden TSA
- estimated 1 035 PYs of total employment and $48.1 million of employment income in the province
- estimated $4.3 million of stumpage revenues, $2.5 million of other forestry taxes and fee revenues and $5.2 million of BC income and sales taxes from employment tied to the harvest and processing of Golden TSA timber.

As the base case harvest forecast is above the current AAC there is a positive impact on the regional economy in the short-, mid- and long-term.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against other social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities, to name a few.

This document contains a timber supply analysis and socio-economic analysis specific to the Golden Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The general objective of the TSR process is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous timber supply review #3 Analysis Report was completed in August 2003, with an associated Allowable Annual Cut (AAC) of 485,000 m^3/yr determined starting in June 1, 2004. This current review is working toward a new AAC determination to be in place before July 1, 2009.

The TSR4 Data Package, which provides detailed, technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in July 2008. The release of this Analysis Report is the next step in the TSR4 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide British Columbia's Chief Forester with only a portion of the information that is needed to make an informed AAC determination. **This report does not define a new AAC – it is intended only to provide insight into the likely future timber supply of the Golden TSA and recommend a future course of action to the Chief Forester.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

This report focuses on a single forest management scenario that reflects current management practices in the TSA. In addition to this current management or "base case" scenario, several other scenarios are examined. An assessment of how results might be affected by uncertainties has also been completed using a number of sensitivity analyses and critical issue analyses. Together, these analyses and the base case form a solid foundation for discussions among stakeholders about appropriate timber harvesting levels in the Golden TSA.

1.1 Background

The Ministry of Forests (MOF) has implemented a policy framework that establishes obligations and opportunities for collaborative forest management within the province's 37 timber supply areas (TSA). This framework is commonly referred to as the Defined Forest Area Management (DFAM) initiative. Under DFAM, specified licensees and BC Timber Sales (BCTS) can assume a collective responsibility for timber supply analysis within each timber supply area. In this case, the licensees of the Golden TSA chose to assume this responsibility.

Under contract to the DFAM group, Forsite prepared the Data Package released for public and First Nations review in July 2008. The Data Package (most of which is provided in Appendix A) reflects the final inputs and assumptions used during modeling. Forsite has now completed the analysis, and compiled this report.

2.0 Description of the Golden TSA

2.1 Location

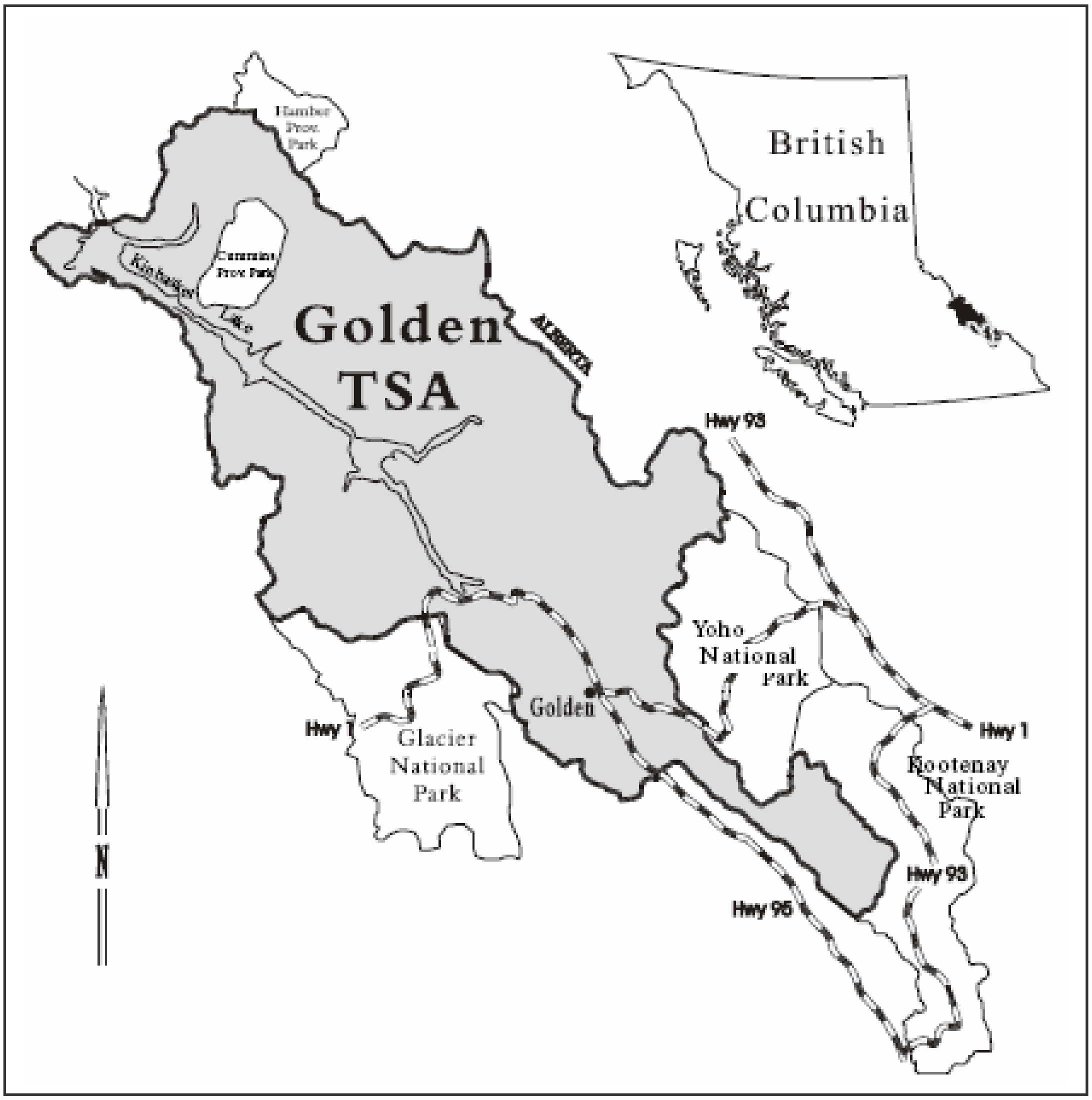


Figure 1 Overview Map of Golden TSA

The Golden Timber Supply Area (TSA) lies in the mid-eastern part of British Columbia within the Southern Interior Forest Region (Figure 1 It is administered from the Columbia Forest District office in Revelstoke and satellite office in Golden bounded by the Revelstoke Timber Supply Area to the west, Robson Valley TSA to the north, the Invermere Timber Supply Area to the south, and the province of Alberta to the east. Topographically it is bounded by by the Selkirk and Purcell Mountains to the west and the Rocky Mountains to the east.

Bordering the TSA are five national parks and one provincial park; and within its borders is Cummins Provincial Park. Some of these parks contribute to the TSA's management of biodiversity, adding a further

283 000 hectares to the land base used in the timber supply analysis for the assessment of biodiversity. This expanded land base, totaling 1 185 000 hectares, is referred to as the Golden analysis area. The Golden analysis area coincides with the Golden Resource Management Zone of the Kootenay-Boundary Higher Level Plan Order (KBHLPO). It is subdivided into 29 landscape units (LU)* averaging around 41 000 hectares in size (Figure 2)*

Source: Golden TSR3 Analysis Report (paraphrased).

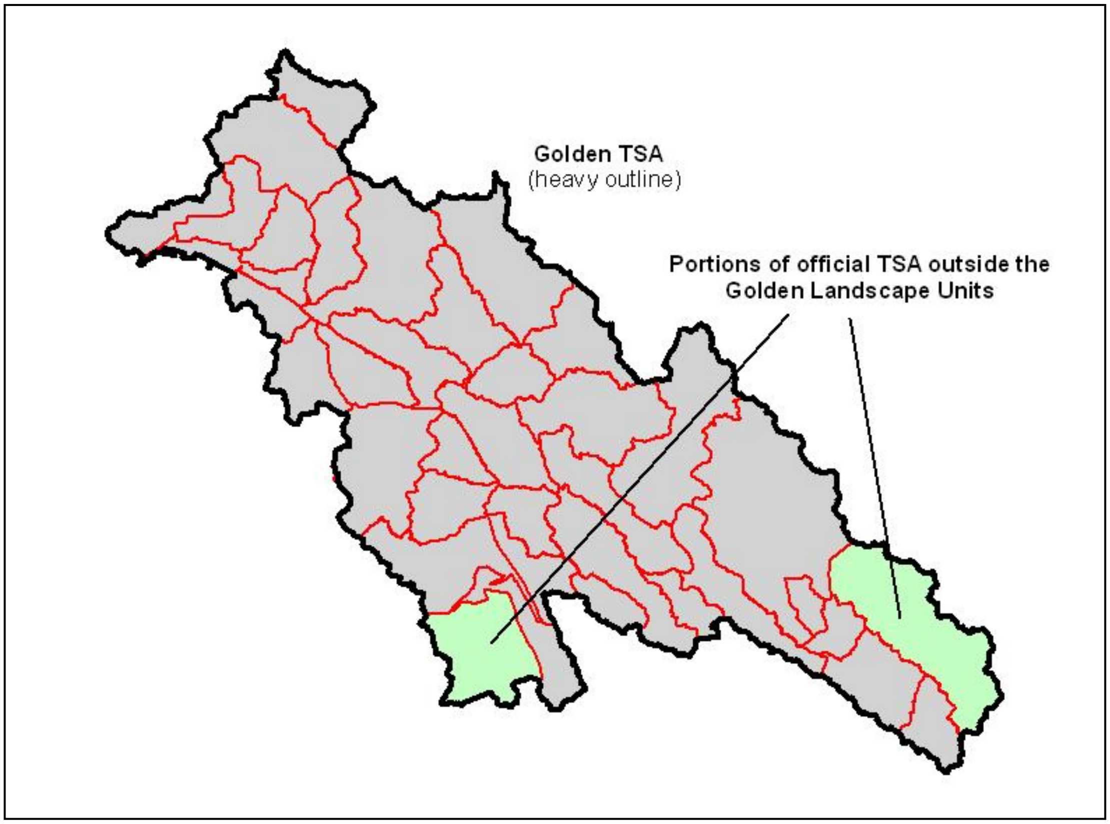


Figure 2 Golden TSA – official administrative boundary versus analysis boundary

Of note, the official TSA boundary of today extends beyond what is considered to be the Golden landscape units (Figure 2). The "extra" areas, which fall totally within Parks, are considered to be either Invermere landscape units (the south-east area) or considered to be part of the Revelstoke landscape units (the south-west area).

In summary, the official TSA area (1,310,865 ha) is reduced by these two areas to arrive at the area analyzed in this TSR4 (1,184,611 ha). This is the same area of 1,185,000 ha referred to in TSR 3 as the "Golden analysis area" (TSR3 Analysis Report, page 4). Throughout this report the term "Golden TSA" will be use to refer to the area covered by the Golden landscape units, rather than the official TSA area.

2.2 First Nations

Currently there are no First Nation communities or Indian Reserves in the Columbia Forest District. The Golden TSA falls within the 'asserted traditional territories' of the Ktunaxa Nation, the Shuswap Nation (Secwepemc) and the Okanagan Nation (Sylix). In total there are seven (7) First Nation groups - 3 tribal councils and 4 bands, who have an interest in the Golden TSA.

The Shuswap Nation is represented by the Shuswap Nation Tribal Council (SNTC) in Kamloops. Affiliated bands include the Shuswap Indian Band in Invermere, and the Simpcw First Nation (formerly North Thompson Indian Band) in Barriere. Note, the Shuswap Indian Band was previously affiliated as a member band of the Ktunaxa Nation, but realigned with the SNTC in 2006.

The Okanagan Nation is represented by the Okanagan Nation Alliance (ONA) in Westbank. The Okanagan Indian Band (OKIB) in Vernon is an affiliated member of the ONA.

The Ktunaxa Nation is represented by the Ktunaxa Nation Council (KNC) in Cranbrook. The KNC were formerly known as the Ktunaxa/Kinbasket Tribal Council (KKTC). The Akisq'nuk First Nation (formerly the Columbia Lake Band) in Windermere is an affiliated member of the KNC.

The Adams Lake Indian Band and the Neskonlith Indian Band (both located in Chase) are affiliated members of the SNTC. These bands are co-owners of a Traditional Use Study (TUS) which identifies Cultural Heritage Resources (CHRs) within the Golden TSA. Neither Adams Lake nor Neskonlith have 'asserted traditional territory' in the Golden TSA, however the traditional uses in the study make reference to both bands and the Secwepemc peoples. As a due diligence pre-caution both bands have been incuded in the TSR consultation process for the Golden TSA.

The Ktunaxa Nation is a participant in the BC Treaty process. The Golden TSA is within the Ktunaxa Nation area of interest. It is not known when or if a treaty settlement will be made prior to the CF's determination on this TSR. Forest and Range Opportunity Agreements (FROs) have been signed with the KNC (includes Akisq'nuk), Shuswap Indian Band, Simpcw First Nation, Okanagan Indian Band and the Adams Lake Indian Band. Development of consultation protocols under the FRO agreements were initiated with most of these First Nations, however there are no approved protocols in place at this time.

2.3 Environment

The Golden TSA contains five biogeoclimatic zones. Four of the zones are characterized by extensive forests. These range from the low elevation, warm and dry ecosystems in the southern portions of the TSA, through cool and very wet forests in mid elevations, especially in the mid and northern portions of the TSA, to the high elevation, cold, mountainous forests throughout the TSA, and finally up to the alpine tundra zone, which is characterized by little or no forest. Table 1, which is arranged along an elevation gradient, summarizes the contribution of the five zones to the gross area and timber harvesting land base area of the TSA.

Table 1 Biogeoclimatic subzones in the Golden TSA

Subzone	Subzone Name	Approximate Elevation Range (m ASL)	Golden TSA THLB Area (ha)	Golden TSA Gross Area (ha)
IMA (or AT)	Alpine Tundra	2250+	0	242,475
ESSF	Englemann Spruce – Subalpine Fir zone	1200 - 2100	22,258	586,723
MS	Montane Spruce	1100 - 1700	14,502	70,758
ICH	Interior Cedar Hemlock	400 - 1500	104,528	278,521
IDF	Interior Douglas Fir	300 - 1450	240	6,135
All			**141,530**	**1,184,611**

The **Interior Douglas-fir (IDF)** zone typically occurs between the Ponderosa Pine Zone (present in the Invermere TSA, just to the south of Golden TSA) and the Montane Spruce zone. The IDF is characterized by warm, dry summers, a fairly long growing season and cool winters. Moisture deficits are common during the growing season. Douglas-fir is the dominant tree species in this zone, while ponderosa pine occur at lower elevations; spruce at higher elevations, and lodgepole pine throughout.

The **Interior Cedar - Hemlock zone (ICH)** occurs at lower to middle elevations. The ICH occupies the lower slopes of the Columbia Mountains (where it is commonly called the Interior Wet Belt), and the windward or western side of the continental divide along the Rocky Mountains. The ICH has cool wet winters and warm dry summers. This zone is one of the wettest in the interior of the province, and has the highest diversity of tree species of any zone in the province. The climax forests are western redcedar and western hemlock. White spruce, Engelmann spruce, and subalpine fir are common, as well as western hemlock and redcedar, especially in areas of cold air drainage or at higher elevations. The majority of the timber harvesting land base in the Golden TSA occurs in this zone.

The **Montane Spruce (MS)** zone is found at mid-elevations, often between the Interior Douglas-fir Zone and the Engelmann Spruce-Subalpine Fir Zone. This zone is characterized by cold winters and moderately short, warm summers. Although subalpine fir and spruce are the climax tree species, one of the most distinctive features of this zone is the extensive even-aged stands of lodgepole pine that have formed following relatively frequent wildfire. Other common species found in this zone are Douglas-fir, western red cedar, trembling aspen and cottonwood.

The **Engelmann Spruce-Subalpine Fir (ESSF)** zone is the uppermost forested zone, usually in steep and rugged terrain. It lies below the Alpine Tundra zone and above the Montane Spruce zone. Growing seasons are cool and short while winters are long and cold. Forests are continuous at the lower elevations of this zone, but at higher elevations clumps of trees occur within areas of heath, meadow and grassland. Engelmann spruce and subalpine fir are the dominant climax tree species, while lodepole pine is common after fires. At lower elevations of this zone, western white pine, Douglas-fir, western hemlock and western red cedar can also be found.

The **Alpine Tundra Zone** lies above the Engelmann Spruce-Subalpine Fir Zone, and is by definition treeless although stunted (or krummholz) trees are common at the lower elevations of this zone. Overall, this zone is dominated by rock, ice and grassy meadows.

Ref: Meidinger, Del and Jim Pojar, eds. 1991. Ecosystems of British Columbia. BC Ministry of Forests, Special Report Series 6, February 1991.

Approximately 36% of the Golden analysis area is covered by productive forest. Spruce, Douglas-fir and pine are the dominant tree species making up the productive forest. Most of this TSA lies in the interior wet belt. The southern portion of the area has a drier climate, resulting in a greater proportion of Douglas-fir and lodgepole pine. Mountain peaks are covered by expanses of alpine tundra, rock and ice.

As a result of its mountainous terrain, the Golden timber supply area has a diverse forested environment that provides habitat for a wide variety of wildlife species. According to a 1992 inventory, approximately 274 bird, 63 mammal, 9 amphibian and 8 reptile species inhabit the area. Large mammal species include black and grizzly bear, moose, elk, mule deer, bighorn sheep and mountain goat. The northern part of the Golden TSA also overlaps the range of one of only three viable populations of mountain caribou in western Canada. Wildlife species that live at high elevations or rely on young forests for habitat are generally abundant. More than one-half of all species rely on low elevation habitats, including grasslands, wetlands and riparian forests. Animals that depend on the retention of mature forests include peregrine falcon, bald eagle, great blue heron, grizzly bear, caribou, fisher, cavity-nesting birds and small mammals. The majority of species that occur or potentially may be found in the Golden timber supply area, and that are considered at risk or regionally significant, are presented in Appendix C. In addition, there are 14 rare plant communities that are either red or blue listed in the Columbia Forest District.

Source: Golden TSR 3 Analysis Report (paraphrased).

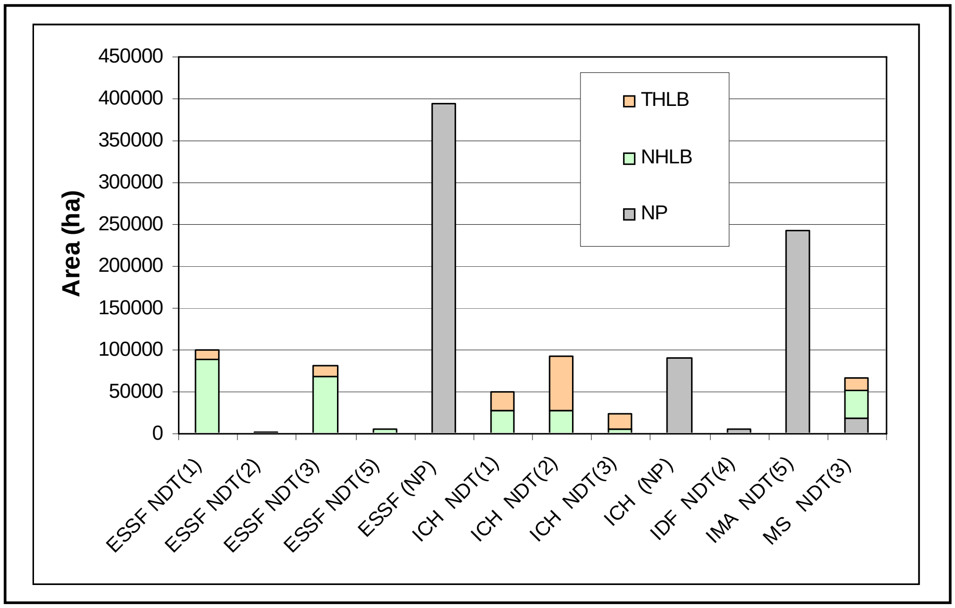


Figure 3 Biogeoclimatic Ecosystem Classification within the Golden TSA

Note: “NP” includes non-forested, non-productive forest, and non-contributing ownership classes.

2.4 Integrated Resource Management Considerations

Integrated resource management is the basic premise for the practice of forestry in the Golden TSA. Timber harvesting is planned and managed is such a way that allows a wide range of other values to co-exist on the land base. The manner in which each value is considered is dictated by federal or provincial legislation or BC government policy. Examples of these are the federal Fisheries Act, the Forest Practices Code / Forest and Range Practices Act, and several Columbia Forest District Policies. These documents address requirements for a wide range of non-timber issues.

The most significant issues influencing forest management in the Golden TSA are:

- Biodiversity
- Caribou
- Riparian habitat
- Ungulate winter range (mule deer, elk, moose, bighorn sheep, mountain goats)
- Grizzly bear
- Identified wildlife
- Domestic watersheds
- Viewscapes in scenic corridors
- Forest recreation

The areas affected by each of these non-timber resource values and the specific forest management practices required to address them are discussed in detail in Appendix A.

2.5 Current Attributes of the TSA

This section of the document describes the current state of the Golden TSA and provides descriptions of the forests that are useful to understanding the timber supply analyses presented later in the document. The Timber Harvesting Land Base (THLB) and Crown Forested Land Base (CFLB) referenced in this section are defined in detail in Appendix A.

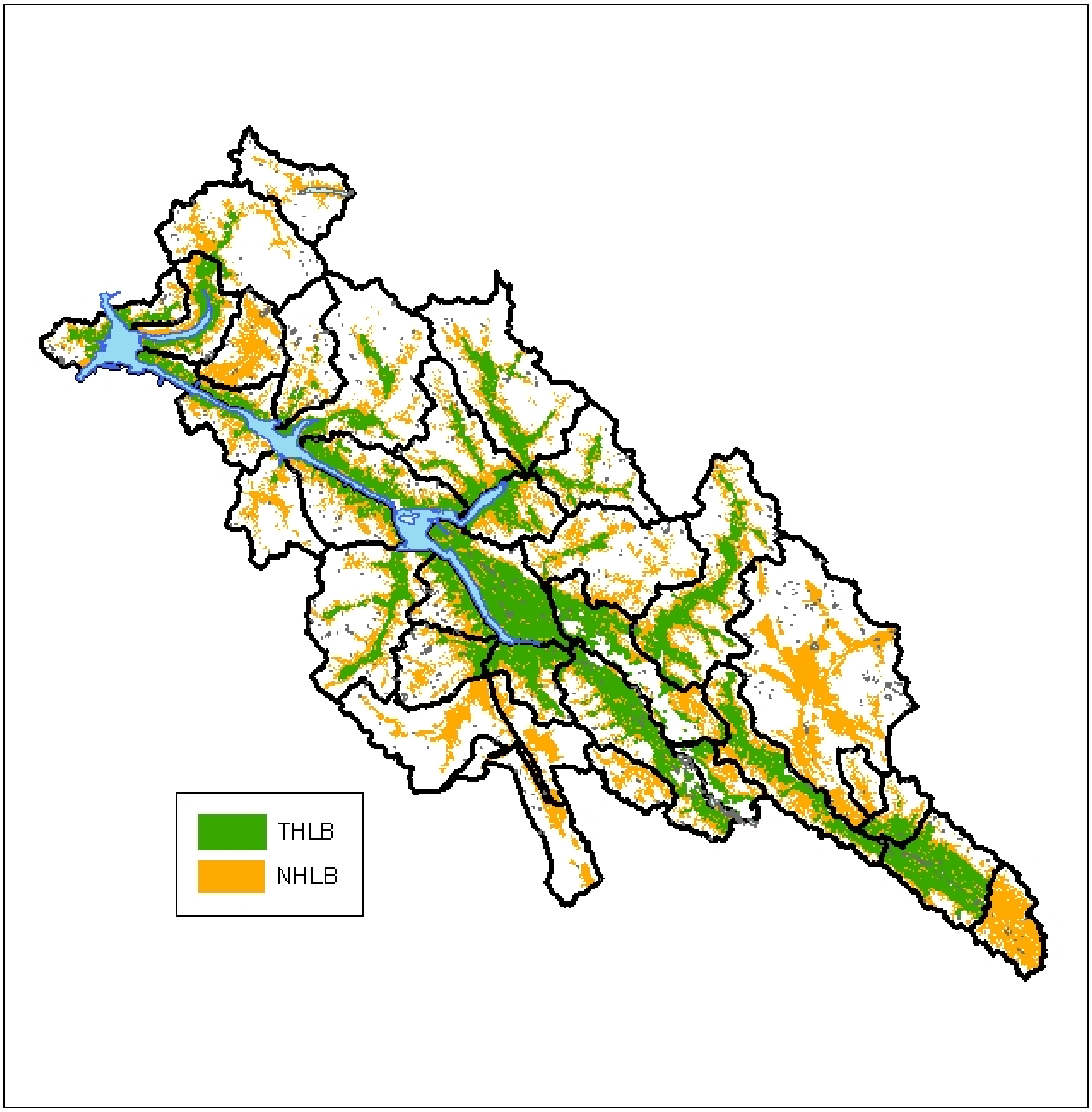


Figure 4 Map of Golden TSA THLB

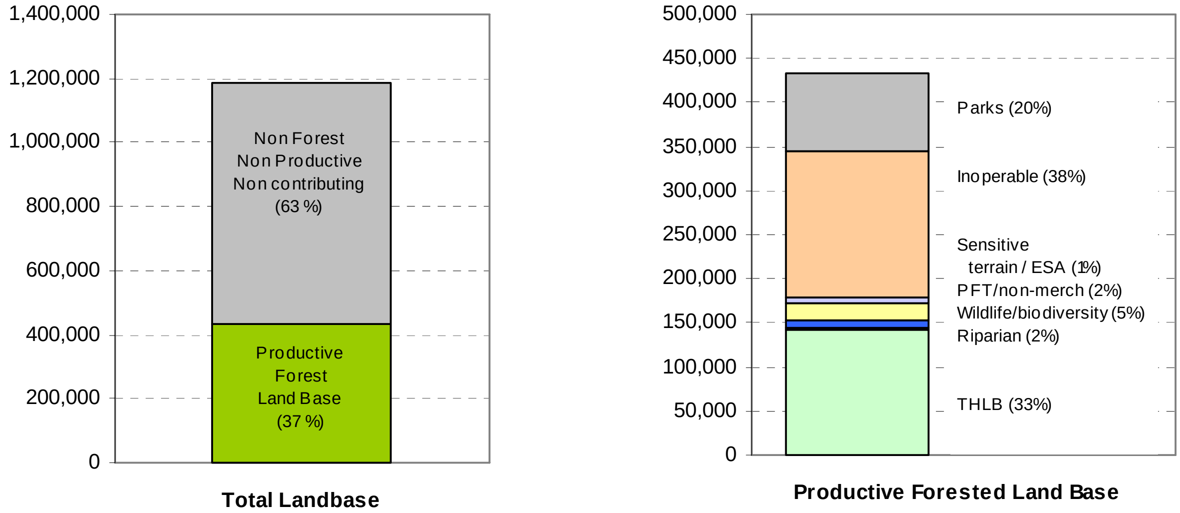


Figure 5 Golden TSA land base breakdown

Approximately 36.5% of the total area of the Golden TSA is considered productive forest land (Figure 5). The remaining 63.5 % is considered non productive (i.e. rock, ice, alpine, roads, etc). Within the productive land base, 32.7% is considered available for timber harvesting.

The forests of the Golden TSA are dominated by Engelmann spruce and subalpine fir (40%), Douglas-fir / western larch (25%), lodgepole pine (19%), and western hemlock / western red cedar (13%) (Figure 6). Other tree species that occur less commonly in the TSA are cottonwood, birch and aspen (3% in total), and mountain hemlock and whitebark pine.

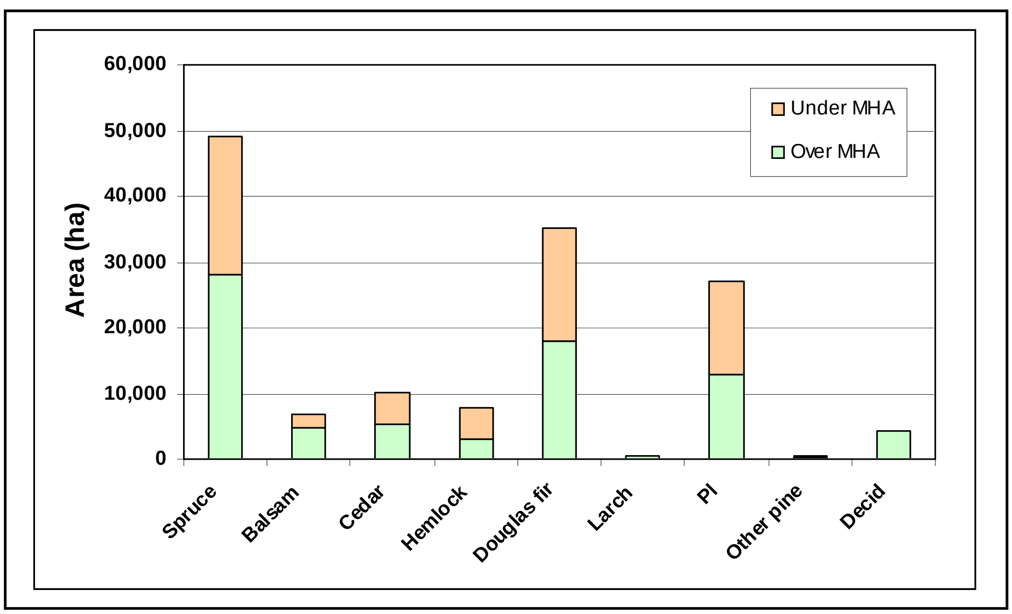


Figure 6 THLB area by dominant tree species relative to minimum harvest age.

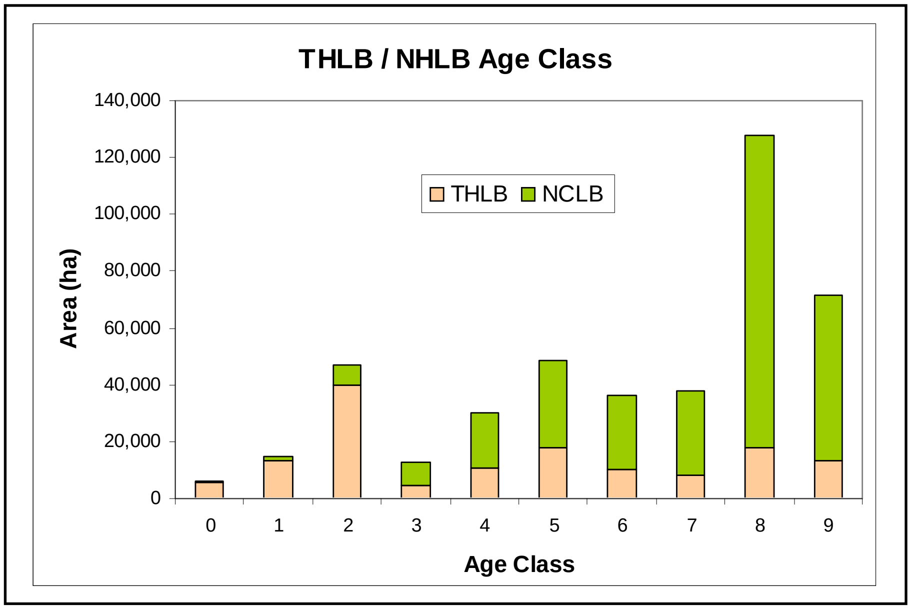


Figure 7 THLB and NHLB age class distribution.

Note: Age classes in the figure are the common MoF age classes (Age Class=1 represents stands with age 1-20, Age Class=2 represents stands with age 21-40, etc. Age Class=0 represents stands with no age, or NSR.)

The timber harvesting landbase (THLB) has a high proportion of age classes 1 and 2 (Figure 7), although 55% of the THLB is currently older than minimum harvest age (Figure 6). The non-timber harvesting landbase (NHLB) is skewed towards the older age classes, especially age classes 8 and 9 (Figure 7).

Figure 8 shows that spruce/balsam and cedar/hemlock leading stands tend to make up the majority of those older age classes.

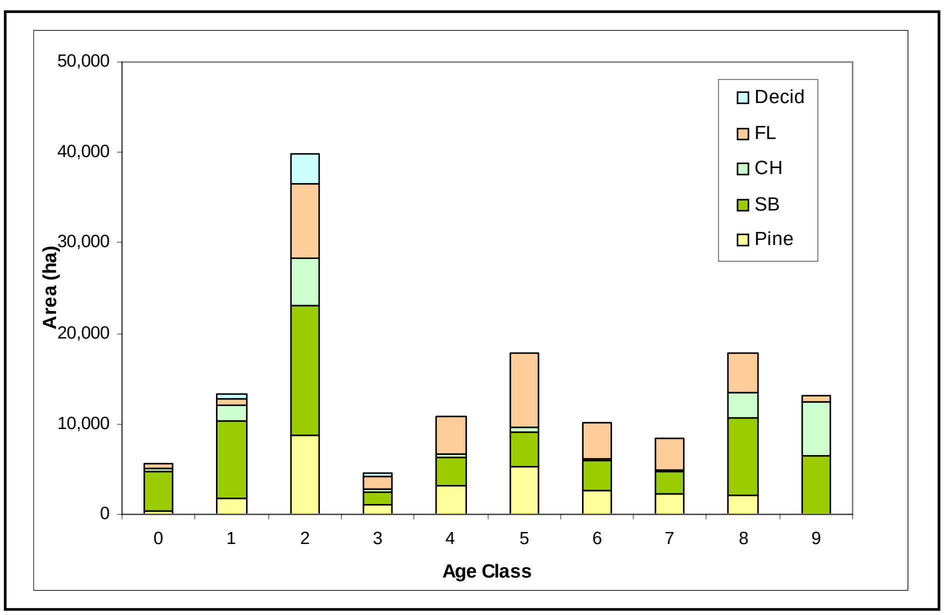


Figure 8 THLB area by age class and leading species.

Within the timber harvesting land base (THLB) only, spruce and balsam leading stands are the most predominant forest type, with fir and larch leading stands being the second most predominant forest type. Pine leading types are the third largest type, followed by cedar/hemlock and then deciduous-leading types.

A 10-year age class structure over the entire crown forest land base (CFLB) is shown in Figure 9. The forest stands are relatively well distributed over a wide range of age classes, with most of the NHLB area falling within age classes over 70 years, and most of the THLB falling within age classes less than 100 years old. The younger age classes have a high percentage of THLB within them because the predominant method of creating young stands in recent years has been through forest harvesting.

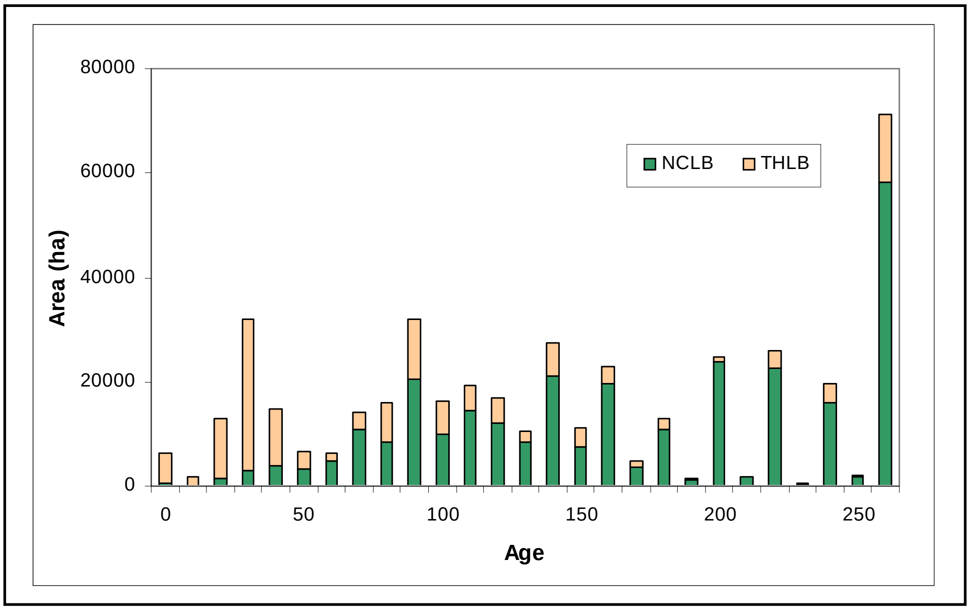


Figure 9 THLB and NHLB area by 10-year age class

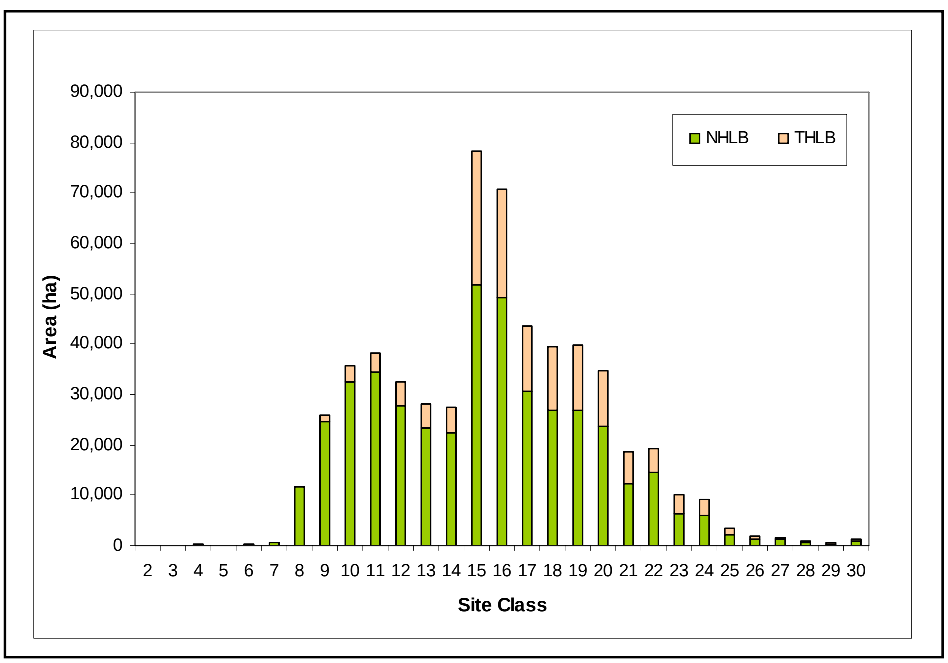


Figure 10 THLB and NHLB site productivity (site index).

The distribution of site productivity (inventory site index) is shown in Figure 10. The THLB portion is skewed toward the higher site indexes. Little of the THLB area has a site index less than 8. This is consistent with the low site index net down criteria described in the Information Package Report. The average site index of the THLB, based on the forest inventory, is 17.1 meters. No site index adjustments were applied to the managed (future) stands, therefore the site index of managed stands is the same as the natural stands.

3.0 Timber Supply Analysis Methods

A large amount of information is required to complete a timber supply analysis. Information must be obtained in four broad categories: land base, forest inventory, management practices, and forest dynamics. This information is then translated into a computer model formulation that can explore sustainable rates of harvest in the context of integrated resource management. This section summarizes the data inputs, assumptions, and modeling procedures that are provided in more detail in Appendix A.

3.1 Land Base Definition

The c*rown forested land base* (CFLB) is the area of productive forest under provincial crown ownership. This portion of the landbase contributes to forest management objectives, such as landscape-level objectives for biodiversity, wildlife habitat, and visual quality. The *crown forested land base* excludes non-crown lands (these are mostly private lands), and non-forest and non-productive areas. It does not include alpine forest or non-productive areas with tree species.

The *timber harvesting land base* (THLB) is the portion of the management unit where forest licensees under licence to the province of BC are expected to be able to harvest timber. The THLB is a subset of the *crown forested land base.* It excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise off-limits to timber harvesting. Table 2 summarizes the land base for the Golden TSA. A more detailed description of netdown areas can be found in the Golden TSR4 Information Package, and in this report as Appendix A.

Table 2 Timber Harvesting Land Base Determination

	Park Area (ha)	Non-Park Area (ha) (*)	Total Area (ha)	Percent Of Total Area (%)	Percent Of Productive Area (%)
Total land base	290,917	893,694	1,184,611	100.0	
Reductions					-
Private, Woodlots, non-contributing administrative classes	0	22,975	22,975	1.9	
Non-forest, non-productive forest	202,630	522,253	724,883	61.2	
Roads, trails, landings	60	4,016	4,076	0.3	
Total productive land base (*)	88,227	344,449	432,677	36.5	100.0
Reductions					
Parks and protected areas (**)	88,227	0	88,227	7.4	20.4
Inoperable	0	165,829	165,829	14.0	38.3
Unstable terrain (ESA & TSIL)	0	3,376	3,376	0.3	0.8
Non-merch (low site)	0	3,067	3,067	0.3	0.7
PFT (Hw and Decid)	0	5,548	5,548	0.5	1.3
Wildlife (caribou HLPO and SARCO)	0	8,348	8,348	0.7	1.9
Archaeological sites	0	0	0	0.0	0.0
Riparian	0	5,194	5,194	0.4	1.2
Biodiversity - WTRA	0	1,543	1,543	0.1	0.4
Biodiversity – OGMA and MOGMA	0	9,910	9,910	0.8	2.3
Permanent sample plots	0	105	105	0.0	0.0
Total Reductions	88,227	202,920	291,147	24.6	67.3
Current Timber Harvesting Land Base	0	141,530	141,530	11.9	32.7
Future WTPs	0	652	652	0.1	0.2
Future roads and trails	0	2,516	2,516	0.2	0.6
Net long-term Timber Harvesting Land Base	0	138,362	138,362	11.7	32.0

Notes:
1. All totals are subject to rounding.
2. (*) Park area is included for biodiversity modeling of the productive landbase. Totals below (**) do not include any of this Park area.
3. Any overlaps between net-downs are removed. Any overlapping area will accrue to the first (highest) category in the table.

3.2 Forest Inventory Data

There are two forest cover formats in the Golden TSA: Forest Inventory Planning (FIP-type, or “FIP rollover”) and Vegetation Resource Inventory (VRI, or “true VRI”). Approximately 15% of the Golden TSA analysis area is FIP-type forest cover. This forest cover is largely within the national parks (ownership code = “51-N”). It was input into the provincial forest cover inventory in years 1995, 1996 and 1997. This inventory is included in the analysis for purposes of modeling biodiversity.

The majority of the forest cover for the Golden TSA (non-Park area) was completed in December of 2001. It is a true VRI-type forest inventory. Irregular updates of the inventory have been completed since that date for fires and logging. Licensee harvest block data, current to late 2007, has been embedded onto the forest cover data using a GIS.

The inventory has been adjusted for height, age and volume based on a Phase 2 field sampling project completed in 2002. Inventory Statistical Adjustment and Net Volume Adjustment Factors were compiled in 2007 by Jahraus & Associates. The VAF factors have been incorporated into the forest cover when it was projected to January 2008.

Site index adjustment occurs indirectly as a result of adjusting the stand ages and heights. Overall, the adjustment procedure decreased heights, increased or decreased some ages, and decreased volumes. Site indices were indirectly increased or decreased depending on the combinations of height and age adjustments. Across the target population, the net effect of all adjustments was a 1.1% decrease in merchantable volume (see Appendix A for additional details.)

3.3 Management Practices

Management practice assumptions can be grouped into three broad categories: Integrated Resource Management, Silviculture, and Harvesting.

3.3.1 Integrated Resource Management

Forest cover requirements are applied within the timber supply model to accommodate the timber and non-timber resource objectives. These requirements maintain appropriate levels of specific forest types needed to satisfy the objectives for wildlife habitat, visual quality, biological diversity, etc. Forest cover requirements are used by the model to limit harvesting within the THLB. A summary of the areas over which various non-timber resource values occur is provided in Table 3 (Current Practice, or Base Case scenario). The specific forest cover requirements modeled for each objective are provided in Appendix A - Section 7.0.

Table 3 Resource emphasis areas and forest requirements

Name	Crown Forested Area (ha)	THLB Area (ha)	Forest resource requirements.
High Biodiversity Emphasis Option (BEO) Areas	107,928[1]	23,663[1]	Old seral: no harvest within spatial OGMAs. Mature-plus-old seral: no harvest within spatial MOGMAs.
Intermediate BEO Areas	109,001[1]	55,775[1]	
Biodiversity: Low BEO Areas	209,488[1]	62,092[1]	Old seral: no harvest within spatial OGMAs for first rotation; apply a seral percentage requirement at 2/3 full target for the second rotation; increase the seral requirement to (3/3) full target for the third rotation onwards. Mature-plus-old seral: no harvest within spatially mapped MOGMAs.
Caribou Management zones	21,690	0	HLPO: No harvest within spatially mapped caribou areas. SARCO: No harvest within spatially mapped caribou areas.
Riparian Areas	13,125	0	Reserves around classified streams, lakes and wetlands.
Domestic or Sensitive Watersheds	322	0	Reserves around portions of streams upstream of intakes.
Ungulate Winter Range (UWR)	49,566	31,546	MF - dry: min 10% > 100 years MF – dry: min 10% >100 years MF – trans: min 10% >60 years MF – trans: min 10% >100 years; S,F leading MF – mesic: min 10% >60 years MF – mesic: min 20% >100 years; S,F leading MF – moist: min 20% >60 years MF – wet: min 30% >60 years
Visual landscapes	36,152	20,036	Maximum of X% < visual greenup age of Y, applied within each VQO class within each LU.
Integrated Resource Management Zone (IRM)	98,210	98,210	Maximum of 25% < 2.5 m tall. within LU / IRM zone
Enhanced Resource Development Zone (ERDZ)	43,319	43,319	Maximum of 33%<2 yr within LU / ERDZ zone

Notes:
1 = These numbers are the area assigned to that BEO according to the HLPO, not the areas of the OGMAs and MOGMAs.

3.3.2 Silviculture

Historical and current silvicultural practices in the Golden TSA have been included in the model. These include:

- Silvicultural systems,
- Regeneration assumptions (establishment method, species distribution, and establishment density),
- Regeneration delay (time between harvesting and when the site is stocked with crop trees), and
- Use of select seed.

All harvesting was modeled as clear-cut with reserves. For additional details refer to Appendix A.

3.3.3 Timber Harvesting

Assumptions around timber harvesting practices have also been included in the model. These include the following (see Appendix A for details):

- A minimum harvest age to ensure a viable log is produced and long term volume production is maximized.
- Several minimum economic criteria for log size and stand volumes.
- Land base definition criteria (unstable slopes, inoperable areas, low sites, etc.).
- Harvest priorities across the land base.

Harvest priorities were established based on: (1) Relative oldest first harvest rule while ensuring that all forest cover requirements are met at all times; (2) then the highest priority stand types are lodgepole pine leading stands, with a maximum of 70% of the harvest to come from Pl leading stands; then (3) Douglas fir-leading leading stands; then (4) other stands in the THLB. The pine-leading choice was based on the objective of managing mountain pine beetle (MPB) issues.

3.4 Forest Dynamics

Forest dynamics refers to the changing state of the forest through time. Changes occur as the forest ages, or when natural or human caused disturbances occur. The way in which the model addresses these issues is described below.

3.4.1 Growth and Yield Projections

Timber growth and yield refers to the prediction of the growth and development of forest stands over time, and of particular interest, the volume and size of trees that would occur at the time of harvest. For modeling purposes, stands of similar characteristics, growth rates, and management are grouped together into Analysis Units (AUs). Analysis Units are described in the Appendix A. The attributes of each analysis unit are input into growth and yield models to predict gross and net volume per hectare at various stand ages. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters near the base and the top of a tree.

Each analysis unit is associated with its own yield curve, which is a prediction of the gross and net volume per hectare at various stand ages. Minimum harvest ages are determined by comparing the yield curves to merchantability criteria, such as the minimum volume per hectare, or minimum stand diameter that must be reached before the stand will be eligible for harvest.

Two growth and yield models were used to estimate the yield curves used in the Golden TSA timber supply analysis. The Variable Density Yield Prediction model (BatchVDYP 6.6d), supported by the Forest Analysis and Inventory Branch, was used for estimating timber volumes for all existing natural stands. The Table Interpolation Program for Stand Yields model (BatchTIPSY 3.2), developed by the Research Branch was used to estimate timber volumes for both existing and future managed stands. Existing managed stands are those that are currently under 30 years of age with a history of logging. Future managed stands are stands that will regenerate after they are harvested by the model during the planning horizon.

Based on forest inventory estimates, the current timber inventory or growing stock on the timber harvesting land base is approximately 26.5 million cubic metres. Approximately 88 % of this growing stock (23.31million m3) is currently merchantable, i.e. in stands older than their minimum harvest age.

3.4.2 Disturbances

The timber supply model relies upon three mechanisms to disturb stands. Harvesting is the most common method of disturbance in the model (either clear-cut or partial cut) and occurs only within the timber harvesting land base. In order to recognize that natural disturbances also occur on the land base, the following are also modeled.

<u>Natural disturbances in the timber harvesting land base</u>:
Each year timber volume is damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects (mountain pine beetle included), disease, blowdown, snowpress, wildfires, etc. In order to address losses from catastrophic natural events in the THLB, the model 'harvests' an extra volume of timber in each time period that is not counted toward harvest levels. Endemic pest losses are dealt with through factors applied in the growth and yield models. The annual unsalvaged loss applied in this analysis was 7,627m^3/yr. Unsalvaged loss estimates address only the loss of merchantable volume from mature stands. The losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data is available to estimate the extent or impact of these losses. These disturbances are not modeled, but are captured during periodic inventory updates and are therefore reflected in subsequent timber supply analyses.

<u>Natural disturbances outside the timber harvesting land base:</u>
Because stands outside of the THLB contribute toward several forest cover objectives (i.e. landscape level biodiversity), it is important that the age class distributions in these stands are also modeled in a manner that is consistent with natural processes. By simulating natural disturbance in these stands, a more natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured. An area of approximately 930 ha is disturbed each year in the analysis to prevent age classes in the non-THLB from becoming unrealistically old during modeling.

3.5 Timber Supply Model

Forest Planning Studio (FPS) version 6.0.2.0 was used to complete the timber supply analysis. This model has been used previously in the timber supply analysis of other units, for example: TFL 14 (MP#9, 2008), TFL 56 (MP#3, 2001) and the Lillooet TSA (TSR 3, 2005).

FPS was developed by Dr. John Nelson at the University of British Columbia (UBC) and is a spatially explicit forest estate simulation model. All events in the model are directly linked to stand level polygons or harvest units and thus allow tracking of individual stand attributes and spatial relationships through time. Each polygon belongs to a specific stand group (analysis unit) and has attributes such as age, harvest system, and land base status (THLB or Non-THLB). Results are typically aggregated for reporting at higher levels (i.e. harvest flow for the entire unit).

A wide range of constraints can be modeled on the land base: harvest exclusion, spatial adjacency or maximum cutblock size, maximum disturbance/young seral, minimum mature/old seral, and equivalent clearcut area (ECA) limits. Constraints are applied to groups of polygons (cliques) and harvest is restricted if a constraint is not satisfied. A single polygon can belong to many overlapping cliques and each of them must be satisfied in order to allow harvest of the polygon. Where a mature or old cover constraint is not met, harvesting may still occur if there are any eligible stands remaining after the oldest stands are reserved to meet the constraint.

Harvest is implemented using a set of priorities to queue stands for harvest. In each period, the model harvests the highest priority eligible stands until it reaches the harvest target or exhausts the list of opportunities. Harvest periods can be set at single years, multiple year periods or a combination of these. Where periods are used, the midpoint of the period is typically used as the point where harvest opportunity is evaluated because it is a good balance between the start of the period (pessimistic) and the end of the period (optimistic).

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in Golden TSA, in light of current forest management practices. Modeling assists the timber supply analyst in assessing the harvest flows associated with various scenarios. Management scenarios are groups of assumptions that define the extent of the timber harvesting land base, timber volumes, and the management regimes. The dominant scenario in this report is the Base Case Option, or current management scenario. Modeling was completed for a minimum of 300 years for each scenario to confirm that the harvest and growing stock levels remain stable, but only the first 250 years are reported.

The results of the analysis are an important part of the annual allowable cut determination process and aim to document future harvest flows that will not restrict future options in the Golden TSA. **The results presented here do not define a new AAC – they are intended only to provide insight into the likely future timber supply of the TSA**. The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

3.6 Major Changes from the Previous Timber Supply Analysis

Changes have occurred in both the input data and management assumptions since the last timber supply analysis for the Golden TSA (2003). The major changes from TSR3 are:

- The size of the current practice timber harvesting land base is smaller by 8% (141,530 ha vs. 153,870 ha in TSR3). This is mostly due to the spatially explicit mapping of caribou and biodiversity reserves, which reduce the current THLB by 18,258 hectares.
- Road losses are better defined (spatially) and removed from the land base contributing to timber supply.
- New riparian buffer mapping was completed for the whole TSA, which incorporates all the available stream inventory information.
- A composite of all the existing terrain stability mapping was completed and replaces almost all (94%) of the ESA mapping that was used in TSR 3. The exception is a small portion of the TSA where TSIL mapping was not available. This area of ESA mapping is 12,454 ha in size, or 3.6% of the productive, non-Park landbase.
- Archaeological sites and permanent sample plots were explicitly identified, buffered, and removed.
- The HLPO domestic watershed streams have been buffered and removed.
- Existing forest inventory age and height values were adjusted based on the Volume Adjustment Factor Development report (Jahraus & Churlish, 2007)
- Reserves for biodiversity old seral and mature-plus-old seral have been explicitly (spatially) mapped and were used to reduce the THLB.
- Reserves for caribou habitat have been spatially mapped, both for the HLPO caribou habitat requirements, and for the recent Species at Risk Coordination Office (SARCO) incremental caribou reserves. These reserves also reduce the THLB.

- Ownership data was updated to reflect new boundaries of woodlots and the Golden Ski Hill reserve. The net result is a decrease in the reductions to the THLB for ownership compared to TSR 3 (22,975 versus 28,228 hectares).

The net result after all reductions are applied, compared to last analysis, is a reduction of the current THLB to 141,530 ha, versus 153,870 ha (8% less than TSR3), and a reduction in the future THLB to 138,362 ha versus 147,252 ha (6% less than TSR3).

Differences in input data and management assumptions in the current practice base case also occurred relative to TSR3. The major differences are:

- Existing forest inventory volume estimates were adjusted to reflect VRI ground plot data. The adjustment produced an average volume decrease of 1.1 % across the THLB. Managed stands volumes were indirectly impacted because the age and height adjustment also impacted site index values on many polygons. The result is a net decrease in average SI.
- TSR4 modeled higher volume gains associated with the use of select seed (20.8% gain for Sx, 12.0% for Pl, 20% for Lw, and 21.1% for Fd). Much smaller volume gains were modeled in TSR3 (14.07 for Sx, 3.13 for Pl, and 5.73% for Fd).
- Different cover constraints were modeled for ungulate winter range (UWR) in TSR4. These are based on a draft UWR GAR Order that is under development by the Ministry of Environment and Parks staff. The TSR3 UWR required that at least 40% of the CFLB was older than 100 yrs old. This appears to be a significant constraint in that analysis in the TSR3 analysis (pg 28 of TSR3 AAC Rationale).
- Forest cover constraints for caribou management are modeled as no-harvest reserves in TSR 4. A set of draft, HLPO caribou forest cover constraints were modeled in TSR 3.
- Spatially explicit Old Growth Management Areas (OGMAs) were implemented in this analysis. TSR3 applied percent seral requirements based on the biodiversity emphasis option (BEO) as specified in the HLPO and as per the newest BEC mapping.
- TSR4 disturbed the non-THLB (NHLB) areas at a rate of 930 ha/yr. The amount of disturbance applied in TSR3 was only 370 hectares.

4.0 Base Case Analysis (Current Practice)

The Base Case Option (or scenario) presented in this report is based on the best information currently available and reflects current management practices in the TSA. The current allowable annual cut (AAC) for the Golden TSA is 485,000 m^3/yr.

Non-recoverable losses in the THLB are estimated to be 7,267 m^3/yr. This volume has been subtracted from the graphs, tables, and harvest forecasts in this report.

4.1 Alternative Harvest Flow Scenarios

Numerous alternative harvest forecasts are possible for a given set of modeling assumptions, i.e. the Base Case as defined in detail in Appendix A. The alternative flows represent tradeoffs between short, mid, and long term harvest level objectives. Figure 11 shows three potential harvest flows for the Golden TSA Base Case.

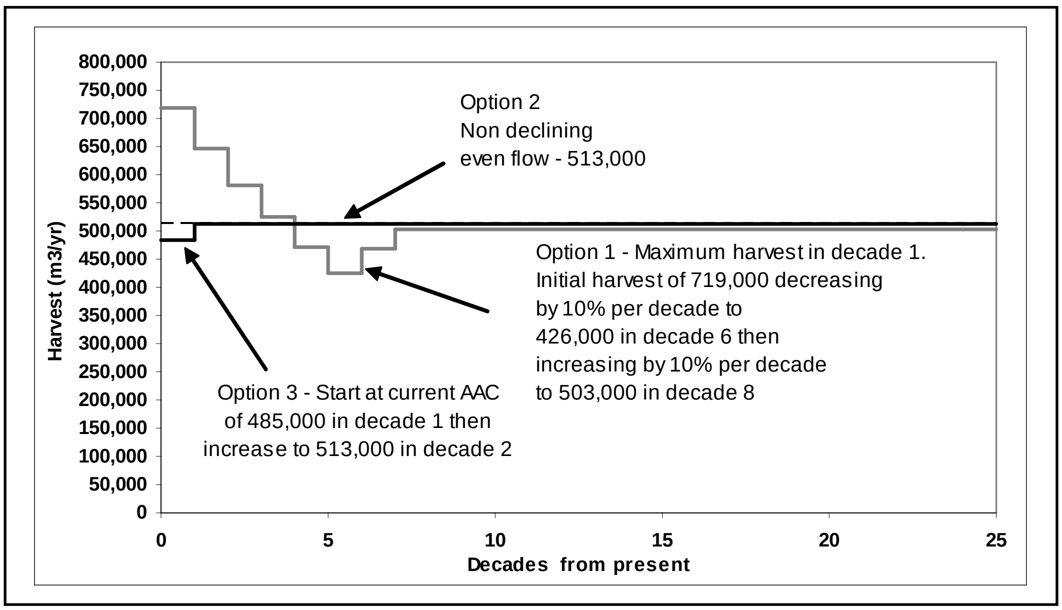


Figure 11 Alternative harvest forecasts for the Golden TSA (Current Practice)

One alternative is the highest initial harvest rate of 719,000 m^3/yr that can be maintained for one decade before declining at a rate of 10% per decade, to a low of 426,000 m^3/yr in the sixth decade, which is 41% below the first decade's harvest rate. Then, it rises to the long term harvest level occurs in decades 7 and 8 to 503,000 m^3/yr. This is 3.7% above the current AAC.

Another alternative is a non-declining harvest scenario with an initial harvest of 513,000 m^3/yr. This harvest level, which is 5.8% above the current AAC, is sustained for the full planning horizon.

The third alternative starts at 485,000 m^3/yr in decade 1 (i.e. equal to the current AAC), then increases to 513,000 m^3/yr in decade 2 (5.8 % higher than current AAC) where it is maintained at that level for the rest of the planning horizon.

4.2 Selected Base Case Harvest Flow

The second alternative from Figure 11 was selected as the Base Case flow and is shown in Figure 12 relative to the last analysis' Base Case harvest flow projection. The Base Case flow from this analysis (TSR 4 Base Case in the figure) is below the TSR3 Base Case in decade 1, and then is greater than the TSR3 Base Case for decades 2 through 25. Note that the TSR 3 Base Case was a prediction for the period 2003 onwards and Base Case for TSR 4 is for 2008 onwards (i.e. offset by one half of a decade) but the chart shows them both starting in 2008.

This Base Case flow chosen was considered to best meet the provincial policy objective of providing for a sustained flow, with smallest possible reductions or increases to the mid- or the long-term (there are none in this case). The harvest attributes and forest level attributes presented later in this section correspond with this base case harvest forecast. The sensitivity analyses are also compared to this base case harvest forecast.

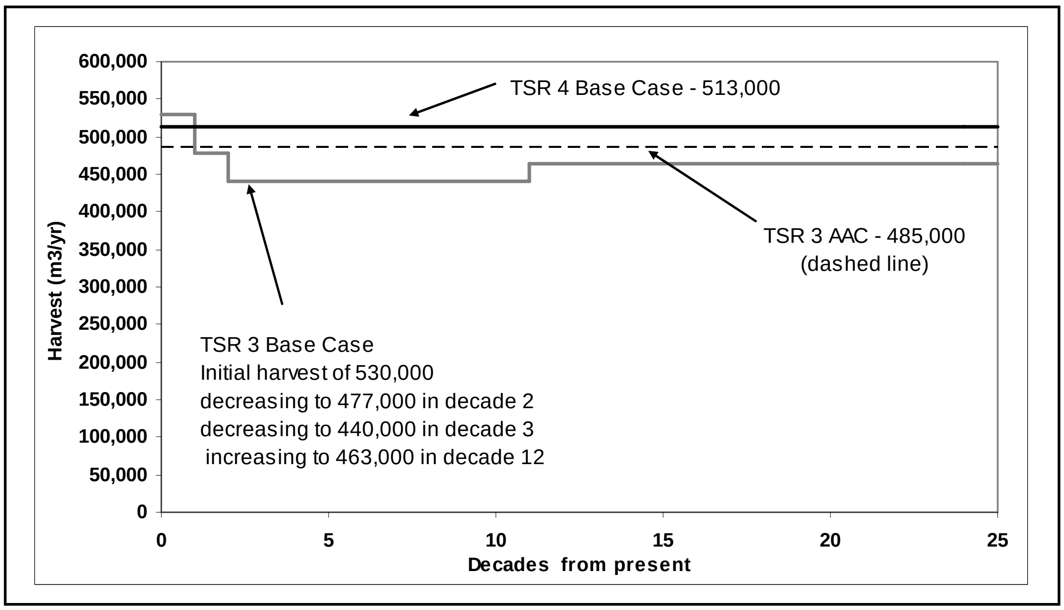


Figure 12 Harvest forecast for the Golden TSA Base Case scenario

4.3 Base Case Attributes

In order to understand and evaluate the base case harvest forecast, this section describes the stands being harvested and the state of the forest over time. Numerous forest management assumptions have been modeled in the base case analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

4.3.1 Growing Stock

The total current volume on the timber harvesting land base is 26.5 million cubic meters (Figure *13* and Table 4). Of this total volume, just over 23.3 million cubic meters is currently merchantable; that is, in stands older than minimum harvestable age. The TSR 3 base case total growing stock was 30.7 million cubic metres. Of that, about 26.6 million cubic metres, or 86.6% of the total was merchantable. The reduction in growing stock is primarily due to the reduction in the THLB area, and due to harvesting since TSR3. A small portion is due to the application of the volume adjustment factors that were not available in TSR3.

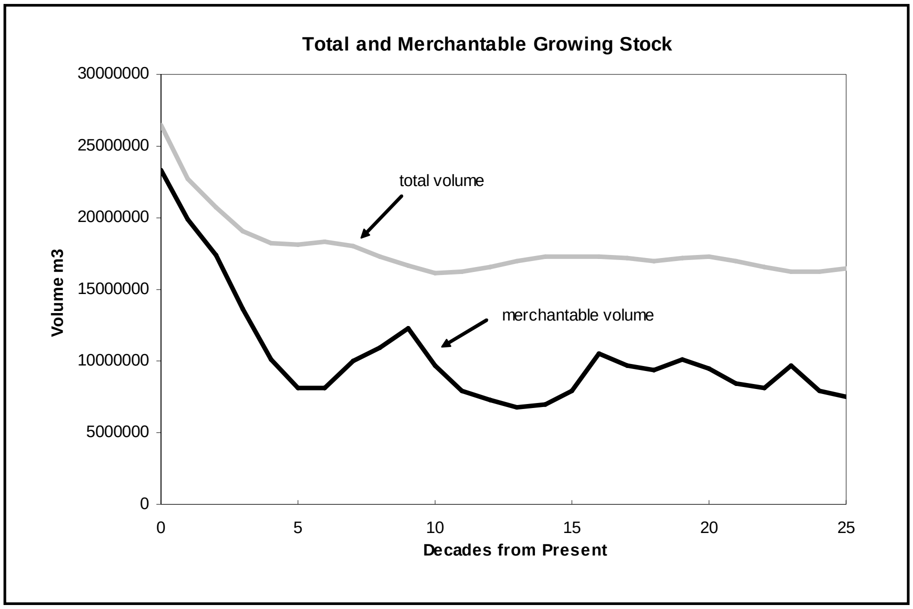


Figure 13 Merchantable and Total Growing Stock on the THLB

Table 4 Merchantable and Total Growing Stock on the THLB

Decade	Total (million m3)	Merch (million m3)		Decade	Total (million m3)	Merch (million m3)
Start	26.50	23.31		13	17.00	6.74
1	22.75	19.94		14	17.26	6.95
2	20.71	17.36		15	17.28	7.97
3	19.06	13.68		16	17.31	10.50
4	18.28	10.06		17	17.14	9.72
5	18.15	8.09		18	17.02	9.41
6	18.31	8.09		19	17.18	10.09
7	18.06	9.98		20	17.27	9.44
8	17.32	10.93		21	16.98	8.47
9	16.63	12.29		22	16.57	8.07
10	16.15	9.64		23	16.30	9.69
11	16.23	7.87		24	16.22	7.93
12	16.58	7.25		25	16.47	7.54

Short term and near mid-term merchantable growing stock is the lowest in decade 13, corresponding to a pinch-point in the timber supply in decades 13 and 14. The growing stock fluctuates in the 8 to 9 million m3 range during the rest of the planning horizon (25 decades). Although only decades up to 25 are presented here, the growing stock very slowly declines until decade 30 then is stable thereafter.

4.3.2 Harvest Attributes

Figure 14 depicts the transition from harvesting of natural stands to managed stands. In the first 4 decades the harvest of timber is exclusively from existing natural stands. In the 5th through 7th decades the harvest of natural stands drops significantly as existing managed stands become available for harvest. From the 7th decade onward managed stands comprise a greater proportion of the harvest than natural stands, and by the 9th decade onward the harvest of managed stands comprises almost all of the harvest.

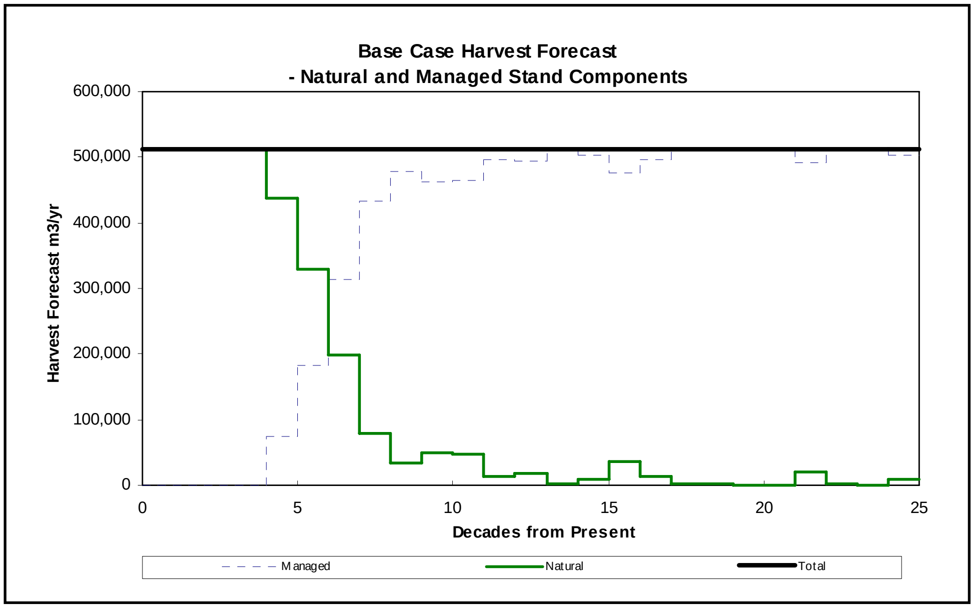


Figure 14 Contribution of natural and managed stands to the base case harvest projection

The Base Case harvest priority rules prioritized pine-leading stands first (up to a maximum of 70% of the harvest), then fir/larch-leading stands next, followed by other species last. The model aggressively harvested pine and fir/larch stands in the first two decades (Figure 15). Then in the third decade the available stands were exhausted and the model moved on to other species. The other species, especially the cedar and hemlock stands have, on average, much higher stand ages than the pine and fir/larch stands. This is reflected in the average harvest age and harvest volumes, especially during the third decade.

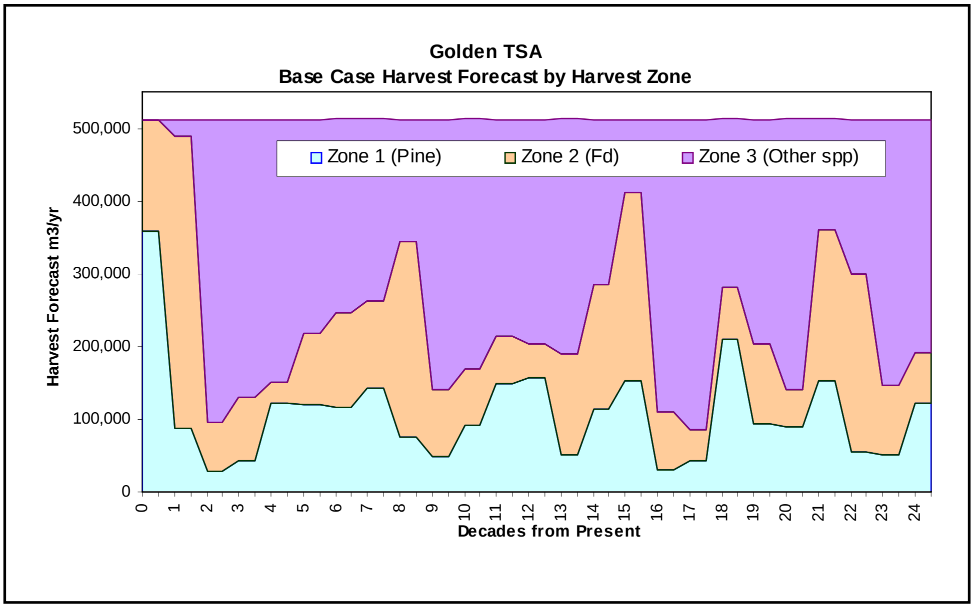


Figure 15 Contribution of species groups to the base case harvest projection.

Mean harvest age provides an indicator of the type and age of stands harvested over time. In general the timber harvesting land base contains either older natural stands or younger managed stands (previously harvested stands). Mean harvest age is initially between 120 and 250 years in the near-term, and then drops off to a long term level of approximately 80 to 90 years in the future. This is consistent with the trend of harvesting the relatively older, natural stands early in the planning horizon.

The large spike in decade 3, as discussed above, is caused by the harvest priority rules based on species interacting with the much different, average stand age for different species groups. The harvest in decades 1 and 2 is composed almost entirely of pine and fir/larch stands, while the harvest in decade 3 is composed of very old cedar, hemlock, spruce and balsam stands.

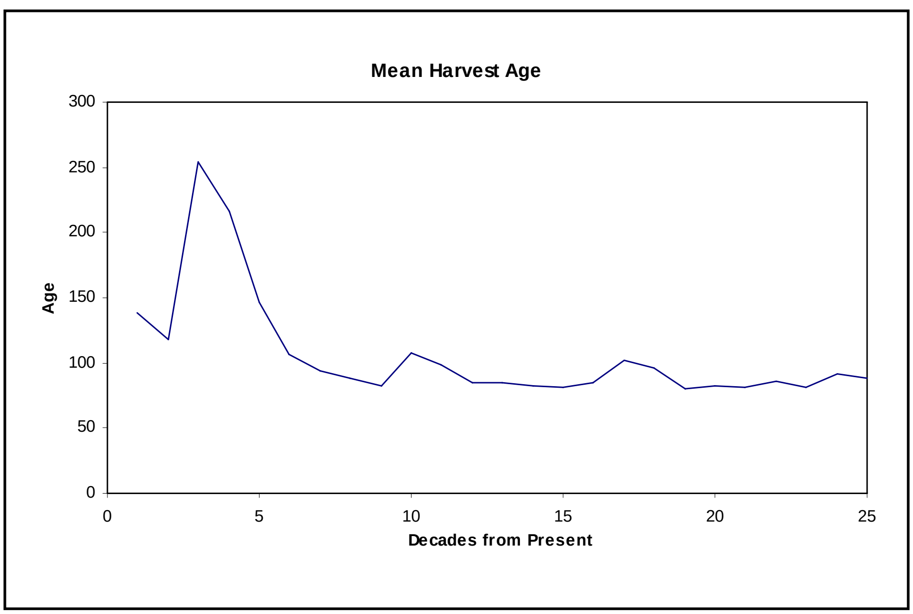


Figure 16 Mean harvest age for current practice base case

The mean harvest volume per hectare is shown in Figure 17. Average harvest volume generally is fairly constant around the mean of 339 m3/ha, although it fluctuates whenever the older, natural stands are harvested, if and when they become available (see the natural vs. managed harvest profile in Figure 14).

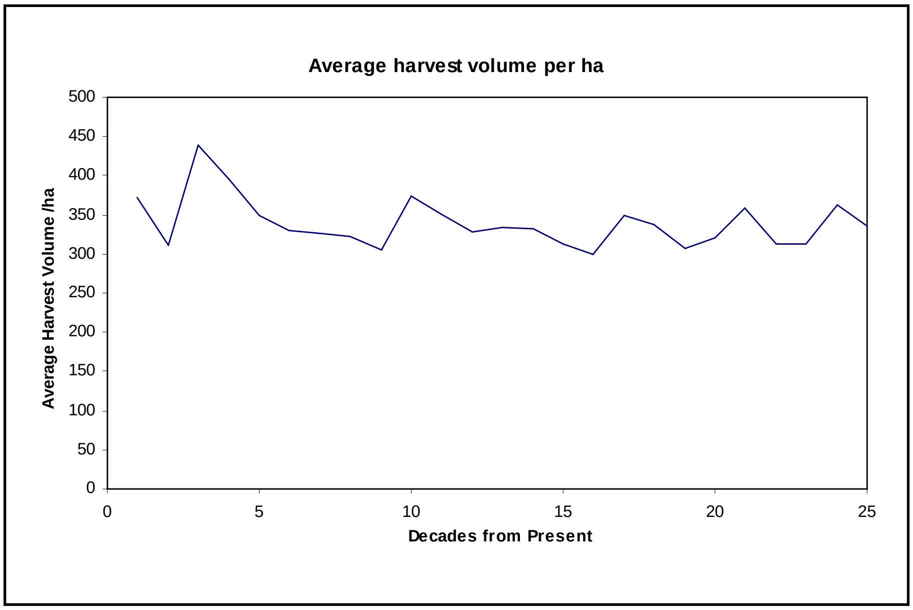


Figure 17 Mean annual harvest volume/ha for the current practice base case

Figure 18 shows the average harvest area in the TSA each period. The harvest area curve has a reverse relationship with harvest volume per hectare curve. As harvest volume goes up, the harvest area goes down, and vice versa. Harvest area fluctuates around the mean of 1,547 hectares per year. Whenever a greater area is harvested it is correlated with a lower volume per hectare (Figure 17).

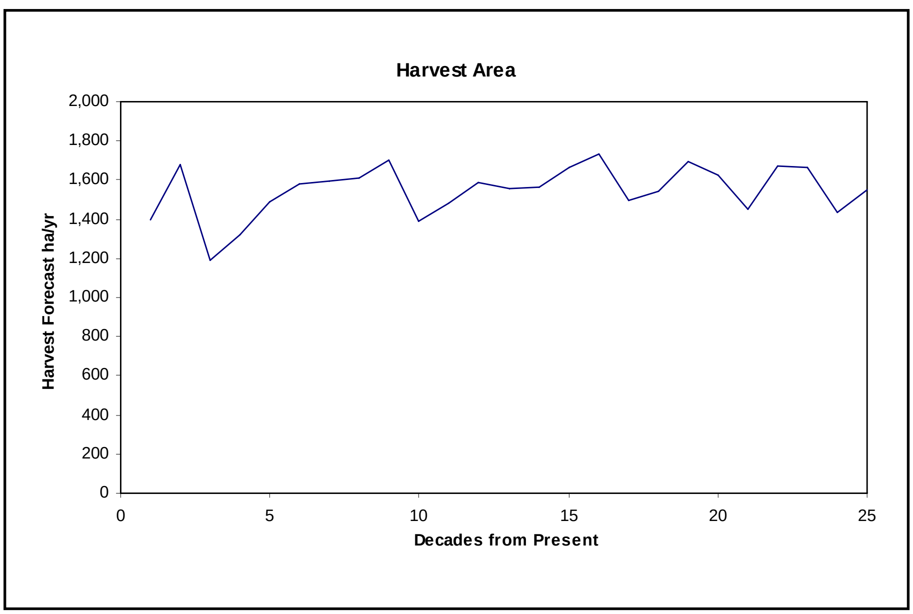


Figure 18 Total harvest area per year for the current practice base case

4.3.3 Age Class Distribution

Figure 19 provides a temporal forecast of the age-class distribution for the TSA in 50 year increments. The present day stand ages are distributed over a wide range of age classes from 0 to 250+ years. Gaps and spikes appear throughout the age classes.

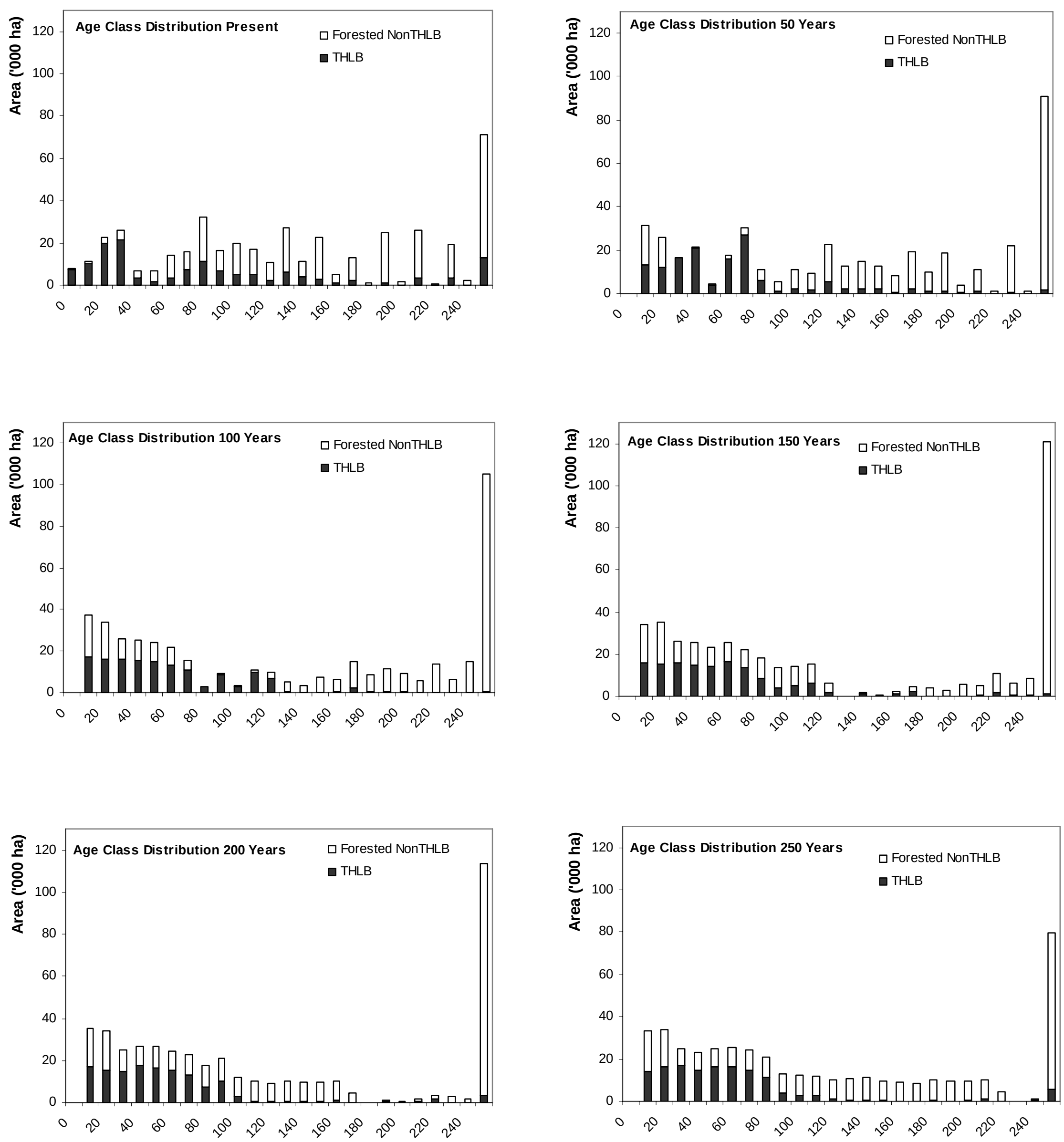


Figure 19 Age class composition of the Golden TSA: six snapshots from the base case

Note: Age classes (X-axis) are 10-year age classes up to 250 years, then all ages greater than 250 grouped together.

The age class distribution of the THLB over time becomes more and more evenly distributed due to harvesting a more-or-less constant number of hectares each year. In the far future the age class distribution of the THLB becomes concentrated within the age classes under 100 years old. These stands are those that are harvested and re-harvested with minimum harvest ages less than 100 years.

In the long term, the modeling of natural disturbances within the non-THLB (NHLB) stands creates a relatively uniform age class distribution as well. The average rate of natural disturbance is approximately 306 years (range of 231 to 395) and so the uniform age class distribution is distributed over ages from 1 to 357+/- years.

4.4 Constraints Analysis

In the analysis, cover constraints are modelled to ensure that non-timber values are represented on the land base. These constraints address issues related to wildlife habitat, biodiversity, and visual quality, etc. This section of the report provides a summary of the cover constraints in the base case, and how the constraints are being met over the 250 year planning horizon.

4.4.1 Landscape Level Biodiversity

Spatial OGMAs (for old seral) and MOGMAs (for mature-plus-old seral) were used in the model to meet biodiversity objectives for the duration of the planning horizon. They act like netdowns during modeling. No harvesting occurs in those stands.

The one exception to OGMAs is the “phased-in” low BEO targets. In low BEO LU-BEC units, only the initial 1/3 of the old seral targets were mapped as OGMAs. The 2/3 and 3/3 targets for the second and third rotations, respectively, had to be applied in the model as percentage older seral retention requirements (in addition to the OGMA no-harvest, 1/3 target reserves). These 2/3 and 3/3 targets (or constraints) maintain the desired level of old growth above that mapped as OGMAs. The success of these constraints in meeting the targets and the level of constraint due to the requirements are shown in Figure 20 to Figure 23.

Figure 20 shows that over the TSA as a whole, in all low BEO areas, that the actual old seral area is generally well above the target old seral.

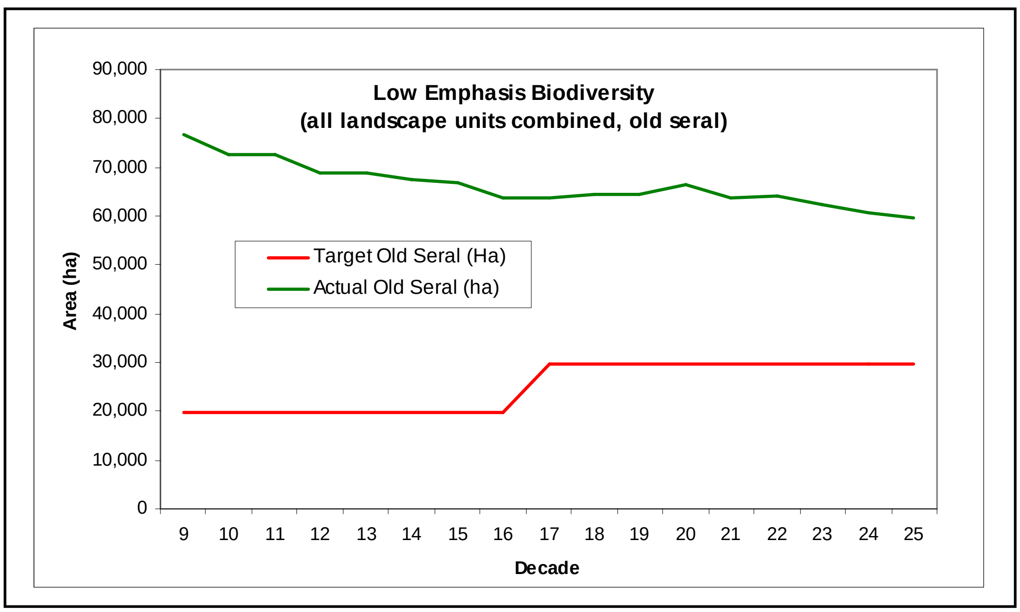


Figure 20 Target and actual old seral within low emphasis biodiversity areas.

Figure 21 (LU G17 ICHmw1) is an example of a unit that shows, in some periods, where the actual old seral just meets the target old seral. Figure 22 (LU G08, ESSFwc2) is an example where the LU-BEC's old seral is always maintained above the target.

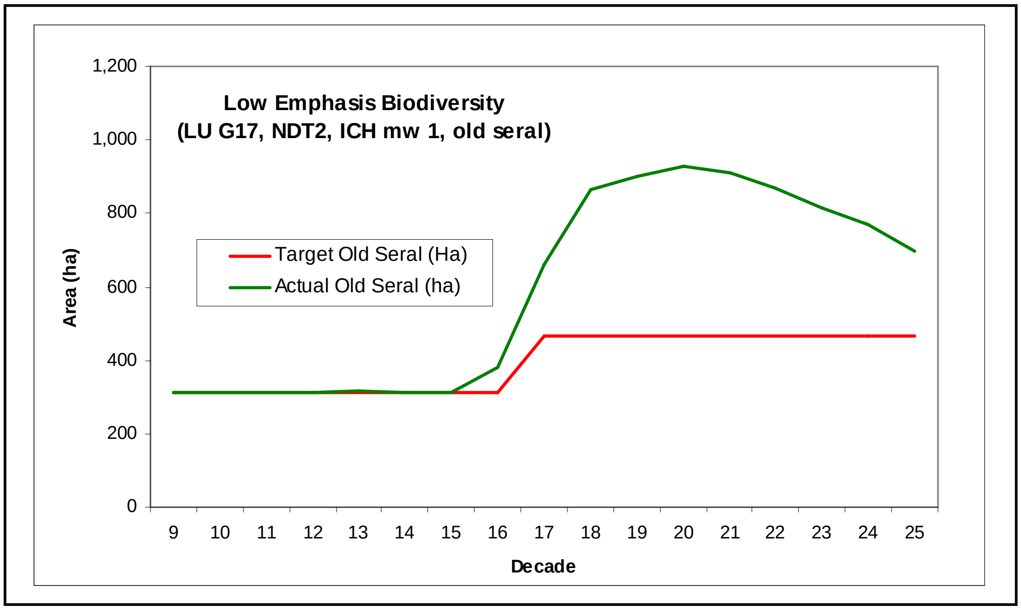


Figure 21 Target and actual old seral within LU G17 ICHmw1

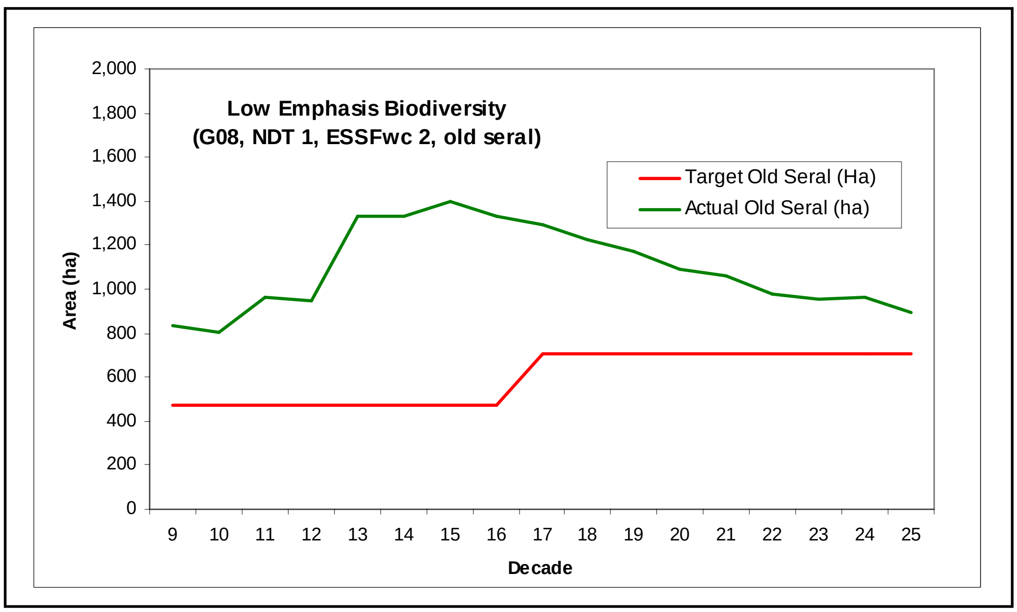


Figure 22 Target and actual old seral with LU G08 ESSFwc2

In general, the low emphasis BEO-type biodiversity old seral requirement is in a "tight situation" in only a relatively small portion of the TSA at any one time (Figure 23). This indicates that the low BEO old seral requirements are not a significant constraint on the timber harvest.

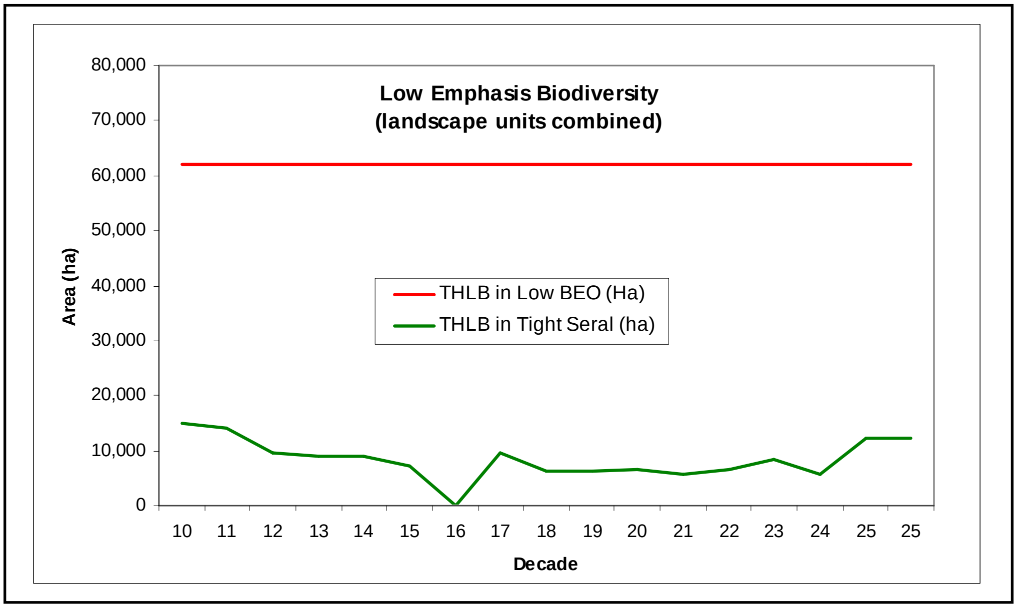


Figure 23 Total area in tight old seral condition – all THLB within all LUs combined

4.4.2 Greenup

The objective of "greenup" is to disperse harvesting across the landscape. Greenup requirements are typically phrased in terms of what conditions must be achieved in one cutblock before an adjacent cutblock can be harvested, for example: "Greenup is achieved when regeneration attains the height of 2 meters."

Modeling of adjacency-type greenup is difficult. One reason is that future cutblock locations cannot be reliably predicted. The surrogate used in this project, which is typical of many TSR projects, was to apply a maximum early seral limit.

Two types of greenup constraints were applied to the THLB area and evaluated at the landscape unit level. These are "IRM" and "ERDZ" greenup. Enhanced Resource Development Zone (ERDZ) type greenup is applied wherever it was mapped in the Kootenay Boundary Higher Level Plan Order (KBHLPO). Wherever ERDZs are not mapped, then Integrated Resource Management (IRM) greenup is applied.

IRM-type Greenup:
In the Golden TSA, the IRM-type greenup (20,036 ha) is more predominant than ERDZ-type greenup (13,319 ha). IRM greenup is applied as "a maximum of 25% of the THLB in the IRM zone can be less than 2.5 m. tall". Examples of IRM greenup conditions are depicted in Figure 24 and *Figure* 25.

In general, the actual young seral is well below the young seral limits, although in some landscape units in some periods the greenup requirements are limiting additional harvesting.

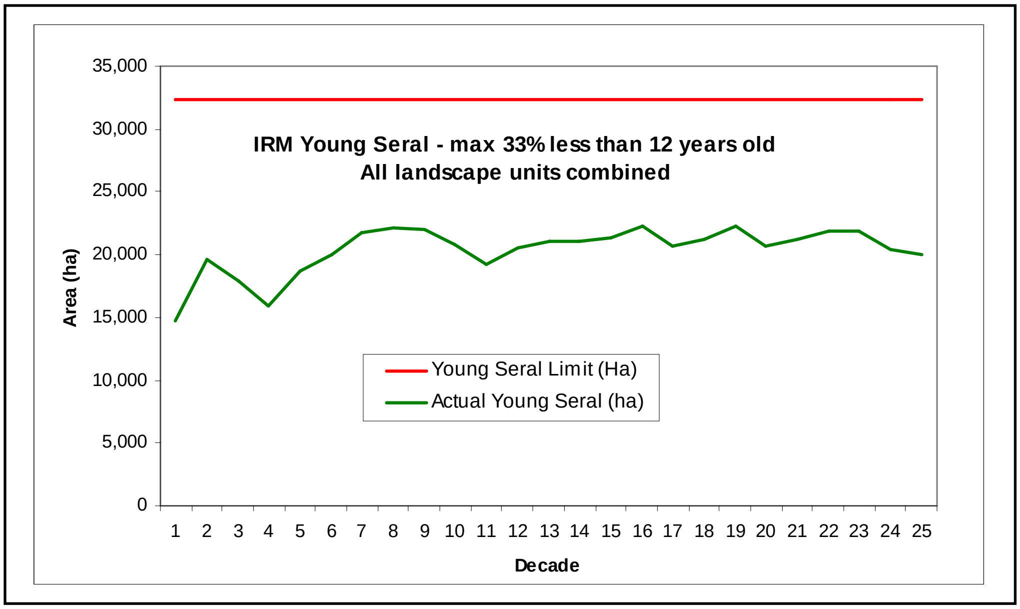


Figure 24 Maximum allowed IRM-type early seral – all LUs combined

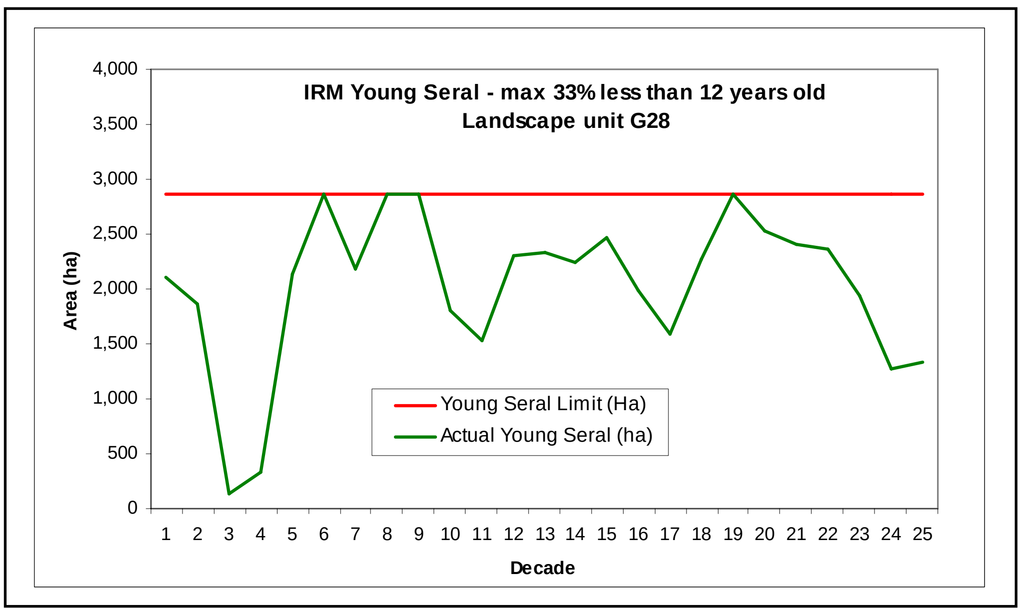


Figure 25 Actual early seral and maximum IRM-type early seral within LU G28

ERDZ-type Greenup:
ERDZ green-up is applied as "a maximum of 33% of the THLB in the ERDZ zone can be less than 2 years old". Examples of ERDZ green-up conditions are depicted in Figure 26 to Figure 28

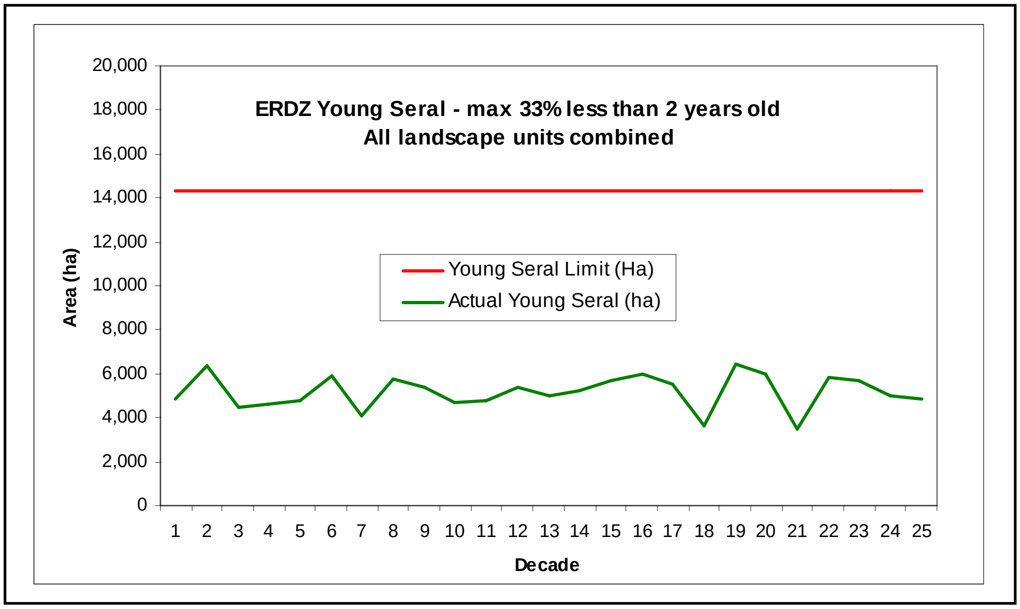


Figure 26 Actual early seral and maximum ERDZ-type early seral within all LUs combined.

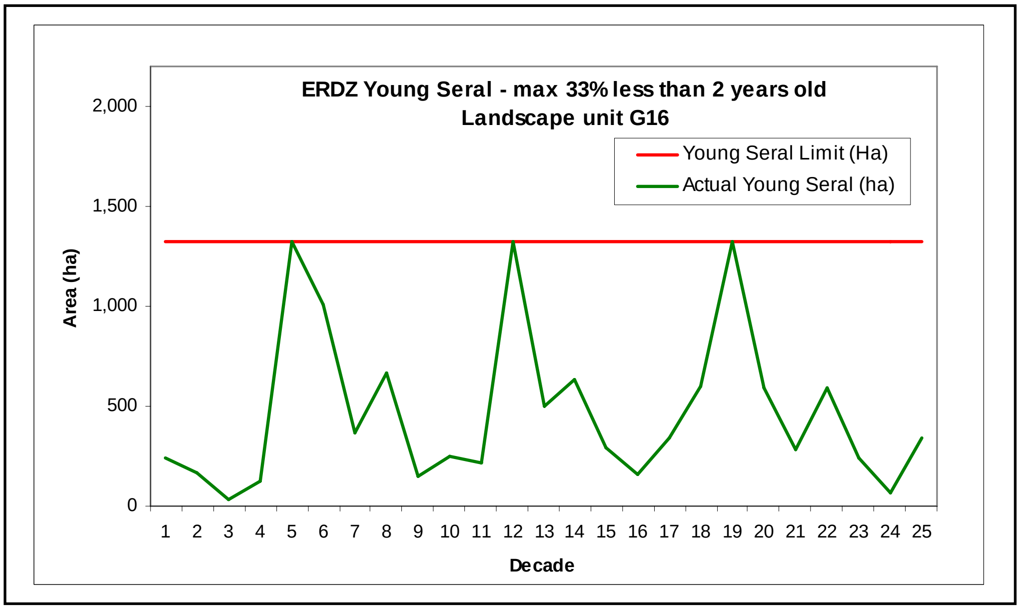


Figure 27 Actual early seral and maximum ERDZ-type early seral within LU G16

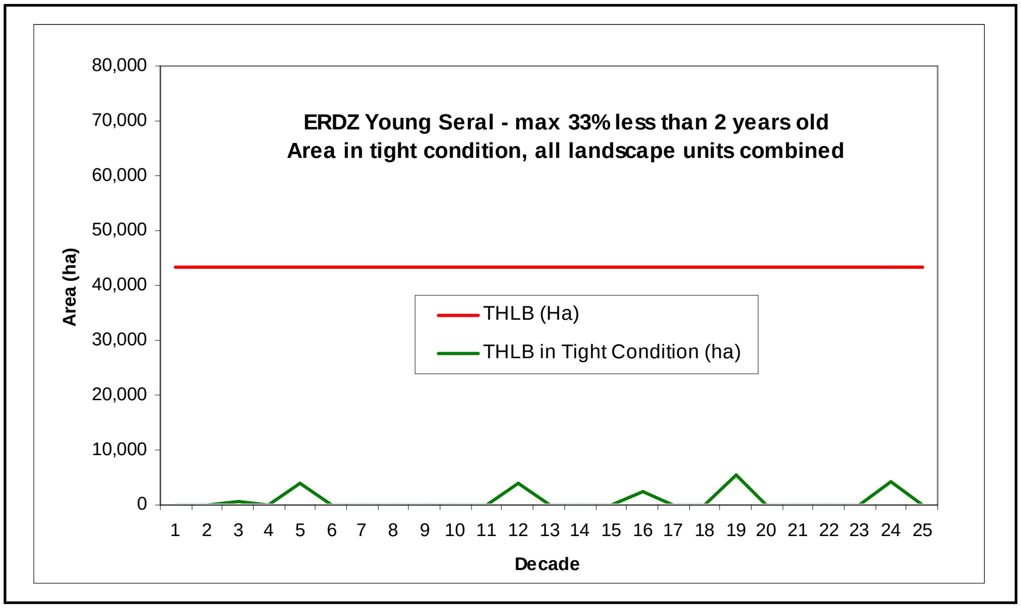


Figure 28 Area of THLB in tight condition associated with the ERDZ early seral requirements.

The charts indicate that IRM-type greenup is a small constraint on timber harvest in some LU's in some periods, and ERDZ-type greenup is a very small constraint on the timber harvest.

4.4.3 Ungulate Winter Range

Ungulate winter range (UWR) has both maximum early seral and minimum older seral requirements. These requirements vary by UWR habitat type (see Table 3).

<u>UWR early seral</u>
UWR early seral is evaluated across all the crown forest landbase within all UWR habitat types within each landscape unit. The UWR early seral requirement is always "a maximum of 30% in stands less than 21 years old". Figure 29 and Figure 30 are examples of early seral forest conditions within the UWR.

Figure 29 shows that within all the UWR combined, the early seral limits are being met, i.e. they are not being exceeded. Early seral limits in some habitat-types and LUs are tight, however, as seen in Figure 30.

The conclusion is that UWR early seral limits are likely constraining the harvest level to a small degree.

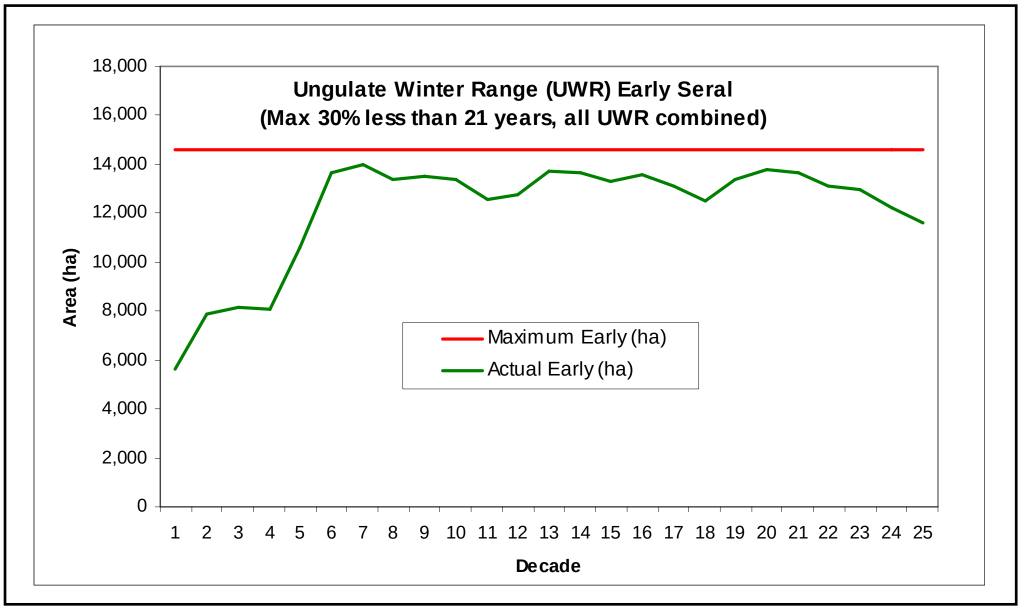


Figure 29 Existing and maximum UWR early seral limit for all LUs combined.

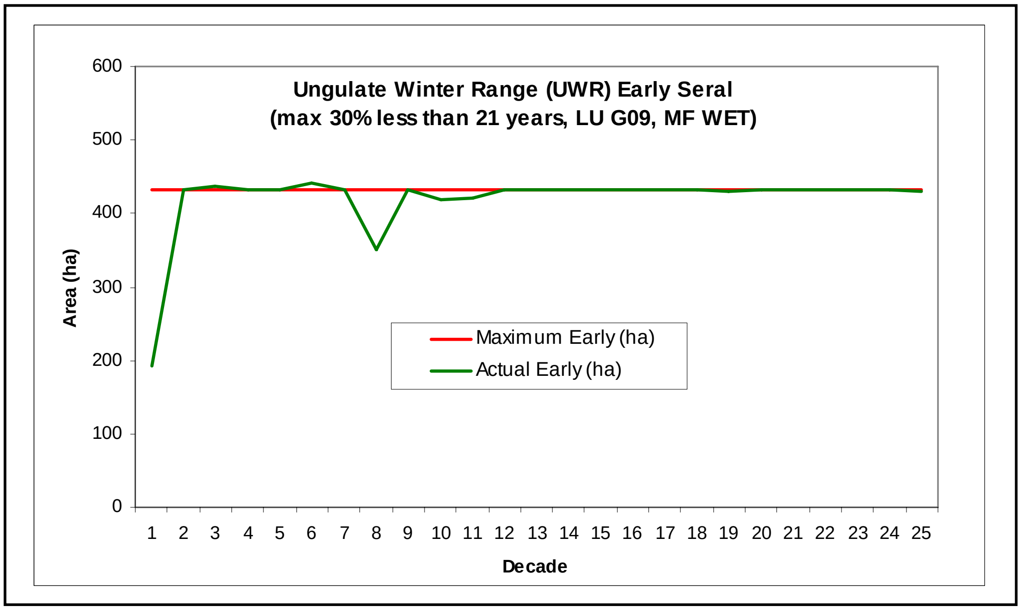


Figure 30 Existing and maximum UWR-early seral limit for LU G09, wet-type UWR.

<u>UWR mature seral (60 years)</u>
Minimum older seral requirements also pertain to ungulate winter range. Depending on habitat type, some requirements are for older seral over 60 years old, and some for over 100 years old (Table 3). The following are examples of older seral conditions in both the 60 and 100 year habitat types.

Figure 31 shows that in general, across all the habitat types with 60 year old seral requirements, that the older seral requirement is being met. However, in some habitat types and LUs, for some periods, conditions are "tight" as in the Managed Forest Wet habitat type in LU G16 (Figure 32, decades 12 to 25).

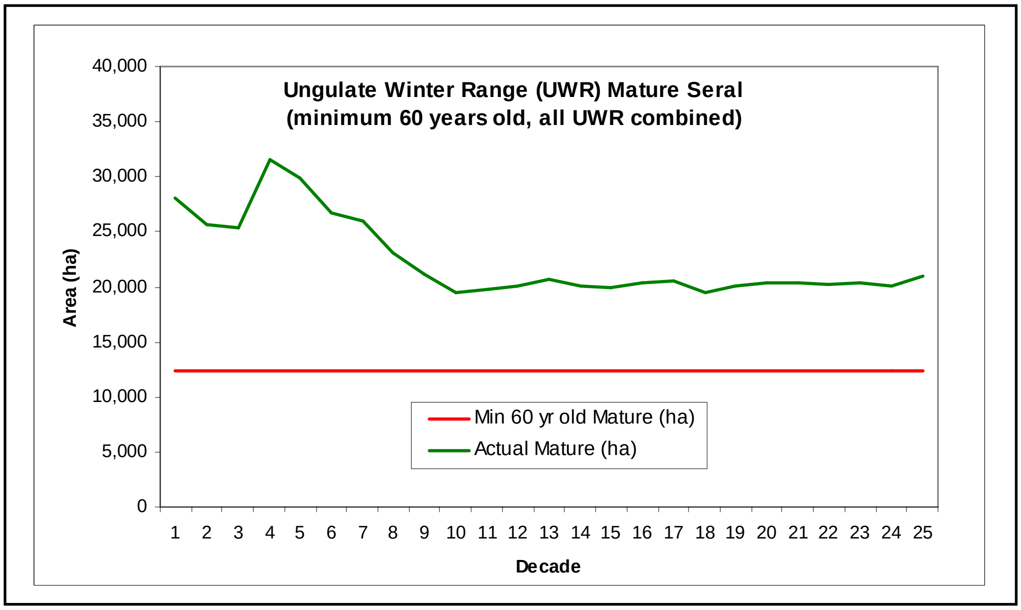


Figure 31 Existing mature and UWR-type mature seral target for all UWR combined.

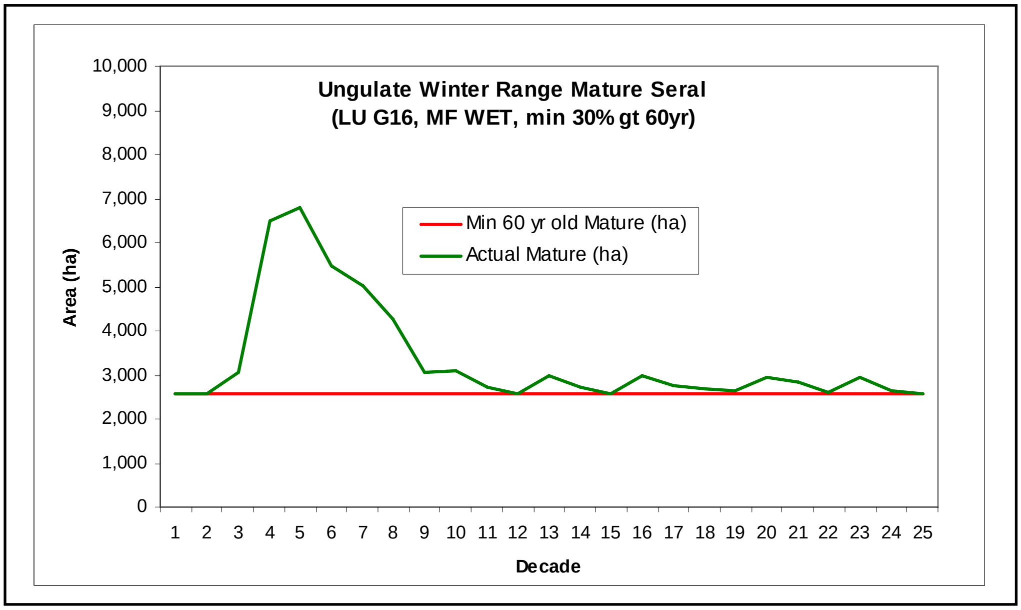


Figure 32 Existing mature and UWR-type mature seral target for LU G16, MF wet-type UWR.

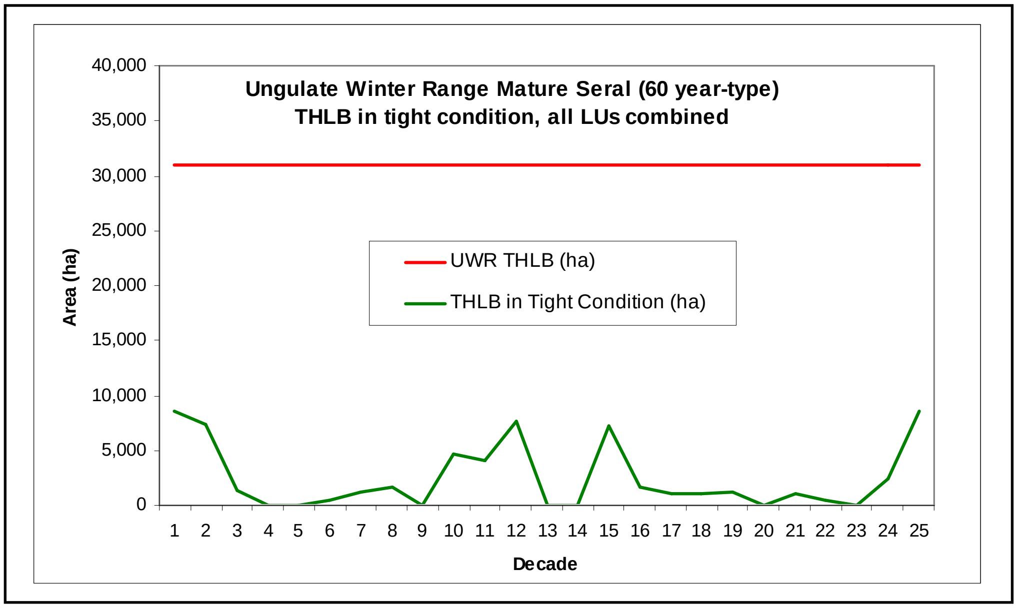


Figure 33 THLB in tight condition due to 60 year old UWR seral requirement, all UWR combined

<u>UWR mature seral (100 years)</u>

Very similar trends are seen in the 100 year old type UWR seral units (Figure 34, Figure 35). The small area in "tight" conditions leads to the conclusion that the UWR 100-year old type seral requirement is a minor constraint on the timber harvest.

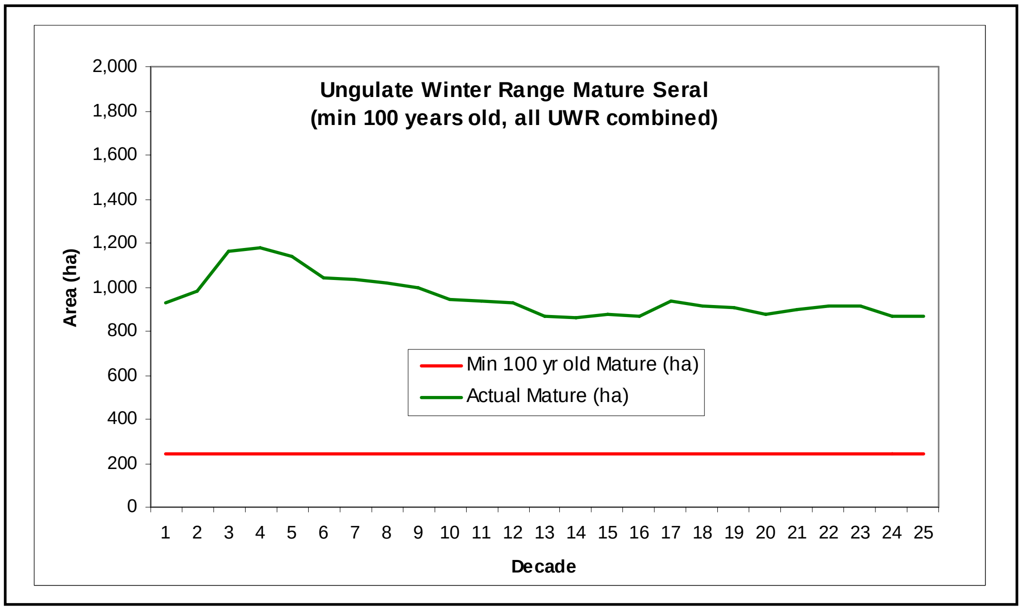


Figure 34 Existing mature and UWR-type mature seral target for all UWR combined

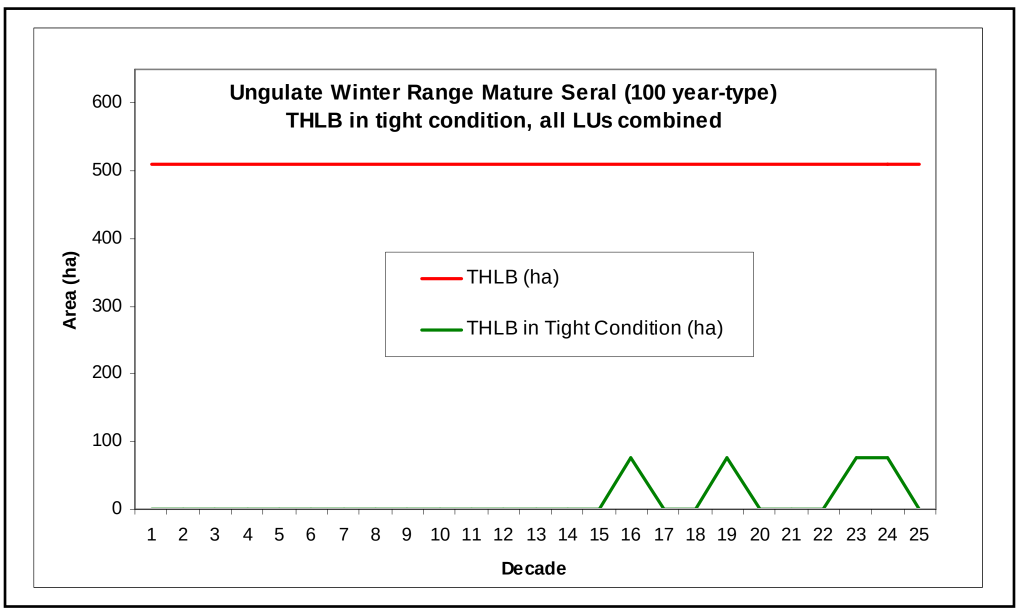


Figure 35 THLB in tight condition due to 100 year old UWR seral requirement, all UWR combined

The charts indicate that both the UWR early seral limit and the UWR 60-year type older seral requirement are a small constraint on the timber harvest. The 100-year type UWR older seral requirement is a very small or insignificant constraint on the timber harvest.

4.4.4 Visual Quality Objectives

Visual Quality Objectives (VQO) were implemented as maximum disturbance constraints (i.e. in the same manner as greenup constraints). Figure 36 shows that as the planning horizon progressed, a large portion of the VQO constraint area was pushed up to threshold levels. Note that the actual young seral area rises slightly above the young seral limit due to harvesting raising the early seral close to the VQO limit and then, after harvesting stops, the random disturbances within the NHLB sometimes push the early seral slightly beyond the limit. Of the 20,000 hectares of THLB covered by VQO's, a substantial portion is in "tight" conditions from the 7th decade onwards (*Figure* 37). The conclusion is that VQO's are a significant factor in restricting harvesting in the mid- and long-term portions of the planning horizon.

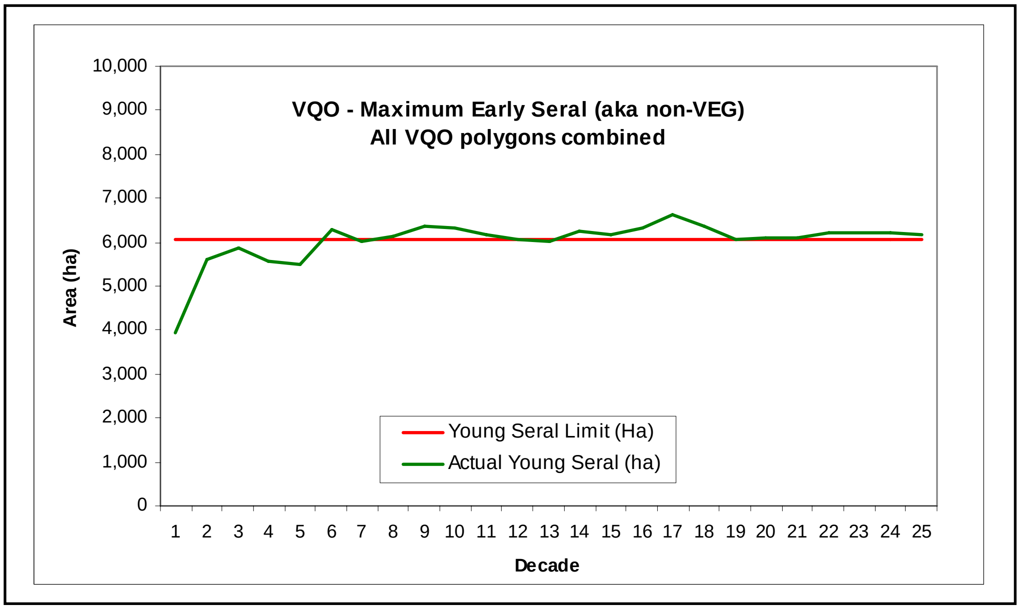


Figure 36 Existing early seral and VQO-type early seral limit for all VQO classes combined

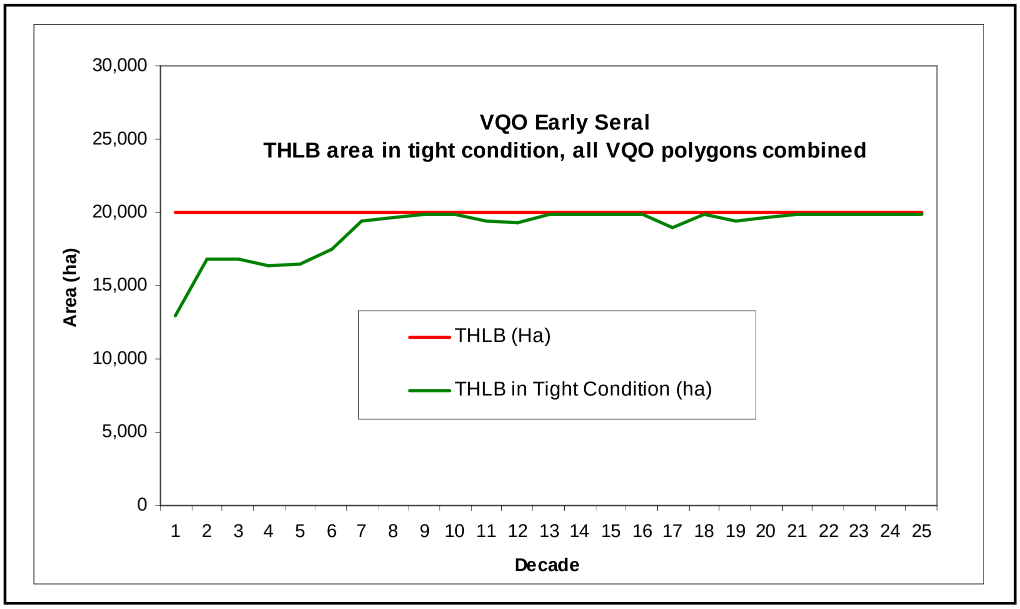


Figure 37 THLB in tight condition associated with all VQO classes combined

4.4.5 Domestic Watersheds

Domestic watershed requirements were implemented as streamside reserves and thus they act like netdowns during modeling (see the summary of land base netdowns in Table 2). No harvesting occurs within those reserves.

4.4.6 Overall Timber Availability

A “timber availability” chart illustrates when timber harvesting options are constrained in the model for all the constraints (or limits) combined. *Figure* 38 illustrates the trend in harvest availability over time for the base case scenario. The availability shown in the chart does not represent a potential harvest flow - it identifies the slack in the system or, the total volume available for harvest in any particular decade assuming the harvest flow was followed for all prior periods. In other words, as an example, if the harvest in decade 6 was increased so that all the available timber in decade 6 was harvested, then all or most of the slack in decade 7 would likely disappear.

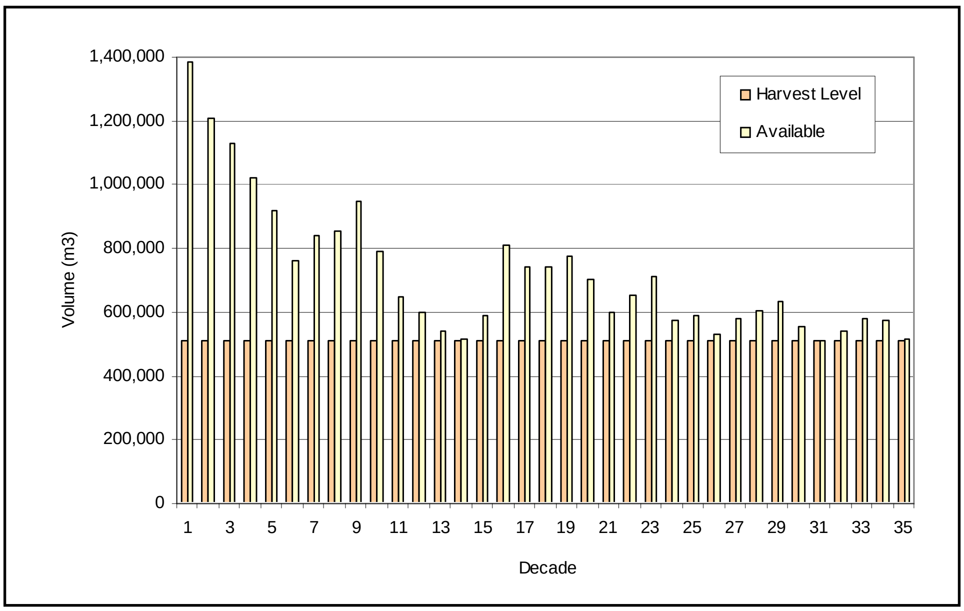


Figure 38 Periodic harvest availability for the Base Case

Periods 13 and 14, 26, 31 and 35 are all ‘pinch points’ that control or limit the harvest throughout portions of the planning horizon. The available wood supply has to be “metered out” prior to each of these pinch points. Each pinch point is a point in time when the available timber is essentially depleted. Once the model passes though the pinch-point the harvest level might be increased to a higher level, barring other pinch points further in the future. The multiple pinch points seen in Figure 38 indicated that the short- and mid-term harvest is controlled by the pinch points in decades 13 and 14, and the long-term harvest level is largely controlled by the pinch points in decades 30+.

4.5 Base Case Differences from the Last Analysis

Relative to the last analysis (TSR3) the Base Case presented here shows an increased harvest forecast. This section summarizes and explains, where possible, the differences between the harvest flows. More details on the different inputs and assumptions included in the two analyses can be found in the previous sections. Of note, the AAC was set after the last, TSR 3 analysis at 485,000 m3/yr.

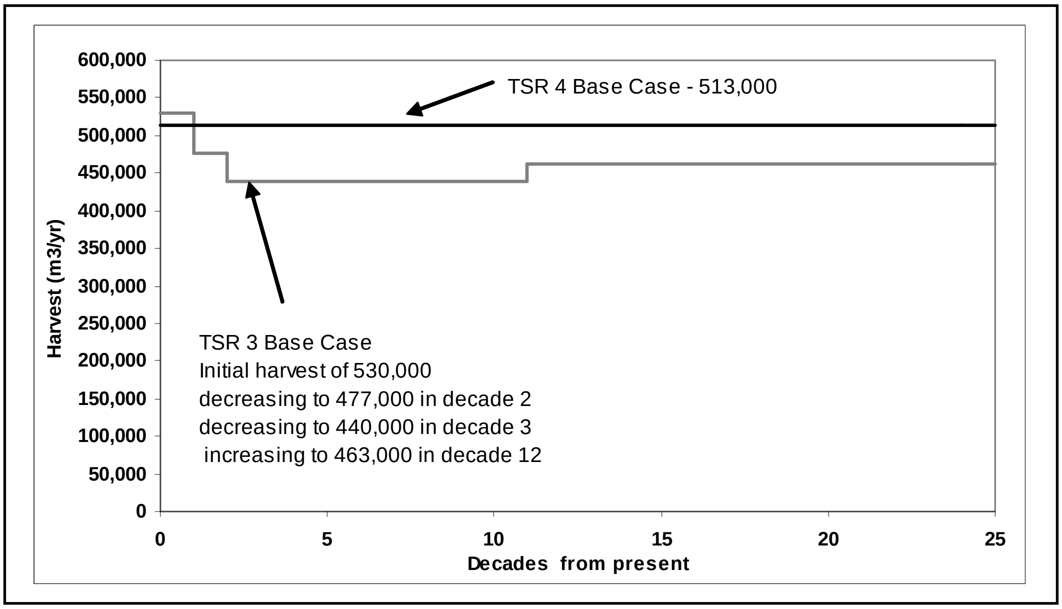


Figure 39 Golden TSA TSR3 Base Case and TSR4 Base Case Harvest Flow

Comparisons made below are made relative to the TSR3 Base Case shown in *Figure* 39. Note that time zero in the TSR 3 Base Case is actually 5 years (one half decade) earlier than time zero in this analyses' Base Case Option (TSR4) although the graph presents them both using 2008 as time zero.

The most significant similarities and differences between TSR 3 and TSR 4 are summarized in tables of the input data (Table 5), netdowns and net landbase statistics (Table 6), management assumptions (Table 7), modeling assumptions (Table 8), and yield curve assumption (Table 9).

Table 5 TSR3 versus TSR 4 – Input data

Input data	TSR3	TSR4
VRI	VRI projected to January 2003 No volume adjustment factors (VAF) were applied	VRI projected to January 2008, applied VDYP6-version VAF's
Operability	2002 version	updated, 2007 version (the 2002 version after updates by the forest licensees)
Ownership	Taken from the Inventory Branch fc1 files, slightly more non-Crown, landbase reduction due to the exclusion of recreation reserves.	A composite using LRDW data.
ESAs	FC1 data, used as the basis of slope stability netdowns	New, composite TSIL map for the majority of the unit, used ESAs on a small portion without TSIL data
Caribou maps	(draft) HLPO version map	Spatially mapped reserves equating to the 2007-version HLPO caribou requirements
SARCO caribou map	none	Spatially mapped reserves
Harvested cutblocks	licensee data as of 2001 FDP mapping	Licensee in-house data as of end-2007
Current roads	TRIM data, updated using 1996 air photos, NP buffers around roads excluding highways, secondary roads and trails	TRIM and Licensee data circa 2007, NP buffers around roads including highways and secondary roads, excluding trails.
Riparian reserves and management areas	Stream class map derived from the watershed atlas (1:50,000 scale), incorporated field classified streams	Stream class map derived from the LRDW stream network data (1:20,000 scale),incorporated field classified streams

Table 6 TSR 3 versus TSR 4 – landbase netdowns and net landbase

Netdowns and net landbase statistics	TSR3	TSR4
Area analyzed	1,185,000	1,184,611
Netdowns	TSR3 definitions	Essentially the same as the TSR3 definitions
Productive landbase (CFLB) with Parks and protected areas and non-Crown ownership excluded	351,450	344,450
Net current THLB	153,870	141,530
Net future THLB	147,252	138,363
Future roads	6,618 ha (3% yield curve reduction)	2,516 ha (1.78 % yield curve reduction)
WTP netdown	8,982 ha (all from current THLB)	2195 ha (1,543 from current THLB, 652 from future THLB)
Non-vegetated unproductive netdowns	VRI based (eg land cover codes)	True VRI-type 'VRI': same netdowns as TSR3, FIP-type 'VRI': FIP-type netdowns
Biodiversity spatially mapped reserves	0	9,910
Caribou spatially mapped reserves	0	8,348

Table 7 TSR 3 versus TSR 4 – management assumptions

Management assumptions	TSR3	TSR4
Biodiversity Emphasis Options	HLPO version	HLPO version
Biodiversity management	Old and mature-plus-old seral percentages	Spatially mapped reserves.
Caribou Management	HLPO (draft,2002) forest cover requirements	Spatially mapped reserves
SARCO caribou reserves	None	Spatially mapped reserves
Domestic watersheds	TSR2-type assumptions, max 25% under 6 meters	Spatial reserves around streams above water intakes, as per HLPO specifications
UWR	HLPO version UWR,	PEM-based UWR, draft
VQOs MoF District map	Early seral percentages for each VQO class	Early seral percentages varied by slope, viewing distance and VQO class.
ERDZ map and requirements	HLPO version	HLPO version

Table 8 TSR 3 versus TSR 4 – modelling assumptions

Modeling assumptions	TSR3	TSR4
Timber license reversions	189 ha	none
Disturbance of the inoperable, based on Biodiversity Guidebook NDT types	370 ha/year	930 ha/yr
Harvesting	Clear-cut and partial-cut	Clear-cut only
Harvest scheduling priorities	CP areas highest priority, first entry for partial cutting (F,S,Pine) second, Spruce & cedar next, Fir & pine in south next, other species and geographic areas, final partial cut entry last	Pl-types highest priority (max 70% of the harvest), Fd types next priority, Other species last priority
Woodlots	All excluded, boundaries of 2002	All excluded, boundaries of 2007 (different from 2002)
Non-recoverable losses	7,627 m3/yr	7,627 m3/yr (same)
Biodiversity old and mature-plus-old seral requirements	applied	not applied
Caribou older seral requirements	applied	not applied

Table 9 TSR 3 versus TSR 4 – yield curve assumptions

Yield curve assumptions	TSR3	TSR4
Analysis unit definitions	TSR3 definitions	TSR3 definitions with the addition of AUs for existing managed stands.
Yield curve development	A detailed methodology was not stated.	Cannot cannot compare to TSR3
Yield curve software	VDYP6 (natural) and TIPSY (managed stands), VAF's not applied	VDYP6 (natural) and TIPSY (managed stands), VAF's applied
Yield curves	Generally lower volumes, higher MHAs than TSR4	Generally higher volumes, lower MHAs than TSR3
Regeneration assumptions	2 year regen delay, 100% planted, higher percentages of Fd than TSR4	2 year regen delay, 100% planted, higher percentages of Sx than TSR3
Genetic gain	It is not clear which values were used in the managed stand curves. It is assumed the maximum values were: Fd (14.74), Pl (9.93), Sx (21.13)	Existing managed stands: Sx(2.9), Pl (0.3), Lw (1.6), Fd(0) and Future managed stands: Sx (20.8), Pl (12), Lw (20), Fd (21.1)

Based on past experience, the factors that most influenced the timber supply in an upwards or downwards direction are:

<u>Downward pressures on TSR4 base case timber supply relative to TSR3</u>

The lower net, current THLB landbase: 141,530 ha in TSR4 versus 153,870 ha in TSR3.
Biodiversity old and mature-plus-old reserves (landbase netdowns): 9,910 ha in TSR4 versus 0 ha in TSR3
Caribou reserves (landbase netdowns): 8,348 ha in TSR4 versus 0 ha in TSR3
Higher disturbance rate in the NHLB: 930 ha in TSR4 versus 370 ha in TSR3

<u>Upward pressures on TSR4 Base Case timber supply relative to TSR3</u>

Future roads netdown: 2,516 ha in TSR4 versus 6,818 ha in TSR3
WTP netdown: 2,195 ha in TSR4 versus 8,982 ha in TSR4
Biodiversity forest cover requirements: not applied in TSR4, applied in TSR3
Caribou forest cover requirements: not applied in TSR4, applied in TSR3
Genetic gains: higher in TSR4 compared to TSR3, higher percentages of Sx regeneration (with a higher genetic gain) assumed in TSR4 than in TSR3
Yield curves: generally higher in TSR4 than in TSR3, lower minimum harvest ages in TSR4 than TSR3
HLPO-type UWR in TSR 3, PEM-type UWR in TSR 4.

4.6 Base Case Sensitivity Analyses

The data and assumptions used in any timber supply analysis are often subject to uncertainty. To provide perspective on the sensitivity of changes to modeled assumptions, sensitivity analyses are commonly performed. Typically only one variable (data or assumption) from the information used in the base case is changed in order to explore the sensitivity of that variable. Sensitivity analyses help to frame the potential impacts of uncertainty by analyzing scenarios that are more pessimistic and more optimistic than the base case. The sensitivities listed in Table 10 were performed on the base case and the results are presented below.

Table 10 Base Case sensitivity analyses

Sensitivity analysis	Zone/ group / analysis unit subject to uncertainty	Suggested Changes in Sensitivity Run
Size of THLB	Timber Harvesting Land Base (THLB)	The timber harvesting land base will be increased and decreased by +/– 10%. The NHLB is decreased or increased by the same area (hectares) so that the total area of productive forest remains the same.
Managed Stand Yields	Managed Stands (200, 500 and 600 series AU's)	The volume associated with managed stand yield curves will be increased and decreased by +/- 10%.
Natural Stand Yields	Natural Stands (100 series AU's)	The volume associated with natural stand yield curves will be increased and decreased by +/- 10%.
Minimum Harvest Ages (+/- 10yrs)	All Stands	Minimum harvest ages will be increased and decreased by +/- 10 years.
Minimum Harvest Ages (95% MAI only)	All Stands	Minimum harvest ages will be based only on achieving 95% of maximum mean annual increment versus all the merchantability criteria.
Minimum Harvest Ages (Merch criteria only)	All Stands	Minimum harvest ages will be based only on reaching the minimum volume criteria versus all the merchantability criteria.
Regeneration Delays	Future Managed Stands	Regeneration delays increased by two years to 4 years, and decreased by one year to 1 year.
Use of Select Seed.	Future Managed Stands	No gains applied to future managed stands (no select seed use).
VQOs turned down one class	All VQO polygons	VQO polygons with class R (retention) were down-classed to PR (partial retention), PR to M, M to MM, etc.

4.6.1 Size of Timber Harvesting Land Base

Several factors that determine the size of the THLB have uncertainty around their definitions (operable area, problem types, low sites, riparian management, impacts from trails and landings, etc). Different market conditions in the future or changes in harvesting or milling technology can also serve to reduce or expand the land base considered to be economical.

The timber harvesting land base in the Golden TSA has changed significantly since the last analysis. A recent review of the operability lines, for example, fine tuned the mapping for the Golden TSA just prior to this analysis. It is not known if the THLB used in this analysis is over or under-estimated, so two sensitivity runs have been completed. These runs increase and decrease the size of the THLB by 10%.

Methodology

Run	How was it analyzed?
Timber harvesting land base + 10%	The modeled size the THLB was increased by 10%. The non-THLB area was reduced proportionately so that the total productive forest landbase remained the same.
Timber harvesting land base - 10%	The modeled size of the THLB was decreased by 10%. The non-THLB was increased proportionately so that the total productive forest landbase remained the same.

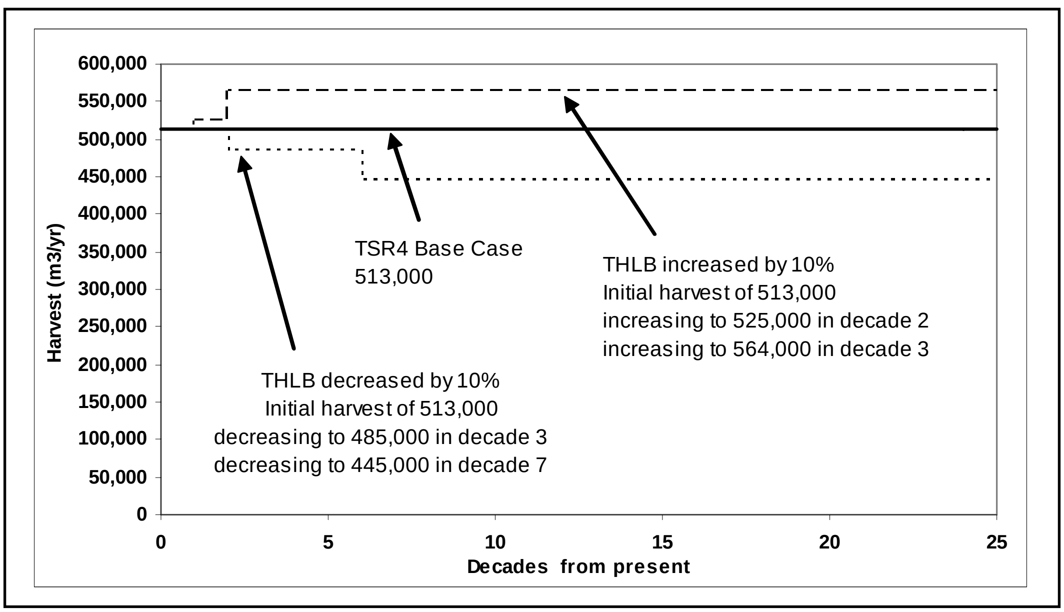


Figure 40. Timber harvesting land base increased and decreased by 10%

Results

Run	Short Term	Mid Term	Long Term
Timber Harvesting Land Base + 10%	The Base Case Option harvest level of 513,000 m3/yr is increased to 525,000.	Increased by 9.9 %.	Increased by 9.9 %
Timber Harvesting Land Base - 10%	The Base Case Option harvest level of 513,000 m3/yr is maintained (no change).	Decreased by 8.1 %.	Decreased by 13.3 %

The impacts are on both the existing natural stands (hence the short term wood supply is impacted) and the managed stands (hence the long term harvest level is impacted).

4.6.2 Yields from Natural and Managed Stands

Stand yields are a critical input into timber supply analysis. The short and mid-term timber supply is heavily influenced by the availability of timber in natural stands that make up the current growing stock. The current standing and mature timber provide all of the timber harvesting opportunities before managed stands come online for harvest. Figure 14 indicated that the harvest of natural stands diminishes very quickly by the 6th decade, at which time managed stands are the greater part of the timber harvest profile.

Uncertainty in timber yields can result from many different factors. Natural stand yields are based on the VDYP yield model, which predicts yields from stand attributes in forest inventory maps. Inaccuracies in the model, in decay estimates, or stand attributes can create uncertainties around actual stand yields. Managed stand yields are based on the TIPSY growth model, which predicts yields from estimates of site index, and stand attributes such as species, density, and expected gains from planting stock grown from select seed. The over or under estimation of any of these factors can lead to uncertainties in the yields of these future stands.

Methodology

Run	How was it analyzed?
Natural Stands + 10%	The yield associated with each natural stand analysis unit was increased by 10%. MHA's were adjusted to align with the new curves.
Natural Stands - 10%	The yield associated with each natural stand analysis unit was decreased by 10%. MHA's were adjusted to align with the new curves.
Managed Stands + 10%	The yield associated with each existing managed and future managed stand analysis unit was increased by 10%. MHA's were adjusted to align with the new curves.
Managed Stands - 10%	The yield associated with each existing managed and future managed stand analysis unit was decreased by 10%. MHA's were adjusted to align with the new curves.

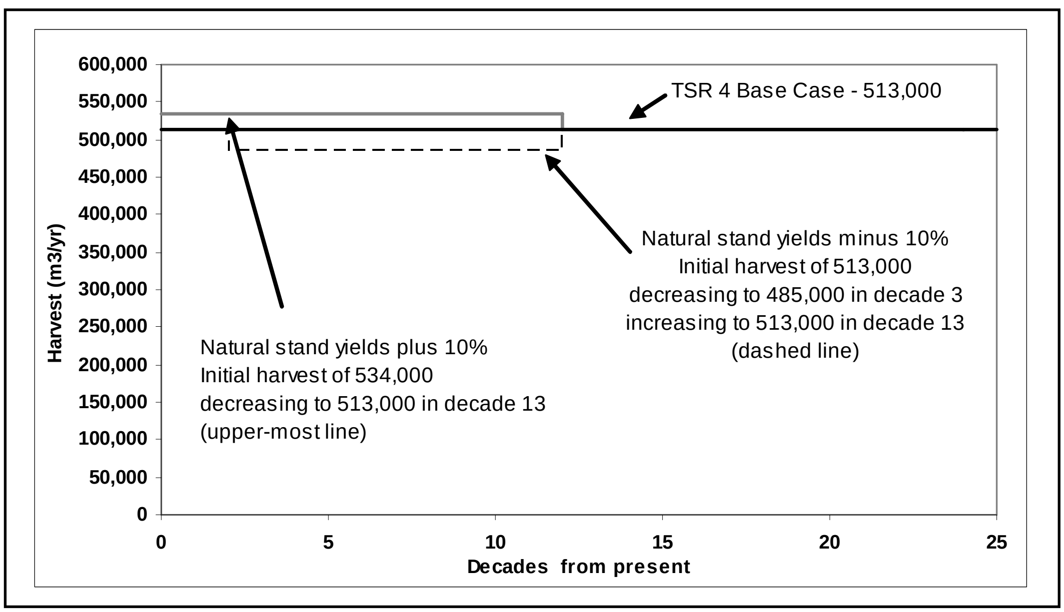


Figure 41. Natural stand yields increased and decreased by 10%

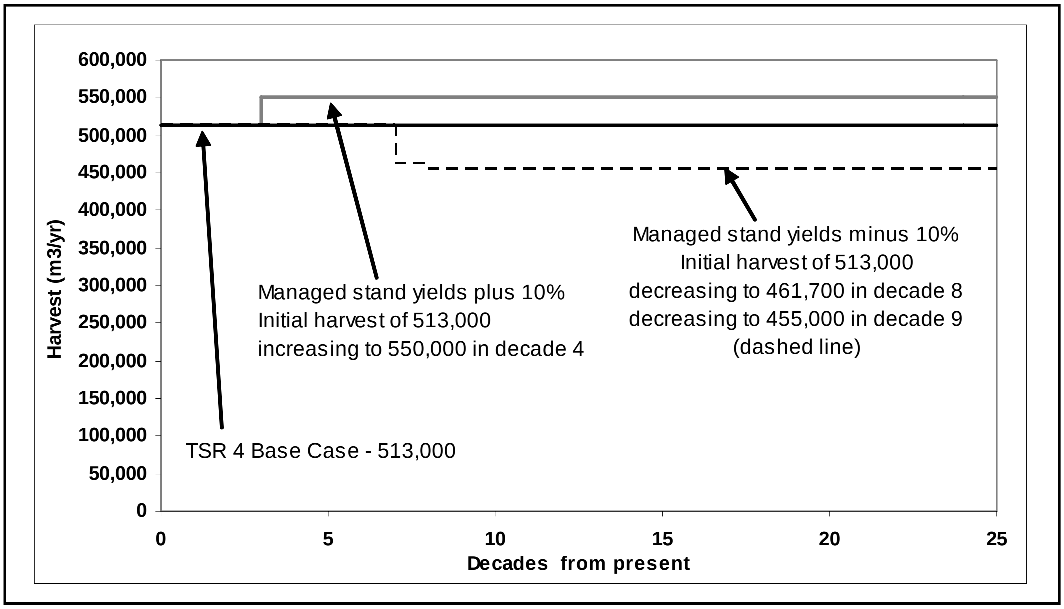


Figure 42. Managed stand yields increased and decreased by 10%

Results

Run	Short Term	Mid Term	Long Term
Natural Stands +10%	The Base Case Option harvest level of 513,000 m3/yr is increased to 534,000 m3/yr.	Increased by 4.1%	Increased by 1% (no change after decade 13)
Natural Stands - 10%	The Base Case Option harvest level of 513,000 m3/yr is maintained (no change).	Reduced by 5.5 %	Decreased by 1.3 %
Managed Stands + 10%	The Base Case Option harvest level of 513,000 m3/yr is maintained (no change).	Increased by 6.0 %	Increased by 7.2 %
Managed Stands - 10%	No change.	Reduced by 1.7 %	Reduced by 11.3 %

Changes to natural stands yields have significant impacts on the length of time the current AAC can be maintained because it is this stock of existing volume that must be metered out until managed stands come online in significant volumes.

Changes to managed stand yields usually have no impact in the short term but do have significant impacts in the long term. The scale of the impact is almost directly proportional with the over/under estimation of volume.

4.6.3 Minimum Harvest Ages

Uncertainty around the age that stands become merchantable for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions that will define merchantability (markets / products). The large majority of minimum harvest ages used in the base case scenario were based on achieving 95% of the stands maximum mean annual increment (MAI). This age almost always delivered the minimum stand and log requirements, i.e. minimum volume per hectare (vol/ha), and average diameter at breast height (dbh). These latter economic criteria occasionally did push the harvest ages higher. It is important to note that minimum harvest ages are only meant to approximate the time when a stand first becomes merchantable, and that harvesting can and does occur well beyond these ages in the model.

The use of minimum harvest ages associated with maximum mean annual increment (MAI) tends to optimize long term harvest levels, but also allowing stands to be harvested at the minimum harvest age set, provides flexibility in the transition from short term to long term harvest levels. The transition from short- to mid-term harvest levels in the Golden TSA is heavily influenced by when managed stand volumes become available in significant quantities. It is unknown if there are more appropriate minimum harvest ages than those used in the base case, so sensitivity runs have been completed to explore the impact of both higher and lower ages.

Methodology

Run	How was it analyzed?
Min Harvest Ages decreased by 10yr	Minimum harvest age for each analysis unit (AU) was decreased by 10 years.
Min Harvest Ages increased by 10yr	Minimum harvest age for each AU was increased by 10 years.
Min Harvest Ages based on mai	Minimum harvest age was based only on achieving 95% of maximum m.a.i.
Min Harvest Ages based in minimum volume	Minimum harvest age was based only on achieving the minimum merchantable volume.

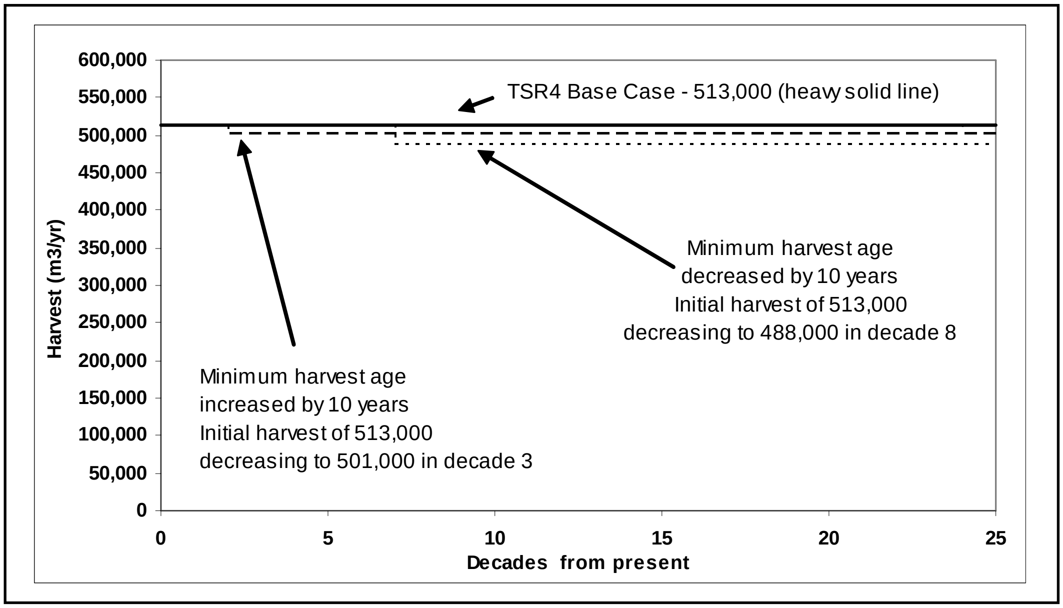


Figure 43. Minimum harvest ages increased and decreased by 10 years

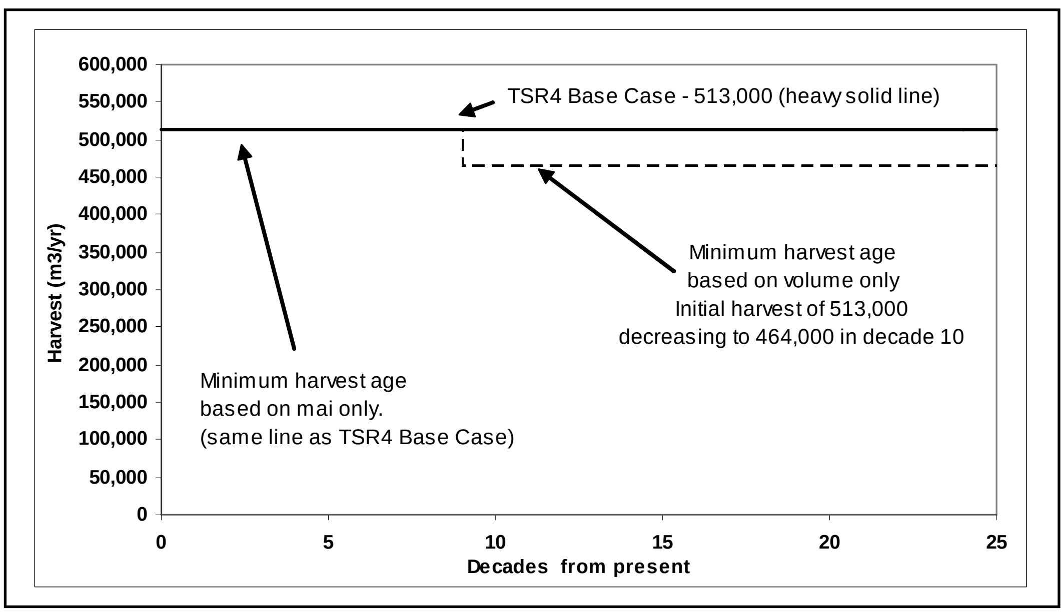


Figure 44. Minimum harvest ages based on mean annual increment and minimum volume

Results

Run	Short Term	Mid Term	Long Term
Min Harvest Ages increased by 10yr	The Base Case Option harvest level of 513,000 m3/yr is maintained (no change).	Decreased by 2.3 %	Decreased by 2.3 %
Min Harvest Ages decreased by 10yr	No change.	Decreased by 0.8 %	Decreased by 4.9 %
Min Harvest Ages based on 95% of maximum m.a.i.	No change.	No change.	No change.
Min Harvest Ages based in minimum volumes	No change.	No change.	Decrease by 9.0 %

The base case forecast is sensitive to both increases and decreases in minimum harvest ages. Increased harvest ages reduce the availability of stands in the mid- and long-term more than they increase the long-term harvest level by forcing stands to be harvested closer to culmination age.

Decreases in the minimum harvest age theoretically result in additional flexibility in the transition from short- to mid-term harvest levels because more managed stand volume is available earlier. However, the harvest priorities (such as pine versus other species) force the model to choose these priority stands much earlier than their culmination of mean annual increment (CMAI). This movement away from harvesting at CMAI is so significant that it results in a significant decrease in both the mid- and long-term harvest level.

Basing minimum harvest ages on minimum volume criteria resulted in a reduction in minimum harvest ages for many analysis units as the majority of the MHA were originally based on mean annual increment. These younger ages resulted in further movement away from culmination ages and a large decrease in the long-term harvest level.

Basing minimum harvest ages on 95% of MAI alone resulted in no significant change because most analysis units' harvest ages were already based on this criterion.

4.6.4 Regeneration Delays

Regeneration delay is the length of time between timber harvesting and stand re-establishment. Regeneration delays can influence harvest forecasts by impacting the length of time that it takes to meet green-up requirements and/or minimum harvest ages.

In the base case, stands have been assigned a 2 year regeneration delay. This sensitivity examines the risk of taking 4 years to regenerate stands, or the opportunity of shortening the delay to 1 year.

Methodology

Run	How was it analyzed?
Decreased regeneration delay.	Analysis units in the base case were changed from a 2 year regeneration delay to a 1 year delay. TIPSY minimum harvest ages were adjusted to align with the new curves.
Increased regeneration delay.	Analysis units in the base case were changed from a 2 year regeneration delay to a 4 year regeneration delay. TIPSY minimum harvest ages were adjusted to align with the new curves.

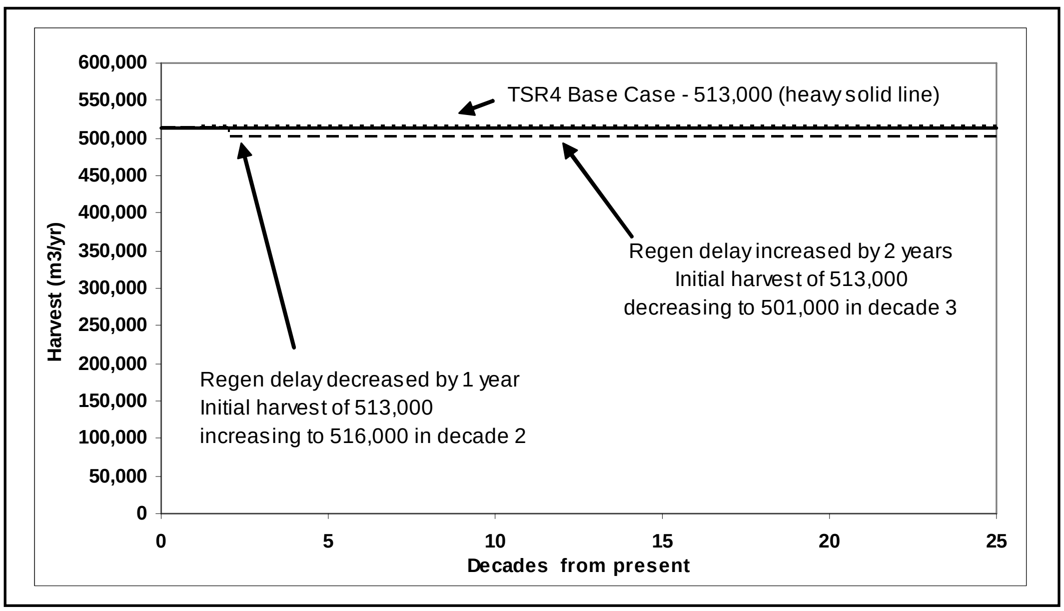


Figure 45. Changes in regeneration delays

Results

Run	Short Term	Mid Term	Long Term
Decrease regen delay to 1 year.	Increased by 0.3%.	Increased by 0.6 %	Increased by 0.6 %
Increase regen delay to 4 years.	No change.	Decreased by 2.3 %	Decreased by 2.3 %

Short term harvest levels are largely controlled by the availability of natural stands, and natural stand yield curves are not influenced by regeneration delays.

Regeneration delays influence the minimum harvest ages of managed stands, which strongly influence mid- and long-term harvest levels. There is an insignificant increase in mid- and long-term harvest levels associated with decreasing the regeneration delay to 1 year, and a small reduction to mid- and long-term harvest levels if the regeneration delay is increased to 4 years.

4.6.5 Gains from Select Seed

The licensees use the best genetic quality seed and vegetative material available for regeneration. The use of select seed from tree breeding programs increases expected future volume yields. TIPSY yields for future managed stands were adjusted in the base case to account for past and current use of select seed. Ongoing breeding programs in seed orchards are expected to continue to improve the quality of this select seed and deliver even higher gains than the seed used today. The genetic gain sensitivity shown below examines the impact of removing all gains associated with class A seed from both the existing and future managed stands. This run demonstrates the risks associated with under-performance of select seed.

Methodology

Run	How was it analyzed?
No gains from select seed	All gains from the use of select seed were removed from the base case yield tables. Minimum harvest ages were adjusted to align with the new curves.

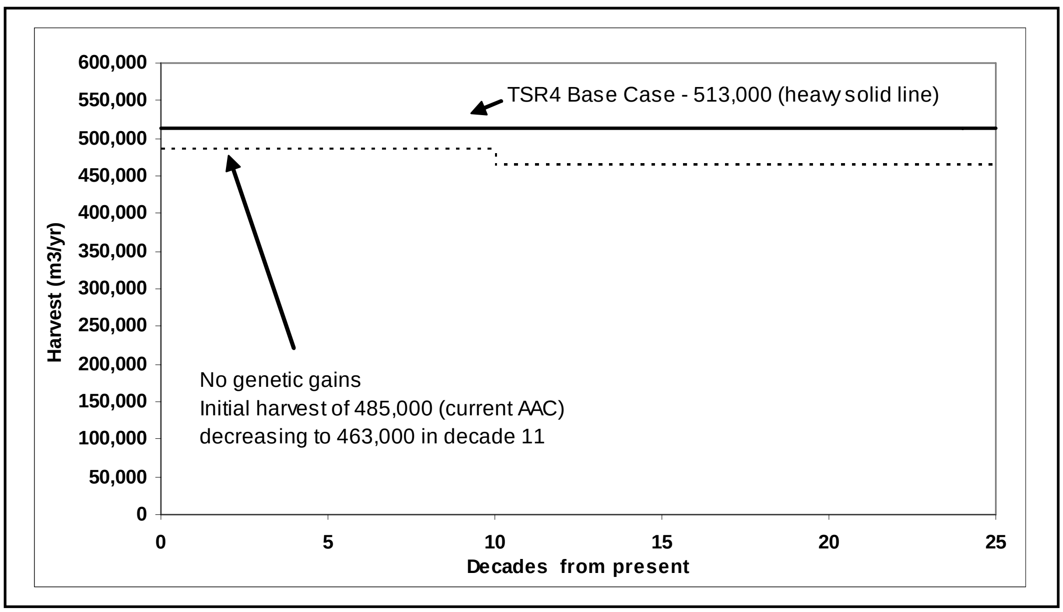


Figure 46. Harvest forecasts after removing genetic worth gains

Results

Run	Short Term	Mid Term	Long Term
No gains from select seed	Reduction of Base Case harvest forecast from 513,000 m3/yr to 485,000 m3/yr (a decrease of 5.5 %).	Reduced by 5.5 %	Reduced by 5.5 %

This factor influences the managed stand yield tables (the harvested stands that are regenerated by planting). When genetic gains are removed from the managed stand yield tables there is less volume available in the mid- and long-term. Removal of the base case's projected genetic gains results in a large (5.5 %) decrease in long-term harvest level.

The large reduction in managed stand volumes that are required in the near mid-term requires the natural stands (with no changes in their yield curves) to be metered out even more sparingly, so the short term harvest is indirectly impacted, and is significantly reduced by 5.5 %.

5.0 Additional Analyses

There are a number of questions that arose during the analysis that required further model runs. Answers to these questions help us to understand the current timber supply projections. The analyses included:

- Meeting old and mature-plus-old seral objectives, and caribou habitat objectives using seral constraints instead of spatial reserves; and
- Examining the impact of applying TSR3-type ungulate winter range (UWR) objectives rather than PEM-type (TSR4) UWR objectives; and
- Examining the geographic distribution of timber supply in the TSA (north versus south); and
- Possible impacts of a mountain pine beetle epidemic.

5.1 Application of non-spatial of biodiversity and caribou objectives

The Kootenay Boundary Higher Land Use Plan specifies a retention percentage of old seral forest within the crown forested area within each Landscape Unit (LU) and biogeoclimatic (BEC) variant combination. In the Golden TSA, spatially explicit Old Growth Management Areas (OGMAs) and Mature-plus Old Management Areas (MOGMAs) have been delineated to address this requirement. Similarly, caribou reserves have been mapped to address the forest cover requirements for caribou. The OGMA and MOGMA areas and the caribou reserves are not eligible for harvest in the current practice, base case scenario. The analysis in this section explores the use of percent seral goals applied to (a) each LU-BEC variant instead of the spatial OGMAs and MOGMAs, and (b) forest cover requirements applied instead of caribou reserves.

As well, the public expressed an interest during the Public and First Nations review of the Information Package Report to see what the effect would be of meeting the forest requirements by excluding the contribution within Parks, or conversely, of meeting the requirements solely from the non-Park landbase.

Methodology

Run	How was it analyzed?
Non-spatial reserves.	Spatial OGMAs and MOGMAs were turned off rather than treating these as THLB landbase reductions. Seral constraints were applied at the landscape unit / BEC variant level, as was done in TSR3. Constraints were applied to the CFLB portion of each LU-BEC variant as specified in the Kootenay Boundary Higher Level Plan Order, (for details see Appendix A) 1/3 drawdown was implemented for Low BEO landscape unit / BEC combinations Caribou reserves were turned off and seral constraints were applied at the landscape unit / habitat type level, as per the HLPO caribou guidelines.
Non-spatial reserves with no contribution from Parks	Same as above, except only the non-Park crown forest land base was included in the analysis. Biodiversity targets remained the same percentage-wise, but decreased in direct proportion to the area of Parks that was excluded. Only the non-Park productive forests contributed to the forest requirements.

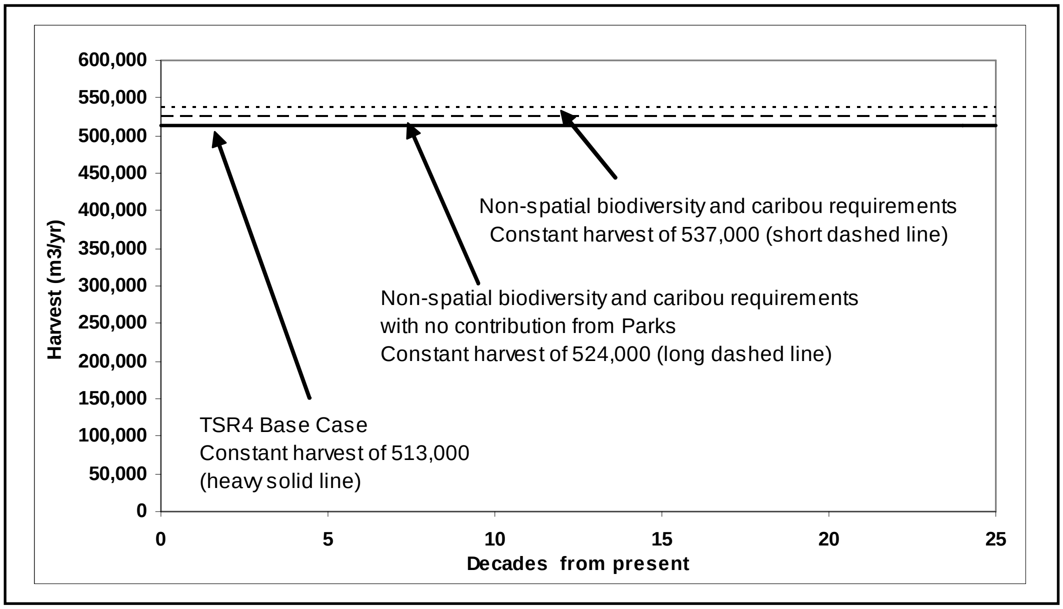


Figure 47 Harvest projections for non-spatial biodiversity and caribou requirements.

Results

Run	Short Term	Mid Term	Long Term
Non-spatial biodiversity and caribou reserves.	Increase in the Base Case harvest forecast from 513,000 m3/yr to 537,000 m3/yr (an increase of 4.7 %).	Increased by 4.7 %	Increased by 4.7 %
Non-spatial biodiversity and caribou reserves with no contribution from Parks.	Increase in the Base Case harvest forecast from 513,000 m3/yr to 524,000 m3/yr (an increase of 2.1 %).	Increased by 2.1 %	Increased by 2.1 %

Applying the biodiversity and caribou requirements as non-spatial, percentage forest requirements could increase the harvest level by 4.7%. Applying these requirements to only the non-Park forest land could increase the harvest level by 2.1%. The difference of 2.6 % between these scenarios indicates that the Park landbase provides a disproportionately higher proportion of the non-spatial requirements than the non-Park landbase.

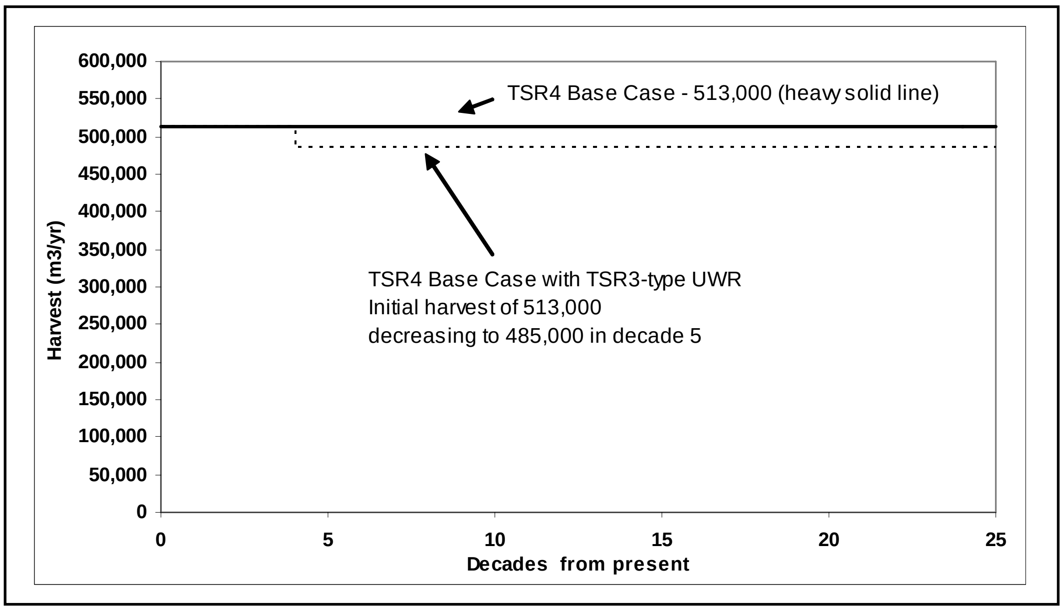
Conversely, applying the biodiversity and caribou requirements as spatial, land-base netdowns rather than non-spatial requirements acts to reduce the harvest projection by 4.7%, or 2.1%, depending on which landbase is used.

5.2 TSR3 type Ungulate Winter Range

Sensitivity analyses in both the Cranbrook and Invermere TSR3 analyses showed that a switch from HLPO-type UWR requirements to PEM-based UWR requirements was an upward pressure on harvest flows. The switch to PEM-based UWR objectives in the Golden TSA was a possible contributor to the increased harvest projections in the Golden TSR4 analysis compared to the previous analysis.

Methodology

Run	How was it analyzed?
Base case with TSR3-type UWR	TSR 4-type UWR was replaced with TSR-3 type UWR. Both the spatial location of the UWR zones and the forest cover requirements changed. PEM-based requirements varied by habitat type (see Appendix B), while TSR3 UWR requirements are a simple stipulation of "*maintain 40% of the winter range in stands over 100 years old*".



Results

Run	Short Term	Mid Term	Long Term
Base Case with TSR3-type UWR	No change in the Base Case harvest forecast of 513,000 m3/yr.	Decreased by 3.6 %	Decreased by 5.5 %

When TSR3 UWR is substituted for the TSR4 PEM-type UWR the mid- and long-term harvest level falls to 485,000 m3/year.

The switch from TSR3-type UWR cover requirements to TSR4, PEM-based UWR requirements was a significant upward pressure on the TSR4 Base Case mid- and long-term harvest projection.

5.3 Reduced REA constraints: VQOs and REAs

The constraint analysis section indicated that VQOs were a significant factor in limiting the Base Case harvest projection. This scenario tested that conclusion by reducing the VQO constraints. This was accomplished by reclassifying the VQOs down one class. These changes effectively increased the early seral limits in each VQO category and allowed more harvest within each VQO.

In addition to reducing the VQO constraints, a second scenario estimated the harvest flow assuming all the non-spatial forest requirements for VQOs, UWR and greenup were removed.

Methodology

Run	How was it analyzed?
VQO classes re-classified down one class.	All VQO classes were reduced by one class (R to PR, PR to M, M to MM). Maximum early seral limits, or "non-VEG" were increased for each VQO class as per Appendix A.
Removal of all non-spatial forest requirements.	The non-spatial, REA forest cover requirements for greenup (both IRM- and ERDZ-type), ungulate winter range, VQOs and low BEO biodiversity were "turned off". All other spatial-type requirements were retained, such as the OGMAs and MOGMAs for biodiversity, caribou reserve areas for both HLPO and SARCO, domestic watershed reserves, and WTPs. The THLB area did not change.

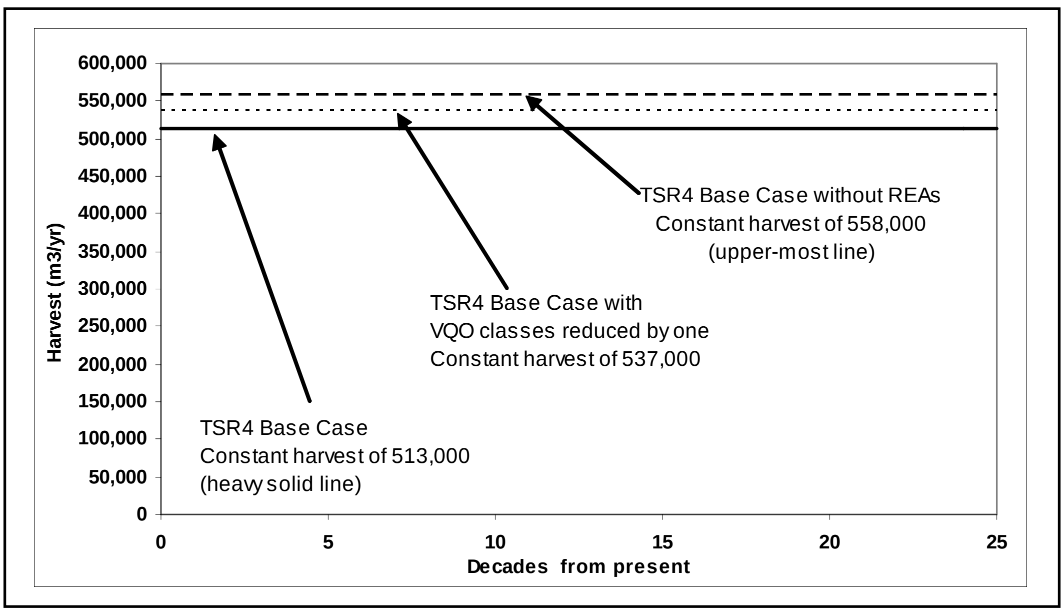


Figure 48 Harvest projections for Base Case with modified VQOs and no REAs.

Results

Run	Short Term	Mid Term	Long Term
VQO classes re-classified down one class.	Increase in the Base Case harvest forecast from 513,000 m3/yr to 537,000 m3/yr (an increase of 4.7 %).	Increased by 4.7 %	Increased by 4.7 %
Removal of all non-spatial forest requirements.	Increase in the Base Case harvest forecast from 513,000 m3/yr to 558,000 m3/yr (an increase of 8.8 %).	Increased by 8.8 %	Increased by 8.8 %

Reclassifying the VQOs down one class could increase the potential harvest level by 4.7%. Conversely, VQOs are a significant limit on the potential harvest level.

In their entirety, the non-spatial forest requirements limit the potential harvest level by 8.8%. This does not include the THLB landbase netdowns for biodiversity, caribou and other resource emphasis areas.

5.4 TSR4 Base Case with TSR3 REA requirements

As a further check on why the TSR4 Base Case harvest flow was greater than the TSR3 Base Case harvest projection, the most likely factors/assumptions from TSR3 were applied to the TSR4 database.

Methodology

Run	How was it analyzed?
TSR4 Base Case with TSR3 assumptions.	Biodiversity OGMA and MOGM reserves and caribou reserves were turned off. TSR3-type biodiversity and caribou non-spatial forest requirements were added. Low BEO phase-in periods from TSR3 (70 years) were used instead of TSR4 phase in periods (80 years). TSR3 yield curves and minimum harvest ages were assigned to the TSR4 analysis units. The TSR3-type ungulate winter range map and forest cover requirements were applied.

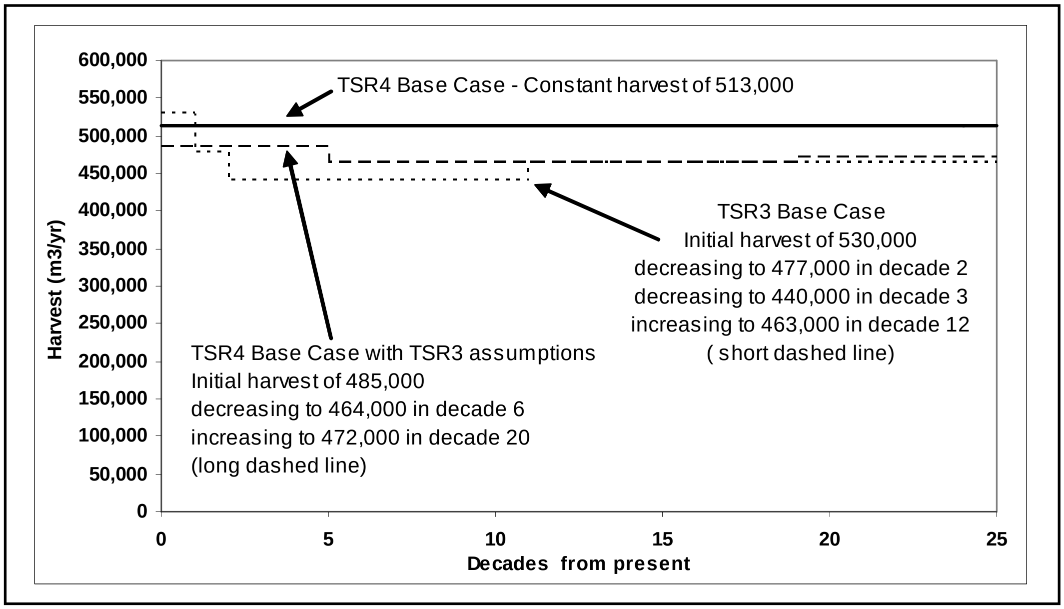


Figure 49 Harvest projection for Base Case with TSR3-type assumptions.

Results

Run	Short Term	Mid Term	Long Term
TSR4 Base Case with TSR3 assumptions.	The Base Case harvest forecast of 513,000 m3/yr was reduced to 485,000 m3/year (a reduction of 5.5%).	Decreased by 7.5 %	Decreased by 9.0 %

Applying TSR-3 type assumptions resulted in a greatly reduced harvest flow projection that was quite similar to the TSR3 Base Case harvest flow. The combination of modeling assumptions used in TSR was a significant downward pressure on the TSR3 harvest level.

The factors of:

- TSR3-type ungulate winter range requirements, and
- lower yield curves with associated higher minimum harvest ages

appear to more than offset the effects of

- the greater THLB, and
- non-spatial requirements for biodiversity and caribou

which were seen to be an upward pressure on harvest level in Section 5.1.

5.5 North and South Timber Supply

The harvest in the Golden TSA is naturally divided into a north and south zone. The timber in the north zone flows towards Revelstoke, and timber in the south flows towards Golden. Landscape units within the "North" zone were: G01 Upper Wood, G02 Encampment, G03 Lower Wood, G04 Tsar, G06 Kinbasket, G11 Goosegrass, G12 Windy and G07 Sullivan (small portion only).

Three scenarios examined this timber flow:

- Apply two harvesting priorities instead of the three harvest priority zones (i.e. pine-leading stands as priority 1, all other species-leading stands as priority 2); and
- Model the north and south zones independently, as if they were each their own sustained yield unit, and then combine the results; and
- Model the north and south zones independently, but delete LU G12 and a portion of LU G07, as both are suspected as being uneconomic to develop.

Methodology

Run	How was it analyzed?
Apply two versus three harvest priorities.	Harvest priority #1 (pine leading stands) applied as per the Base Case. Harvest priorities #2 (Fir/larch leading stands) and #3 (other species) were combined together.
North and south combined (including all of LU G07).	The "north" and "south" portions of the TSA were treated as separate landbases, each was modeled separately and then the harvest flows were added together.
North and south combined (excluding a portion of LU G07).	Same as above, except LU G12 and a portion of LU G07 that is possibly uneconomic was dropped from the "south" landbase. The harvest flows from the "north" and "south" portions were then added together.

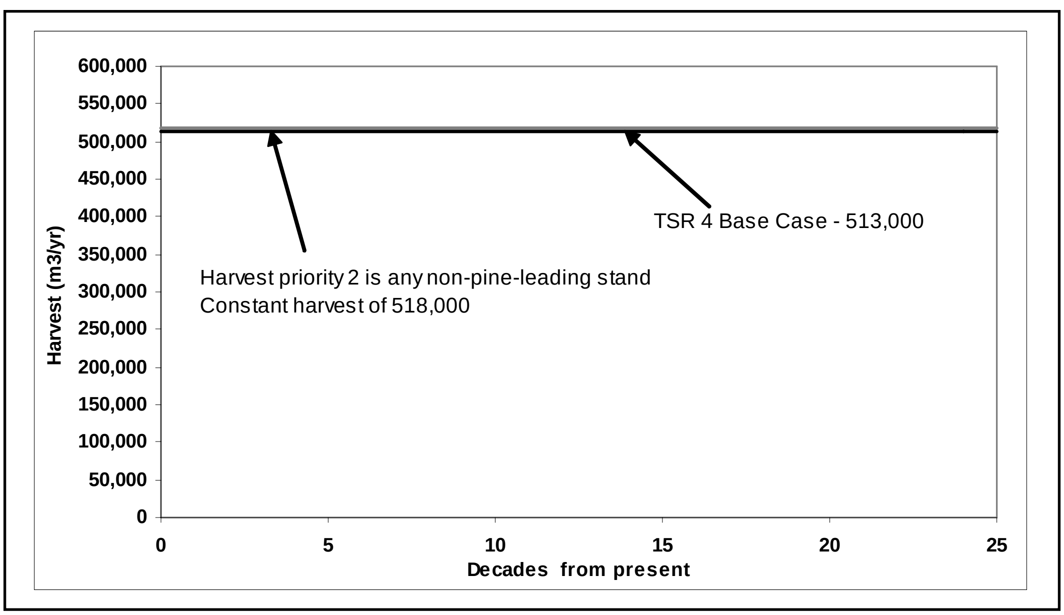


Figure 50 Harvest flow assuming two rather than three harvest priorities

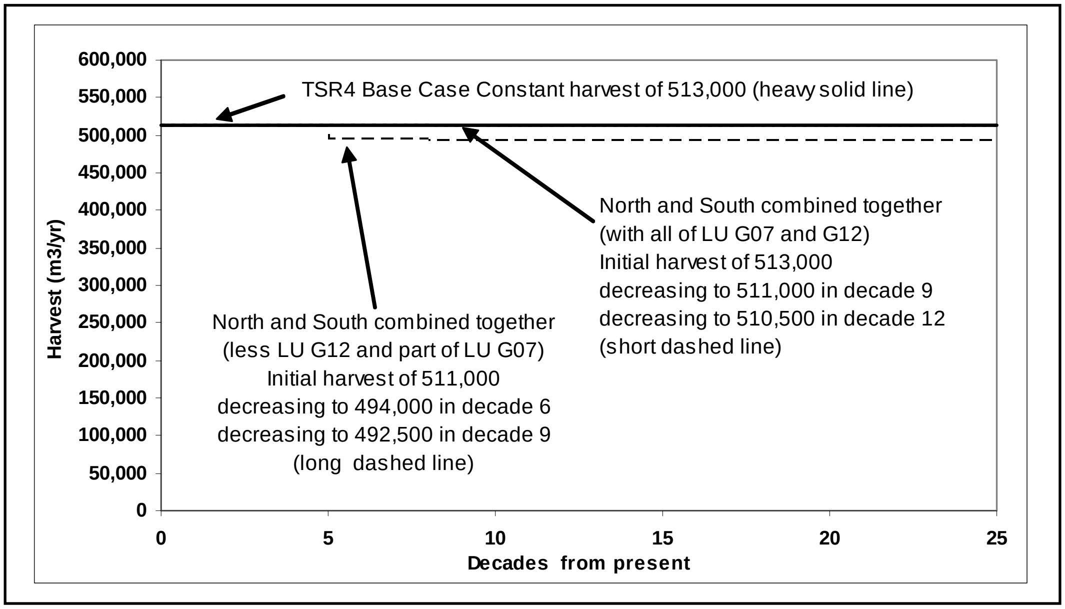


Figure 51 Harvest flow after combining the separate north and south flows

Results

Run	Short Term	Mid Term	Long Term
Two versus three harvest priorities.	The Base Case harvest forecast of 513,000 m3/yr was increased to 518,000 m3/year (+ 1.0 %).	Increased by 1.0 %	Increased by 1.0 %
North and south (all of G07 and G12 included)	The Base Case harvest forecast of 513,000 m3/yr was not changed.	No change.	Decreased by 0.5 %
North and south (suspected uneconomic area of G07 and G12 removed)	The Base Case harvest forecast of 513,000 m3/yr was reduced to 511,000 (-0.4%).	Decreased by 2.0 %	Decreased by 4.0 %

Combining the Base Case harvest priorities #2 (fir/larch) and #3 (other-non-pine species) into one harvest priority increased the short-term harvest projection, and decreased the mid- and long-term harvest projections by amounts that are deemed insignificant.

The impact on volume was not the focus of this scenario. In the Base Case scenario the harvest profile of spruce, cedar and hemlock stands during the first two decades was very low (*Figure* 15). As these are the predominant species in the north portion of the TSA, this meant that the model was harvesting very little volume in the north portion of the TSA during the first two decades. The intent of combining the second and third harvest priorities was to see if the model would harvest a more realistic portion of the total harvest from the north portion of the TSA, especially in the first two decades.

This was largely accomplished as per Figure 52. However, the harvest flow in the north still varied by a factor of approximately 5.4, with the minimum harvest of 17,400 occurring in decade 7 and a maximum harvest of 94,800 occurring in decade 2.

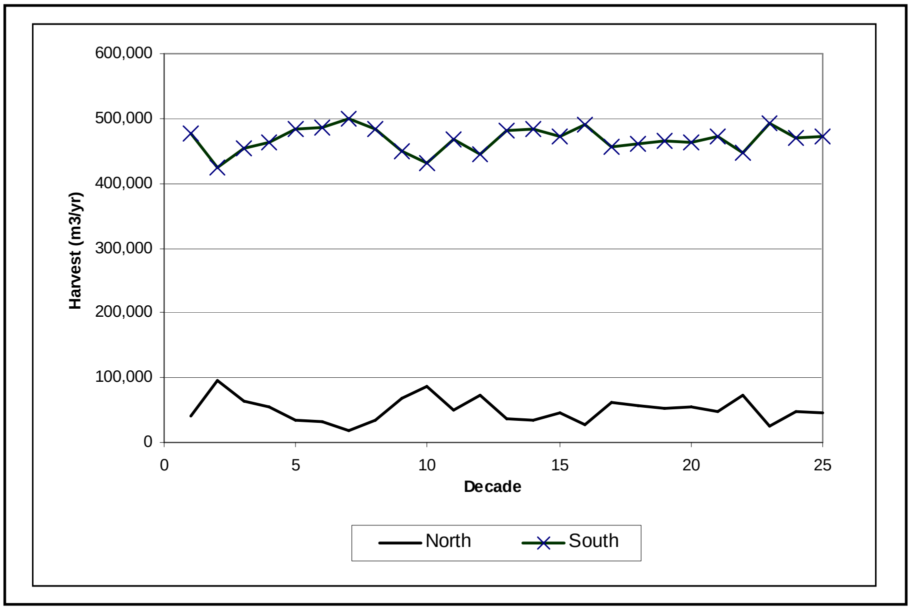


Figure 52 Harvest flows from north and south based on two harvest priorities

Analyzing the north and south zones as if they were separate sustained units and then combining the two harvest projections resulted in:

- small but insignificant changes in the harvest flow, in the case where all of LU G07 and G12 was included in the THLB, and
- a small but insignificant change in the short term harvest flow, and significant decreases (of 4.0%) in both the late portion of the mid-term, and the whole of the long-term harvest flow, in the case of excluding LU G12 and a portion of LU G07.
- Very uniform harvest rates of harvest can be obtained in both the north and south zones (Figure 53)

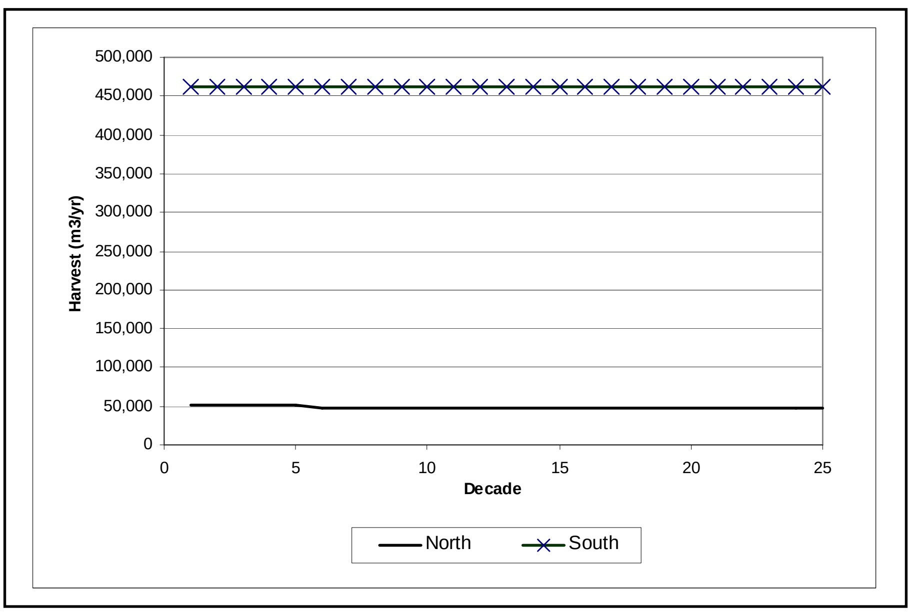


Figure 53 Harvest flows from north and south when modelled as separate units

5.6 Mountain Pine Beetle Infestation

This option examines the impact of assuming a catastrophic infestation of mountain pine beetle (MPB). One possible impact is a decline in mid-term harvest volume once the epidemic is over due to high mortality of attacked pine. In the short term, as much of the beetle-killed stands as possible would be salvaged. The original intent was to model an uplift in the harvest rate, if necessary, to capture the majority of impacted pine volume.

The assumptions in this Option are largely based on the Base Case Option, with additional MPB-related assumptions adopted from the Mountain Pine Beetle Initiative Modeling Project by M. Eng. Et al. (2005, 2006) and Walton et al. (2007). In many cases the assumptions are simplifications of the complex assumptions used in the Eng and Walton projects.

In this scenario, the pine stands that were attacked in both the NHLB and THLB were based on the pine volume (m3) and the proportion of pine volume (m3/ha) in each stand. As pine volume increased and/or the pine proportion increased, and if the stand age was over 60 years old, then it was more likely that the stand would be attacked. The spatial spread of the MPB, as predicted by Walton et al. (2007) was not modeled.

MPB-attacked stands in the THLB that met the Base Case merchantability criteria (minimum volume, diameter, and mean annual increment) were salvaged. Stands that were killed in the THLB that were below merchantability specifications, or that were in the NHLB were killed and no salvage was allowed. These stands were assumed to regenerate to natural stand analysis units.

The Walton et al (2007) project estimated that 68% of the pine volume in the Golden TSA will be killed over the next 15 years, barring some agent like cold weather ending the epidemic. The volume of pine attacked and killed generally follows a rising, then falling curve. We approximate this curve as three 5-year attack periods (Table 11).

Table 11 Percent pine volume killed during the first four 5-year periods of the MPB epidemic.

Period (5 years/period)	**Cumulative volume killed over 15 years (% total) (Ref: Walton et al, 2007)**	**Pine volume killed in the model during this period (% of total pine volume)**
1	16	16
2	48	32
3	68	20

The modeling is simplified by assuming that the estimated volume of pine killed (total volume of Pl on the landscape times the percentage killed in Table 11 is translated to a stand volume. If 100,000 m3 of pine is to be killed in one period, then we modelled this as 100,000 m3 of stand volume killed, but with priority on pine-volume stands.

Stands that are salvaged are assumed to be reforested within 2 years. Non-salvaged stands are subject to a 10-year regeneration delay. No stands in the NHLB were salvaged. Some stands in the THLB were not salvaged due to economics (as reflected in the minimum harvest ages), or due to REA requirements.

We also assumed that immature, pine-leading stands less than 60 years old would also be attacked, as per MacLauchlan (2006).

Table 12 Mortality applied to pine-leading stands < 60 years old

Age class	**% of stands with attack**	**Extent of mortality**	**% pine mortality**
<20	0%	0%	0%
20-29	30%	50%	15%
30-39	62%	50%	31%
40-49	83%	50%	41%
50-59	93%	50%	47%

After the preliminary analysis was complete and the results were examined, it was evident that the total volume of MPB-attacked, mature, THLB, pine-leading stands that would be eligible for salvage during the first 15 years (i.e. the 3 five-year periods) was less than the maximum 70% harvest volume cap on pine-leading stands that was applied, by decade, in the Base Case harvest projection. This meant that all the MPB-attacked stands for the first 15 years that would be eligible for salvage could be accommodated within one decade, rather than two, and that no AAC uplift was necessary to accommodate the salvage of MPB-attacked stands. Therefore, the modeling for this scenario was simplified by assuming that all the MPB attack occurred within the first decade, and all stands were either salvaged or killed-but-not-salvaged within the first decade, rather than over the 15 years. This is actually a more dramatic, pessimistic assumption than the original intent.

Methodology

Run	How was it analyzed?
Mountain Pine Beetle Infestation	Mature, pine-leading stands and immature pine-leading were designated for MPB attack based on the estimated volume of mortality in Walton et al (2007), and MacLauchlan (2006), respectively. Potential salvage was based on merchantability criterion (THLB, volume, diameter, percentage of maximum mean annual increment.) Salvage volume of pine-leading stands was capped at 70% of the current AAC. All REA-type forest cover requirements were respected, such as maximum harvesting disturbance within VQO zones.

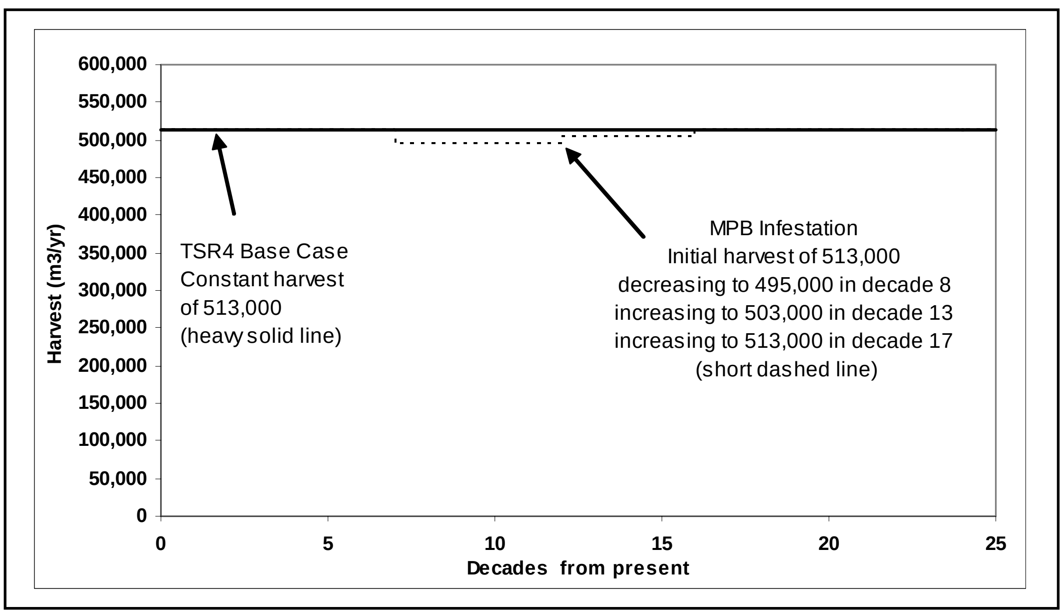


Figure 54 Harvest flow for the mountain pine beetle option

Results

Run	Short Term	Mid Term	Long Term
Mountain Pine Beetle Infestation	No change from the Case harvest level of 513,000 m3/year.	Reduced by 0.6%	Reduced by 1.3%

Even if a beetle epidemic occurs, the results suggest that the short-term harvest projection is maintained. All the predicted MPB-caused mortality within the mature, pine-leading stands within the THLB could be salvaged within the Base Case’s maximum 70%-of-AAC cap on pine-leading stands. Based on these results, no AAC uplift would be required.

Note that this is a simplified analysis of a beetle epidemic. For example, there is no rationalization in this scenario between the competing objectives of

- salvage harvesting a large pine volume in the south of the TSA, by licensees who operate in the south of the TSA, and
- the harvest of other species in the north (and south) by a different mix of licensees.

The MPB-killed stands in the THLB and NHLB that are not salvaged, and which undergo a lengthened regeneration period, result in a 0.6% reduction and a 1.3% reduction in the mid- and long-term harvest projections, respectively.

6.0 Summary of Analysis Scenarios

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecast, a series of sensitivity analyses were completed. The results are summarized below, along with the results of the additional, non-sensitivity analysis scenarios.

Table 13. Summary of Analysis Results

Run	Percentage Change Compared to Base Case			
	Starting Value	Decades 1-2	Decades 3-8	Decades 9-25
Base Case 2008	0.0	0.0	0.0	0.0
TSR3 Base Case	3.3	-1.9	-14.2	-10.5
TSR3 AAC	-5.5	-5.5	-5.5	-5.5
BC_Start_at Current AAC	-5.5	-2.7	0.0	0.0
BC_Maximum First Decade Harvest	40.2	33.1	-3.4	-1.9
THLB Reduced by 10%	0.0	0.0	-8.1	-13.3
THLB Increased by 10%	0.0	1.2	9.9	9.9
Natural stands yields decreased by 10%	0.0	0.0	-5.5	-1.3
Natural stand yields increased by 10%	4.1	4.1	4.1	1.0
Managed stand yields decreased by 10%	0.0	0.0	-1.7	-11.3
Managed stand yields increased by 10%	0.0	0.0	6.0	7.2
Minimum harvest ages (MHA) reduced by 10 years	0.0	0.0	-0.8	-4.9
MHA increased by 10 years	0.0	0.0	-2.3	-2.3
MHA based only on attaining 95% MAI	0.0	0.0	0.0	0.0
MHA based only on attaining minimum volume	0.0	0.0	0.0	-9.0
Regeneration delay reduced by 1 year	0.0	0.3	0.6	0.6
Regeneration delay increased by 2 years	0.0	0.0	-2.3	-2.3
No genetic gains in planted stock	-5.5	-5.5	-5.5	-9.2
Base Case with TSR3-type UWR	0.0	0.0	-3.6	-5.5
Base Case with VQOs reduced by one class	4.7	4.7	4.7	4.7
Base Case with no REA requirements	8.8	8.8	8.8	8.8
Biodiversity & caribou non-spatial requirements (NS)	4.7	4.7	4.7	4.7
Non-spatial (NS) with no contribution from Parks	2.1	2.1	2.1	2.1
Base Case with TSR3-like assumptions	-5.5	-5.5	-7.5	-9.0
Base Case with TSR3 assumptions, no REAs	3.3	3.3	1.2	-3.1
North and south combined (all of G07 and G12)	0.0	0.0	0.0	-0.5
North and south combined (part of G07 and G12)	-0.4	-0.4	-2.0	-4.0
Mountain Pine Beetle Scenario	0.0	0.0	-0.6	-1.3

7.0 Socio-Economic Assessment

7.1 Introduction

To help inform the TSR4 process, this socio-economic assessment (SEA) estimates the likely economic activity associated with alternative timber supply scenarios. A region's timber supply is a fundamental determinant of the size of its forest industry, which is often a leading sector in BC regional economies. The Chief Forester determined allowable annual cut (AAC) effectively sets the upper limit on the annual timber supply available for harvest in a TSA. Changes to an AAC can have important economic consequences so gauging their likely impacts provides important decision-making information for TSA stakeholders, including the Chief Forester.

The primary output of this socio-economic analysis is a comparison of employment, employment income and government revenues that the current AAC can support with the levels that could be supported by the base case forecast of this timber supply analysis. This analysis shows the potential incremental change in forest sector employment, employment and government revenues from implementing the short term timber supply of the base case as the AAC. The analysis also includes the following elements.

- Brief socio-economic profile of the Golden TSA
- Brief profile of the Golden TSA's forest industry
- Estimate of employment supported by recent timber harvesting in the TSA

7.2 Socio-economic setting

7.2.1 Population and demographic trends

The Golden TSA is situated in southeastern BC, between the Rocky Mountains to the east and the Purcell and Selkirk Mountains to the west. The Town of Golden is the TSA's largest and only incorporated community and accounts for approximately 50% of the TSA's relatively small population of about 7 500. It is located in the southern reaches of the TSA at the intersection of the Trans-Canada Highway, which bisects the TSA, and Highway 95, which carries traffic north and south from Cranbrook and ends in Golden. The community is near five major parks, Yoho National Park, Glacier National Park, Kootenay National Park, Banff National Park and Jasper National Park. The Columbia River and man-made Kinbasket Lake (or Columbia Reach) divides the TSA on a north-south axis and Golden sits at the confluence of the Kicking Horse and Columbia Rivers.

Nicholson is an unincorporated bedroom community for Golden with approximately 1 000 residents and lies 8 km south along Highway 95. There are year round residents at the Kicking Horse Mountain Resort now and this population is expected to grow with the resort's expansion. The resort is approximately 15 km east of Golden. A smaller community with approximately 100 residents, Donald Station is located 26 km to the north of Golden along Highway 1.

There are neither Aboriginal communities nor Indian Reserves in the TSA. The portion of the area's population that self-identifies as Aboriginal is small, approximately 330, or 2%, based on the 2006 Census. The following First Nations have claimed traditional territory within all or part of the TSA (Wood River Forest Inc. undated).

- Ktunaxa Nation
- Akisq'nuk First Nation
- Shuswap Band
- Shuswap Nation
- Simpcw First Nation
- Okanagan Nation Alliance
- Okanagan Indian Band

The Ktunaxa Kinbasket Treaty Council has submitted a comprehensive land claim that covers the southeast corner of the province and includes the Golden TSA.

The population growth of the Town of Golden and the Golden Local Health Area (LHA) has lagged the province-wide performance by a wide margin over the past decade[1]. Over the 1996-2006 period, the town's population dropped by 2.5% to 4 022. The Golden LHA's population decreased by a smaller amount (0.5%) due to small population growth in the rural residential areas along Highways 1 and 95. The province's population went up by 11.5% during this decade. The northern half of the TSA is mountainous and unpopulated.

The local population has leveled off due to its aging and to gains in ski resort associated employment being offset by some losses in forestry and railway employment. The 45-64 year-old age cohort grew by 21.6% and the 16-24 year-old age cohort shrunk by 15.9% over the 1996-2006 decade in Golden. Table 14 presents population data for the Town of Golden, Golden LHA and the rural-residential areas in the vicinity of Golden.

Table 14 Population (1996 – 2006)

Areas	2006 Population	Change '06 over '01	Change '01 over '96	Change '06 over '96
Town of Golden	4 022	4 195	4 126	-104 (-2.5%)
Rural-residential	3 502	3 272	3 436	66 (+1.9%)
Golden Local Health Area	7 524	7 467	7 562	-38 (-0.5%)
BC	4 320 255	4 078 447	3 874 276	445 979 (+11.5%)

Source: BC Stats

7.2.2 Economic profile

Employment data from the 2006 Census indicates that the tourism sector is Golden's biggest employer (26.0% share), followed by the forestry (16.9%) and public (15.3%) sectors.[2] The labour force numbers and percentage shares for these leading local sectors changed little between the 2001 and 2006 Censuses. The following table gives Golden's labour force numbers and percentage shares for the larger economic sectors for 2005 and 2000.[3]

[1] There is no population data that corresponds to the TSA boundaries so population data from BC Stats for the Golden Local Health Area (LHA) is used because it has similar boundaries to the Golden TSA.

[2] These labour force numbers are from the 2006 Census so they reflect the size of the labour force for the time when the census was conducted. The size of the Golden tourism sector is likely larger than shown during the winter due to the seasonal employment of the skiing and accommodation operations of the Kicking Horse resort.

[3] The labour force data from the Census has a one year lag because Census respondents are asked about their employment as of June 30 of the previous year, June 30, 2005 in the case of the 2006 Census.

Table 15 Golden Labour Force (2005 and 2000)

Industry	2005 #	2005 %	2000 #	2000 %	% change 2005 vs 2000
Forestry	380	16.9	355	16.1	+7.0
Mining & mineral products	10	0.4	30	1.4	-66.7
Construction	290	12.9	150	6.8	+93.3
Non-wood manufacturing	10	0.4	55	2.5	-450.0
Retail & Wholesale Trade	255	11.3	310	14.1	-17.7
FIRE [4]	80	3.5	45	2.0	+77.8
Public Sector	345	15.3	325	14.8	+6.2
Accommodation & Food Services	450	20.0	435	19.8	+3.4
Total	2 255	100.0	2 200	100.0	+2.5
Tourism [5]	586	26.0	550	25.0	+6.5

Source: BC Stats and Statistics Canada

The mix of employment within the forestry sector changed markedly between 2005 and 2000 as the number of wood products manufacturing jobs went up and forestry services and logging job numbers went down. The forestry services and logging labour force shrunk by almost 50%, from 130 in 2000 to 70 in 2005 and the wood products manufacturing labour force went up by approximately 20%, from 200 to 235.

Historically, the railway and forestry industries were the mainstays of the Golden area economy. In 1997 Ballast Nedam NV, one of the top five Dutch construction companies, set up a subsidiary to acquire the local ski hill, then known as Whitetooth Mountain, from the Columbia Shuswap Regional District, and re-named the operation as Kicking Horse Mountain Resort and started its expansion into a four season resort, which anchored tourism as a new pillar of the local economy. Over the past eight years, an estimated $200 million has been invested in the resort infrastructure and properties. Columbia Basin Trust is a minority shareholder in the resort. It now includes a high speed gondola, three condominium hotels, a bed base of 1,300 units and eight restaurants, including the Eagle's Nest, which is billed as the country's highest. There are several smaller tourism operations that leverage the area's nature-based resources and include the following.

- Purcell Mountain Lodge – accessible only by helicopter, it offers backcountry skiing and snowshoeing in the winter, alpine hiking in the summer and a luxury mountain lodge experience, the lodge has 10 bedrooms and there is a separate chalet.
- Golden Mountain Holidays – operates four lodges situated in the Esplanade Range 50 kilometers north of the town of Golden at elevations between 2000 to 2200 meters, which offer backcountry skiing in the winter and hiking in the summer.
- Great Canadian Heli-Skiing – With a lodge located 55 km west of Golden, this Golden-based company has operated since 1988 offering heli-skiing in the Selkirk and Purcell Mountains.
- Kinbasket Lake Resort – cabins and campground situated at the south end of Kinbasket Lake and accessed via a forest service road.
- McLaren Lodge and Wet n Wild – 10 room log lodge in Golden that offers river rafting adventures, as well, on the Kicking Horse River.

Various stakeholders came together in the Golden area and created a draft Golden Backcountry Recreation Access Plan that was published in December 2002 and since has provided a largely guidance based approach for backcountry land and resource use and a Golden Backcountry Recreation Advisory Committee process for managing issues and conflicts tied to backcountry recreation land and resource use.

A $1 billion major infrastructure project is underway in the Golden area; the four-phase Kicking Horse Canyon Highway Improvement is a re-construction of 25 km of highway and bridges between Golden and the eastern border of Yoho National Park. Phase I, twinning of the Yoho Bridge was completed in 2006, and

[4] Finance, Insurance & Real Estate

[5] Statistics Canada does not organize its labour force data to include figures for the tourism sector. All accommodation employment is categorized as being part of the tourism sector. However, some employment in several other sectors, including food services and retail trade, is due to tourism activity. A few years ago, BC Stats developed a methodology for estimating tourism sector employment and it has been employed for this report to estimate employment in the tourism sector of Golden.

Phase II, a, $125 million project, which includes replacement of the Park Bridge and upgrading of 5 km to four lanes was completed in Fall 2008. Phase II is a public-private partnership project and Trans-Park Highway Group is building, financing and operating the project. Construction started on Phase III in Fall 2008. Improved access from the Alberta direction by tourists to the Golden area is seen as a main long term benefit of the project. There is employment and several million dollars injected into the local economy from this massive infrastructure project.[6]

The local economy has three main private sector employers.

- Louisiana-Pacific Canada Ltd. operates adjacent laminated veneer lumber (LVL) and plywood plants that employ approximately 325.
- CP Rail built a coal car repair and maintenance facility and railyard in 1987 that employ approximately 250 (Golden Area Initiatives 2008).
- Kicking Horse Mountain Resort L.P. and other businesses at this resort employs approximately 300 during the winter ski season and 150 in the summer season (Pheidias Project Management Corporation 2008).

The Golden area economy has been notable for a strong level of stability in the past few years. Kicking Horse Mountain Resort L.P. submitted an application for a ski area master plan expansion under the BC Government's Commercial Alpine Ski Policy in December 2008. The Dutch owners of this company want to build up the four season resort attributes of their Golden operations into a destination resort. The plans include expanding on-mountain beds from 1 300 to 20 000, expanding ski lifts from three to 14 and constructing a resort-style golf course.

Despite the upheavals in the American housing market, the Louisiana-Pacific plants have maintained reasonably steady production levels over the past few years. In mid 2008, the plants were put on a 3 day per week production schedule.

A recent negative note was sounded in December 2008, when CP Rail announced the temporary lay-off of approximately 100 employees in each of its Golden and Revelstoke operations due to declining freight traffic levels. The expectation is that most of these laid-off CP Rail employees will be re-called when freight traffic levels are restored.

Although the Golden tourism sector has the largest share of the local labour force it does not have the largest share of income. A BC Stats study of local economic dependencies based on 2001 Census data showed that the tourism sector of the Columbia Forest District[7] had employment and income shares of 34% and 15%, respectively (Horne 2004). The economic importance of the resource extraction industries is more noticeable when the focus is on employment income. This study listed the forestry sector's shares of employment and income in the Columbia Forest District as 23% and 24%, respectively. The lower share of income for the tourism sector (compared to the forest sector) is due to its higher levels of seasonal and part-time employment and lower average hourly and weekly pay rates.

The indirect and induced employment generating power[8] of the logging and wood products manufacturing sectors in the Golden area is much higher than for tourism and slightly higher than for the public sector. The logging industry creates more than double the indirect and induced employment of the local tourism sector (0.26 indirect and induced jobs per logging industry job versus 0.11 indirect and induced jobs per tourism sector job).

The following table lists indirect and combined indirect and induced multipliers by economic sector for the Town of Golden.

[6] The project proponents do not appear to have quantified the local impacts as yet, see the web site for project information, www.kickinghorsecanyon.ca

[7] This study was organized by forest district. The Columbia Forest District encompasses the Golden and Revelstoke TSAs.

[8] The local employment supported by spending of firms and their employees.

Table 16 Golden TSA employment multipliers (2001)[9]

Industry	Indirect Multiplier	Indirect/Induced[10] Multiplier
Logging	1.18	1.26
Wood products manufacturing	1.28	1.39
Construction	1.27	1.34
Public Sector	1.14	1.20
Tourism	1.07	1.11

Source: Horne Undated

The average total income of Golden residents ($32 946) is 3.7% below the province-wide level of $35 834 (BC Stats 2008)

The portion of the working age population in the Golden LHA depending on social safety net income assistance has been slightly higher than the province-wide portion but much lower than in several other BC communities, which have been hard hit by re-structuring and production slowdowns in the BC forestry and commercial fishing sectors. The June 2008 rate of social safety net assistance recipients in the Golden LHA was 3.9% versus 3.7% for the province. As an example of a more economically stressed community the June 2008 rate for Quesnel was 9.2%.

Table 17 Dependency on the social safety net (%)[11]

Region	June 2006	Sept 2006	Dec 2006	March 2007	June 2007	Sept 2007	Dec 2007	March 2008	June 2008
Golden LHA	3.6	2.8	5.6	6.3	3.6	2.8	5.8	5.1	3.9
Quesnel LHA	7.0	5.7	6.5	6.4	6.8	5.4	6.4	7.5	9.2
BC	3.5	3.3	3.9	3.9	3.4	3.2	3.9	4.1	3.7

Source: BC Stats

7.3 Golden TSA Forest Industry

7.3.1 Current Allowable Annual Cut (AAC)

The current AAC of 485 000 m3 became effective June 1, 2004, and is 45 000 m3 lower than the previous AAC of 530 000 m3 (that came into effect on January 1, 2000). The Chief Forester lowered this TSA's AAC in 2004 because of "…current indications of future risks to timber supply…" (Pedersen 2004, pg. 46).

Louisiana-Pacific Canada Ltd. (LP) and Downie Timber Ltd. (Downie) hold the TSA's replaceable forest licences (FL). There are no First Nation-based non-replaceable forest licences. Table 18 presents the current apportionment and commitments for the Golden TSA.

[9] These multipliers are for the Columbia Forest District, which includes the Golden TSA and the Revelstoke TSA.

[10] Assumes no migration in the event of lay-off

[11] Percentage of the 19-64 year old population receiving either Basic Income Assistance or Employment Insurance

Table 18 Golden TSA AAC Apportionment and Commitments (m3 & % of AAC)

Licensee by Form of Agreement	m3	% of AAC
Forest Licences Replaceable	354 781	73.1
A17645 - Louisiana-Pacific Canada Ltd.	*263 466*	54.3
A82664 - Louisiana-Pacific Canada Ltd.	*40 000*	8.2
A17644 - Downie Timber Ltd.	*51 315*	10.6
Forest Licences Non-Replaceable	10 000	2.1
Pioneer Forest Consulting Ltd.	*10 000*	2.1
BCTS Timber Sale Licence/Licence to Cut	105 912	21.8
Community Forest Agreement	20 000	4.1
Forest Service Reserve	4 307	0.9
Total Allowable Annual Cut	**485 000**	**100.0**

Source: Revenue Tenures and Engineering Branch, Ministry of Forests and Range November 10, 2008

FL A82664 was awarded on November 30, 2006 for a volume of 40 000 m3 to Louisiana-Pacific. It was a result of a cut control regulation subdivision of FL A17645 which had its commitment volume reduced from 303 466 m3 to 263 466 m3. There was no change in commitment volume for Louisiana-Pacific as a result of these forest licence changes.

MOFR authorized Louisiana-Pacific, under a Section 18 Forest Act transfer, to transfer timber harvesting rights to the Okanagan TSA and attribute volume to their A17645 forest licence in the Golden TSA. The transfer took place between August 1, 2006 and November 30, 2006. This transfer was undertaken to increase the allowable salvage harvest of MPB infested timber in the Okanagan TSA and was facilitated by the longstanding undercut for this licence in the Golden TSA.

Pioneer Forest Consulting Ltd. holds a non-replaceable forest licence to salvage harvest 10 000 m3 per annum for five years, a total of 50 000 m3, but it has yet to harvest timber from this licence. There is a forest stewardship plan in place.

Although there is an apportionment for a Community Forest Agreement (CFA), no parties have a CFA proposal underway.

An undercut was cited as an influential factor by the Chief Forester in his 2004 decision to reduce the AAC. An undercut was evident again in 2004, 2005, and 2006 and will likely occur when the 2008 harvest figures are finalized.

7.3.2 Golden TSA harvest history

The average harvest level per annum in the Golden TSA for the 2005-07 period was 413 044 m3, compared to an AAC of 485 000 m3. The Golden TSA's harvest had been consistently below its AAC up until 2007. The gap between harvest and AAC is due to recent poor conditions in wood product markets and higher harvesting cost for and poorer quality of timber in some northern woodsheds of the TSA.[12] The Chief Forester noted the undercut in his 2004 AAC rationale and based his decision to lower the AAC, in part, on its presence. The TSA's billed harvest averaged 74.3% of its AAC for the ten-year 1998-2007 period. The harvest, for the 11-month 2008 period, totals 319 037, which indicates that the TSA's harvest will once again be well below its AAC. The main factor in the gap between the AAC and the 2008 harvest is the sharp downturn in the U.S. new housing market, which has severely weakened demand for Canadian made wood building products. Table 19 summarizes the TSA's timber billed harvest volume over the 10-year 1998-2007 period.

[12] Downie and L-P have endeavoured to address the matter of harvesting timber in L-P's chart areas in the northern part of the TSA and a possible option is for Downie to harvest some of this timber under an agreement with L-P and transport these logs to its Revelstoke mill for processing.

Table 19 Golden TSA Volume (m3) Billed by Form of Agreement (1998-2007)

Tenure	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Forest Licence	198 608	285 342	336 271	296 754	279 056	261 650	310 262	347 967	263 357[13]	379 958
SB TSL S21 Bid Proposal multi-mark				55 405	7 092	25 737	856			
Road Permit	53 682	41 539	39 902	27 956	30 636	19 265	26 962	18 516	27 128	23 963
Occupant Licence to Cut		375	15 357	5 319	2 459		4 458	3 239	499	339
Forestry Licence to Cut								1 246	13 805	517
SB TSL S20 single mark	5 691	31 985	33 416	33 632	31 717	29 020	64 670	31 662	26 563	100 254
SB Direct TSL S23 single mark			6 794	1 383	2 852	17	218	15		
SB TSL S21 Bid Proposal	9 739	2 545	9 397	19 609	4 364	1 507		104		
Total	267 720	361 786	441 136	440 059	358 175	337 194	407 425	402 749	331 352	505 031
AAC	540 000	540 000	530 000	530 000	530 000	530 000	530 000[14]	485 000	485 000	485 000
AAC variance	(272 280)	(178 214)	(88 864)	(89 941)	(171 825)	(192 806)	(122 575)	(82 251)	(153 648)	20 031
Harvest as % of AAC	49.6%	67.0%	83.2%	83.0%	67.6%	63.6%	76.9%	83.0%	68.3%	104.1%

Source: BC MOFR Harvest Billing System

[13] The 2006 data was adjusted downwards to account for the 375 052 m3 harvested in the Okanagan TSA and billed to FL A 17645 in the Golden TSA.

[14] The AAC was changed on June 1, 2004 to 485 000

7.3.3 Golden TSA major licensees and processing facilities

Overview

Louisiana-Pacific Canada Ltd. is the largest forest industry company operating in the TSA; the company has tenure rights for 62.6% of the TSA's AAC and owns adjacent laminated veneer lumber and plywood plants in Golden. Table 20 lists the TSA's wood processing facilities and their locations, main products and estimated annual output capacities.

Table 20 Golden TSA timber processing facilities

Timber Processing Facility	Location	Main Products	Annual output capacity[15]
Louisiana-Pacific Canada Ltd.	Golden	LVL	4 million cu. ft.
Louisiana-Pacific Canada Ltd.	Golden	Plywood & veneer	135 million sq. ft.

Source: BC MOFR 2006 and Louisiana Pacific Corporation 2007 Annual Report

Louisiana-Pacific Canada Ltd.

Louisiana-Pacific Canada Ltd. is a subsidiary of Nashville, TN-headquartered Louisiana Pacific Corporation. A $2.2 billion per year publicly traded company, it operates adjacent laminated veneer lumber and plywood plants in Golden, which were purchased from Evans Forest Products Ltd. in 1999. Louisiana Pacific Corporation pioneered the development of oriented strand board (OSB) and now operates 13 OSB panel plants in the U.S. and Canada, including one in Dawson Creek, two in Chile and four OSB siding and specialty plants in the U.S. It also operates two hardboard plants, an I-joist plant, a plastic mouldings plant and one other LVL plant. The company has been negatively affected by the downturn in the American housing industry and has temporarily shuttered four OSB plants and cut production at others.

The two Golden plants use Douglas fir timber. The company trades some veneer with Tolko Industries Ltd.'s Armstrong plywood operation to obtain higher grade veneer to help produce its LVL product. By having the two plants in one location, the company can use low grade veneer for plywood manufacture that is not accepted for LVL manufacture. A significant portion of the LVL production is directed to Louisiana Pacific's I-joist plant in Red Bluff, California. The plywood is sold in Canada mainly. The byproduct chips are sold to Mercer International's Celgar pulp mill at Castlegar.

The Golden operation has a cogeneration plant that produces electricity and steam for the two plants and uses mainly bark from input logs for fuel. Prior to the start-up of the LVL plant in 1996, the former owner sold electricity from this cogeneration plant to BC Hydro. The largest recent capital expenditure was approximately $12 million for a new kiln dryer for veneer that is used in the manufacture of LVL and plywood.

Louisiana-Pacific Canada Ltd. generated an average of 240 PYs of timber harvesting, silviculture and processing employment[16] from Golden TSA timber over the 2005-2007 period. There was an average of 120 PYs involved with harvesting and re-planting L-P's Golden TSA tenures. The two manufacturing plants in Golden employed an average of 326 PYs per annum over the 2005-07 period and 36.7% of that employment (120 PYs) was tied to Golden TSA timber. Almost all of the timber harvesting and processing employees resided in the Golden TSA.

The company's two plants consumed approximately 300 000 m3 of timber per year on average at 2005-2007 production rates. Approximately 40% of the fibre input for Louisiana Pacific's Golden operation comes from the Golden TSA. To help meet the Douglas fir timber needs of the Golden plants, the company has a log trading agreement with Canfor's Radium sawmill whereby Douglas fir logs come to Golden and spruce logs are sent by L-P to Radium.

The volumes attached to the company's Golden TSA replaceable forest licences, A17645 and A82664, are 263 466 m3 and 40 000 m3, respectively.

[15] Based on 480 8-hour shifts per year

[16] Including harvesting, planning, administration, log hauling, road building, silviculture, and LVL and plywood manufacturing operations

The company does not currently contract for either log purchase or forestry services with First Nations owned companies.

The following table presents data on L-P's recent Golden TSA harvest and annual forest industry employment in the Golden TSA supported by this harvest.

Table 21 Louisiana-Pacific Canada Ltd. annual average Golden TSA Forest Licence harvests and employment (2005-2007)

Harvest	Timber volume (m3)
AAC Commitments[17]	314 781
Annual average billable harvest, 2005-2007	261 384
2008 billable harvest (as of Nov. '08)	152 493
Employment (2005-2007)	**Person-Years (PYs)**
Harvesting, planning & administration	62.9
Log transport	26.1
Road construction & maintenance	16.4
Development	12.3
Silviculture	2.6
Timber processing (in Golden)[18]	119.6
Total	**239.9**

Source: Survey of licensees, author's calculations and MOFR

Downie Timber Ltd.

Downie Timber Ltd. is a subsidiary of Revelstoke-based and privately owned Downie Street Sawmills Ltd. Its Golden TSA Forest Licence has an AAC commitment of 51 315 m3. The chart area includes the Upper Wood River, Lower Wood River and Landscape Units (LUs) in the most northerly portion of the TSA. The remote harvesting operations of the company are accessed via a private barge ferry across Kinbasket Lake and the harvested timber is trucked to Downie's Revelstoke mill. There is a land-based camp on the east side of Kinbasket Lake. This Golden TSA timber helps feed Downie's modern operation Revelstoke, which includes a cedar sawmill, planermill and remanufacturing plant (chopline, fingerjointer, edge gluing, molder, planer and resaw).

Downie generated an average of 56.7 PYs of timber harvesting and processing[19] from Golden TSA timber over the 2005-2007 period. There was an average of 30.8 PYs involved with harvesting and re-planting Downie's Golden TSA tenures. An average of 25.9 PYs of timber processing employment in Downie's Revelstoke cedar sawmill and value added operation over the 2005-07 period was tied to harvested Golden TSA timber. None of the harvesting, silviculture and processing employment associated with Downie's Golden TSA tenure timber resided in the Golden TSA during this period. This situation arises because the transportation connections to Downie's harvesting areas are to Revelstoke and not to Golden.

The following table presents data on Downie's recent Golden TSA harvest and annual forest industry employment supported by this harvest. Almost all of this employment resides in the Revelstoke area.

[17] As of Nov. 10, 2008

[18] Based on Golden TSA timber processed at L-P's Golden operations.

[19] Including harvesting, planning, administration, log hauling, road building, silviculture, and cedar sawmilling and value-added manufacturing operations.

Table 22 Downie Timber Ltd. annual average Golden TSA Forest Licence harvests and employment (2005-2007)

Harvest	**Timber volume (m3)**
AAC Commitment	51 315
Annual average billable harvest, 2005 -2007	39 399
2008 billable harvest (as of Nov. '08)	21 339
Employment (2005-2007)	**Person-Years (PYs)**
Harvesting, planning & administration	12.1
Log transport	10.4
Road construction & maintenance	2.9
Ferry & camp	2.2
Silviculture	3.2
Timber processing (in Revelstoke)[20]	25.9
Total	**56.7**

Source: Survey of licensees, author's calculations and MOFR

BC Timber Sales (BCTS)

BCTS has been apportioned 21.8% of the TSA's AAC, 105 912 m3. The BCTS harvest in the TSA averaged 52 866 m3 over the past three-year period. This average was raised by a 2007 harvest of approximately 100 000 m3.

In 2006 the BCTS harvest shifted into the pine dominated stands of the Ice River LU in the southern part of the TSA to help address its MPB issues. BCTS and Louisiana-Pacific have been targeting green and MPB affected pine stands in the southern part of the TSA. BCTS plans a road building program for 2009 in the Columbia West LUs where cedar-hemlock stands dominate and it intends to shift its harvest target there in 2010.

The following table presents data on BCTS's recent Golden TSA harvest and an estimate of recent annual forest industry employment in the Golden TSA supported by this harvest.[21]

Table 23 BCTS annual average Golden TSA Forest Licence harvests and employment (2005-2007)

Harvest	**Timber volume (m3)**
AAC Apportionment	105 912
Annual average billable harvest, 2005-2007	52 866
2008 billable harvest (as of Nov. '08)	56 680
Harvesting, planning & administration	13.2
Log transport	6.4
Road construction & maintenance	3.4
Development	2.6
Silviculture	1.0
Timber processing (in Golden)	22.9
Total	**49.5**

Source: BC MOFR and author's calculations

Other Wood Products Manufacturing

There are several smaller wood product companies that have started in the Golden area in recent years that either manufacture or construct timber frame or log buildings, building components and architectural features. All purchase logs and with the current round of mill shutdowns and production cutbacks experience difficulties in sourcing suitable timber for their operations. Although individually small businesses, in total they represent a significant source of employment and entrepreneurial energy in the local economy. The four largest are the following.

- Canadian Timber Frames Ltd. – manufactures timber frame building components, buildings and architectural features from high grade Douglas fir logs that it purchases from licensees and private landowners. The company was established in 1999 and employs 15 to 20 persons.

[20] Based on Golden TSA timber processed at Downie's Revelstoke operations

[21] The BCTS employment estimate was made with the employment per m3 co-efficients calculated from the forest licensee survey data. The Downie and L-P employment figures reported in Tables 1-6 and 1-7 are based on survey data.

- International Timberframes Inc. - manufactures timber frame building components, houses and architectural features from high grade Douglas fir logs that it purchases from licensees and private landowners. The company was established in 2003 and employs 6 to 10 persons.
- Dogtooth Log & Timber Ltd. – constructs log and timber frame homes, manufactures log and timber frame building components, and mills logs for itself and customers in its small band saw operation. The company purchases logs from licensees and private landowners. The company was established in 2001 and employs 10 to 15 persons.
- Suddwick Homes International Ltd. - manufactures log and timber frame buildings using timber frame components from Golden-based Canadian Timber Frames and peeled and dried logs from a supplier outside the Golden TSA. The company employs approximately 20 persons and has recently begun installing geothermal and solar thermal energy systems.

7.3.4 Forest sector employment and employment co-efficients

The average total direct forest industry employment supported by Golden TSA harvested timber over the 2005-2007 period is 330 PYs in the TSA and 492 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total[22] employment of approximately 834 PYs in recent years.

Table 24 presents estimates of annual employment supported by the 2005-2007 Golden TSA harvest broken down by forest industry activity. Employment is reported as an annual average and as the intensity of employment per '000 m3 of harvested timber. The latter figure is used to calculate potential employment impacts of alternative timber supply scenarios. The average employment levels and coefficients are reported at TSA and provincial levels.

Table 24 Golden TSA timber employment estimate (2005-2007)

Activity	TSA		Province	
	Employment (PYs)	**Employment Coefficient [23] (PYs/'000 m3)**	**Employment (PYs)**	**Employment Coefficient (PYs/'000 m3)**
Direct employment				
Harvesting[24]	153	0.37	206	0..50
Timber processing[25]	178	0.43	285	0.69
Total direct employment	330	0.80	492	1.19
Indirect/induced employment[26]	109	See footnote[27]	342	See footnote[28]
Total employment	439	NA	834	NA

Source: survey of licensee's and author's calculations

[22] Total employment is comprised of direct, indirect and induced employment. Direct employment estimates come from a survey of licensees. Indirect and induced employment estimates are calculated with the aid of multipliers developed by BC Stats, which uses its input/output model and 2001 census results to estimate local and provincial multipliers. For more explanation about the estimates see the Appendix entitled, Socio-Economic Analysis Background Information.

[23] The direct employment co-efficients are calculated from a survey of Forest Licence holders undertaken by the author for this project. The licensees supplied data for the 2005-2007 period.

[24] Includes harvesting, log salvage, log scaling, log transportation, road building and maintenance, harvest planning and administration, silviculture site preparation, planting, spacing, fertilization, pruning and silviculture planning.

[25] Includes management and administration as well as facility operations

[26] Indirect employment arises from the purchases of goods and services by forest industry companies, an example would be the purchase of timber harvesting equipment by a logging company. Induced employment arises from purchases of goods and services by forest industry employees, an example would be their grocery purchases.

[27] The local indirect/induced multiplier for timber harvesting is 1.26 and for "Other Wood Processing" (i.e. not pulp & paper manufacturing) it is estimated as 1.39. The indirect employment co-efficients were sourced from BC Stats and are based on 2001 Census employment data.

[28] The BC local indirect/induced multiplier for timber harvesting is 1.93, for pulp & paper manufacturing it is 2.29 and for "Other Wood Processing" (i.e. not pulp & paper manufacturing) it is estimated as 1.94. The BC level indirect/induced employment co-efficients were calculated based on BC Stats data in a publication entitled British Columbia Provincial Economic Multipliers and How to Use Them.

The residency of harvesting employment varies by licensee. An estimated 95% of Louisiana-Pacific generated harvesting employment resides within TSA boundaries whereas none of the Downie Timber generated harvesting employment resides in the Golden TSA. The majority of silviculture employment resides outside of the TSA, 75% in the case of Louisiana-Pacific generated employment and 100% in the case of Downie Timber, because silviculture workers belong to mobile planting crews. Almost 100% of Louisiana-Pacific's employment at its plywood and LVL plants in Golden is thought to reside in the TSA. Downie's cedar sawmill and value-added plant are located in Revelstoke, and none of its employees reside in the Golden TSA.

Golden TSA licensees are responsible for basic silviculture (i.e. establishment of a free-growing stand) on areas harvested under major licences. BC MOFR is responsible for silviculture on areas harvested by BCTS award holders and on backlog not satisfactorily restocked (NSR) areas. If an area is harvested in the early summer, planning and site preparation work will often occur in the fall and planting in the following spring.

The forest sector employment estimates do not include BC MOFR employment in the TSA[29]. Golden TSA, along with Revelstoke TSA, is part of the Columbia Forest District. The Columbia District Office is located in Revelstoke but there is a Field Office in Golden, which has a 4 person staff as of December 2008.

7.3.5 Forest sector employment income

On a province-wide basis, in recent years, the Golden TSA harvest supported an estimated average annual total employment income of $38.7 million; $25.2 million of direct forest industry employment income and $13.5 million of indirect and induced employment income.

The employment income contribution of the forest industry is high in part because of the industry's relatively higher income levels. Results in Table 25 suggests that there is about $41 000 of forest industry direct employment income in the Golden TSA per '000 m3 of harvested Golden TSA timber.

Table 25 Golden TSA timber supported employment income estimates and employment income coefficients (2005-2007)

Activity	Employment (PYs)	Annual income per PY[30] ($)	Total employment income[31] ($million)	Employment income co-efficient ($/'000 m3)
Direct employment				
Harvesting	153	53 872	8.2	19 933
Timber processing	178	49 036	8.7	21 085
Sub-total direct employment	330		16.9	41 018
Indirect/induced employment	109	39 572	4.3	10 443
Total employment	439		21.2	51 461

Source: Statistics Canada and author's calculations

7.3.6 Provincial government revenues

There are three main sources of BC Government revenues from the forest sector as follows.

- Stumpage[32] – The average Golden TSA stumpage was $8.33/ m3 over the 1998-2007 decade, $9.81/ m3 in more recent times (2005-2007) and a much lower level in 2008 of $4.72/ m3. There is a noticeable difference in per cubic meter revenues between Forest Licence and BCTS timber. The average revenue for Forest Licence timber over the 2005-07 period was $6.51 per m3 whereas the average for BCTS timber was $36.62 per m3.

[29] Ministry of Forests employment is not included as part of direct forest industry employment because it is related to administration and statutory requirements and not to timber harvest levels and would not be affected by marginal timber supply changes. MOF employees are accounted for in the public service sector employment estimates reported in Section 1.2.2.

[30] Sourced from Statistics Canada, CANSIM Table 281-0027, based on 2007 average weekly earnings by 4-digit NAICS code industry

[31] Province-wide basis

[32] Includes BC Timber Sales revenues

- Other forest industry taxes and fees – This category includes harvesting rents and fees, SLA export border tax (only in effect since fiscal 2006/07), logging taxes, and export fee in lieu of manufacture against exported logs. The 2007-08 average for the province was $4.67 per m3, mostly made up of revenues from the Export Border Tax. The province collects other revenues from forest industry companies such as corporate taxes, sales tax, gas tax, and Workers Compensation Board premiums paid by forest industry employers. A per m3 estimate of total revenues other than stumpage revenues[33] from 1999 is a unit cost total[34] of $11.42 per harvested m3. This figure was not used to create an estimate in this report because it does not reflect recent experience in the BC Interior forest industry.
- Provincial income taxes and sales taxes – Forest industry employees and employees in the industry's indirect and induced sectors pay sales taxes on their personal purchases and provincial income taxes.

The BC Government collected annual revenues of an estimated $5.3 million on average over the 2005-2007 period from stumpage and other forest industry taxes and fees[35] from the TSA's harvest. It also collected an estimated $4.2 million in BC income and sales taxes from employment tied to the harvest and processing of Golden TSA timber.

Table 26 Certain BC Government revenues derived from the Golden TSA timber harvest (2005-2007)[36]

BC Government revenue source	Est'd avg. annual revenues ($million)	BC Govt. revenue co-efficient ($/'000 m3)
Stumpage	3.4	8 330
Other forest industry taxes	1.9	4 670
Employment income & employee sales taxes	4.2	10 057
Total revenues	9.5	23 057

7.4 Socio-economic implications of the base case harvest forecast

7.4.1 Introduction

The socio-economic analysis focuses on harvest level changes in the short- to medium-terms (0 – 30 years). Economic impacts are gauged by comparing economic activity that could be supported by the current AAC with activity that could be supported by the base case harvest forecast. Actual harvest levels drive economic impacts, although for the past several years, they have fallen below the TSA's AAC level. Therefore, employment estimates based on AAC timber volume are expressions of possible future forest industry activity and not the likely activity.

The base case timber supply forecast is 513 000 m3. This level is maintained for 25 decades. The volume of 513 000 m3 is 5.8% higher than the current AAC of 485 000 m3 and approximately 25% greater than the average TSA harvest level over the 2005-07 period.

A sensitivity analysis that divided for base case harvest along north and south lines attributed 462 000 m3 to the south portion of the TSA, and 51 000 m3 to the north part.

[33] Unit costs for each tax item were obtained from PriceWaterhouseCoopers (2000) The Forest Industry in British Columbia 1999

[34] Removing Workers Compensation Board premiums reduces the unit tax cost to $6.95 per m3.

[35] Defined as including SLA export border tax (only in effect since fiscal 2006/07), logging taxes, and export fee in lieu of manufacture against exported logs.

[36] The table does not include estimates for all sources of BC Government revenues that is tied to Golden TSA timber. For example, corporate tax and gas tax revenues have not been estimated.

7.4.2 Short- and Medium-term implications of alternative harvest levels

There is a slight difference in potential economic activity over the short- and medium-terms between the current AAC and the base case forecast because of the higher timber supply of the latter. The base case harvest forecast of 513 000 m3 will extend over the short- and medium- terms and could annually generate the following key economic impacts.

- estimated 545 PYs of total employment and $26.4 million of employment income in the Golden TSA
- estimated 1 035 PYs of total employment and $48.1 million of employment income in the province
- estimated $4.3 million of stumpage revenues, $2.5 million of other forestry taxes and fee revenues and $5.2 million of BC income and sales taxes from employment tied to the harvest and processing of Golden TSA timber.

7.4.3 Requirements of BC timber processing facilities

The higher available timber supply is good news for timber processing facilities that rely on Golden TSA wood fibre. It could form the basis of more capacity as current capacity is based on a lower harvest but decisions on changes in new production investment are made on the basis of considering many factors, timber supply being only one, albeit an important consideration.

7.4.4 Golden TSA level impacts

The DFAM base case timber supply of 513 000 m3 will not lead to impacts on the regional economy in the short-term because recent annual harvest levels are well below the current AAC, excepting the 2007 harvest. There would be significant job gains for the region in the event that the TSA harvest rises above its current levels and approaches the AAC level. Timber harvesting and processing in the Golden area is mainly constrained now and for the foreseeable future by weak end market demand for the products of the wood processing operations that Golden TSA timber feeds into, and not by the TSA's AAC level.

7.4.5 Regional timber supply implications

The base case timber supply will contribute to regional timber supply stability as Downie Timber directs its Golden TSA harvest to its Revelstoke operations and there is a significant volume of log movement in and out of the TSA because of the higher grade Douglas fir requirements of the Louisiana-Pacific operation in Golden, the nearby location of a SPF mill at Radium and the cedar-focused mill and value-added plant in Revelstoke.

7.4.6 Summary Comparison Table

Estimated employment, employment income and BC Government revenue impacts based on harvesting the base case harvest forecast appears in Table 27, along with figures for the current AAC and the 2005-07 average billable harvest.

7.5 Summary

The TSA's population shrunk slightly over the past decade while the provincial numbers climbed by 11.5%. The local population is aging but the economy is adding tourism related jobs. The forest industry's share of TSA employment has held fairly steady, although the mix has changed with fewer harvesting jobs and more in timber processing. A few small timber frame-focused companies have emerged in Golden since the turn of the century. Significant forces in the local economy have been the continuing transformation of the local ski hill since 1997 into a four season destination resort and the underway billion dollar Kicking Horse Canyon highway infrastructure project.

The Chief Forester set the current AAC of 485 000 m3 effective June 1, 2004, which is 45 000 m3 lower than the previous AAC of 530 000 m3 (that became effective in January 2000). Under the current AAC apportionment, replaceable forest licences account for 73.1% of the apportionment of the AAC. Louisiana-

Pacific Canada has the TSA's largest commitment, 303 466 m3 (attached to its two replaceable forest licences), accounting for 62.6% of the AAC.

Table 27 Estimated socio-economic impacts of implementing the base case harvest forecast

	Base Case harvest forecast	**Current AAC**	**2005-2007 Average harvest**
	m3	*m3*	*m3*
Annual timber supply	513 000	485 000	413 044
Golden TSA			
Employment	*PYs*	*PYs*	*PYs*
Direct	410	388	330
Indirect/induced	135	128	109
Total	545	516	439
Employment income	*$ millions*	*$ millions*	*$ millions*
Direct	21.0	19.9	16.9
Indirect/induced	5.4	5.1	4.3
Total	**26.4**	**25.0**	**21.2**
British Columbia			
Employment	*PYs*	*PYs*	*PYs*
Direct	610	577	492
Indirect/induced	425	402	342
Total	1 035	979	834
Employment income	*$ millions*	*$ millions*	*$ millions*
Direct	31.3	29.6	25.2
Indirect/induced	16.8	15.9	13.5
Total	48.1	45.5	38.7
BC Government revenues	*$ millions*	*$ millions*	*$ millions*
Stumpage revenues	4.3	4.0	3.4
Other forest industry taxes & fees	2.5	2.4	2.0
BC income & sales tax revenues	5.2	4.9	4.2
Total	**12.0**	**11.3**	**9.6**

The Golden TSA's billable harvest has been consistently below its AAC in recent years, approximately 80% of the AAC for the five-year 2002-2007 period. The gap between harvest and AAC arises from current weakness in end product markets of the timber processing plants that Golden TSA timber feeds into and relatively higher harvesting costs and some decadent timber stands in certain northern areas of the TSA.

The average total direct forest industry employment supported by Golden TSA harvested timber over the 2005-2007 period was 330 PYs in the TSA and 492 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total employment of approximately 834 PYs in recent years.

Several First Nations have traditional territory interests in the Golden TSA, and about 300 persons are of Aboriginal heritage, about 2% of its population, but there are no Indian Reserves or Aboriginal communities in the TSA. There are no Aboriginal owned forestry companies that are active in the TSA.

There is a slight difference in potential economic activity over the short- and medium-terms between the current AAC and the base case forecast because of the higher timber supply of the latter. The base case harvest forecast of 513 000 m3 will extend over the short- and medium- terms and could annually generate the following key economic impacts.

- estimated 545 PYs of total employment and $26.4 million of employment income in the Golden TSA
- estimated 1 035 PYs of total employment and $48.1 million of employment income in the province
- estimated $4.3 million of stumpage revenues, $2.5 million of other forestry taxes and fee revenues and $5.2 million of BC income and sales taxes from employment tied to the harvest and processing of Golden TSA timber.

The potential increase in economic activity associated with the base case forecast compared to the current AAC is as follows.

- estimated 29 PYs of total employment and $1.4 million of employment income in the Golden TSA
- estimated 56 PYs of total employment and $2.6 million of employment income in the province
- estimated $0.3 million of stumpage revenues, $0.1 million of other forestry taxes and fee revenues and $0.3 million of BC income and sales taxes from employment tied to the harvest and processing of Golden TSA timber.

8.0 Conclusions

This analysis report presents a harvest flow with a stable short-, mid- and long-term timber supply under the current practice (or Base Case) scenario. The current practice scenario shows the current AAC (485,000 m3/yr) can be increased to and maintained at 513,000 m3/yr for an indefinite period.

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecast, a series of sensitivity analyses were completed. The short-term harvest levels (decades 1 and 2) and long-term harvest levels (decades 9+) were sensitive to several of the factors that were examined in the sensitivity runs.

Factors that impacted the short term harvest levels by at least 3% were:

- changes to existing natural stand yields, and
- removal of class A seed volume gains (genetic gain/genetic worth) from managed stands

Factors that impacted long-term harvest levels by at least 3% were:

- changes to the size of the timber harvesting land base (±10%),
- changes to future managed stand yields (±10%),
- changes to minimum harvest ages (-10yrs),
- minimum harvest ages based only on attaining a minimum volume.
- removal of class A seed volume gains (genetic gain/genetic worth) from managed stands

Other, non-standard scenarios were completed to determine which other factors were significantly influencing the Base Case harvest projections, which were responsible for the differences between the TSR3 and TSR4 Base Case harvest projections, or to answer local questions-of-interest.

The major factors contributing to the increased harvest projection in this analysis is the switch to PEM-based UWR management objectives, which have reduced cover constraints, and the increased genetic gain values predicted for spruce, fir, pine and larch regeneration. Overall, the factors which provided upward pressures on the harvest forecast were more influential than the significant reduction in THLB, which was largely associated with the “spatializing” of the biodiversity and caribou requirements.

All short-term harvest projections within all the sensitivity runs are above or equal to the current AAC. Harvest projections for the mid- and long-term are generally at or above the current AAC. The notable exceptions are the two sensitivities that significantly reduced the managed stand yields, i.e. a 10% reduction in managed stand yields, and the removal of all genetic worth for all planted stock.

The magnitude of the long-term harvest level is significantly influenced by the timber availability in the 13^{th} and 14^{th} periods and by other “pinch-points” in periods 30+. The lateness of the pinch points, and the absence of a mid-term depression in the harvest flow both indicate that the transition from natural stands to managed stands is not the most significant limitation to the harvest level.

Cover requirements associated with non-timber objectives influence the base case harvest flow. Cover requirements interact with the age class structure to limit the availability of timber over the planning horizon. Without requirements to limit disturbance and/or maintain older stands on the land base, more timber would be available for harvest in the pinch points. The cover requirements for visual quality objectives (VQOs) have the most influence (limitation) on harvest flow, followed by ungulate winter range (UWR) and green-up requirements (for both IRM- and ERDZ-type green-up). The latter factors are significantly less influential in limiting the harvest than the VQOs.

The Golden TSA is unique in that a high proportion of the cover requirements for biodiversity, caribou and domestic watersheds (as modeled in TSR3) have been translated into spatially-identified reserves (in TSR4). The trend of fewer cover requirements expressed as minimum older-seral requirements, and conversely the trend to expressing these requirements as landbase reductions has led to a new balance in terms of the factors that are most controlling the harvest flow.

In TSR3 the harvest projections were much more influenced by forest cover requirements to meet objectives of biodiversity, UWR, etc. The harvest projections in TSR4 are much more limited by the growth rate of the forest, which is associated with factors such as the total area of THLB, and the yield-curves with their associated minimum harvest ages, genetic worth, regeneration delays, etc.

The interplay of factors and their tradeoffs is complex. For example, our results indicate that the spatializing of the biodiversity and caribou older seral requirements has been a net downward pressure on harvest flow. However, when all the factors are combined the result is an increase in the mid- and long-term harvest levels projected in TSR4 compared to those projected in TSR3.

References

BC Ministry of Forests (March 2003) BC Heartlands Economic Strategy - The Forestry Revitalization Plan.

BC Ministry of Forests and Range, Economics and Trade Branch (August 2008) Major Primary Processing Facilities in British Columbia, 2006.

BC Ministry of Forests and Range, Forest Analysis Branch (August 2003) Golden Timber Supply Area Analysis Report.

BC Ministry of Agriculture and Lands (2007) Guidelines for Socio-Economic and Environmental Assessment.

Golden Area Initiatives (2008) Kicking Horse Country Community Profile.

Golden Interagency Committee Technical Committee (December 2002) Golden Backcountry Recreation Access Plan. Prepared for BC Ministry of Sustainable Resource Management and Backcountry recreation Stakeholders of Golden.

Horne, Garry (undated) The Forest District Tables. Available at http://www.for.gov.bc.ca/HET/tsr_sea/index.htm

Horne, G. (January 2004) British Columbia Local Area Economic Dependencies and Impact Ratios – 2001. BC Stats, BC Ministry of Finance and Corporate Relations.

Horne, G. (2007) British Columbia Provincial Economic Multipliers and How to Use Them. BC Stats.

Izett, Al. (October 2007) The Trans-Canada Highway's Kicking Horse Canyon. A Project Update, and the Road Ahead.

Jackie Hamilton & Associates (September 2008) Major Projects Inventory. BC Ministry of Technology, Trade and Economic Development.

MacLauchlan, L., 2006. Determining susceptibility of young pine plantations to the mountain pine beetle Dendroctonus ponerosae, and manipulating future stands to mitigate losses. Forest Investment Account (FIA project Y0610003) – Forest Science Program. Ministry of Forests and Range.

Meidinger, Del and Jim Pojar, eds. 1991. Ecosystems of British Columbia. BC Ministry of Forests, Special Report Series 6, February 1991.

Pederson, Larry (2004) Golden Lillooet Timber Supply Area, Rationale for Allowable Annual Cut Determination, Effective June 1,2004. BC Ministry of Forests and Range.

Pheidias Project Management Corporation (December 2008) Kicking Horse Mountain Resort Master Plan 2008. Prepared for Kicking Horse Mountain Resort Partnership.

Pierce Levebvre Consulting (December 2008) Central Kootenay Region Timber Harvesting & Processing Employment Survey. Prepared for BC MOFR and BC MAL.

PriceWaterhouseCoopers (2000) The Forest Industry in British Columbia. 1999.

Wood River Forest Inc. (undated) Forest Stewardship Plan Forest Licence A17644 2006-2011.

Appendix A – Data Inputs and Modeling Assumptions

LIST OF TABLES

1.0 Introduction

1.1 Purpose

"Appendix A" is a duplication of most of the information in the Timber Supply Analysis Data Package report that was previously published and reviewed by the public and First Nations. The key purpose of Appendix A (or the Data Package) is to:

- provide a detailed account of the land base, growth and yield, and management assumptions related to timber supply that the chief forester must consider under the *Forest Act* when determining an allowable annual cut (AAC) for the Golden TSA and how these were applied and modelled in the timber supply analysis;
- provide a means for communicating data inputs and analysis methodology among licensees, MoF, ILMB, and MoELP staff, and other users;
- provide the evidentiary basis for the information used in the analysis.

1.2 Changes Made to the July 18th Data Package

A number of changes were made to the July 18 2008 version of the Data Package in response to comments received during the Public and First Nations Review. These are:

- Genetic worth values for Douglas-fir were missing from the TIPSY input data file. This was corrected, and that change influenced the
- The managed stand yield table volumes, and
- The minimum harvest ages for managed stands.

All changes are reflected in the final version of the Golden TSR4 Timber Supply Analysis Data Package, dated November 22, 2008.

1.3 Data Sources

Many resource inventories are used in the modeling process. These are summarized in Table 1. Their use is briefly described after the table.

Table 1 Resource inventories

Data file	Inventory	Source, Date	Comments / Source
Dgo_arc	Archaeology sites	Archaeology Branch, Victoria, Feb 14, 2008	Known archaeological sites
Dgo_blk	Cutblocks	Forest licensees, March 2008.	Recently logged, and planned cutblocks
Dgo_car	Caribou – HLPO	ILMB, Feb14, 2008	HLPO spatially mapped caribou areas.
Dgo_ca1	Caribou – HLPO	KSDP ftp site, Feb 09 2008	HLPO caribou habitat.
Dgo_con	HLPO Connectivity	KSDP ftp site, Feb 09, 2008	HLPO connectivity map
Dgo_dws	HLPO Domestic Watersheds	KSDP ftp site, Feb 09, 2008	For info only. Not used for analysis.
Dgo_erd	HLPO ERDZ	KSDP ftp site, Feb 09, 2008	HLPO enhanced resource development zones.
Dgo_esa	ESA	TSR3 data, circa 2002	Environmental sensitive area polygons; extracted from the pre-2002 forest cover maps
Dgo_fc	Forest cover	FAIB, Jan 1 2008.	Forest cover; projected and adjusted by FAIB staff.
Dgo_ga2	(Draft GAR) UWR	MoELP ftp site, Feb 14 2008	Draft ungulate winter range.
Dgo_lu	Landscape Units	KSDP ftp site, Feb 09 2008	
Dgo_nbe	Biogeoclimatic subzones	LRDW, Feb 09 2008	
Dgo_oar	Operating Areas	KSDP ftp site, Feb 09 2008	
Dgo_obo	BEO Assignments	KSDP ftp site, Feb 09 2008	Biodiversity emphasis options map; based on "old bec" ;
Dgo_ogm	OGMA; MOGMA	KSDP ftp site, Feb 09 2008	Old growth management areas (OGMA); Mature and old management areas (MOGMA)

Dgo_ope	Operability	Forest licensees, April 2008	2002 version operability; updated in 2008 by licensees.
Dgo_own	Parks and protected	LRDW, Feb 15 2008	Ownership classes. A consolidation for TSR4 of: LRDW Parks and protected, LRDW Woodlot licenses, TSR3 private land parcels, and LRDW CRA tenures (ski hill recreation area/reserve).
	Private lands	TSR 3, 2000	
	Ski Hill reserve	MoF staff, April 2008	
	Woodlot licenses	LRDW, Feb 15 2008	
Dgo_pob	POD Buffers	Derived for TSR4, May 2008	Buffers around streams for HLPO defined distances above consumptive use points of diversion (POD);
Dgo_psb	PSP reserves	LRDW, Feb 05 2008	Reserves around permanent sample plots
Dgo_rdb	Road Buffers	Derived for TSR4, April 2008	Compilation of licensee road data; buffered by GIS.
Dgo_rib	Riparian Buffers	Derived for TSR4, June 2008.	Derived FRPA S-class based on a correlation of the FDIS fisheries field samples with GIS-based upstream stream length; then buffers generate by a GIS.
Dgo_rst	Logged areas	RESULTS, Feb 12 2008	Block footprints (helps identify logged areas)
Dgo_sar	SaRCO Caribou	SaRCO ftp, Jul 11 2008	Species at Risk Coordination Office “incremental” caribou
Dgo_ter	Overview terrain	Compiled for TSR4, Licensee data, June 2008	Slope stability ratings; a compilation of all the available overview terrain mapping projects
Dgo_vqo	VQO	KSDP ftp site, Feb 09, 2008	Visual Quality Objectives (VLI)
Dgo_wtp	Wildlife Tree Patches	Licensee data, April 2008	Compilation of licensee data

Notes:
Dates are often the download date, because source data has a range of updates, or no production date was available.
LRDW = Land and Data Warehouse
KSDP = Kootenay Spatial Data Partnership ftp site.
This data has been made available for review to the staff of government ministries/branches of MoF, MoE and ILMB.

2.0 Timber Harvesting Land Base

2.1 Landbase Definitions

There are three major landbase classifications of interest in this analysis: gross, productive and timber harvesting landbase. The gross area modeled in this analysis includes Parks and non-park lands (Table 2). The productive landbase contributes to landscape level objectives for biodiversity and non-timber resource management. The productive land base excludes water, non-forest and non-productive types. The timber harvesting land base (THLB) is that portion of the productive landbase where timber harvesting occurs. It excludes areas that are inoperable or uneconomic for timber harvesting; areas set aside for other resources; or areas otherwise off-limits to timber harvesting. Estimates are made for both existing and future reductions to the THLB.

Table 2 Total area of Golden TSA

Geographic Area	Gross Area (ha)
Parks and protected	290,917
Non-park	893,694
Total Area modeled	1,184,611

Table 3 presents the individual reductions to the gross area of the Golden TSA to arrive at the Timber Harvesting Land Base (THLB), the area available for timber harvesting. Again, the statistics include some of the area of adjacent parks to allow complete coverage of the landscape units for the purpose of analyzing biodiversity management. No timber harvesting is allowed in the parks and protected areas during the timber harvest modelling.

Table 3 Base Case Timber Harvesting Land Base Area Netdown Summary

	Park Area (ha)	Non-Park Area (ha) (*)	Total Area (ha)	Percent Of Total Area (%)	Percent Of Productive Area (%)
Total land base	**290,917**	**893,694**	**1,184,611**	**100.0**	
Reductions					-
Private, Woodlots, non-contributing administrative classes	0	22,975	22,975	1.9	
Non-forest, non-productive forest	202,630	522,253	724,883	61.2	
Roads, trails, landings	60	4,016	4,076	0.3	
Total productive land base (*)	**88,227**	**344,449**	**432,677**	**36.5**	**100.0**
Reductions					
Parks and protected areas (**)	88,227	0	88,227	7.4	20.4
Inoperable	0	165,829	165,829	14.0	38.3
Unstable terrain (ESA & TSIL)	0	3,376	3,376	0.3	0.8
Non-merch (low site)	0	3,067	3,067	0.3	0.7
PFT (Hw and Decid)	0	5,548	5,548	0.5	1.3
Wildlife (caribou HLPO and SARCO)	0	8,348	8,348	0.7	1.9
Archaeological sites	0	0	0	0.0	0.0
Riparian	0	5,194	5,194	0.4	1.2
Biodiversity - WTRA	0	1,543	1,543	0.1	0.4
Biodiversity – OGMA and MOGMA	0	9,910	9,910	0.8	2.3
Permanent sample plots	0	105	105	0.0	0.0
Total Reductions	88,227	202,920	291,147	24.6	67.3
Current Timber Harvesting Land Base	**0**	**141,530**	**141,530**	**11.9**	**32.7**
Future WTPs	0	652	652	0.1	0.2
Future roads and trails	0	2,516	2,516	0.2	0.6
Net long-term Timber Harvesting Land Base	**0**	**138,362**	**138,362**	**11.7**	**32.0**

Note:
1. All totals are subject to rounding.
2. (*) Park area is included for biodiversity modeling of the productive landbase. Totals below (**) do not include any of this Park area.

Note that any overlaps between net-downs are removed in Table 3. Any overlap will accrue to the first (highest) category in the table. In subsequent sections the same netdown categories are discussed in more detail and both the gross and the non-overlapping areas are tabulated. The gross areas in subsequent tables may be greater than those in Table 3

2.2 Exclusions from the Crown Forested Landbase

2.2.1 Non-contributing administrative classes

Private (fee-simple) lands, municipal lands, and certain classes of reserves do not contribute to the productive forest landbase. These are summarized in Table 4.

Table 4 Non-contributing administrative classes

Class	Description	Total Area (ha)	Reduction Area (ha)
40-N	Private land	12,963	12,963
77-N	Woodlot Licenses	8,315	8,315
99-N	Golden ski hill reserve	1,697	1,697
Totals		**22,975**	**22,975**

2.2.2 Non-productive and non-forest area

Non-productive forest land is not capable of producing a merchantable stand within a reasonable length of time. This includes alpine forest, non-productive land covered with commercial species, deciduous and/or coniferous.

Non-forest areas are "*not primarily intended for growing or supporting forest. This includes alpine, rock, slide, non-productive burn, non-productive brush, swamp or muskeg, cultivated, cleared, urban, open range, wild hay meadow, clay bank, gravel bar, and other categories.*" (MoF, 2007).

All non-productive and non-forest stands are removed from both the THLB, and the CFLB. These stands do not contribute to meeting the requirements for biodiversity or other non-timber resources (see the Resource Management sections).

These stands are identified in a FIP-type forest inventory database with a non-productive code value greater than 0 [np_code > 0]. The remaining forest inventory is the newer VRI-type that no longer has non-productive codes assigned. The productive stands have been estimated using the following logic:

- trees must cover a minimum of 10% of the polygon; and
- crown closure must be greater than 25%; and
- site index must be greater than or equal to 8.0 meters.

The area of landbase reduction for each criterion is summarized in Table 5.

Table 5 Non-productive and non-forest area exclusions

Descriptor	Forest Cover Inventory Type	NP Code	Gross area (ha)	Effective reduction Area (ha)
Ice	FIP	1	9,573	9,573
Alpine	FIP	2	72,753	72,753
Rock	FIP	3	768	768
Alpine Forest	FIP	10	9,560	9,560
Non Productive Brush	FIP	11	1,894	1,894
Non-Productive	FIP	12	26,065	26,065
Lake	FIP	15	363	363
River	FIP	25	531	531
Swamp	FIP	35	993	993
Cultivated	FIP	42	6	6
Urban	FIP	54	42	42
VRI – non treed	VRI	n/a	519,514	514,960
VRI – Low cc	VRI	n/a	65,404	63,598
VRI – SI < 8	VRI	n/a	23,808	23,776
Total	--		**731,274**	**724,883**

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.2.3 Non-commercial cover

Non-commercial cover is any "*Productive forest land covered with non-commercial tree species or non-commercial brush*." (MoF, 2007) This is identified in the FIP-type forest cover database as [type identity = 5]. VRI-type forest cover does not have type identify values assigned. All non-commercial stands are removed from the THLB. As well, these stands do not contribute to meeting the biodiversity or other non-timber resource requirements (section 7.0).

There are no NC stands identified in the FIP inventory. This section was included for completeness only.

Table 6 Non-commercial cover

Category	Total Area (ha)	Reduction Area (ha)
Non-commercial	0	0

Non-commercial class is only found within the FIP-type forest inventory (approximately 15% of the gross area).
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.2.4 Roads trails and landings

A small proportion of the roads may be large enough to be typed as non-forest polygons on the forest cover map. However, these classified roads, trails and landings are not identified as roads per se; they are usually lumped with other non-forest types such as "urban". Classified roads, trails and landings are, therefore, a portion of the non-forest reductions in Table 3.

2.2.5 Unclassified roads, trails and landings

Most of the roads, trails and landings (RTL) are too narrow to be typed out as polygons in the forest inventory map. These roads are referred to as unclassified. The landbase reduction for unclassified roads was performed by determining an average disturbance width for three classes of roads: 28 m (14 m. each side of centerline) for paved roads, 0 m for trails, and 14 m (7 m. each side of centerline) for all other non-paved and non-trail road type, and then buffering the roads in the GIS. The buffers then were used as landbase netdowns, as per Table 7.

These three road classes correspond to the three classes used in TSR3. However, in TSR3 the analysts assumed that paved roads likely fell on non-forest polygons in the forest inventory, and so no accounting for paved roads was done in TSR3. The road database used in this analysis contained few roads classified as paved, most of these were municipal roads within the city of Golden, so the vast majority of roads in this analysis are "other roads" (Table 7).

Table 7 Reductions for unclassified roads, trails, and landings

<table>
<tr><th>(1)
Road
Type</th><th>(2)
Road Width
(m)</th><th>(3)
Reduction
(%)</th><th>Road
Length
(km)</th><th>Gross
area
(ha)</th><th>Effective
reduction
area (ha)</th></tr>
<tr><td>Paved roads</td><td>28</td><td>100</td><td rowspan="2">4915</td><td rowspan="2">6,314</td><td rowspan="2">4,076</td></tr>
<tr><td>Other roads</td><td>14</td><td>100</td></tr>
<tr><td>Trails</td><td>0</td><td>0</td><td>1315</td><td>0</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Totals</td><td>-</td><td></td><td>6230</td><td>6,314</td><td>4,076</td></tr>
</table>

Width is total buffer width, e.g. 14m represents 7m on each side of the road centreline.
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

The landbase reduction for future roads, trails and landings is described in section 2.3.11.2.

2.3 Exclusions from the Timber Harvesting Land Base

2.3.1 Parks and Protected Areas

The reduction area of parks and protected areas is summarized in Table 8.

Table 8 Reductions for parks and protected areas

Classification	Productive Forest Area (ha)	Effective Reduction Area (ha)
Parks and Protected	290,917	88,227

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.2 Inoperable / Inaccessible

Area that is not available for timber harvesting due to physical, silvicultural or regeneration difficulties, and economic inaccessibility is classified as "inoperable". Three classes exist in the operability inventory: inoperable, denoted as "I" (Inoperable) or "N" (non-classified, within Parks) and operable (denoted as "A"). The area of classes "I" and "N" are treated as landbase reductions, as per Table 9.

Table 9 Inoperable land base reduction

Classification	Productive Forest Area (ha)	Effective Reduction Area (ha)
I, N	960,242	165,829

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.3 Unstable terrain and environmentally sensitive areas

Environmentally Sensitive Areas (ESA's) are a broad classification of areas that indicate sensitivity for unstable soils (E1s), forest regeneration problems (E1p), snow avalanche risk (E1a), and high water values (E1h). The ESA classification was originally part of the forest cover inventory. The ESA polygons were copied from the forest cover to a separate map, and the map is essentially unchanged from the original forest cover data.

Where completed the ESA soils mapping has been replaced with Terrain Stability mapping. The new terrain mapping was available for 97.1% of the CFLB, the ESA mapping was used on the remaining 2.9%. This terrain mapping is a composite of several projects, all of which utilized the RIC standards of that time (circa 1990's). Terrain stability mapping is thought to provide a better estimate of unstable soils than the Es1 mapping, and is used in this analysis for the bulk of the unstable landbase netdown. Where not available, the ESA cover is used to identify landbase netdowns (Table 10).

The landbase reduction for unstable terrain was based on the profile of unstable (class U) and potentially unstable (class P) in the harvest. Analyses were made of the percentage of U and P class terrain classes within the harvest profile of three periods: the last 30 years (for most of the TSA), and for the last 10 years and 5 years. These latter two were for a smaller portion of the TSA. They also excluded blocks that addressed MPB attack as those blocks usually fell on gentler terrain, and including them would bias the results. The analyses showed an increase in the percentage of U and P in the harvest over time, as we approach the present day. The results from the last 10 years were chosen to determine the netdown for unstable terrain. The following procedure was used:

- The profile of unstable (U) and potentially unstable (P) terrain classes within the operable, productive forest landbase was calculated as 5.3% and 18.5%, respectively;
- The harvest profile of U and P terrain classes within the last 10 years harvest is 3.6 and 32%, respectively;
- The harvest profile for the P class shows no avoidance of that class, so no reduction for P class terrain is required, nor applied;
- The harvest profile for the U class shows that 1.7% of the U is being avoided (a raw percentage which is calculated as 5.3 – 3.6 = 1.7). This represents 32% of the U profile (this is a percent of percent, i.e. 32% = 1.7% avoidance of U in the harvest profile / 5.3% of U in the landbase profile.)
- If the trend from this last 10 years continues, then we expect 32% of the U class polygons will not have been harvested after the whole THLB is developed. And, 32% is our best estimate of the landbase netdown for U class terrain.
- Using an equivalent area concept, 32% of the U class polygons were randomly chosen, and these polygons were treated as a landbase netdown.

The resulting landbase netdowns for unstable terrain and ESAs (where terrain mapping did not exist) are summarized in Table 10.

Table 10 Unstable terrain and environmentally sensitive sites

Description		Percentage Removal	Productive Forest Area (ha)	Effective Reduction (ha)
ESA Soils	S1	90	612	381
ESA Soils	S2	10	6	6
Unstable terrain	TSIL U	32	27,743	2,988
Total			**28,360**	**3,376**

ESA percentage removals are from TSR 3. The ESA classes in TSR3 included other types of ESA, such as avalanche-type ESAs but those types were not found within the area not covered by the new terrain mapping.
32%% of the unstable areas were removed, roughly consistent with field practices.
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown". By far, the majority of the unstable terrain class U polygons fall within the inoperable, so the effective reduction area is only a small portion of the total area of class U polygons.

2.3.4 Non-merchantable / low site and Problem Forest Types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume, or steep topography, or low stocking.

2.3.4.1 Non-merchantable / low site

Site class is "*The measure of the relative productive capacity of a site for a particular crop or stand, generally based on tree height at a given age*" (MoF 2007). Low site stands grow so slowly that they are not deemed to be suitable for forest production. The landbase reductions for low site stands are summarized in Table 11.

Table 11 Landbase reductions for non-merchantable, low site types

Class	Leading Species	Inventory Type Groups	Site index Or volume (m^3)	Age (years)	Productive area reduction (ha)	Effective area reduction (ha)
Low Productivity Site Index[1]	Spruce, Hemlock, Balsam	12-26	<= 8.0	Any	89,185	1,048
Low Productivity Site Index[1]	Fir, Cedar, Pw, Pl, Py, Larch, Decid	1-11, 27-42	≤ 9.0	Any	549,968	2,020
Total					639,154	3,067

[1] Not applied where stands have logging history and are within the operable.
"Effective reduction" is the area netted out after all previous netdowns are removed; this is sometimes referred to as the "non-overlapping netdown".

Table 12 provides estimates of the stand diameter and volumes at the upper limits of the low site classes. Note that Table 11 is a cut-off value for including/excluding stands in the THLB, and Table 12 is the volume and diameter expected at the same site index values at a reference age=100. If one varies the reference age then one can derive the same numbers as seen in Table 11. And, if the threshold values in Table 11 were varied then the minimum merchantability criteria will force changes in the minimum harvest ages.

Table 12 Non-merchantable forest types –diameter and volumes at threshold site index

Leading Species	SI Upper Limit	Diameter (cm) at breast Height (cm) at upper limit of low site	Volume/ha at upper limit of Low site (m3/ha)
Pine	≤ 9.0	17.4	94.4
Fir	≤ 9.0	23.1	17.3
Cedar	≤ 9.0	20.3	72.8
Spruce	≤ 8.0	21.2	44.8
Hemlock	≤ 8.0	22.8	56.0
Balsam	≤ 8.0	21.4	63.7

Notes: Upper limit d.b.h. and volume are based on a reference age of 100 years; FIZ G, and PSYU 175.

2.3.4.2 Problem Forest Types

In the Golden TSA the deciduous-leading (hardwood) stands are not considered economically viable. These and the older, high percentage hemlock stands were excluded from the timber harvesting land base (Table 13).

Table 13 Problem Forest Types

Class	Leading Species or Criteria	Inventory Type Groups	Site index Or volume (m^3)	Age (years)	Productive area reduction (ha)	Effective area reduction (ha)
Deciduous[1]	Any deciduous	35-42	n/a	> 30 yr	15,929	4,787
Hemlock	Hw (>= 80%)	12-17	n/a	141 +	4,247	761
Total					**20,176**	**5,548**

[1] Natural stands only, not applied to operable stands with a logging history.
"Effective reduction" is the area netted out after all previous netdowns are removed; this is sometimes referred to as the "non-overlapping netdown".

2.3.5 Wildlife: Caribou habitat

2.3.5.1 HLPO caribou habitat requirements

When the OGMAs were being mapped, the equivalent area of the HLPO requirements for caribou were also mapped. Where possible, areas were identified that met both objectives. Caribou areas are also managed as "no harvest" zones, and are therefore treated as landbase exclusions in this analysis. This contrasts with the previous timber supply review where the caribou requirements were modelled as percentage older forest requirements.

2.3.5.2 SARCO caribou habitat requirements

The Species At Risk Coordination Office (SARCO) recently identified caribou habitat areas that are additional to the HLPO caribou requirements. The SARCO area are also expected to be managed as "no harvest" zones, and therefore are modelled as landbase exclusions in this analysis. The area of HLPO and SARCO caribou habitat exclusions are summarized in Table 14.

Table 14 Caribou habitat landbase exclusions

Source of Caribou Habitat Mapping	Productive area (ha)	Effective reduction area (ha)
Caribou - HLPO Mature	20,426	6,157
Caribou - HLPO Old	2,595	1,834
Caribou - SARCO	507	356
Wildlife (Caribou) Total	**23,529**	**8,348**

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.6 Cultural heritage and Archaeological reductions

Archaelogical Overview (AOA) mapping has been completed for all of the TSA. As development proceeds, detailed archaeological impact assessments (AIA) are completed. To date, the area reserved from forestry activities for protection of heritage resources at the site-specific level has been very small. The area reduction does not significantly impact the timber supply analysis.

Maps of the registered archaeological and heritage sites were obtained from Archaeology Branch. There are 121 individual sites, most being very small, some only 1 square meter. Only those sites over 0.02 ha were incorporated into the data as the very small polygons would have simply been removed by the GIS during the sliver removal process. The gross area of archaeological sites was 14.3 ha (number of sites=55), with a final, effective reduction area of 0.09 ha (Table 15).

Table 15 Registered archaeological site reductions

Archaeological Sites (#)	Productive Area (ha)	Effective Reduction Area (ha)
55	13.82	0.09

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.7 Riparian reserves and management zones – streams

Riparian reserve strategies were implemented in the model by establishing effective reserve buffers around the riparian features inventories (streams, wetlands, lakes) using a GIS.

The HLPO specifies a 30 meter reserve around streams for a specified distance upstream of water intakes (also called points of diversion, or POD). The distance upstream is based on stream order. PODs were located, and the streams with reserves were mapped by hand, and GIS buffers created. The riparian exclusions for HLPO-type stream reserves are summarized in Table 16.

The remainder of the riparian reductions were based on Forest and Range Practices Regulation (FRPR) defaults. To implement this as a landbase net-down, an effective reserve width is determined by adding the effective retention width for the default management zone width to the reserve buffer and assuming it is a (100%) reserve-type buffer (Table 16).

Table 16 Riparian reserve zones – streams

Riparian Class	Riparian Reserve Zone (metres)	Riparian management Zone (metres)	Retention Level (% basal area)	Effective Reserve Width (metres)	Productive area (ha)	Effective area reduction (ha)
DWS Stream Reserves	30	0	100	30	451	92
S1a	0	100	20	20	4,798	279
S1b	50	20	20	54	10,187	2,003
S2	30	20	20	34	6,330	1,260
S3	20	20	20	24	4,015	776
S4	0	30	10	3	1,776	324
S5	0	30	10	3	754	63
Total					**28,312**	**4,798**

Notes: Based on FRPR Sec 47 to 51.
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.8 Riparian reserves and management zones – wetlands and lakes

The reserves and management zones for wetlands and lakes were handled the same way as the streams (above). Effective width landbase reductions are listed in Table 17 and Table 18.

Table 17 Riparian reserve zones –lakes

Riparian Class*	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)	Retention Level (% basal area)	Effective Reserve Width (metres)	Productive area (ha)	Effective area reduction (ha)
Rip L1b	10	0	10	10	2,917	28
Rip L3	0	30	10	3	698	3
Rip Lake total					**3,615**	**31**

Notes: Based on FRPR Sec 47 to 51
* The table only includes the lake classes that occur in the TSA and require riparian reserves (e.g. class L1A do not).
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

Table 18 Riparian reserve zones - wetlands

Riparian Class*	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)	Retention Level (% basal area)	Effective Reserve Width (metres)	Productive area (ha)	Effective area reduction (ha)
W1	10	40	10	14	4,450	290
W3	0	30	10	3	866	75
Total					5,316	365

Notes: Based on FRPR Sec 47 to 51
* The table only includes the wetland classes that occur in the TSA.
"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.9 Biodiversity

2.3.9.1 Biodiversity – Wildlife Tree Retention Areas

Reserves for existing wildlife tree retention and other cutblock-level, mapped reserves are tallied in Table 19. These areas are the mapped WTPs and other reserves. During the modelling runs they will be set to no-harvest status, and treated as non-THLB.

Table 19 Wildlife tree retention and block-level reserves

Class	Productive area (ha)	Effective reduction area (ha)
WTP and other reserves	2,600	1,543

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.9.2 Old Seral and Mature-plus-old Seral

The Higher Level Plan Order specifies the percentage requirements of old seral and mature-plus-old seral that must be retained within each LU and BEC combination. The equivalent area of both the old and mature-plus-old seral has been mapped by ILMB staff. These areas are called OGMAs (old growth management areas) and MOGMAs (mature old growth management areas). They are modelled as "no-harvest" zones and are treated as landbase exclusions in this analysis. In TSR 3 the biodiversity requirements were modeled as percentage older seral requirements. The exclusions of each type are summarized in Table 20.

Table 20 OGMA and MOGMA landbase exclusions

Biodiversity Reserve Type	Productive area (ha)	Effective reduction area (ha)
Old growth management area (OGMA)	11,074	720
Mature plus old management area (MOGMA)	44,416	9,190
Totals	**55,490**	**9,910**

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.10 Permanent sample plots

The landbase reductions for reserves around permanent sample plots (PSP) are provided in Table 21.

Table 21 Permanent sample plot reductions

PSP Reserves	Productive Area (ha)	Effective Reduction Area (ha)
Total	190	105

"Effective reduction" is the area netted out after all previous netdowns are removed; sometimes referred to as the "non-overlapping netdown".

2.3.11 Future Land Base Reductions

2.3.11.1 Future wildlife tree retention areas

The licensees' Forest Stewardship Plans are based on retaining the default 7% of each cutblock as wildlife tree retention areas (WTRA). When possible, WTRAs are placed within existing non-THLB stands, so only a portion of the 7% is actually a landbase reduction. Wildlife tree retention areas are required to be placed at a maximum distance of 500 meters apart. Based on these two factors (7.0% of the THLB reserved when beyond the 500m maximum distance spacing) the area of future wildlife tree retention areas (Table 22) was estimated using the following procedure.

- Within the THLB (Table 22, column 1) apply a 500m buffer around all productive, non-THLB stands to determine the THLB area within 500 m of existing stands that could meet WTRA requirements(column 2);
- The area outside the buffer is the area that requires additional wildlife tree retention (column 3);
- Apply a 7% retention rate to this area to estimate the equivalent area of future wildlife tree retention (column 4);
- Calculate the equivalent, blended rate of retention across the whole THLB (the developed area plus the un-developed area), which is 0.4604 % of the THLB (column 5);
- Apply that percentage as a yield curve reduction against all the future managed stand yield curves.

Table 22 Estimate of future wildlife tree retention areas

(1) Sample THLB Area (ha)	(2) THLB Area within 500 meters of NHLB (%)	(3) THLB Area requiring additional WT retention (%)	(4) Equivalent THLB Retention Area Assuming 7% Retention (7%) X (3) (ha)	(5) Future THLB Reduction (4) / (1) (%)
141,525	93.422 %	6.578 %	652 ha	0.4604 %

2.3.11.2 Future roads, trails and landings

A recent Forest Practices Branch audit of licensee blocks found that only 4.6% of the area of cutblocks was in permanent access structures (PAS). This included roads, trails and landings. Based on this factor (4.6% of THLB), the area of future roads, trails and landings (Table 23) was estimated using the following sequence:

- Within the THLB (Table 23, column 1) apply a 300m buffer around all existing mapped roads to determine the "developed area" (column 2); the remaining THLB area is the "undeveloped area";
- Within the undeveloped THLB area (column 3), apply a 4.6 % reduction to find the total area (in hectares) representing all future roads, trails and landings (column 4); this translates to a blended percentage of the total THLB landbase (column 5); and
- Apply that blended percentage as a reduction to the future, managed stand yield curves (column 5).

Table 23 Estimate of future roads, trails, and landings

(1) THLB Area (ha)	(2) Developed THLB Area (%)	(3) Non-developed THLB Area (%)	(4) (4) Equivalent THLB Retention Area Assuming 4.6% Area in PAS (3) X (4.6%) (ha)	(5) Future THLB Reduction (4) / (1) (%)
141,525	61.365 %	38.635 %	2,516	1.778 %

2.3.12 Area additions

No area is added to the landbase during the modelling. In TSR3 there were some Timber Licences that did revert, however the last of the Timber Licenses in the TSA reverted to the Crown just prior to the beginning of this timber supply analysis (March 31, 2008).

3.0 Inventory Aggregation

3.1 Analysis Units

To reduce the complexity and volume of information in the timber supply analysis, individual stands are aggregated into 'analysis units' (AU). Groups are largely based on dominant tree species (inventory type group), timber growing capability (site index) and silvicultural management regimes. For example, all fir/larch stands on moderate growing sites with a clearcut silviculture regime may be grouped into a single analysis unit. Each analysis unit has at least one associated yield table that provides the model with the net merchantable volume that is available for harvest at different stand ages.

Several sets of analysis units were created to reflect forest management practices on the THLB:

Existing non-harvested, natural stands (100 series – 95,727 ha of THLB)

> These are stands with no history of harvesting in the past. Most of these stands are >=30 years old today but some younger stand created through natural disturbances are also included. Once harvested, these stands move onto the 200 series as future managed stands (clearcut).

Future managed stands (200 series – same area as 100 series)

> These analysis units are the same as the 100 series analysis units after being harvested. The 200 and 600 series analysis units (see below) undergo the full benefits of forest management practices, such as better initial stocking and planting of stock with higher genetic gains.

Existing clearcut, managed stands (500 series – 45,803 ha of THLB)

> These are previously logged stands. Forest management has had some positive impact on the establishment and growth of these stand compared to natural stands, but not as much as stands logged from today forward. Most of these stands are less than 30 years old today. Once harvested, these stands move onto the 600 series and realize the full benefits of current regeneration practices, such as volume gains from the use of select seed.

Future existing-managed stands (600 series – same area as 500 series)

> These analysis units are the 500 series analysis units after being harvested.

Non-contributing stands (800 series – 0 ha of THLB; 291,147 ha of NHLB)

> These are productive stands in the non-timber harvest land base (NHLB). They track along their own yield curve, undergo disturbances, but do not experience any harvesting. They contribute to biodiversity and other resource requirements.

These broad groups are further sub-divided by criteria of:

- <u>leading species</u>, and
- <u>NSR class</u> (not sufficiently restocked), and
- <u>site index</u> (to differentiate the regeneration and growth characteristics).

Classification thresholds for defining analysis units were determined by balancing the competing objectives of using the fewest number of analysis units (to reduce unnecessary complexity), that are significantly different (in terms of biology, growth characteristics, etc), while trying to maintain reasonable-sized areas (hectares) of each analysis unit. The common species and site index thresholds chosen for the clearcut-based analysis units are listed in Table 24.

Table 24 Existing stand analysis unit species and site index classification thresholds

Leading Species	Logging History	Site Group	Site Index Break-points	Analysis Unit	Inventory Type Groups Name (number)
Douglas-fir, Larch (dry)	NO	1 2 3	>=22 >=17 and <22 <17	Natural - 101 Natural - 102 Natural - 103	F, FPl, FPy, FL, FDecid, LF, L (1, 5, 6, 7, 8, 33, 34)
Douglas-fir (wet)	NO	1 2 3	>=21 >=17 and <21 <17	Natural - 104 Natural - 105 Natural - 106	FC, FH, FS (2, 3, 4)
Cedar	NO	1 2 3	>=19 >=14 and <19 <14	Natural - 107 Natural - 108 Natural - 109	C, CF, CH (9, 10,11)
Hemlock	NO	1 2 3	>=18 >=13 and <18 <13	Natural - 110 Natural - 111 Natural - 112	H, HF, HC, HB, HS, HDecid (12, 13, 14, 15, 16, 17)
Balsam, Spruce S predominant	NO	1 2 3	>=18 >=13 and <18 <13	Natural - 113 Natural - 114 Natural - 115	B, BH, BS, S, SB (18, 19, 20, 21, 24)
Spruce mixed	NO	1 2 3	>=21 >=17 and < 21 <17	Natural - 116 Natural - 117 Natural - 118	SF, SH, SPl, SDecid (22, 23, 25, 26)
Pine	NO	1 2 3 4	>=21 >=19 and <21 >=16 and <19 <16	Natural - 119 Natural - 120 Natural – 121 Natural - 122	PwPa, Pl, PlF, PlS, PlDecid, Py (27, 28, 29, 30, 31, 32)
Decid	YES (1)	Any	Any	Natural – 123	CotConif, CotDecid, DConif, DDecid, Mb, Bi, AConif, ADecid (35, 36, 37, 38, 39, 40, 41, 42)
Douglas-fir, Larch (dry)	YES (2)	Any	ALL	Existing Managed – 501	F, FPl, FPy, FL, FDecid, LF, L (1, 5, 6, 7, 8, 33, 34)
Douglas-fir (wet)	YES (2)	Any	ALL	Existing Managed – 502	FC, FH, FS (2, 3, 4)
Cedar	YES (2)	Any	ALL	Existing Managed – 503	C, CF, CH (9, 10,11)
Hemlock	YES (2)	Any	ALL	Existing Managed – 504	H, HF, HC, HB, HS, HDecid (12, 13, 14, 15, 16, 17)
Balsam, Spruce S predominant	YES (2)	Any	ALL	Existing Managed – 505	B, BH, BS, S, SB (18, 19, 20, 21, 24)
Spruce mixed	YES (2)	Any	ALL	Existing Managed – 506	SF, SH, SPl, SDecid (22, 23, 25, 26)
Pine	YES (2)	Any	ALL	Existing Managed – 507	PwPa, Pl, PlF, PlS, PlDecid, Py (27, 28, 29, 30, 31, 32)
Deciduous (logged)	YES (2)	Any	ALL	Existing Managed – 508	CotConif, CotDecid, DConif, DDecid, Mb, Bi, AConif, ADecid (35, 36, 37, 38, 39, 40, 41, 42)
Backlog 1 (fire or logged)	YES (3)	Any	ALL, >= 60% MSS (4)	Existing Managed – 525	(3)
Backlog 2 (fire or logged)	YES (3)	Any	ALL, < 60% MSS (4)	Existing Managed - 526	(3)

Notes:
YES (1) = With any history of logging; YES (2) = History of logging within last 30 years; YES (3) = History of logging or wildfire

(3) = Any leading species, the areas are statistically assigned based on silviculture records.
(4) = Backlog NSR areas are is divided into those above and below 60% Minimum Stocking Standards (MSS)

4.0 Growth and Yield

This section describes the information/data sources, assumptions, and methods for generating growth and yield estimates for the analysis units described in section 3.1.

4.1 Forest Cover Inventory

The forest cover inventory is a key component of the analyses. There are two forest cover formats in the Golden TSA: Forest Inventory Planning (FIP-type, or "FIP rollover") and Vegetation Resource Inventory (VRI, or "true VRI").

4.1.1 FIP-type forest inventory

Approximately 15% of the Golden TSA analysis area is FIP-type forest cover. This forest cover is largely within the national parks (ownership code = "51-N"). It was input into the provincial forest cover inventory in years 1995, 1996 and 1997. This inventory is included in the analysis for purposes of modeling biodiversity.

4.1.2 VRI-type forest inventory

The majority of the forest cover for the Golden TSA was completed in December of 2001. It is a true VRI-type forest inventory. Irregular updates of the inventory have been completed since that date for fires and logging. Licensee harvest block data, current to late 2007, has been embedded onto the forest cover data using a GIS.

The inventory has been adjusted for height, age and volume based on a Phase 2 field sampling project completed in 2002. Inventory Statistical Adjustment and Net Volume Adjustment Factors were compiled in 2007 by Jahraus & Associates. The VAF factors have been incorporated into the forest cover when it was projected to January 2008. Phase 2 height, age and volume adjustment factors are listed in Table 25. Site index adjustment occurs indirectly as a result of changing the stand ages and heights. Overall, the adjustment procedure decreased heights, increased or decreased some ages, and decreased volumes. Site indices were indirectly increased or decreased depending on the combinations of height and age adjustments. Across the target population, the net effect of all adjustments was a 2.6% decrease in merchantable volume (Table 26, using VDYP 6 at the close utilization level.)

Table 25 VDYP6 Adjustment factors for VT, operable polygons >=30 years of age in the Golden TSA.

Inventory leading species stratum	Height adjustment Ratio of Means	Age Adjustment Ratio of means	"Attribute-adjusted" volume adjustment ratio of means
Cedar/hemlock	0.943	1.214	1.065
Deciduous	0.980	0.732	1.491
Fir/pine	0.954	1.071	1.093
Spruce/balsam	0.867	0.919	1.158

Notes: VT = vegetated; Volume utilization is net dw2:12.5cm+ dbh.
Source: Jahraus & Associates (2007)

Table 26 VDYP6 estimated volume impacts of adjustment (VT, operable, >=30 years of age)

Inventory leading species stratum	N	VDYP6 estimated volume impact (12.5cm Pl or Deciduous; all others 17.5 cm+ dbh net dwb)
Cedar/hemlock	15	0.981 +/- 26.0%
Deciduous	8	0.977 +/- 84.4%
Fir/pine	31	1.018 +/- 13.1%
Spruce/balsam	31	0.932 +/- 16.7%

Overall	85	0.974 +/- 9.5%

Notes: VT = vegetated.
Source: Jahraus & Associates (2007)

The adjustments were applied within this analysis to natural stands using the following methodology:

- The whole forest was projected from the year of inventory (2000) to the year the Phase 2 adjustments were completed (2003) using VDYP6;
- Operable stands over 30 years old were selected for adjustments. Call these stands "**adjusted stands**". Other stands were not adjusted. Call these the "**non-adjusted stands**".
- For **adjusted stands**
  - Stands were assigned to adjustment strata based on leading species (see tables above);
  - The age and height adjustments were applied to the age and height, as of 2003;
  - The adjusted age and height numbers were used to derive an adjusted site index;
  - The stand species, adjusted age, site index were input to VDYP6 along with the volume adjustment factors to derive new stand volumes and stand diameters.
- For **non-adjusted stands**
  - Unadjusted age and site index from the 2000 inventory were used to derive stand volume and diameter at year=2008.

The outputs from both the adjusted and unadjusted stands were input to VDYP6 to produce natural stand yield tables for each stand. Later, the yield tables are assigned to analysis units and the curves for each stand in each analysis unit are weighted by the stand area to generate an area-weighted yield table for each analysis unit.

4.2 Site Index

Site index (SI) is a measure of the stand's productive potential for a particular tree species. SI in British Columbia is expressed as potential tree height at 50 years breast height age. SI provides standardized comparisons of productive potential between sites, across a broad range of existing stand conditions. As such, we use it as a silvicultural tool to prescribe treatments and analyze investments. SI also serves as the main driver for many growth and yield models, which predict future forest growth and timber yields. Reference: SiteTools V3.3

4.2.1 Site curves

The standard, MoF site index curves are utilized throughout this analysis.

Table 27 Standard MoF site index curves

Species	Source
Douglas Fir (Fdi) + (Pw, Py)	Thrower and Goudie (1992)
Western Larch (Lw)	Brisco, Klinka, and Nigh 2002
Lodgepole Pine (Pli)	Thrower (1994)
Western Red Cedar (Cwi)	Nigh (2000)
Western Hemlock (Hwi)	Nigh (1998)
White Spruce (Sw) + (Sx)	Nigh (1997)
Englemann Spruce (Se)	Chen and Klinka (2000)
Balsam fir (Bl)	Chen and Klinka (2000)
Trembling Aspen (At)	Nigh, Krestov and Klinka (2002)

4.2.2 Site index adjustments

No site index adjustments were used in this analysis. Site index changes occurred indirectly when the age and height adjustments were applied, as per section 4.1.2.

4.3 Utilization level

Utilization levels define the maximum height of stumps that may be left on harvested areas, the minimum top diameter (inside bark), and the minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors (Table 28) are used when calculating the merchantable stand volume in the analysis.

Table 28 Utilization levels

Species	Utilization		
	Minimum dbh	**Maximum stump height**	**Minimum top dib**
Pl	12.5	30	10
All others	17.5	30	10

Notes: dbh = diameter at breast height. Dib = diameter inside bark;
Deciduous species and Pa are netted out of stand volumes

4.4 Decay, waste and breakage for natural stands

Decay, waste and breakage factors are applied to natural stand yield tables to obtain net harvest volumes per hectare. This analysis used the standard values incorporated into the Variable Density Yield Prediction (VDYP 6) model, which are based on species, age, and Special Cruise Number (SC, or PSYU number.)

4.5 Operational adjustment factors for managed stands

4.5.1 Standard Operational Adjustment Factors

Operational Adjustment Factors (OAFs) were applied to adjust (reduce) the yields generated by the TIPSY growth and yield model down to net operational volumes. This included reductions for such factors as gaps in stand stocking, decay/waste/breakage, and endemic forest health losses.

Two types of OAFs were used in the TIPSY model. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems or clumping, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. OAF 2 is applied after OAF 1 and increases linearly over time from 0 percent at age 0 to the specified percentage at 100 years of age.

The OAF1 and OAF2 value used in this analysis were the provincial defaults of 15% and 5%, respectively.

4.6 Volume reductions

All deciduous stands are netted out of the THLB, except for stands with a previous history of logging, and the deciduous component is netted out of coniferous leading stand yield curves (Table 29). Similarly, all whitebark pine (Pa) leading stands or components of other stands are removed from the THLB or yield curves, respectively.

Table 29 Volume reductions

Stand type	Definition	Volume reduction
Deciduous	ITG = 35 to 42	100%
Pa	ITG = 28 to 31	Pa leading stands removed 100% from the THLB.
Deciduous component of coniferous leading stands	Other ITGs	100% of the deciduous volume; 0% of coniferous volume

Note: ITG = Inventory Type Group

4.7 Yield table development – Natural Stands

Stands are grouped into analysis units primarily based on similar species and site index value. A yield table is developed for each analysis unit.

4.7.1 Methodology

Natural stand yield table values were based on weighting the yield curves for each forest stand. These were derived using VDYP 6 software. The sequence of developing the yield curves was:

- Project all stands to 2008 (end of growing season 2007);
- For those polygons that were adjusted the adjusted age and adjusted height were used to estimate a new site index;
- The species and (adjusted) site index were used to assign each stand to an analysis unit (AU), and/or the species, site index and volume were used to assign the stand to a netdown type.
- After netdowns and AU assignment, an AU yield curve was calculated by area-weighting the volume estimates at each time step (i.e. at time = 10 years, 20 years, etc) from each of the stand yield curves.
- Percentage reductions were applied to future managed stand yield curves for future wildlife tree patches and future RTLs. They were not applied to the natural stand yield curves.

Natural stand analysis unit yield curves are included as Appendix A. The site index values for the clearcut analysis units are in Table 30. The site index values for the NCLB analysis units are in Table 31.

Table 30 Site index assignments for THLB natural stand analysis units.

Analysis Unit	Leading Species	Site Group	Area (ha)	Natural stand site Index	Regenerates To AU #
101	Fd (Dry) and Lw	1	3,201	23.7	201
102		2	12,347	18.0	202
103		3	0	n/a	203
104	Fd (wet)	1	2,268	23.4	204
105		2	7,067	18.6	205
106		3	4,357	15.5	206
107	Cw	1	877	19.1	207
108		2	3,897	15.6	208
109		3	1,169	12.9	209
110	Hw	1	792	18.8	210
111		2	2,309	14.7	211
112		3	3,385	11.2	212
113	B, S predominant	1	3,650	20.8	213
114		2	8,389	15.1	214
115		3	5,112	11.0	215
116	S mixed	1	3,260	23.4	216
117		2	4,634	18.9	217
118		3	7,642	13.9	218
119	Pine	1	3,754	22.5	219
120		2	3,652	19.9	220
121		3	9,944	17.1	221
122		4	2,704	14.7	222
123	Decid	All	1,317	21.1	223

Notes:
AU 123 = Operable stands, with a history of logging over 30 years ago, without no additional genetic worth (versus those that were harvested within last 30 years and are assigned to the existing managed AUs) that have regenerated back to deciduous leading but should not be netted out of the THLB landbase.

Table 31 Site index assignments for non-THLB (NHLB) contributing analysis units

AU	Notes	Leading Species	Site Group	Area (ha)	Site Index	Regenerates To AU #
801	NHLB Conif	Coniferous	All	282,068	14.2	801
802	NHLB Decid	Deciduous	All	9,084	19.2	802

4.7.2 Existing timber volume check

The total forest volume was estimated based on the yield curves, and compared to the volume estimated in the forest inventory (VDYP projected volumes, after adjustments for age, height, and volume). Table 32 is a comparison of the two estimates. The volumes are net of the deciduous-leading stands, and net of the deciduous and Pa component volumes.

Table 32 Timber Volume Check

Stand Type	Inventory Polygon volume (m3)	Yield table (AU) volume (m3)	Percent (%) Difference
THLB Natural	26,828,028	26,405,823	1.6
NHLB	80,381,400	80,315,438	0.1

4.8 Yield table development - managed stands

This section summarizes the inputs used in the TIPSY growth and yield model for the managed stand analysis units (200 and 600 number series). Natural stands (100 series) move onto matching 200 series analysis units after harvest. When existing managed stands (500 series) are harvested, they move onto the future managed stand AU's (600 series). These are identical to the 500 series but reflect the genetic gains for future managed stands.

4.8.1 Silviculture management regimes

Only clearcut systems were modelled in this analysis. A small portion of the stands in the TSA are partial cut, but the small area did not warrant creating separate partial-cut type analysis units.

Average, historical regeneration practices were reflected in the existing managed stand AU inputs (500 series AUs) while current regeneration practices are reflected in the future managed stand AU inputs (200 and 600 series).

4.8.2 Regeneration delay

Regeneration delay is the time between harvesting and the time when a new stand is initiated. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable. For this analysis, a regeneration delay was estimated based on local knowledge of the licensees' silviculture staff.

Existing managed stands.

For existing managed stands, regeneration delay was addressed through the use of actual stand age in the forest inventory file. This age represents the actual age of the stand and not the time since harvesting. For example, a stand may have been harvested 15 years ago but the current stand age is 12 – this implies a 3 year regeneration delay. The use of actual ages eliminated the need to estimate an average regeneration delay for these stands.

Future managed Stands

A regeneration delay of 2 years was estimated based on the local knowledge of the licensees' silviculture staff. Regeneration delays for future managed stands were input into TISPY and are therefore embedded in the published yield curves.

4.8.3 Stand rehabilitation

There is no active program of stand rehabilitation in the TSA. No rehabilitation of problem forest or non-merchantable types was included in the model.

4.8.4 Genetic improvement

As required by the Chief Forester's Standards for Seed Use (Nov 23, 2006), the licensees use select seed for regeneration purposes when reasonable gains are projected. This section describes the yield adjustments used in this analysis to account for the use of select seed (i.e., orchard & select provenance seed with a known genetic gain as measured by Genetic Worth [GW]).

The statistics on the historical use of select seed for all the tables in this section was obtained from the Ministry of Forests Seed Planning & Registry system (SPAR), as summarized by L. McAuley (2008) and B. Wadey (2008). This information was used to derive current practice estimates of net genetic gain (Net GW) at the species level (Table 33). This table illustrates the weighted average GW for each species for the last 5 years [A], the percent improved (class A and B) seed use for each species in the TSA [B], and the estimated Net GW for each species [C]. The Net GW was calculated by multiplying [A] x [B].

Table 33 Average net genetic worth of species planted during last 30 years.

Year	Wt Avg GW by Species (Class A) [A]						% Class A of Total Seedlings Planted [B]						Net GW by Species [C]				
	Lw	Pw	Sx	Pli			Lw	Pw	Sx	Pli			Lw	Pw	Sx	Pli	
2003	11	0	18	3			100	100	70	73			11.0	0.0	12.6	2.2	
2004	11	0	22	3			75	0	72	60			8.3	0.0	15.8	1.8	
2005	11	0	20	3			100	0	94	73			11.0	0.0	18.8	2.2	
2006	17	0	24	3			100	0	100	89			17.0	0.0	24.0	2.7	
2007	0	0	19	3			77	0	90	0			0.0	0.0	17.1	0.0	
5 yr Avg	10.0	0.0	20.6	3.0			90.4	20.0	85.2	59.0			9.5	0.0	17.7	1.8	
30 Yr Avg	1.7	0.0	3.4	0.5			15.1	3.3	14.2	9.8			1.6	0.0	2.9	0.3	

The 30 years average gains shown are suitable for use in generating existing managed stands yields as they reflect a watered down gain associated with 25 years of planting seed with no gains followed by 5 years of planting with gains . Genetic gains of 1.6% would be applied to Lw, 2.9% to Sx and 0.3% for Pl within the existing managed stands. While class A Pw seedlings have been used in the last 5 years, there is no reported genetic worth value, so 0% net GW was assumed for Pw.

Seed planning units (SPU's) geographically delineate the appropriate area of seedling use for stock coming from particular seed orchards. Each SPU also has defined elevation range for seedlings. The select seed SPU's that occur within the Golden TSA are listed in Table 34.

Table 34 Seed Planning Units in Golden TSA (Class A seed)

Species	Class A Seed Planning Zone	SPU	Min Elev (m)	Max Elev (m)
Western white pine	Kootenay Quesnel (KQ)	15	500	1400
Interior Spruce	East Kootenay All (EK)	25	750	1700
Interior Spruce	Nelson Mid (NE)	04	1000	1500
Lodgepole Pine	East Kootenay Low (EK)	32	800	1500
Western Larch	East Kootenay Low (EK)	34	800	1500
Fdi	East Kootenay Low (EK)	39	700	1400
Fdi	Quesnel Lakes Low (QL)	37	700	1400
Fdi	East Kootenay Low (EK)	39	700	1400

Increased gains are projected for these SPU's within 10 years while the planning horizon for this analysis is > 250 years. One estimate for the planning horizon is used. It is reasonable to use the projected gains across the planning horizon in the base case as this will result in an overestimate for only the first decade and then realistic or conservative estimates for the remaining 24 decades.

The future projected gains are estimated as per Table 35. The estimated, future effective genetic worth for each SPU is provided in column [B] while the availability to meet SPU seed needs is provided in column [C]. The projected GW to be achieved (column D) is the product [B] and [C]. It is assumed that seed from the SPU is eligible for use where that species is planted in the TSA.

Table 35 Seed planning units (Class A seed) genetic worth and seed availability

SPU	% of Seed Use Eligible to come from SPU	Min Elev (m)	Max Elev (m)	Projected Future Genetic Worth (in Year) [B]	Projected Availability (in Year) [C]	Projected Genetic Worth Achieved In Future [D]
PW KQ (15)	100	500	1400	0 (*)	100	**0** (*)
Sx EK All (25)	95%	750	1700	28% (2017+)	75 % (2025+)	**(20.0) + (0.8) =**
Sx NE Mid (04)	5%	1000	1500	16% (2014+)	100% (2008+)	**20.8**
PLI EK LOW (32)	100	800	1500	12% (2017+)	100% (2019+)	**12**
LW EK LOW (34)	100	800	1500	20% (2017+)	100% (2008+)	**20**
FDI EK LOW (39)	80%	700	1400	25% (2013+)	100% (2016+)	**(20) + (1.1) =**
FDI QL LOW (37)	5%	700	1400	22% (2017+)	100% (2010+)	**21.1**

Values obtained from “Breeding and orchard production” reports (L. McAuley, MoF, 2008)
(*) Although Pw Class A seed is produced the genetic worth is not estimated.

The application of this data by AU in the timber supply model is summarized as Table 36, and is included in the TIPSY inputs tables (Table 38).

Table 36 Summary of genetic worth used for modelling with each species

Species	Existing, Managed Stands Genetic Worth	Future Managed Stands, Genetic Worth
Sx	2.9	20.8
Pli	0.3	12
Lw	1.6	20
Fdi	0.0	21.1

In summary, the 30-year historical average from Table 33 was applied when modeling existing managed stands because this best corresponds with the criteria used to define these stands. When generating the AU yields in TIPSY for these stands, larch will have a 1.6% GW applied, while spruce will have a 2.9% GW applied, and Pl will have 0.3% applied. Future managed stands will have one estimate of the varying future net GW applied, usually chosen at reference year=2017. The Net GW’s will be applied to Fd (21.1%), Lw (20%), Pl (12%), and Sx (20.8%). No change in genetic gains was scheduled during the planning horizon.

Genetic gains (Table 36) will be incorporated into the growth and yield curves through TIPSY model functionality. When a species identified in Table 36 is included in a managed stand AU, its associated Net GW will be input into TIPSY. This Net GW reflects the genetic gain associated with all seedlings of a given species planted in a typical year. Where surrogate species were used in TIPSY, the GW employed is prorated to reflect the relative GW’s of the original species (i.e. Sx used for Bl but Sx GW not applied to Bl proportion).

4.8.5 Planting Density

Values of 2000 sph were assumed for all plantations. These values were derived from a combination of the TSA silviculture records and staff experience. These densities are considered to reflect the number of stems competing to be crop trees and are between the values for well-spaced and total-stocking densities.

4.8.6 TIPSY managed stand yield table inputs

Existing and future managed yield curves will be derived using the BatchTIPSY (ver 3.2) software with the following inputs.

Table 37 Inputs (to TIPSY) for Existing Managed Stand Yield Curves

Existing Managed Stand AU	Regen - Plant/ Natural	Species Composition	Area (ha)	Site Index	OAF VAF	Regen Delay	Utiliz-ation Level	Initial Density	Select Seed Gains
501 – Fd Dry	P 100%	Fd 40 Se 25 Pl 30 Lw 5	3,779	17.2	(2)	2	17.5	2,000	(6)
502 – Fd Wet	P 100%	Fd 40, Se 30 Pl 20 Lw 5 Cw 5	2,477	17.8	(2)	2	17.5	2,000	(6)
503 – Cw	P 100%	Se 40 Cw 40 Fd 10 Hw 10	4,036	18.1	(2)	2	17.5	2,000	(6)
504 – Hw	P 100%	Se 40 Cw 40 Fd 10 Hw 10	1,376	16.3	(2)	2	17.5	2,000	(6)
505 – B, S	P 100%	Se 85 Bl 10 PL5	15,479	16.4	(2)	2	17.5	2,000	(6)
506 – S mixed	P 100%	Sx 60 Cw 20 Fd 10 Pl 10	7,722	15.5	(2)	2	17.5	2,000	(6)
507 – Pine	P 100%	Pli 60 Se 20 Fd 20	7,228	16.3	(2)	2	12.5	2,000	(6)
508 – Decid (1)	P100%	At 50 Sx 35 Pl 10 Fd 5	3,031	19.4	(3)	2	17.5	2,000	(6)
525 Backlog 1	N100	S40 Pli22 Fdi 22 C9 H7	376	16.9	(4)	12	17.5	2,000	n/a
525 Backlog 2	N100	S40 Pli22 Fdi 22 C9 H7	302	18.0	(5)	20	17.5	2,000	n/a

AU 508 = Deciduous leading with a history of logging within the past 30 years.

VAF = volume adjustment factor

(2) OAF1 = 15%, OAF2 = 5%; VAF = 1.00 (no adjustment)

(3) OAF1 = 25%, OAF2 = 5%; VAF = 1.00

(4) OAF1 = 15%, OAF2 = 5%; VAF = 0.90 (10 % reduction)

(5) OAF1 = 15%, OAF2 = 5%; VAF = 0.75 (25 % reduction)

(6) Genetic Worth varies by species; Value based on the limited use of improved stock in the past.

Table 38 Inputs (to TIPSY) for Future Managed Stand Yield Curves

Leading Species	AU No.	Regen Method	Species Composition	Area (ha)	Site Index	Utiliz-ation Level	Initial Density	Select Seed Gains
Lw, Fd (dry)	201	P 100%	Fd 40, Pli 40, Se20	3,201	23.7	17.5	2,000	(1)
	202	P 100%	Fd 40 Pli 40 Se20	12,347	18.0	17.5	2,000	(1)
	203	P 100%	Pli 80 Fd 20			17.5	2,000	(1)
Lw, Fd (wet)	204	P 100%	Fd 40 Se 40 Cw 10 Pl 10	2,268	23.4	17.5	2,000	(1)
	205	P 100%	Fd 40 Se 40 Cw 10 Pl 10	7,066	18.6	17.5	2,000	(1)
	206	P 100%	Fd 50 Pl 40 Se 10	4,358	15.5	17.5	2,000	(1)
Cw	207	P 100%	Se40 Cw40 Fd 10 Pw 5 Hw 5	877	19.1	17.5	2,000	(1)
	208	P 100%	Se40 Cw40 Fd 10 Pw 5 Hw 5	3,873	15.6	17.5	2,000	(1)
	209	P 100%	Se 60 Cw 20 Fd 20	1,169	12.9	17.5	2,000	(1)
Hw	210	P 100%	Se 50 Cw 30 Hw 20	792	18.8	17.5	2,000	(1)
	211	P 100%	Se 50 Cw 30 Hw 20	2,309	14.7	17.5	2,000	(1)
	212	P 100%	Se 50 Cw 25 Fd 15 Hw 5 Pli 5	3,385	11.2	17.5	2,000	(1)
B, S	213	P 100%	Sx 80 Pli 10 Bl 10	3,650	20.8	17.5	2,000	(1)
	214	P 100%	Sx 80 Pli 10 Bl 10	8,388	15.1	17.5	2,000	(1)
	215	P 100%	Se 85, Pli 15	5,130	11.0	17.5	2,000	(1)
S mixed	216	P 100%	Se 50 Cw 30 Fdi 10 Hw5 Pw5	3,260	23.4	17.5	2,000	(1)
	217	P 100%	Se 50 Cw 30 Fdi 10 Hw5 Pw5	4,634	18.9	17.5	2,000	(1)
	218	P 100%	Se 50 Cw 30 Fdi 10 Hw5 Pw5	7,642	13.9	17.5	2,000	(1)
Pine	219	P 100%	Pli 60, Se 20, Fd 20	3,754	22.5	12.5	2,000	(1)
	220	P 100%	Pli 60, Se 20, Fd 20	3,652	19.9	12.5	2,000	(1)
	221	P 100%	Pli 60, Se 20, Fd 20	9,944	17.1	12.5	2,000	(1)
	222	P 100%	Pli 70, Fd 20, Se 10	2,704	14.7	12.5	2,000	(1)
Decid	223	P 100%	Sx 70 Pl20 Fd10	1,317	21.1	17.5	2,000	(1)
Lw, Fd Dry	601	P 100%	Fd 40 Se 25 Pl 30 LW 5	3,779	17.2	17.5	2,000	(1)
Lw, Fd Wet	602	P 100%	Fd 40 Se 35 Cw15 Pw5 Lw5	2,477	17.8	17.5	2,000	(1)
Cw	603	P 100%	Se 40 Cw40 Hw10 Fd5 Pw5	4,036	18.1	17.5	2,000	(1)
Hw	604	P 100%	Se 40 Cw40 Fd10 Hw5 Pw5	1,376	16.3	17.5	2,000	(1)
B, S	605	P 100%	Se 85, Bl 10 PL5	15,479	16.4	17.5	2,000	(1)
S mixed	606	P 100%	Se 55 Cw 25 Fd 10 Hw5 Pw5	7,722	15.5	17.5	2,000	(1)
Pine	607	P 100%	Pl 55 Se 20 Fd 20 Lw5	7,228	16.3	12.5	2,000	(1)
Decid	608	P100%	Sx 70 Pl20 Fd10	3,031	19.4	17.5	2,000	(1)
Backlog 1 (3)	625	P100%	Se 60 Pl 20 Fd10 Cw10	376	16.9	17.5	2,000	(1)
Backlog 2 (3)	626	P100%	Se 60 Pl 20 Fd10 Cw10	302	18.0	17.5	2,000	(1)

Notes:

(1) Genetic Worth varies by species; Values are based on future use of improved genetic stock.

(2) All AU's: OAF1 = 15%, OAF2 = 5%; Regen delay = 2 years.

AU 223 = Operable stands, previously harvested more than 30 years ago, that originally regenerated back to decidous leading and after the first harvest will be planted to coniferous leading.

5.0 Silviculture

5.1.1 Existing managed stands

Existing managed stands are defined as the operable stands with a record of logging within the last 30 years. The 30-year figure corresponds to the time when more intensive silviculture management started within the TSA.

Both existing and future managed stand yield curves were determined using TIPSY. Inputs for the existing managed stands are in Table 38.

5.1.2 Backlog and current non-stocked area (NSR)

Backlog NSR is any area not yet fully stocked that was denuded prior to 1987 when basic silviculture became the obligation of licensees. Not satisfactorily restocked (NSR) areas were determined using RESULTS data. NSR areas include both old burns and past harvesting. Current NSR (2055.2 ha) and backlog NSR (1281.7 ha) is summarized in Table 39.

Table 39 Backlog NSR Area

Leading Species	Current NSR	Estimated backlog NSR >= 60% MSS	Estimated backlog NSR < 60% MSS
Any	2055.2 ha	653.7 ha (51% of backlog)	628 ha (49% of backlog)

Note: MSS = Minimum stocking standard.

Backlog NSR has been assigned to analysis units 525 and 526. Backlog NSR records in the RESULTS data are for portions of opening numbers (a combination of Map + Opening Number) which are often several polygons in the forest cover data. Hence, one cannot identify the forest cover polygons (spatial location) corresponding to the NSR records in the RESULTS data. As a work-around, the equivalent area of backlog NSR, for both the over and under 60% MSS categories, was assigned to forest cover openings (sometimes a group of forest cover polygons). Priority was based on the highest percentage of backlog NSR in the opening number. Openings with the highest proportion of NSR were assigned wholly to NSR, working down to lower percentages of NSR, until the target equivalent-area of NSR had been assigned to openings.

A significant portion of the backlog NSR is due to old fires and is located within the inoperable. That portion remaining on the THLB is summarized in Table 40. The THLB portion of backlog NSR is assigned to analysis unit numbers 525 and 526. The NHLB portion is lumped into the HNLB analysis units (801-coniferous and 802-deciduous) as those backlog NSR polygons will not be logged in the future.

Table 40 THLB portion of backlog NSR

LU	NSR 1	NSR 2	Total
G13	12	0	12
G14	31	35	66
G15	61	0	61
G16	177	285	462
G20	25	0	25
G21	34	5	38
G22	69	0	69
G23	23	0	23
G26	19	0	19
G28	22	20	42
Total	**472**	**345**	**818**

Current NSR status is assumed to be the operable forest cover polygons where the forest cover database has blank (missing) forest cover attribute values and a history of past harvesting. Species and analysis units were assigned to these polygons based on the most prevalent AU found in that same biogeoclimatic subzone, as determined by the polygons which did not have missing species information.

6.0 Unsalvaged Losses

The purpose of this section is to quantify the average annual volume of timber that, in the future, will be damaged or killed on the THLB and will not be salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. This factor is meant to capture catastrophic natural events like the fires that occurred in the Golden TSA in 2005. Endemic pest losses are dealt with through factors applied in the growth and yield models as noted below:

> **TIPSY**: Operational Adjustment Factors reduce the gross volumes to account for losses toward maturity such as decay, and endemic forest health issues like minor infestations.
>
> **VDYP**: The model predicts actual average yields from appropriate inventory ground plots. Endemic losses are inherently recognized in the model data.

The TSR3 values were accepted as the best estimate of unsalvaged losses that were available (Table 41).

Table 41 Unsalvaged losses

NRL Category	Area Disturbed per year (ha / year)	Volume / ha (m3/ha)	Volume per Year (m3 / yr)
Wildfire	19.0	268	5,102
Broadcase / fringe burn	2.0	300	600
Total fires	**21.0**	**271**	**5,702**
Spruce bark beetle	0.0	0	0
Douglas-fir bark beetle	1.0	350	350
Mountain pine beetle	3.0	350	1,050
Total insects	**4.0**	**350**	**1,400**
Windthrow / blowdown	1.5	350	525
Avalanche	0.0	0	0
Total Losses	**29.5**	**288**	**7,627**

Disturbances within the NHLB are described in section 7.1.5.2.

7.0 Resource Management

The resource management zones were introduced in section 6.0. This section describes the forest cover requirements that are associated with those management zones.

7.1 Non-timber forest resource management

7.1.1 Forest Cover Requirements

Forest cover requirements are applied within the timber supply model to accommodate the timber and non-timber resource objectives. These requirements maintain appropriate levels of specific forest types that are needed to satisfy the objectives for wildlife habitat, visual quality, biological diversity, etc. Forest cover requirements are used by the model to limit harvesting within the THLB.

These requirements are typically expressed as one of three conditions:

- a maximum amount of forest that can be younger than age X (or shorter than height Y);
- a minimum amount of forest that must be older than age W (or taller than height Z); or
- no harvesting is allowed.

Forest cover requirements may be overlapping. The model will evaluate each requirement independently to ensure that the harvesting of a specific area does not violate any one of the requirements. Table 42 summarizes the management zones that occur in the Golden TSA. The details of specific forest cover requirements follow.

Table 42 Resource emphasis areas

Name	Criteria used to delineate zone/group	Rationale/comments
High Biodiversity Emphasis Option (BEO) Areas	CFLB within BEO / LU / BEC	Designated by the HLPO (Oct 2002). Requirements exist to maintain old and mature forest for biodiversity. When retained old and/or mature stands for biodiversity – connectivity corridors and grizzly habitat areas were given a high priority. Within the Low BEO areas, old seral targets start at 1/3 full targets and full targets must be met by the third rotation. Requirements have been spatially located as OGMAs and MOGMAs, which are modeled as reserve zones (landbase netdowns).
Intermediate BEO Areas	CFLB within BEO / LU / BEC	
Low BEO Areas	CFLB within BEO / LU / BEC	
HLPO Caribou Management Zones	CFLB forest; no “protected” ownership; below 80% slope; by caribou zones	Designated by HLPO Objective 3 (Variance 04) Requirements exist to maintain old and mature forest habitats. Requirements have been spatially located as reserve zones and are modeled as reserve zones (landbase netdowns).
SARCO Caribou Management Zones	THLB; spatially mapped areas within caribou Planning Areas.	SARCO “Incremental Caribou” areas. Under development, almost complete (map version: March 6, 2008). Requirements are modeled as “no harvest” or reserve zones.
Riparian Areas	Reserve widths around classified streams, lakes and wetlands.	Reserve zones are based on the licensee FSPs, which in turn are based on the FRPR riparian reserve widths and basal area retention.
Domestic Watersheds	Reserves around streams upstream of water intakes used for domestic purposes (not for irrigation).	Designated by HLPO Objective 6 and HLPO Map 6.1. Requirements are modeled as “no harvest” or reserve zones.
Ungulate Winter Range (UWR)	CFLB within each LU by habitat class	Draft GAR Order proposed by MoELP (May 2008). When established, management practices will be equivalent to the Invermere TSA GAR Order U-4-008 for UWR.
Visual landscapes	CFLB within each VQO polygon	Visual Quality Objectives defined by the District Manager.
Integrated Resource Management (IRM)	THLB within each LU, except the ERDZ zone (see below)	Designated by the HLPO (Oct 2002). Specifies a minimum green-up height.
Enhanced Resource Development Zone (ERDZ)	THLB within each LU, within the ERDZ	Designated by the HLPO (Oct 2002). Specifies a relaxed (lower) green-up height requirement.

Table 43 Resource emphasis areas – modeling constraints

Name	Crown Forested Area (ha)	THLB Area (ha)	Forest resource requirements.
High Biodiversity Emphasis Option (BEO) Areas	107,928[1]	23,663[1]	Old seral: no harvest within spatial OGMAs. Mature-plus-old seral: no harvest within spatial MOGMAs.
Intermediate BEO Areas	109,001[1]	55,775[1]	
Biodiversity: Low BEO Areas	209,488[1]	62,092[1]	Old seral: no harvest within spatial OGMAs for first rotation; apply a seral percentage requirement at 2/3 full target for the second rotation; increase the seral requirement to (3/3) full target for the third rotation onwards. Mature-plus-old seral: no harvest within spatially mapped MOGMAs.
Caribou Management zones	21,690	0	HLPO: No harvest within spatially mapped caribou areas. SARCO: No harvest within spatially mapped caribou areas.
Riparian Areas	13,125	0	Reserves around classified streams, lakes and wetlands.
Domestic or Sensitive Watersheds	322	0	Reserves around portions of streams upstream of intakes.
Ungulate Winter Range (UWR)	49,566	31,546	MF - dry: min 10% > 100 years MF – dry: min 10% >100 years MF – trans: min 10% >60 years MF – trans: min 10% >100 years; S,F leading MF – mesic: min 10% >60 years MF – mesic: min 20% >100 years; S,F leading MF – moist: min 20% >60 years MF – wet: min 30% >60 years
Visual landscapes	36,152	20,036	Maximum of X% < visual greenup age of Y, applied within each VQO class within each LU.
Integrated Resource Management	98,210	98,210	Maximum of Max. 25% < 2.5 m tall. within LU / IRM zone
Enhanced Resource Development Zone (ERDZ)	43,319	43,319	Maximum of 33%<2 yr within LU / ERDZ zone

Notes:
[1] = These numbers are the area assigned to that BEO according to the HLPO, not the areas of the OGMAs/MOGMAs.

7.1.1.1 Green-up / Maximum disturbance

The HLPO contains green-up requirements that require a logged block to achieve a specific condition called green-up before adjacent areas can be logged. Green-up refers to the average height of the regenerating forest reaching a specified target. Green-up requirements can often be waived if licensees manage for patch size distributions specified in the HLPO and detailed in the Landscape Unit Planning Guide (MoF/MoE 1999). Modeling of adjacent cut-block green-up requirements was accomplished using forest level objectives, as opposed to block specific objectives, because this is consistent with the operational flexibility afforded by patch size management. Green-up requirements and the area of application are provided in Table 44.

Table 44 Green-up requirements by management zone

Management Zone	Green-up Requirement	Modeled Green-up Constraint	Area to Which it applies
HLPO ERDZ Timber Zone	successful regeneration (stocked)	max 33% < 2 yr within LU/ERDZ	THLB area inside the HLPO mapped ERDZ timber zone
Integrated Resource Management Zone	2.5 m tall trees	Max. 25% < 2.5 m tall within LU/IRM	THLB not in ERDZ zone

Age to green-up was determined by calculating a weighted average stand type for each of the zones and then evaluating the age/height relationship for the stand in SiteTools. The IRM zone was S leading with an average site index of 17.3 – giving an 21 year greenup period to reach 2.5 meters height. A 2 year regeneration delay is then added to this value.

7.1.2 Visual Resources

In this analysis, forest cover requirements aimed at meeting these objectives were applied so that the amount of younger stands that can occur in visually sensitive areas was limited. The following procedure was used to model the visual quality objectives:

All VQO polygons had maximum planimetric percent disturbance values assigned based on VQO class, (values provided in Table 45).

Table 45 Visually sensitive areas: Maximum planimetric disturbance percentage

VQO Class	Percent Alteration
Preservation	1%
Retention	5%
Partial Retention	15%
Modification	25%

VQO polygons within each VQO class within each LU had an area weighted average slope assigned and a "visually effective greenup" (VEG) height calculated according to Table 46 extracted from Procedures for Factoring Visual Resources into Timber Supply Analyses (MoF 1998).

Table 46 Tree heights required for meeting visually effective green-up by percent slope

	Slope Class (%)											
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	60+
Tree Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.3	8.5

Each LU-VQO-class group had the resulting forest cover objective applied to its crown forested area in the model (Table 47). For example, a VQO of Retention and an average slope of 32% would have the following objective: No more than 5% of the crown forested area in that LU and VQO class can be less than 6m tall.

The visually effective green-up heights for each polygon were translated into green-up ages for use during modeling. Age to green-up was calculated in Site Tools using a weighted average stand type. Visually effective greenup ages ranges from 17 to 22 years (plus 2 year regeneration delay), based on an Fd stand with a site index of 17.34.

Table 47 Area weighted slope and greenup height assigned to each LU and VQO combination

LU	VQO	Avg. Slope (%)	Max Non-Veg (%)	Greenup Ht (m) (age a/b)
G14	M	33.228	25	6 (22/24)
G14	PR	28.444	15	5.5 (21,23)
G15	M	22.37	25	5 (20/22)
G15	PR	19.437	15	4.5 (18/20)
G16	M	19.378	25	4.5 (18/20)
G16	PR	17.102	15	4.5 (18/20)
G19	M	20.112	25	4.5 (18/20)
G19	PR	16.592	15	4.5 (18/20)
G20	M	25.217	25	5 (20/22)
G20	PR	24.671	15	5 (20/22)
G20	R	14.345	5	4 (17/19)
G21	M	34.859	25	6 (22/24)
G21	PR	26.681	15	5.5 (21,23)
G22	M	29.774	25	5.5 (21,23)
G22	PR	23.827	15	5 (20/22)
G22	R	11.901	5	4 (17/19)
G23	M	26.126	25	5.5 (21,23)
G23	PR	15.708	15	4.5 (18/20)
G23	R	11.835	5	4 (17/19)
G24	M	32.461	25	6 (22/24)
G25	PR	27.61	15	5.5 (21,23)
G25	R	20.833	5	5 (20/22)
G26	M	26.509	25	5.5 (21,23)
G26	PR	26.438	15	5.5 (21,23)
G26	R	22.534	5	5 (20/22)

Note: (age a/b) = (15/17) = 15 years to reach greenup height; 17 = age including 2 years regeneration delay

7.1.3 Recreation resources

Forest cover retention within the important recreation areas in the Golden TSA was addressed primarily through the netdown process associated with the riparian areas around the streams and lakes.

7.1.4 Wildlife

7.1.4.1 Ungulate winter range

Golden TSA ungulate winter range is currently being managed under both a Section 7 notice, and a pending GAR Order. MoELP staff recommended that the UWR requirements be based on the draft GAR Order. The forest requirements vary by habitat type, as per Table 48.

Table 48 Ungulate winter range requirements

Habitat type	Ungulate Species	Landscape and Stand Level Forest Cover Retention Requirements	Definitions that pertain to Forest Cover Requirements
Open Range	Elk, bighorn sheep, mule deer, white-tailed deer, mountain goat	Stocking standards: 5-75 sph	n/a
Open Forest	Elk, bighorn sheep, mule deer, white-tailed deer, mountain goat	Stocking standards: 76-400 sph	n/a
Managed Forest (dry)	Elk, bighorn sheep, mule deer, white-tailed deer	Min 10% Mature cover	>100 years cc GE 20%; or layer1 age > 100 years
Managed Forest (transitional)	Moose, elk, mule deer, white-tailed deer	Min 10% snow interception cover	>60 years and evergreen cc min 40%
		Min 10% mature cover	>100 years, Fd or Sx leading and cc min 40%
Managed Forest (mesic)	Elk, mule deer	Min 10% snow interception cover	>60 years and evergreen cc min 40%
		Min 20% mature cover	>100 years, Fd or Sx leading and cc min 40%
Managed Forest (Moist)	Moose	Min 20% snow interception cover	>60 years and evergreen cc min 40%
Managed Forest (Wet)	Moose	Min 30% snow interception cover	>60 years and evergreen cc min 40%
Avalanche tracks (*)	Moose, elk	50 m of forest cover adjacent to high value habitat within avalanche tracks	>60 years old

Notes:
cc = evergreen crown closure; all conifers except larch count at full cc; larch and deciduous species at 50% of their crown closure (cited, but not used in modeling).
(*) no GAR-mapping of avalanche tracks, managed through the deployment of OGMAs.

7.1.4.2 Identified wildlife

No Wildlife Habitat Areas (WHAs) have been made know in the Golden TSA as of March 2008. The impacts of future WHA's has been budgeted at a 1% AAC impact by provincial policy. This 1% has not been implemented in the analysis.

7.1.4.3 Caribou

Section 3 of the Kootenay Boundary Higher Level Plan Order specifies caribou habitat management guidelines to be applied in a number of zones within mapped caribou habitat. The forest cover requirements associated with these caribou zones are listed in Table 49. These requirements have been spatially mapped and district policy is to consider these reserves. In addition, the Species at Risk Coordination Office (SARCO) has recommended additional areas of reserves. 23,529 hectares of CFLB are covered by the caribou habitat areas (23,022 hectares associated with the HLPO, and 507 hectares with the SARCO caribou requirements).

Table 49 Example of HLPO caribou forest cover requirements

Caribou Mngt. Zone	Zone Priority	Leading tree species	Minimum Forest retention	Min. Basal Area Remaining	Minimum Forest age class	Notes
1	1,2	Pl, Fd, or Lw	100%	--	--	Previously harvested stands require future decisions
6	2	All	Min 70%	--	8	
8	2	All	Min 30%	--	8	
		All	Min 10%	--	9	
8	2	All	20% Partial cut	70	7	

Notes: Examples of HLPO caribou habitat zones and forest requirements. The equivalent area of the caribou requirements has been spatially mapped and is modeled as a THLB landbase reduction.

7.1.5 Biodiversity

The Landscape Unit Planning Guide (March 1999) provides background direction and guidance on biodiversity management. The Guide dictates that biodiversity be managed at both the landscape and stand levels. The primary mechanism for landscape-level management is retention of old and mature seral forest. Stand-level biodiversity is protected through retention of wildlife trees and wildlife patches. The following sections outline how retention of old and mature forest and wildlife trees/patches was modeled.

7.1.5.1 Landscape level biodiversity

Sections 1 and 2 of the Kootenay Boundary Higher Level Plan Order specify the amount of old and mature forest that must be maintained within each BEC variant inside each Landscape Unit (LU). Landscape units have been legally established along with Biodiversity Emphasis Option (BEO) assignments that guide the level of old/mature forest in each landscape unit.

Several Landscape Units overlap with portions of federal and provincial parks and protected areas. For the purposes of this analysis the productive forest area within all of LUs (with portions in parks and protected) are included in the analysis. The HLPO LU/BEC BEO assignments are listed in Table 50. Old and mature requirements for BEC/BEO combinations are provided in Table 51.

Table 50 LU/BEC BEO Assignments

LU	BEO	NDT	BEC	Area (ha)		LU	BEO	NDT	BEC	Area (ha)
G01	H	1	ESSFwc 2	4,466		G11	I	1	ESSFwc 2	1,996
G01	H	1	ESSFwcw	1,541		G11	I	1	ESSFwcw	853
G01	H	1	ICH wk 1	2,675		G11	I	1	ICH vk 1	1,242
G01	H	3	ESSFdk 1	2,710		G11	I	1	ICH wk 1	1,218
G02	I	1	ESSFvc	761		G12	H	1	ESSFwc 2	1,527
G02	I	1	ESSFwc 2	2,018		G12	H	1	ESSFwcw	950
G02	I	1	ESSFwcw	847		G12	H	1	ICH wk 1	2,342
G02	I	1	ICH vk 1	928		G13	H	1	ESSFvc	5,026
G02	I	1	ICH wk 1	3,110		G13	H	1	ESSFwc 2	3,988
G02	I	2	ICH mw 1	187		G13	H	1	ESSFwcw	1,768
G03	L	1	ESSFwc 2	2,935		G13	H	1	ICH wk 1	4,010
G03	L	1	ESSFwcw	1,446		G13	H	2	ICH mw 1	986
G03	L	1	ICH vk 1	2,119		G14	L	1	ESSFwc 2	6,802
G03	L	1	ICH wk 1	3,778		G14	L	1	ESSFwcw	1,831
G03	L	2	ESSFmm 1	339		G14	L	1	ICH wk 1	7,185
G03	L	2	ICH mw 1	1,334		G14	L	2	ICH mw 1	2,397
G04	I	1	ESSFwc 2	4,451		G15	L	1	ESSFwc 2	2,793
G04	I	1	ESSFwcw	2,754		G15	L	1	ESSFwcw	1,148
G04	I	1	ICH wk 1	5,173		G15	L	1	ICH wk 1	254
G04	I	2	ESSFmm 1	919		G15	L	2	ICH mw 1	5,020
G04	I	2	ICH mw 1	4,220		G16	I	1	ESSFwc 2	765
G06	H	1	ESSFwc 2	1,517		G16	I	2	ICH mw 1	23,533
G06	H	1	ESSFwcw	783		G16	I	3	ESSFdk 2	1,141
G06	H	1	ICH wk 1	1,835		G17	L	1	ESSFwc 2	3,648
G06	H	2	ICH mw 1	365		G17	L	1	ESSFwcw	1,233
G07	L	1	ESSFwc 2	4,224		G17	L	2	ICH mw 1	5,205
G07	L	1	ESSFwcw	1,537		G18	L	1	ESSFwc 2	2,524
G07	L	1	ICH wk 1	6,663		G18	L	1	ESSFwcw	710
G07	L	2	ICH mw 1	1,214		G18	L	2	ICH mw 1	3,591
G08	L	1	ESSFwc 2	3,738		G19	L	1	ESSFwc 2	4,771
G08	L	1	ESSFwcw	1,782		G19	L	1	ESSFwcw	1,488
G08	L	1	ICH wk 1	618		G19	L	1	ICH wk 1	552
G08	L	2	ICH mw 1	7,266		G19	L	2	ICH mw 1	5,455
G09	L	1	ESSFwc 2	4,092		G19	L	3	ESSFdk 2	920
G09	L	1	ESSFwcw	1,506		G20	I	1	ESSFwc 2	497
G09	L	2	ICH mw 1	6,222		G20	I	1	ESSFwcw	194
G10	L	1	ESSFwc 2	4,397		G20	I	2	ICH mw 1	8,126
G10	L	1	ESSFwcw	1,043		G20	I	3	ESSFdk 1	2,512
G10	L	1	ICH wk 1	3,269		G20	I	3	ESSFdk 2	2,526
G10	L	2	ICH mw 1	5,207		G20	I	3	ICH mk 1	1,786

(continued)

LU	BEO	NDT	BEC	Area (ha)		LU	BEO	NDT	BEC	Area (ha)
G20	I	3	MS dk	1,729		G26	H	3	MS dk	19,366
G20	I	4	IDF dm 2n	530		G26	L	2	ICH mw 1	2,857
G21	I	2	ICH mw 1	4,146		G26	L	3	ESSFdk 1	18,914
G21	L	3	ESSFdk 2	14,036		G26	L	3	ESSFdk 2	10,672
G21	L	3	ICH mk 1	8,456		G26	L	3	ICH mk 1	5,393
G22	I	2	ICH mw 1	6,456		G27	H	3	ESSFdk 1	3,947
G22	L	1	ESSFwm	5,418		G27	H	3	MS dk	4,357
G22	L	1	ICH wk 1	3,613		G28	H	3	ESSFdk 1	8,634
G22	L	3	ESSFdk 2	2,142		G28	H	3	ESSFdk 2	865
G23	I	2	ICH mw 1	8,701		G28	H	3	ESSFdku	394
G23	I	3	ESSFdk 2	6,216		G28	H	3	ICH mk 1	2,302
G23	I	3	ICH mk 1	8,017		G28	H	3	MS dk	22,337
G23	I	3	MS dk	1,448		G29	L	1	ESSFwc 2	2,927
G24	H	2	ICH mw 1	598		G29	L	1	ESSFwcw	1,100
G24	H	3	ESSFdk 2	4,150		G29	L	1	ICH wk 1	5,860
G25	L	3	ESSFdk 1	1,831		G29	L	2	ICH mw 1	261
G25	L	3	ESSFdk 2	277		G38	H	1	ESSFvc	179
G25	L	3	ICH mk 1	669		G38	H	1	ESSFwm	2,169
G25	L	3	MS dk	2,611		G38	H	1	ICH wk 1	2,143
G25	L	4	IDF dm 2n	192						

Table 51 Old and mature forest cover requirements for landscape level biodiversity objectives

BEC Zone	NDT	Mature Age (yrs)	Old Age (yrs)	Mature+Old Seral Req			Old Seral Requirements				
				Low	Inter	High	Low * 1st Rot	Low * 2nd Rot	Low * 3rd Rot	Inter	High
ESSFvc, ESSFwcw, ESSFwc2, ESSFwm	1	> 120	> 250	19	36	54	6.3	12.6	19	19	28
ICHvk1, ICHwk1	1	>100	>250	17	34	51	4.3	8.7	13	13	19
ESSFmm1	2	> 120	> 140	14	23	34	4.7	9.3	14	14	21
ICHmw1	2	> 100	> 250	15	31	46	3.0	6.0	9	9	13
ESSFdk, dku, ESSFdk1, dk2, ESSFdkw	3	> 120	> 140	14	23	34	4.7	9.3	14	14	21
ICHmk1	3	> 100	> 140	14	23	34	4.7	9.3	14	14	21
MSdk	3	> 100	> 140	14	26	39	4.7	9.3	14	14	21
IDF dm 2n	4	> 100	> 250	17	34	51	4.3	8.7	13	13	19

* Old seral requirements in Low BEO areas start at 1/3 old for first 80 years, 2/3 old for the next 80 years, and full old beyond for the Base Case (FRPA).

The target amount of old seral retention was calculated for each LU/BEO/BEC variant combination, and both old seral and mature-plus-old retention areas have been spatially identified and mapped as old growth management areas (OGMA) and mature and old management areas (MOGMA), respectively. Within the low biodiversity emphasis (BEO) areas only the 1/3 drawdown requirement for old seral has been mapped, as per the Higher Level Plan Order for the first rotation (assumed to be 80 years). In low BEO units the 2/3 target requirement and full (3/3) target requirements will be modeled as older seral retention requirements for the second and third rotations, respectively (i.e. in years 81-160, and 161 years+). The requirements are applied to the CFLB within each LU-BEC combination.

7.1.5.2 Disturbance of areas above the operability line

As crown forested stands in the non-THLB contribute toward several forest cover objectives (for example, landscape level biodiversity), it is important that the age class distributions in these stands remain consistent with natural processes. By implementing disturbance in these stands, a more natural age class distribution can be maintained in the model and a more realistic contribution toward seral goals ensured. To achieve this, a constant area was disturbed annually in each LU/NDT combination. The amount of disturbance is based on the BEC variants and their associated natural disturbance intervals and old seral definitions as outlined in the Biodiversity Guidebook (September 1995) and Table 52.

Using the negative exponential equation, the proportion of the forest that would typically occur as old seral forest can be calculated based on the disturbance interval (% area old = exp(-[old age / interval]). Using this % area in old, the calculation of an effective rotation age associated with this seral distribution was possible (Effective rotation age = interval / (1 – proportion old)). The effective rotation age can then be used to define an annual area of disturbance. For example, ESSF variants in NDT3 have a disturbance interval of 150 yrs and an old definition of 140 yrs. This translates into a typical age class distribution where 39% of the area is “old” (>140 yrs) and the oldest stands are around 230 years. Thus 1/230th of the area needs to be disturbed each year to maintain this age class distribution.

The Base Case includes:

- Annual disturbance of the inoperable, contributing Non-THLB area. The selection of the stands to be disturbed was determined by random selection.
- OGMAs, plus the application of an old seral stage requirement to maintain a minimum amount of old consistent with the % old targets wherever the target area had not been mapped as OGMAs in low BEO units.

This method is a slight simplification of Option 4 in ‘Modeling Options for Disturbance Outside the THLB - Working Paper’ (MoF, June 2003).

Table 52 Calculation of area to be disturbed annually in forested non-THLB by NDT / BEC

NDT	BEC	Age Old (yrs)	Return Interval (yrs)	Prop-Ortion Burned / Year	Effective Rotation Age (yrs)	Disturbance (proportion per year) [A]	Contributing Non-THLB Area (ha) [B]	Annual Area Disturbed By BEC [A} x [B]
1	ESSF	250	250	0.37	395	0.0025	91,898	232
1	ICH	250	250	0.37	395	0.0025	36,750	93
2	ESSF	200	250	0.29	350	0.0029	1,214	3
2	ICH	250	250	0.37	395	0.0025	38,451	97
3	ESSF	150	140	0.39	231	0.0043	69,919	303
3	ICH	150	140	0.39	231	0.0043	8,830	38
3	MS	150	140	0.39	231	0.0043	37,344	162
4	IDF	250	250	0.37	395	0.0025	483	1
						Totals		**930**

The disturbance is implemented in the model using a random uniform probability. Each NDT is ‘turned over’ once during a period equal to its effective rotation age and then once again over the next effective rotation age, etc. There is no guarantee that any particular portion of the landbase will actually be disturbed in any one year. Across the NCLB, approximately 930 ha is disturbed each year (0.05%), resulting in an average ‘turning over’ of the landbase every ~ 306 years (range is 231 to 395 years).

7.1.5.3 Wildlife tree retention areas (WTRA)

Wildlife tree retention is one of the primary methods to address stand level biodiversity objectives. Section 3.2 and Appendix 3 of the Landscape Unit Planning Guide (March 1999) describe the process for determining wildlife tree retention requirements at the BEC sub-zone level in order to establish LU objectives. On May 15, 2000, the Assistant Deputy Ministers of Forests and Environment, Lands and Parks approved changes to Section 3.2 of the Landscape Unit Planning Guide. Detailed policy on management of wildlife trees is provided in the document Provincial Wildlife Tree Policy and Management Recommendations (MoF/WLAP, February, 2000).

The Licensees' FSPs are based on Section 66 (1) of the Forest and Range Practices Regulation (FRPR). Licensees are retaining, on an area basis, 7% of the total area of their cutblocks. When possible, retention is within non-THLB areas. Existing, mapped WTRA's are removed from the THLB as landbase netdowns. These are within or adjacent to existing cutblocks.

The estimate of future WTRA's was described in section 2.0

7.1.5.4 Coarse Woody Debris

Management of Coarse Woody Debris (CWD) is another factor in the management of stand level biodiversity. As per provincial policy, it was assumed that CWD objectives are managed operationally while meeting the harvest utilization standards.

7.1.5.5 Patch size objectives

Patch size management has been adopted in the Golden TSA in an effort to more closely mimic natural disturbance patterns and minimize fragmentation of the land base. Patch size management attempts to achieve the patch size distributions specified in the Landscape Unit Planning Guide (MoF/MoE 1999), and is an alternative to cut block adjacency green-up objectives. Cutblock green-up requirements (adjacency) are not modeled directly in this analysis because landscape level forest cover objectives are used to approximate these requirements. As patch management is also a spatial issue beyond the resolution of this timber supply analysis, the same landscape level objectives were used to approximate patch management requirements. In the opinion of the authors, spatial analyses completed in previous projects have confirmed that these landscape level forest cover objectives are consistent with the flexibility associated with patch size management and the operational application of green-up requirements.

7.1.5.6 Connectivity

The HLPO objectives for connectivity were incorporated while spatially locating the OGMAs and MOGMAs (2.3.9). Stands within the connectivity corridors were considered as a higher priority when allocating these old and mature forest retention areas. No further modeling was done for connectivity objectives.

7.1.6 Domestic Watersheds

The HLPO Objective 6 and HLPO Map 6.1. identify the water intakes where reserves are required around portions of the streams up-stream of the intakes for domestic water use (versus for purposes of irrigation). Streams are to be protected by a thirty meter reserve on each side of the stream for distance that depends on the stream order. Streams segments were mapped and reserves were modeled as "no harvest" areas in the base case, and hence are treated as THLB exclusions (Section 2.3.7).

7.1.7 Lakeshore, wetland and riparian management zones

In general, riparian management was predominately addressed through a netdown process that reflected both the reserve and management zones (Section 2.3.8).

7.2 Timber Harvesting

7.2.1 Minimum harvesting age / merchantability standards

For this analysis, minimum harvestable ages were defined by the following criteria:

- minimum volume per hectare (200 m3/ha for C or H stands, or 150m3/ha for other species), and
- minimum piece size (25 cm mean DBH, except for 20cm mean DBH for Pl stands), and
- the age at which 95% of the culmination of the mean annual increment (CMAI) is achieved (Table 53).

These merchantability criteria were adopted from TSR 3.

In order for the stand within the timber supply model to be considered for harvesting, it must achieve an age where the criteria described above are achieved. This ensures that the timber supply model is harvesting stands that meet reasonable economic criteria, and emulate what is generally current practice by forest licensees.

Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives while other stands may be not be harvested until well past there "optimal" timber production ages due to management objectives for other resource values, such as requirements for the retention of older forest or ungulate winter range. The minimum harvest age to be utilized for each analysis unit is defined in Table 54 and Table 55.

Table 53 Minimum merchantability rules

Leading Species	Minimum Volume (m3/ha)	Minimum DBH (cm)	Percent of Culmination
C, H	200	25	95
Pine	150	20	95
Decid (logged)	100	25	95
Other	150	25	95

Notes:
The low value for deciduous, previously logged stands (AU = 123) assumes some form of stand rehabilitation, otherwise the minimum harvest age, if based on a minimum of 150 m3/ha, will be 245 years.

Table 54 Minimum age to reach merchantability criteria

Description	AU Nat	Age to Reach			MHA		AU Man	Age to Reach			MHA
		Min DBH	Min Vol	95% MAI				Min DBH	Min Vol	95% MAI	
Fd (dry), Lw	101	50	56	76	76		201	30	37	50	50
Fd (dry), Lw	102	60	76	93	93		202	50	56	68	68
Fd (dry), Lw	103	n/a	n/a	n/a	n/a		203	n/a	n/a	n/a	n/a
Fd (wet), Lw	104	50	46	75	75		204	30	37	53	53
Fd (wet), Lw	105	60	66	85	85		205	50	57	70	70
Fd (wet), Lw	106	70	76	95	95		206	70	66	82	82
Cw	107	50	66	68	68		207	40	46	75	75
Cw	108	60	86	74	86		208	60	66	92	92
Cw	109	80	115	80	115		209	70	76	103	103
Hw	110	50	66	69	69		210	40	46	72	72
Hw	111	70	76	81	81		211	60	66	92	92
Hw	112	80	116	118	118		212	80	86	119	119
B, S	113	60	56	74	74		213	40	47	59	59
B, S	114	70	76	93	93		214	50	66	86	86
B, S	115	100	105	128	128		215	80	86	118	118
S - mixed	116	50	56	73	73		216	30	37	58	58
S – mixed	117	60	66	85	85		217	40	57	73	73
S – mixed	118	80	86	108	108		218	60	66	99	99
Pine	119	50	46	55	55		219	20	37	47	47
Pine	120	60	46	60	60		220	30	36	53	53
Pine	121	70	66	71	71		221	30	46	62	62
Pine	122	80	76	84	84		222	40	66	68	68
Decid	123	80	95	71	95		223	40	47	58	58

Table 55 Minimum age to reach merchantability- Existing Managed Stands

Description	AU Nat	Age to Reach			MHA		AU Man	Age to Reach			MHA
		Min DBH	Min Vol	95% MAI				Min DBH	Min Vol	95% MAI	
Fd (dry), Lw	501	60	66	79	79		601	50	56	74	74
Fd (wet), Lw	502	50	56	79	79		602	50	56	79	79
Cw	503	50	57	81	81		603	50	57	79	79
Hw	504	50	56	90	90		604	50	56	88	88
B, S	505	50	56	84	84		605	50	56	78	78
S mixed	506	60	66	90	90		606	60	56	69	69
Pine	507	40	56	68	68		607	40	56	66	66
Decid	508	40	47	64	64		608	40	47	64	64
Backlog 1	525	70	86	110	110		625	50	56	75	75
Backlog 2	526	70	78	115	115		626	40	57	69	69

7.2.2 Operability / harvest systems

An operability line separates the operable and inoperable portions of the Golden TSA. The last complete operability mapping project was completed in 2002. A minor update was completed in April, 2008 by the forest licensees and that version is used in this analysis.

Any past harvesting above the 2008 operability line is considered as inoperable in this analysis.

8.0 Timber Supply Modeling

This section provides a summary of the modeling which will be completed following the acceptance of the Data Package. This includes the model and the intended harvest forecasts that will be completed, and which will then be documented in the TSR Analysis Report.

8.1 Model

Forest Planning Studio (FPS) version 6.0.2.0 will be used to complete the timber supply analysis. FPS was developed by Dr. John Nelson at the University of British Columbia (UBC) and is a spatially explicit forest estate simulation model. All events in the model are directly linked to stand level polygons or harvest units and thus allow tracking of individual stand attributes and spatial relationships through time. Each polygon belongs to a specific stand type (Analysis Unit) and has attributes such as age, harvest system, and land base status (THLB or Non THLB). Results are typically aggregated for reporting at higher levels (i.e. harvest flow for the entire unit).

A wide range of constraints can be modeled on the land base: harvest exclusion, spatial adjacency/maximum cutblock size, maximum disturbance/young seral, minimum mature/old seral, and equivalent clearcut area (ECA) limits. Constraints are applied to groups of polygons (cliques) and harvest is restricted if a constraint is not satisfied. A single polygon can belong to many overlapping cliques and each of them must be satisfied in order to allow harvest of the polygon. Where a mature or old cover constraint is not met, harvesting may still occur if there are any eligible stands remaining after the oldest stands are reserved to meet the constraint.

Harvest is implemented using a set of priorities to queue stands for harvest. In each period, the model harvests the highest priority eligible stands until it reaches the harvest target or exhausts the list of opportunities. Harvest can be implemented in single years, multiple year periods or a combination of these. Where periods are used, the midpoint of the period is typically used as the point where harvest opportunity is evaluated because it is a good balance between the start of the period (pessimistic) and the end of the period (optimistic).

8.2 Initial Harvest Rate

The Base Case harvest forecast will use 492,627 as the initial harvest rate, based on:

485 000 m3/yr [A] + **7,627** m3/yr [B] = **492 627** /yr [C]

Where: [A] = current AAC, [B] = un-salvaged losses, [C] = initial harvest rate.

8.3 Harvest rules

Harvest rules have the objective of influencing the model so the harvest profile in the model will reasonably match the harvest profile seen on-the-ground. Licensees don't necessarily follow an "oldest-first" harvest priority. Numerous pressures influence forest operations and the harvest profile may vary greatly between 5-year periods. The more notable examples are the recent bark beetle infestations and fires.

To reflect the current concentration on harvesting to control the MPB, the harvest priority rules in Table 56 were adopted for the Base Case scenarios.

Harvest Priorities are: (1) relative-oldest first; (2) intent is to cap % pine in harvest at 70%; then (3) prioritize within groups: (a) Pine; (b) fir; then (c) other species.

Table 56 Harvest priority rules

Harvest priority	Description
Overall harvest priority; Cover constraints	Relative oldest first harvest rule; and Ensure all forest cover requirements are met at all times.
Susceptible to Mountain pine beetle stands	Highest priority is lodgepole pine leading stands, with a maximum of 70% of the harvest to come from Pl leading stands; then
Fir-leading stands	Fir-leading leading stands; then
Other species	Other stands in the THLB.

8.4 Harvest profile

No specific harvest profile was modeled, although pine-leading stands are expected to dominate due to a priority placed on harvesting pine-leading stands before other species (above). The maximum contribution of pine-leading stands to the harvest was capped at 70% each model period (each decade, unless otherwise specified).

8.5 Silviculture Systems

Silviculture systems are predominately clearcut and clearcut-with-reserves, with negligible areas of partial cutting. Partial cutting is employed largely within the visual landscapes. This was deemed to be too minor to model separately. In the past, partial cutting was used within pine-salvage stands but this practice is no longer followed, and re-entries into past salvage stands have set these stands into a clearcut management regime.

Planting is by far the predominant method of regeneration. Natural regeneration was modeled only in the existing, backlog NSR stands.

8.6 Harvest flow objectives

Except for the sensitivity analyses where alternate harvest flow objectives are examined, the objectives for harvest flow in the Base Case are:

- Initially, start at the current AAC,
- Maintain the current AAC for as long as possible (the intent is that the mid-term harvest level will not be reduced to below the LTSY level), and
- If necessary, reduce the harvest flow at a maximum rate of 10% in any one decade,
- If necessary, minimize the length of any fall-down period,
- When possible, increase the harvest flow at a maximum rate of 10% per decade, and
- Reach a stable, long-term harvest flow rate associated with a constant (flat line) total inventory.

Modeling will be performed for at least 300 years, using 10-year periods, and reporting will be for the first 250 years.

9.0 References

Eng, M., Andrew Fall, Josie Hughes, Terry Shore, Bill Riel, Peter Hall, and Adrian Walton. 2005. Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPB v2) and Results of Year 2 of the Project. Mountain Pine Beetle Initiative of the Canadian Forest Service and the BC Forest Service. April 2005.

Eng, M., Andrew Fall, Josie Hughes, Terry Shore, Bill Riel, Adrian Walton, and Peter Hall. 2006. Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the 2005 Provincial Aerial Overview of Forest Health and revisions to the model (BCMPB.v3). http://www.for.gov.bc.ca/hre/bcmpb/ April 21, 2006

Forest Practices Board. 2008. (Draft) Audit of Soil Conservation Columbia Forest District. Audit Report. (Draft) May 2008.

Government of British Columbia. 1995. Biodiversity Guidebook.

Government of British Columbia. 1995. Riparian Management Area Guidebook.

Government of British Columbia. 1999. Landscape Unit Planning Guide.

Government of B.C. 2002. Kootenay-Boundary Higher Level Plan Order. B.C. Ministry of Sustainable Resources. October 26, 2002. http://srmwww.gov.bc.ca/kor/rmd/docs/nov4_2002/KBHLPOrder0925.pdf

Government of British Columbia. 2002. Forest and Range Practices Act

Government of British Columbia. 1995. Forest Practices Code of British Columbia Act

Government of British Columbia. 2006. Notices for UWR. Website: ftp://ribftp.env.gov.bc.ca/pub/outgoing/cdc_data/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/UWR/Tree_Farm_Licenses/TFL_14/ and ftp://ribftp.env.gov.bc.ca/pub/outgoing/cdc_data/Approved_FRPR_sec7_WLPPR_sec9_Notices_and_Supporting_Info/Species_at_Risk/Rocky_Mountain_FD/

Jahraus & Associates, and Churlish Consulting Ltd. 2007. Golden TSA. Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment And Net Volume Adjustment Factor Development. Report PREPARED FOR LOUISIANA-PACIFIC CANADA LTD., Golden. PREPARED BY Jahraus & Associates Consulting Inc., Maple Ridge BC, And Churlish Consulting Ltd., Victoria BC. MARCH 2007

Holmes, Peter. 2008. Personal communication. Ecosystems Biologist, Ministry of Environment, Invermere.

Kootenay Inter-Agency Management Committee. 1997. Kootenay-Boundary Land Use Plan Implementation Strategy. Land Use Coordination Office.

Mah, Shirley. 2007. Personal communication. Interpretations Ecologist, Ministry of Forests, Victoria.

Ministry of Environment, Environmental Stewardship Division. Identified Wildlife Handbook web site: http://www.env.gov.bc.ca/wld/identified/index.html

Ministry of Environment and Ministry of Forests (MoE/MoF). 1999. Managing Identified Wildlife: Procedures and measures. Forest Practices Code of BC. February 1999. Web site address: http://www.env.gov.bc.ca/wld/identified/index.html

Ministry of Forests. 1996 Nelson Forest Region Technical Report MIT-003, Effect of Silviculture Practices on Green-up Delay in the Nelson Forest Region

Ministry of Forests. 1997. Visual impacts of partial cutting. Summary Report. A Technical Analysis and Public Perception Study. B.C. Ministry of Forests, Forest Development Section, Forest Practices Branch. August 1997.

Ministry of Forests. 1998. Procedures for Factoring Visual Resources into Timber Supply Analyses. Forest Practices Branch and Timber Supply Branch. March 17, 1998

Ministry of Forests. 2003a. Bulletin: Modelling Visuals in TSR III. Update to 'Procedures for Factoring Visual Resources into Timber Supply Analyses'. December 12 2003.

Ministry of Forests. 2003b. Modeling Options for Disturbance Outside the THLB - Working Paper. Timber Supply Branch, Ministry of Forests, June 2003.

Ministry of Forests. 2004. Chief Forester’s Standards for Seed Use. Ministry of Forests. November 20, 2004 Amended November 23, 2006.

Ministry of Forests. 2007. Glossary of Statistical Reporting Terms. Timber Supply Branch. Web site address: http://www.for.gov.bc.ca/hts/inventory/reports/glossary/index.html

Monchak, Darcy. 2004. Golden TSA LU Deployment Tables. Excel summary tables. December, 2005. Prepared by Darcy Monchak, R.P.F., MSRM, Southern Interior Region.

Monchak, Darcy. 2005. Spatial Deployment Of KBHLP Biodiversity And Caribou Objectives For The Golden TSA, Documentation of Procedures and Results. Version 1.2, January 17, 2005. Prepared by Darcy Monchak, R.P.F., MSRM, Southern Interior Region.

Nigh, G.D. 2007. Personal communication. Leader, Strategic Analysis, Ministry of Forests, Victoria.

Nigh, G.D. and B.A. Love. 1998. A Model for Estimating Juvenile Height of Lodgepole Pine

Nigh, G.D. 1995. Site Index Conversion Equations for Mixed Species Stands

Walton, A., Josie Hughes, Marvin Eng, Andrew Fall, Terry Shore, Bill Riel, and Peter Hall. 2007. Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the 2006 Provincial Aerial Overview of Forest Health and revisions to the "Model" (BCMPB.v4). http://www.for.gov.bc.ca/hre/bcmpb/ April 30, 2007

Appendix B – Yield Curves

Analysis Units starting with digit	Description
1	THLB, natural stand analysis units, based on VDYP.
2	THLB, future managed stand analysis units, based on TIPSY.
5	THLB, existing, managed stand analysis units, based on TIPSY.
6	THLB, future, existing managed stand analysis units, based on TIPSY.
8	Non-THLB, natural stand analysis units, based on VDYP.

<Tables are inserted after this page>

Lw, Fd (dry) - best

Analysis Unit	Age	Volume	Diameter	MAI
101	0	0	0	0.0
101	10	0	0	0.0
101	20	0	2	0.0
101	30	23	20	0.8
101	40	76	22	1.9
101	50	129	24	2.6
101	60	180	26	3.0
101	70	229	28	3.3
101	80	275	30	3.4
101	90	318	32	3.5
101	100	355	34	3.6
101	110	386	36	3.5
101	120	414	38	3.5
101	130	440	40	3.4
101	140	461	42	3.3
101	150	481	44	3.2
101	160	498	45	3.1
101	170	513	47	3.0
101	180	526	49	2.9
101	190	538	50	2.8
101	200	550	52	2.8
101	210	561	54	2.7
101	220	572	55	2.6
101	230	582	57	2.5
101	240	591	59	2.5
101	250	600	61	2.4
101	260	600	61	2.3
101	270	600	61	2.2
101	280	599	61	2.1
101	290	599	61	2.1
101	300	598	61	2.0
101	310	597	61	1.9
101	320	597	61	1.9
101	330	596	61	1.8
101	340	595	61	1.8
101	350	593	61	1.7

Lw, Fd (dry) - mod

Analysis Unit	Age	Volume	Diameter	MAI
102	0	0	0	0.0
102	10	0	0	0.0
102	20	0	0	0.0
102	30	1	6	0.0
102	40	26	19	0.7
102	50	62	22	1.2
102	60	99	23	1.7
102	70	135	25	1.9
102	80	169	27	2.1
102	90	201	28	2.2
102	100	232	30	2.3
102	110	261	32	2.4
102	120	286	34	2.4
102	130	309	35	2.4
102	140	328	37	2.3
102	150	346	38	2.3
102	160	360	39	2.3
102	170	373	41	2.2
102	180	385	42	2.1
102	190	396	44	2.1
102	200	407	45	2.0
102	210	417	46	2.0
102	220	426	48	1.9
102	230	435	49	1.9
102	240	444	51	1.9
102	250	452	52	1.8
102	260	452	52	1.7
102	270	453	52	1.7
102	280	453	52	1.6
102	290	453	52	1.6
102	300	453	53	1.5
102	310	453	53	1.5
102	320	453	53	1.4
102	330	452	53	1.4
102	340	452	53	1.3
102	350	452	53	1.3

Lw, Fd (wet) - best

Analysis Unit	Age	Volume	Diameter	MAI
104	0	0	0	0.0
104	10	0	0	0.0
104	20	0	4	0.0
104	30	25	20	0.8
104	40	88	22	2.2
104	50	153	24	3.1
104	60	215	26	3.6
104	70	273	28	3.9
104	80	327	30	4.1
104	90	376	32	4.2
104	100	420	34	4.2
104	110	457	36	4.2
104	120	489	39	4.1
104	130	519	41	4.0
104	140	547	42	3.9
104	150	571	44	3.8
104	160	594	46	3.7
104	170	614	48	3.6
104	180	633	49	3.5
104	190	650	51	3.4
104	200	666	53	3.3
104	210	682	54	3.2
104	220	696	56	3.2
104	230	710	58	3.1
104	240	724	60	3.0
104	250	736	61	2.9
104	260	738	61	2.8
104	270	739	62	2.7
104	280	741	62	2.6
104	290	742	62	2.6
104	300	743	62	2.5
104	310	744	62	2.4
104	320	745	63	2.3
104	330	745	63	2.3
104	340	746	63	2.2
104	350	747	63	2.1

Lw, Fd (wet) - mod

Analysis Unit	Age	Volume	Diameter	MAI
105	0	0	0	0.0
105	10	0	0	0.0
105	20	0	1	0.0
105	30	2	12	0.1
105	40	41	21	1.0
105	50	91	22	1.8
105	60	139	24	2.3
105	70	184	26	2.6
105	80	226	27	2.8
105	90	265	29	2.9
105	100	301	31	3.0
105	110	334	33	3.0
105	120	363	34	3.0
105	130	390	36	3.0
105	140	413	38	3.0
105	150	434	39	2.9
105	160	453	40	2.8
105	170	470	42	2.8
105	180	486	43	2.7
105	190	500	44	2.6
105	200	514	46	2.6
105	210	527	47	2.5
105	220	540	49	2.5
105	230	551	50	2.4
105	240	563	51	2.3
105	250	573	53	2.3
105	260	575	53	2.2
105	270	577	53	2.1
105	280	578	53	2.1
105	290	579	53	2.0
105	300	581	54	1.9
105	310	582	54	1.9
105	320	583	54	1.8
105	330	584	54	1.8
105	340	585	54	1.7
105	350	586	55	1.7

Lw, Fd (wet) - poorest

Analysis Unit	Age	Volume	Diameter	MAI
106	0	0	0	0.0
106	10	0	0	0.0
106	20	0	0	0.0
106	30	0	5	0.0
106	40	10	18	0.3
106	50	45	21	0.9
106	60	83	22	1.4
106	70	119	24	1.7
106	80	153	25	1.9
106	90	184	27	2.0
106	100	213	28	2.1
106	110	240	30	2.2
106	120	264	31	2.2
106	130	286	32	2.2
106	140	307	34	2.2
106	150	325	35	2.2
106	160	341	36	2.1
106	170	355	37	2.1
106	180	369	38	2.1
106	190	382	39	2.0
106	200	395	40	2.0
106	210	407	41	1.9
106	220	419	43	1.9
106	230	430	44	1.9
106	240	441	45	1.8
106	250	451	46	1.8
106	260	453	46	1.7
106	270	455	46	1.7
106	280	456	46	1.6
106	290	458	47	1.6
106	300	459	47	1.5
106	310	461	47	1.5
106	320	462	47	1.4
106	330	463	47	1.4
106	340	464	47	1.4
106	350	465	48	1.3

Cw - best

Analysis Unit	Age	Volume	Diameter	MAI
107	0	0	0	0.0
107	10	0	0	0.0
107	20	0	1	0.0
107	30	5	20	0.2
107	40	62	22	1.6
107	50	114	24	2.3
107	60	161	26	2.7
107	70	203	29	2.9
107	80	241	31	3.0
107	90	270	33	3.0
107	100	293	35	2.9
107	110	313	38	2.8
107	120	328	40	2.7
107	130	350	42	2.7
107	140	372	44	2.7
107	150	392	46	2.6
107	160	410	48	2.6
107	170	427	50	2.5
107	180	443	52	2.5
107	190	458	53	2.4
107	200	473	55	2.4
107	210	487	57	2.3
107	220	503	58	2.3
107	230	520	60	2.3
107	240	535	61	2.2
107	250	550	62	2.2
107	260	551	62	2.1
107	270	553	63	2.0
107	280	554	63	2.0
107	290	555	64	1.9
107	300	556	64	1.9
107	310	557	64	1.8
107	320	558	65	1.7
107	330	558	65	1.7
107	340	559	65	1.6
107	350	560	66	1.6

Cw - mod

Analysis Unit	Age	Volume	Diameter	MAI
108	0	0	0	0.0
108	10	0	0	0.0
108	20	0	0	0.0
108	30	0	5	0.0
108	40	26	21	0.7
108	50	74	22	1.5
108	60	118	24	2.0
108	70	157	26	2.2
108	80	192	27	2.4
108	90	219	29	2.4
108	100	241	31	2.4
108	110	259	33	2.4
108	120	273	35	2.3
108	130	294	36	2.3
108	140	314	38	2.2
108	150	333	40	2.2
108	160	351	41	2.2
108	170	367	43	2.2
108	180	383	44	2.1
108	190	398	45	2.1
108	200	413	47	2.1
108	210	427	48	2.0
108	220	444	49	2.0
108	230	460	51	2.0
108	240	476	51	2.0
108	250	492	52	2.0
108	260	494	53	1.9
108	270	496	53	1.8
108	280	498	53	1.8
108	290	499	54	1.7
108	300	501	54	1.7
108	310	502	54	1.6
108	320	503	55	1.6
108	330	505	55	1.5
108	340	506	55	1.5
108	350	507	56	1.4

Cw - poorest

Analysis Unit	Age	Volume	Diameter	MAI
109	0	0	0	0.0
109	10	0	0	0.0
109	20	0	0	0.0
109	30	0	4	0.0
109	40	3	15	0.1
109	50	35	21	0.7
109	60	70	22	1.2
109	70	102	23	1.5
109	80	131	25	1.6
109	90	154	26	1.7
109	100	173	27	1.7
109	110	188	29	1.7
109	120	201	30	1.7
109	130	218	31	1.7
109	140	235	33	1.7
109	150	251	34	1.7
109	160	265	35	1.7
109	170	279	36	1.6
109	180	292	37	1.6
109	190	304	38	1.6
109	200	316	39	1.6
109	210	328	40	1.6
109	220	341	41	1.6
109	230	354	42	1.5
109	240	368	42	1.5
109	250	380	43	1.5
109	260	383	43	1.5
109	270	385	44	1.4
109	280	387	44	1.4
109	290	389	44	1.3
109	300	391	44	1.3
109	310	392	45	1.3
109	320	394	45	1.2
109	330	395	45	1.2
109	340	397	45	1.2
109	350	398	46	1.1

Hw - best

Analysis Unit	Age	Volume	Diameter	MAI
110	0	0	0	0.0
110	10	0	0	0.0
110	20	0	2	0.0
110	30	3	17	0.1
110	40	54	21	1.4
110	50	123	23	2.5
110	60	183	25	3.1
110	70	237	27	3.4
110	80	283	29	3.5
110	90	316	31	3.5
110	100	342	33	3.4
110	110	362	36	3.3
110	120	377	38	3.1
110	130	399	40	3.1
110	140	420	41	3.0
110	150	438	43	2.9
110	160	453	45	2.8
110	170	467	46	2.7
110	180	480	47	2.7
110	190	491	48	2.6
110	200	502	50	2.5
110	210	512	51	2.4
110	220	522	52	2.4
110	230	530	53	2.3
110	240	538	54	2.2
110	250	546	55	2.2
110	260	549	56	2.1
110	270	551	57	2.0
110	280	553	58	2.0
110	290	555	58	1.9
110	300	557	59	1.9
110	310	558	60	1.8
110	320	560	60	1.8
110	330	561	61	1.7
110	340	563	62	1.7
110	350	564	62	1.6

Hw - mod

Analysis Unit	Age	Volume	Diameter	MAI
111	0	0	0	0.0
111	10	0	0	0.0
111	20	0	0	0.0
111	30	0	4	0.0
111	40	7	15	0.2
111	50	47	21	0.9
111	60	105	23	1.8
111	70	157	24	2.2
111	80	204	26	2.6
111	90	241	28	2.7
111	100	270	30	2.7
111	110	294	32	2.7
111	120	313	34	2.6
111	130	337	36	2.6
111	140	359	37	2.6
111	150	379	39	2.5
111	160	396	40	2.5
111	170	412	41	2.4
111	180	426	42	2.4
111	190	438	43	2.3
111	200	451	45	2.3
111	210	463	46	2.2
111	220	474	47	2.2
111	230	485	48	2.1
111	240	494	49	2.1
111	250	503	50	2.0
111	260	507	51	2.0
111	270	511	52	1.9
111	280	514	52	1.8
111	290	517	53	1.8
111	300	520	54	1.7
111	310	523	55	1.7
111	320	526	55	1.6
111	330	528	56	1.6
111	340	530	57	1.6
111	350	532	57	1.5

Hw - poorest

Analysis Unit	Age	Volume	Diameter	MAI
112	0	0	0	0.0
112	10	0	0	0.0
112	20	0	0	0.0
112	30	0	0	0.0
112	40	0	4	0.0
112	50	2	14	0.0
112	60	22	20	0.4
112	70	60	22	0.9
112	80	100	24	1.3
112	90	134	25	1.5
112	100	164	27	1.6
112	110	188	28	1.7
112	120	209	30	1.7
112	130	232	32	1.8
112	140	254	33	1.8
112	150	274	35	1.8
112	160	291	36	1.8
112	170	307	37	1.8
112	180	322	38	1.8
112	190	335	39	1.8
112	200	348	40	1.7
112	210	360	41	1.7
112	220	372	42	1.7
112	230	383	43	1.7
112	240	394	44	1.6
112	250	404	45	1.6
112	260	410	46	1.6
112	270	415	46	1.5
112	280	420	47	1.5
112	290	424	48	1.5
112	300	428	49	1.4
112	310	431	49	1.4
112	320	434	50	1.4
112	330	437	51	1.3
112	340	440	51	1.3
112	350	442	52	1.3

B, S - best

Analysis Unit	Age	Volume	Diameter	MAI
113	0	0	0	0.0
113	10	0	0	0.0
113	20	0	0	0.0
113	30	2	12	0.1
113	40	33	21	0.8
113	50	105	23	2.1
113	60	170	25	2.8
113	70	227	27	3.2
113	80	275	29	3.4
113	90	315	30	3.5
113	100	348	32	3.5
113	110	377	34	3.4
113	120	401	35	3.3
113	130	423	37	3.3
113	140	443	38	3.2
113	150	461	40	3.1
113	160	476	41	3.0
113	170	489	42	2.9
113	180	501	43	2.8
113	190	511	43	2.7
113	200	521	44	2.6
113	210	530	45	2.5
113	220	538	46	2.4
113	230	545	47	2.4
113	240	551	48	2.3
113	250	557	49	2.2
113	260	560	50	2.2
113	270	563	50	2.1
113	280	565	51	2.0
113	290	567	52	2.0
113	300	569	52	1.9
113	310	570	53	1.8
113	320	572	53	1.8
113	330	573	54	1.7
113	340	574	55	1.7
113	350	575	55	1.6

B, S - mod

Analysis Unit	Age	Volume	Diameter	MAI
114	0	0	0	0.0
114	10	0	0	0.0
114	20	0	0	0.0
114	30	0	1	0.0
114	40	6	15	0.2
114	50	28	19	0.6
114	60	74	22	1.2
114	70	121	24	1.7
114	80	162	25	2.0
114	90	198	27	2.2
114	100	230	28	2.3
114	110	258	30	2.3
114	120	282	32	2.4
114	130	306	33	2.4
114	140	327	34	2.3
114	150	347	35	2.3
114	160	364	36	2.3
114	170	380	37	2.2
114	180	394	38	2.2
114	190	407	39	2.1
114	200	420	40	2.1
114	210	431	41	2.1
114	220	441	42	2.0
114	230	451	43	2.0
114	240	460	44	1.9
114	250	469	45	1.9
114	260	473	45	1.8
114	270	476	46	1.8
114	280	480	47	1.7
114	290	483	47	1.7
114	300	485	48	1.6
114	310	487	48	1.6
114	320	490	49	1.5
114	330	491	49	1.5
114	340	493	50	1.5
114	350	495	50	1.4

B, S - poorest

Analysis Unit	Age	Volume	Diameter	MAI
115	0	0	0	0.0
115	10	0	0	0.0
115	20	0	0	0.0
115	30	0	0	0.0
115	40	0	2	0.0
115	50	4	14	0.1
115	60	14	20	0.2
115	70	42	21	0.6
115	80	76	22	1.0
115	90	107	24	1.2
115	100	136	25	1.4
115	110	162	26	1.5
115	120	186	27	1.6
115	130	209	29	1.6
115	140	230	30	1.6
115	150	250	31	1.7
115	160	268	31	1.7
115	170	285	32	1.7
115	180	300	33	1.7
115	190	315	34	1.7
115	200	328	35	1.6
115	210	341	35	1.6
115	220	352	36	1.6
115	230	363	37	1.6
115	240	374	38	1.6
115	250	383	39	1.5
115	260	388	39	1.5
115	270	393	40	1.5
115	280	397	40	1.4
115	290	401	41	1.4
115	300	405	42	1.4
115	310	408	42	1.3
115	320	412	43	1.3
115	330	414	43	1.3
115	340	417	44	1.2
115	350	419	44	1.2

S mixed - best

Analysis Unit	Age	Volume	Diameter	MAI
116	0	0	0	0.0
116	10	0	0	0.0
116	20	0	0	0.0
116	30	0	8	0.0
116	40	50	21	1.3
116	50	132	23	2.6
116	60	205	25	3.4
116	70	269	27	3.8
116	80	324	29	4.1
116	90	370	31	4.1
116	100	409	33	4.1
116	110	443	35	4.0
116	120	470	37	3.9
116	130	495	38	3.8
116	140	515	40	3.7
116	150	532	41	3.5
116	160	546	42	3.4
116	170	558	43	3.3
116	180	568	44	3.2
116	190	576	45	3.0
116	200	584	45	2.9
116	210	591	46	2.8
116	220	598	47	2.7
116	230	604	48	2.6
116	240	609	49	2.5
116	250	614	50	2.5
116	260	617	51	2.4
116	270	620	51	2.3
116	280	622	52	2.2
116	290	624	52	2.2
116	300	625	53	2.1
116	310	627	53	2.0
116	320	628	54	2.0
116	330	629	55	1.9
116	340	630	55	1.9
116	350	631	56	1.8

S mixed - mod

Analysis Unit	Age	Volume	Diameter	MAI
117	0	0	0	0.0
117	10	0	0	0.0
117	20	0	0	0.0
117	30	0	4	0.0
117	40	9	17	0.2
117	50	72	22	1.4
117	60	138	24	2.3
117	70	198	26	2.8
117	80	251	27	3.1
117	90	297	29	3.3
117	100	337	31	3.4
117	110	372	33	3.4
117	120	402	34	3.4
117	130	430	36	3.3
117	140	453	37	3.2
117	150	472	38	3.1
117	160	488	39	3.1
117	170	502	40	3.0
117	180	514	41	2.9
117	190	524	42	2.8
117	200	534	43	2.7
117	210	543	44	2.6
117	220	552	45	2.5
117	230	559	46	2.4
117	240	566	46	2.4
117	250	572	47	2.3
117	260	576	48	2.2
117	270	579	48	2.1
117	280	582	49	2.1
117	290	585	50	2.0
117	300	588	50	2.0
117	310	590	51	1.9
117	320	592	51	1.9
117	330	593	52	1.8
117	340	595	52	1.8
117	350	596	53	1.7

Pine - best

Analysis Unit	Age	Volume	Diameter	MAI
118	0	0	0	0.0
118	10	0	0	0.0
118	20	0	0	0.0
118	30	0	0	0.0
118	40	0	7	0.0
118	50	10	17	0.2
118	60	48	21	0.8
118	70	96	23	1.4
118	80	142	24	1.8
118	90	185	26	2.1
118	100	223	28	2.2
118	110	256	29	2.3
118	120	286	31	2.4
118	130	315	32	2.4
118	140	340	33	2.4
118	150	362	35	2.4
118	160	381	36	2.4
118	170	398	37	2.3
118	180	414	37	2.3
118	190	428	38	2.3
118	200	441	39	2.2
118	210	453	40	2.2
118	220	464	41	2.1
118	230	475	42	2.1
118	240	485	43	2.0
118	250	494	44	2.0
118	260	499	44	1.9
118	270	503	45	1.9
118	280	507	45	1.8
118	290	511	46	1.8
118	300	515	46	1.7
118	310	518	47	1.7
118	320	521	47	1.6
118	330	523	48	1.6
118	340	526	49	1.5
118	350	528	49	1.5

Pine - best

Analysis Unit	Age	Volume	Diameter	MAI
119	0	0	0	0.0
119	10	0	0	0.0
119	20	0	1	0.0
119	30	55	16	1.8
119	40	123	18	3.1
119	50	181	20	3.6
119	60	231	21	3.9
119	70	275	23	3.9
119	80	313	24	3.9
119	90	347	26	3.9
119	100	377	27	3.8
119	110	404	28	3.7
119	120	429	30	3.6
119	130	452	31	3.5
119	140	467	32	3.3
119	150	479	33	3.2
119	160	488	33	3.1
119	170	493	34	2.9
119	180	495	34	2.8
119	190	494	35	2.6
119	200	496	35	2.5
119	210	500	35	2.4
119	220	503	36	2.3
119	230	506	36	2.2
119	240	509	37	2.1
119	250	512	37	2.0
119	260	514	38	2.0
119	270	517	38	1.9
119	280	518	38	1.9
119	290	520	38	1.8
119	300	522	39	1.7
119	310	523	39	1.7
119	320	525	39	1.6
119	330	526	40	1.6
119	340	527	40	1.6
119	350	528	40	1.5

Pine - mod+

Analysis Unit	Age	Volume	Diameter	MAI
120	0	0	0	0.0
120	10	0	0	0.0
120	20	0	1	0.0
120	30	33	16	1.1
120	40	95	17	2.4
120	50	151	19	3.0
120	60	199	20	3.3
120	70	242	21	3.5
120	80	279	23	3.5
120	90	313	24	3.5
120	100	343	25	3.4
120	110	370	26	3.4
120	120	396	28	3.3
120	130	420	29	3.2
120	140	435	30	3.1
120	150	448	31	3.0
120	160	457	31	2.9
120	170	462	32	2.7
120	180	465	32	2.6
120	190	463	33	2.4
120	200	466	33	2.3
120	210	470	34	2.2
120	220	473	34	2.2
120	230	476	34	2.1
120	240	479	35	2.0
120	250	483	35	1.9
120	260	485	36	1.9
120	270	487	36	1.8
120	280	489	36	1.7
120	290	491	36	1.7
120	300	492	37	1.6
120	310	494	37	1.6
120	320	495	37	1.5
120	330	496	38	1.5
120	340	497	38	1.5
120	350	498	38	1.4

Pine - mod

Analysis Unit	Age	Volume	Diameter	MAI
121	0	0	0	0.0
121	10	0	0	0.0
121	20	0	2	0.0
121	30	7	10	0.2
121	40	54	16	1.4
121	50	100	17	2.0
121	60	142	19	2.4
121	70	179	20	2.6
121	80	212	21	2.7
121	90	242	22	2.7
121	100	270	23	2.7
121	110	295	25	2.7
121	120	318	26	2.7
121	130	340	27	2.6
121	140	354	28	2.5
121	150	366	28	2.4
121	160	375	29	2.3
121	170	381	30	2.2
121	180	383	30	2.1
121	190	383	31	2.0
121	200	386	31	1.9
121	210	389	32	1.9
121	220	392	32	1.8
121	230	396	33	1.7
121	240	399	33	1.7
121	250	402	34	1.6
121	260	404	34	1.6
121	270	406	34	1.5
121	280	407	34	1.5
121	290	409	35	1.4
121	300	410	35	1.4
121	310	412	35	1.3
121	320	413	35	1.3
121	330	414	36	1.3
121	340	415	36	1.2
121	350	416	36	1.2

Pine - poorest

Analysis Unit	Age	Volume	Diameter	MAI
122	0	0	0	0.0
122	10	0	0	0.0
122	20	0	2	0.0
122	30	0	2	0.0
122	40	27	15	0.7
122	50	67	17	1.3
122	60	106	18	1.8
122	70	141	19	2.0
122	80	172	20	2.2
122	90	202	21	2.2
122	100	229	22	2.3
122	110	254	23	2.3
122	120	277	24	2.3
122	130	299	25	2.3
122	140	314	26	2.2
122	150	326	26	2.2
122	160	335	27	2.1
122	170	341	27	2.0
122	180	344	28	1.9
122	190	343	28	1.8
122	200	347	29	1.7
122	210	350	29	1.7
122	220	353	30	1.6
122	230	357	30	1.6
122	240	360	31	1.5
122	250	363	31	1.5
122	260	365	32	1.4
122	270	367	32	1.4
122	280	369	32	1.3
122	290	370	33	1.3
122	300	372	33	1.2
122	310	373	33	1.2
122	320	374	33	1.2
122	330	375	34	1.1
122	340	376	34	1.1
122	350	377	34	1.1

Decid - all

Analysis Unit	Age	Volume	Diameter	MAI
123	0	0	0	0.0
123	10	0	0	0.0
123	20	0	1	0.0
123	30	4	8	0.1
123	40	19	12	0.5
123	50	36	18	0.7
123	60	53	20	0.9
123	70	69	22	1.0
123	80	83	24	1.0
123	90	94	26	1.0
123	100	104	27	1.0
123	110	112	29	1.0
123	120	118	31	1.0
123	130	124	32	1.0
123	140	129	33	0.9
123	150	134	34	0.9
123	160	136	35	0.9
123	170	138	35	0.8
123	180	140	36	0.8
123	190	142	36	0.7
123	200	143	36	0.7
123	210	145	37	0.7
123	220	146	37	0.7
123	230	148	38	0.6
123	240	149	38	0.6
123	250	150	38	0.6
123	260	151	38	0.6
123	270	151	39	0.6
123	280	151	39	0.5
123	290	152	39	0.5
123	300	152	39	0.5
123	310	152	39	0.5
123	320	152	39	0.5
123	330	152	39	0.5
123	340	152	40	0.4
123	350	153	40	0.4

CFLB Coniferous

Analysis Unit	Age	Volume	Diameter	MAI
801	0	0	0	0.0
801	10	0	0	0.0
801	20	0	0	0.0
801	30	3	3	0.1
801	40	15	10	0.4
801	50	38	17	0.8
801	60	69	21	1.2
801	70	103	22	1.5
801	80	136	24	1.7
801	90	166	25	1.8
801	100	193	27	1.9
801	110	217	28	2.0
801	120	238	29	2.0
801	130	259	31	2.0
801	140	278	32	2.0
801	150	294	33	2.0
801	160	309	34	1.9
801	170	322	35	1.9
801	180	333	36	1.9
801	190	343	36	1.8
801	200	353	37	1.8
801	210	363	38	1.7
801	220	372	39	1.7
801	230	381	40	1.7
801	240	389	41	1.6
801	250	397	42	1.6
801	260	400	42	1.5
801	270	403	43	1.5
801	280	405	43	1.4
801	290	408	44	1.4
801	300	410	44	1.4
801	310	412	44	1.3
801	320	414	45	1.3
801	330	416	45	1.3
801	340	417	46	1.2
801	350	418	46	1.2

CFLB Deciduous

Analysis Unit	Age	Volume	Diameter	MAI
802	0	0	0	0.0
802	10	0	0	0.0
802	20	0	2	0.0
802	30	5	12	0.2
802	40	23	16	0.6
802	50	44	19	0.9
802	60	63	21	1.1
802	70	80	23	1.1
802	80	95	25	1.2
802	90	107	27	1.2
802	100	118	29	1.2
802	110	126	30	1.1
802	120	133	32	1.1
802	130	139	34	1.1
802	140	144	35	1.0
802	150	149	36	1.0
802	160	152	37	1.0
802	170	155	37	0.9
802	180	157	37	0.9
802	190	159	38	0.8
802	200	160	38	0.8
802	210	162	39	0.8
802	220	164	39	0.7
802	230	165	39	0.7
802	240	167	40	0.7
802	250	168	40	0.7
802	260	169	40	0.7
802	270	169	40	0.6
802	280	169	41	0.6
802	290	169	41	0.6
802	300	170	41	0.6
802	310	170	41	0.5
802	320	170	41	0.5
802	330	170	41	0.5
802	340	170	41	0.5
802	350	170	41	0.5

Not Used

Analysis Unit	Age	Volume	Diameter	MAI
900	0	0	0	0.0
900	10	0	0	0.0
900	20	0	0	0.0
900	30	0	0	0.0
900	40	0	0	0.0
900	50	0	0	0.0
900	60	0	0	0.0
900	70	0	0	0.0
900	80	0	0	0.0
900	90	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0

Not Used

Analysis Unit	Age	Volume	Diameter	MAI
900	0	0	0	0.0
900	10	0	0	0.0
900	20	0	0	0.0
900	30	0	0	0.0
900	40	0	0	0.0
900	50	0	0	0.0
900	60	0	0	0.0
900	70	0	0	0.0
900	80	0	0	0.0
900	90	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0

Not Used

Analysis Unit	Age	Volume	Diameter	MAI
900	0	0	0	0.0
900	10	0	0	0.0
900	20	0	0	0.0
900	30	0	0	0.0
900	40	0	0	0.0
900	50	0	0	0.0
900	60	0	0	0.0
900	70	0	0	0.0
900	80	0	0	0.0
900	90	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0

Not Used

Analysis Unit	Age	Volume	Diameter	MAI
900	0	0	0	0.0
900	10	0	0	0.0
900	20	0	0	0.0
900	30	0	0	0.0
900	40	0	0	0.0
900	50	0	0	0.0
900	60	0	0	0.0
900	70	0	0	0.0
900	80	0	0	0.0
900	90	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0

Not Used

Analysis Unit	Age	Volume	Diameter	MAI
900	0	0	0	0.0
900	10	0	0	0.0
900	20	0	0	0.0
900	30	0	0	0.0
900	40	0	0	0.0
900	50	0	0	0.0
900	60	0	0	0.0
900	70	0	0	0.0
900	80	0	0	0.0
900	90	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0
900	100	0	0	0.0

Lw, Fd (dry) - best

Analysis Unit	Age	Volume	Diameter	MAI
201	0	0	0	0.0
201	10	0	0	0.0
201	20	3	14	0.2
201	30	82	22	2.7
201	40	204	27	5.1
201	50	304	31	6.1
201	60	381	34	6.4
201	70	439	37	6.3
201	80	474	39	5.9
201	90	495	41	5.5
201	100	517	42	5.2
201	110	514	42	4.7
201	120	512	42	4.3
201	130	509	42	3.9
201	140	506	42	3.6
201	150	503	42	3.4
201	160	501	42	3.1
201	170	498	42	2.9
201	180	495	42	2.8
201	190	493	42	2.6
201	200	490	42	2.5
201	210	487	42	2.3
201	220	484	42	2.2
201	230	482	42	2.1
201	240	479	42	2.0
201	250	476	42	1.9
201	260	474	42	1.8
201	270	471	42	1.7
201	280	468	42	1.7
201	290	465	42	1.6
201	300	463	42	1.5
201	310	460	42	1.5
201	320	457	42	1.4
201	330	454	42	1.4
201	340	452	42	1.3
201	350	449	42	1.3

Lw, Fd (dry) - mod

Analysis Unit	Age	Volume	Diameter	MAI
202	0	0	0	0.0
202	10	0	0	0.0
202	20	0	0	0.0
202	30	6	16	0.2
202	40	55	21	1.4
202	50	125	24	2.5
202	60	192	27	3.2
202	70	249	29	3.6
202	80	294	31	3.7
202	90	330	33	3.7
202	100	360	34	3.6
202	110	386	35	3.5
202	120	408	36	3.4
202	130	425	37	3.3
202	140	438	38	3.1
202	150	449	38	3.0
202	160	456	39	2.9
202	170	464	39	2.7
202	180	470	40	2.6
202	190	475	40	2.5
202	200	479	41	2.4
202	210	482	41	2.3
202	220	484	41	2.2
202	230	486	41	2.1
202	240	488	41	2.0
202	250	489	42	2.0
202	260	489	42	1.9
202	270	487	42	1.8
202	280	484	42	1.7
202	290	481	42	1.7
202	300	478	42	1.6
202	310	475	42	1.5
202	320	473	42	1.5
202	330	470	42	1.4
202	340	467	42	1.4
202	350	464	42	1.3

Lw, Fd (wet) - best

Analysis Unit	Age	Volume	Diameter	MAI
204	0	0	0	0.0
204	10	0	0	0.0
204	20	1	13	0.1
204	30	57	21	1.9
204	40	182	26	4.6
204	50	300	31	6.0
204	60	382	35	6.4
204	70	449	38	6.4
204	80	496	41	6.2
204	90	529	42	5.9
204	100	561	44	5.6
204	110	558	44	5.1
204	120	555	44	4.6
204	130	552	44	4.2
204	140	549	44	3.9
204	150	547	44	3.6
204	160	544	44	3.4
204	170	541	44	3.2
204	180	538	44	3.0
204	190	535	44	2.8
204	200	532	44	2.7
204	210	529	44	2.5
204	220	526	44	2.4
204	230	523	44	2.3
204	240	520	44	2.2
204	250	517	44	2.1
204	260	514	44	2.0
204	270	511	44	1.9
204	280	508	44	1.8
204	290	505	44	1.7
204	300	502	44	1.7
204	310	499	44	1.6
204	320	496	44	1.6
204	330	493	44	1.5
204	340	490	44	1.4
204	350	487	44	1.4

Lw, Fd (wet) - mod

Analysis Unit	Age	Volume	Diameter	MAI
205	0	0	0	0.0
205	10	0	0	0.0
205	20	0	0	0.0
205	30	4	16	0.1
205	40	51	21	1.3
205	50	134	25	2.7
205	60	213	28	3.6
205	70	283	31	4.0
205	80	338	33	4.2
205	90	382	35	4.2
205	100	419	37	4.2
205	110	451	38	4.1
205	120	476	40	4.0
205	130	495	41	3.8
205	140	511	42	3.7
205	150	525	43	3.5
205	160	537	43	3.4
205	170	548	44	3.2
205	180	556	44	3.1
205	190	563	45	3.0
205	200	568	45	2.8
205	210	573	46	2.7
205	220	577	46	2.6
205	230	580	46	2.5
205	240	576	46	2.4
205	250	573	46	2.3
205	260	570	46	2.2
205	270	566	46	2.1
205	280	563	46	2.0
205	290	560	46	1.9
205	300	557	46	1.9
205	310	553	46	1.8
205	320	550	46	1.7
205	330	547	46	1.7
205	340	543	46	1.6
205	350	540	46	1.5

Lw, Fd (wet) - poorest

Analysis Unit	Age	Volume	Diameter	MAI
206	0	0	0	0.0
206	10	0	0	0.0
206	20	0	0	0.0
206	30	1	13	0.0
206	40	16	18	0.4
206	50	55	21	1.1
206	60	104	23	1.7
206	70	152	25	2.2
206	80	191	27	2.4
206	90	225	28	2.5
206	100	253	30	2.5
206	110	278	31	2.5
206	120	298	32	2.5
206	130	315	33	2.4
206	140	331	33	2.4
206	150	344	34	2.3
206	160	356	35	2.2
206	170	366	35	2.2
206	180	375	36	2.1
206	190	383	36	2.0
206	200	389	37	1.9
206	210	394	37	1.9
206	220	399	37	1.8
206	230	402	37	1.7
206	240	405	38	1.7
206	250	407	38	1.6
206	260	410	38	1.6
206	270	411	38	1.5
206	280	413	39	1.5
206	290	416	39	1.4
206	300	413	39	1.4
206	310	411	39	1.3
206	320	408	39	1.3
206	330	406	39	1.2
206	340	403	39	1.2
206	350	401	39	1.1

Cw - best

Analysis Unit	Age	Volume	Diameter	MAI
207	0	0	0	0.0
207	10	0	0	0.0
207	20	0	0	0.0
207	30	3	15	0.1
207	40	55	21	1.4
207	50	152	25	3.0
207	60	251	29	4.2
207	70	333	33	4.8
207	80	403	36	5.0
207	90	463	38	5.1
207	100	515	40	5.2
207	110	556	42	5.1
207	120	592	44	4.9
207	130	628	45	4.8
207	140	658	47	4.7
207	150	683	48	4.6
207	160	703	49	4.4
207	170	722	50	4.2
207	180	738	50	4.1
207	190	752	51	4.0
207	200	764	52	3.8
207	210	776	52	3.7
207	220	771	52	3.5
207	230	767	52	3.3
207	240	763	52	3.2
207	250	758	52	3.0
207	260	754	52	2.9
207	270	750	52	2.8
207	280	745	52	2.7
207	290	741	52	2.6
207	300	737	52	2.5
207	310	732	52	2.4
207	320	728	52	2.3
207	330	724	52	2.2
207	340	719	52	2.1
207	350	715	52	2.0

Cw - mod

Analysis Unit	Age	Volume	Diameter	MAI
208	0	0	0	0.0
208	10	0	0	0.0
208	20	0	0	0.0
208	30	0	0	0.0
208	40	8	17	0.2
208	50	54	21	1.1
208	60	130	25	2.2
208	70	204	28	2.9
208	80	276	30	3.5
208	90	333	33	3.7
208	100	386	35	3.9
208	110	432	37	3.9
208	120	473	39	3.9
208	130	507	40	3.9
208	140	536	42	3.8
208	150	560	43	3.7
208	160	587	44	3.7
208	170	611	45	3.6
208	180	631	46	3.5
208	190	647	47	3.4
208	200	661	47	3.3
208	210	673	48	3.2
208	220	684	49	3.1
208	230	694	49	3.0
208	240	704	50	2.9
208	250	713	50	2.9
208	260	720	51	2.8
208	270	726	51	2.7
208	280	732	51	2.6
208	290	737	52	2.5
208	300	732	52	2.4
208	310	728	52	2.3
208	320	724	52	2.3
208	330	720	52	2.2
208	340	715	52	2.1
208	350	711	52	2.0

Cw - poorest

Analysis Unit	Age	Volume	Diameter	MAI
209	0	0	0	0.0
209	10	0	0	0.0
209	20	0	0	0.0
209	30	0	0	0.0
209	40	1	14	0.0
209	50	15	18	0.3
209	60	57	21	1.0
209	70	114	24	1.6
209	80	169	27	2.1
209	90	221	29	2.5
209	100	270	30	2.7
209	110	311	32	2.8
209	120	346	34	2.9
209	130	374	35	2.9
209	140	399	36	2.9
209	150	420	37	2.8
209	160	439	38	2.7
209	170	453	39	2.7
209	180	467	39	2.6
209	190	478	40	2.5
209	200	491	41	2.5
209	210	501	41	2.4
209	220	511	42	2.3
209	230	518	42	2.3
209	240	523	43	2.2
209	250	527	43	2.1
209	260	531	44	2.0
209	270	534	44	2.0
209	280	537	44	1.9
209	290	539	44	1.9
209	300	536	44	1.8
209	310	533	44	1.7
209	320	530	44	1.7
209	330	527	44	1.6
209	340	523	44	1.5
209	350	520	44	1.5

Hw - best

Analysis Unit	Age	Volume	Diameter	MAI
210	0	0	0	0.0
210	10	0	0	0.0
210	20	0	0	0.0
210	30	2	15	0.1
210	40	55	21	1.4
210	50	153	26	3.1
210	60	249	29	4.2
210	70	336	33	4.8
210	80	404	35	5.1
210	90	459	38	5.1
210	100	508	40	5.1
210	110	545	41	5.0
210	120	576	43	4.8
210	130	607	44	4.7
210	140	632	45	4.5
210	150	653	46	4.4
210	160	672	47	4.2
210	170	688	48	4.0
210	180	702	48	3.9
210	190	715	49	3.8
210	200	726	50	3.6
210	210	736	50	3.5
210	220	744	51	3.4
210	230	752	51	3.3
210	240	747	51	3.1
210	250	743	51	3.0
210	260	739	51	2.8
210	270	735	51	2.7
210	280	730	51	2.6
210	290	726	51	2.5
210	300	722	51	2.4
210	310	718	51	2.3
210	320	713	51	2.2
210	330	709	51	2.1
210	340	705	51	2.1
210	350	701	51	2.0

Hw - mod

Analysis Unit	Age	Volume	Diameter	MAI
211	0	0	0	0.0
211	10	0	0	0.0
211	20	0	0	0.0
211	30	0	0	0.0
211	40	5	16	0.1
211	50	41	20	0.8
211	60	110	24	1.8
211	70	180	27	2.6
211	80	248	29	3.1
211	90	311	32	3.5
211	100	360	34	3.6
211	110	403	36	3.7
211	120	441	37	3.7
211	130	473	38	3.6
211	140	502	40	3.6
211	150	524	41	3.5
211	160	544	42	3.4
211	170	564	43	3.3
211	180	584	44	3.2
211	190	599	44	3.2
211	200	613	45	3.1
211	210	623	46	3.0
211	220	632	46	2.9
211	230	641	47	2.8
211	240	648	47	2.7
211	250	655	47	2.6
211	260	661	48	2.5
211	270	667	48	2.5
211	280	672	49	2.4
211	290	676	49	2.3
211	300	672	49	2.2
211	310	668	49	2.2
211	320	665	49	2.1
211	330	661	49	2.0
211	340	657	49	1.9
211	350	653	49	1.9

Hw - poorest

Analysis Unit	Age	Volume	Diameter	MAI
212	0	0	0	0.0
212	10	0	0	0.0
212	20	0	0	0.0
212	30	0	0	0.0
212	40	0	0	0.0
212	50	3	15	0.1
212	60	21	19	0.4
212	70	60	21	0.9
212	80	108	24	1.4
212	90	156	26	1.7
212	100	200	28	2.0
212	110	242	29	2.2
212	120	280	31	2.3
212	130	311	32	2.4
212	140	341	33	2.4
212	150	365	35	2.4
212	160	388	36	2.4
212	170	407	36	2.4
212	180	424	37	2.4
212	190	439	38	2.3
212	200	452	39	2.3
212	210	463	39	2.2
212	220	473	40	2.2
212	230	484	40	2.1
212	240	494	41	2.1
212	250	503	41	2.0
212	260	511	42	2.0
212	270	519	42	1.9
212	280	524	43	1.9
212	290	528	43	1.8
212	300	525	43	1.8
212	310	522	43	1.7
212	320	519	43	1.6
212	330	516	43	1.6
212	340	512	43	1.5
212	350	509	43	1.5

B, S - best

Analysis Unit	Age	Volume	Diameter	MAI
213	0	0	0	0.0
213	10	0	0	0.0
213	20	0	0	0.0
213	30	19	18	0.6
213	40	115	25	2.9
213	50	223	29	4.5
213	60	323	32	5.4
213	70	391	34	5.6
213	80	435	36	5.4
213	90	465	38	5.2
213	100	485	39	4.9
213	110	493	40	4.5
213	120	496	41	4.1
213	130	498	41	3.8
213	140	500	42	3.6
213	150	499	42	3.3
213	160	497	42	3.1
213	170	496	43	2.9
213	180	493	43	2.7
213	190	490	43	2.6
213	200	488	43	2.4
213	210	485	43	2.3
213	220	482	43	2.2
213	230	479	43	2.1
213	240	477	43	2.0
213	250	474	43	1.9
213	260	471	43	1.8
213	270	469	43	1.7
213	280	466	43	1.7
213	290	463	43	1.6
213	300	461	43	1.5
213	310	458	43	1.5
213	320	455	43	1.4
213	330	452	43	1.4
213	340	450	43	1.3
213	350	447	43	1.3

B, S - mod

Analysis Unit	Age	Volume	Diameter	MAI
214	0	0	0	0.0
214	10	0	0	0.0
214	20	0	0	0.0
214	30	0	13	0.0
214	40	13	17	0.3
214	50	63	22	1.3
214	60	135	26	2.3
214	70	200	28	2.9
214	80	261	30	3.3
214	90	317	32	3.5
214	100	359	33	3.6
214	110	387	35	3.5
214	120	409	36	3.4
214	130	426	36	3.3
214	140	439	37	3.1
214	150	449	38	3.0
214	160	456	38	2.9
214	170	462	39	2.7
214	180	465	39	2.6
214	190	465	40	2.4
214	200	464	40	2.3
214	210	464	40	2.2
214	220	464	40	2.1
214	230	463	41	2.0
214	240	462	41	1.9
214	250	461	41	1.8
214	260	460	41	1.8
214	270	459	41	1.7
214	280	457	41	1.6
214	290	455	41	1.6
214	300	453	41	1.5
214	310	450	41	1.5
214	320	447	41	1.4
214	330	445	41	1.3
214	340	442	41	1.3
214	350	439	41	1.3

B, S - poorest

Analysis Unit	Age	Volume	Diameter	MAI
215	0	0	0	0.0
215	10	0	0	0.0
215	20	0	0	0.0
215	30	0	0	0.0
215	40	0	13	0.0
215	50	3	16	0.1
215	60	26	19	0.4
215	70	66	22	0.9
215	80	112	25	1.4
215	90	159	27	1.8
215	100	198	28	2.0
215	110	236	29	2.1
215	120	275	31	2.3
215	130	308	32	2.4
215	140	333	33	2.4
215	150	352	34	2.3
215	160	367	34	2.3
215	170	379	35	2.2
215	180	389	35	2.2
215	190	397	36	2.1
215	200	404	36	2.0
215	210	410	37	2.0
215	220	414	37	1.9
215	230	418	37	1.8
215	240	420	38	1.8
215	250	422	38	1.7
215	260	424	38	1.6
215	270	426	38	1.6
215	280	426	39	1.5
215	290	425	39	1.5
215	300	422	39	1.4
215	310	420	39	1.4
215	320	417	39	1.3
215	330	415	39	1.3
215	340	412	39	1.2
215	350	410	39	1.2

S mixed - best

Analysis Unit	Age	Volume	Diameter	MAI
216	0	0	0	0.0
216	10	0	0	0.0
216	20	0	0	0.0
216	30	38	20	1.3
216	40	163	26	4.1
216	50	293	31	5.9
216	60	391	35	6.5
216	70	470	38	6.7
216	80	533	41	6.7
216	90	578	43	6.4
216	100	621	45	6.2
216	110	657	47	6.0
216	120	685	48	5.7
216	130	681	48	5.2
216	140	678	48	4.8
216	150	674	48	4.5
216	160	670	48	4.2
216	170	667	48	3.9
216	180	663	48	3.7
216	190	660	48	3.5
216	200	656	48	3.3
216	210	652	48	3.1
216	220	649	48	3.0
216	230	645	48	2.8
216	240	641	48	2.7
216	250	638	48	2.6
216	260	634	48	2.4
216	270	630	48	2.3
216	280	627	48	2.2
216	290	623	48	2.1
216	300	619	48	2.1
216	310	616	48	2.0
216	320	612	48	1.9
216	330	609	48	1.8
216	340	605	48	1.8
216	350	601	48	1.7

S mixed - mod

Analysis Unit	Age	Volume	Diameter	MAI
217	0	0	0	0.0
217	10	0	0	0.0
217	20	0	0	0.0
217	30	2	15	0.1
217	40	50	21	1.3
217	50	145	25	2.9
217	60	239	29	4.0
217	70	323	32	4.6
217	80	389	35	4.9
217	90	445	37	4.9
217	100	492	39	4.9
217	110	529	41	4.8
217	120	560	43	4.7
217	130	589	44	4.5
217	140	613	45	4.4
217	150	633	46	4.2
217	160	650	47	4.1
217	170	665	48	3.9
217	180	678	48	3.8
217	190	689	49	3.6
217	200	699	49	3.5
217	210	707	50	3.4
217	220	714	50	3.2
217	230	710	50	3.1
217	240	706	50	2.9
217	250	702	50	2.8
217	260	698	50	2.7
217	270	694	50	2.6
217	280	690	50	2.5
217	290	686	50	2.4
217	300	682	50	2.3
217	310	678	50	2.2
217	320	674	50	2.1
217	330	670	50	2.0
217	340	666	50	2.0
217	350	662	50	1.9

S mixed - poorest

Analysis Unit	Age	Volume	Diameter	MAI
218	0	0	0	0.0
218	10	0	0	0.0
218	20	0	0	0.0
218	30	0	0	0.0
218	40	2	15	0.1
218	50	23	19	0.5
218	60	79	22	1.3
218	70	147	25	2.1
218	80	210	28	2.6
218	90	270	30	3.0
218	100	320	32	3.2
218	110	364	34	3.3
218	120	401	36	3.3
218	130	434	37	3.3
218	140	462	39	3.3
218	150	487	40	3.2
218	160	507	41	3.2
218	170	525	42	3.1
218	180	542	42	3.0
218	190	560	43	2.9
218	200	575	44	2.9
218	210	587	45	2.8
218	220	596	45	2.7
218	230	604	46	2.6
218	240	611	46	2.5
218	250	617	47	2.5
218	260	623	47	2.4
218	270	628	47	2.3
218	280	633	48	2.3
218	290	638	48	2.2
218	300	634	48	2.1
218	310	631	48	2.0
218	320	627	48	2.0
218	330	623	48	1.9
218	340	619	48	1.8
218	350	616	48	1.8

Pine - best

Analysis Unit	Age	Volume	Diameter	MAI
219	0	0	0	0.0
219	10	0	0	0.0
219	20	13	13	0.7
219	30	108	21	3.6
219	40	213	26	5.3
219	50	298	29	6.0
219	60	363	32	6.1
219	70	410	34	5.9
219	80	448	36	5.6
219	90	471	37	5.2
219	100	485	38	4.9
219	110	490	39	4.5
219	120	494	40	4.1
219	130	496	41	3.8
219	140	501	41	3.6
219	150	498	41	3.3
219	160	495	41	3.1
219	170	493	41	2.9
219	180	490	41	2.7
219	190	487	41	2.6
219	200	485	41	2.4
219	210	482	41	2.3
219	220	479	41	2.2
219	230	477	41	2.1
219	240	474	41	2.0
219	250	471	41	1.9
219	260	468	41	1.8
219	270	466	41	1.7
219	280	463	41	1.7
219	290	460	41	1.6
219	300	458	41	1.5
219	310	455	41	1.5
219	320	452	41	1.4
219	330	450	41	1.4
219	340	447	41	1.3
219	350	444	41	1.3

Pine - mod+

Analysis Unit	Age	Volume	Diameter	MAI
220	0	0	0	0.0
220	10	0	0	0.0
220	20	2	0	0.1
220	30	60	18	2.0
220	40	150	23	3.8
220	50	227	26	4.5
220	60	292	29	4.9
220	70	339	31	4.8
220	80	377	33	4.7
220	90	406	34	4.5
220	100	429	35	4.3
220	110	448	36	4.1
220	120	460	37	3.8
220	130	469	38	3.6
220	140	476	38	3.4
220	150	482	39	3.2
220	160	485	39	3.0
220	170	486	40	2.9
220	180	485	40	2.7
220	190	485	40	2.6
220	200	484	40	2.4
220	210	481	40	2.3
220	220	478	40	2.2
220	230	476	40	2.1
220	240	473	40	2.0
220	250	470	40	1.9
220	260	468	40	1.8
220	270	465	40	1.7
220	280	462	40	1.7
220	290	460	40	1.6
220	300	457	40	1.5
220	310	454	40	1.5
220	320	452	40	1.4
220	330	449	40	1.4
220	340	446	40	1.3
220	350	444	40	1.3

Pine - mod

Analysis Unit	Age	Volume	Diameter	MAI
221	0	0	0	0.0
221	10	0	0	0.0
221	20	1	0	0.1
221	30	25	16	0.8
221	40	88	20	2.2
221	50	154	23	3.1
221	60	210	26	3.5
221	70	257	28	3.7
221	80	298	30	3.7
221	90	327	31	3.6
221	100	349	32	3.5
221	110	368	33	3.3
221	120	384	34	3.2
221	130	397	34	3.1
221	140	408	35	2.9
221	150	417	35	2.8
221	160	424	36	2.7
221	170	428	36	2.5
221	180	432	37	2.4
221	190	435	37	2.3
221	200	438	37	2.2
221	210	440	37	2.1
221	220	442	38	2.0
221	230	443	38	1.9
221	240	443	38	1.8
221	250	444	38	1.8
221	260	443	38	1.7
221	270	443	38	1.6
221	280	443	39	1.6
221	290	443	39	1.5
221	300	440	39	1.5
221	310	437	39	1.4
221	320	435	39	1.4
221	330	432	39	1.3
221	340	430	39	1.3
221	350	427	39	1.2

Pine - poorest

Analysis Unit	Age	Volume	Diameter	MAI
222	0	0	0	0.0
222	10	0	0	0.0
222	20	0	0	0.0
222	30	9	13	0.3
222	40	44	17	1.1
222	50	96	21	1.9
222	60	144	23	2.4
222	70	184	25	2.6
222	80	218	26	2.7
222	90	246	27	2.7
222	100	271	28	2.7
222	110	291	29	2.6
222	120	306	30	2.6
222	130	319	31	2.5
222	140	328	31	2.3
222	150	337	32	2.2
222	160	343	32	2.1
222	170	350	32	2.1
222	180	355	33	2.0
222	190	360	33	1.9
222	200	364	33	1.8
222	210	367	34	1.7
222	220	369	34	1.7
222	230	371	34	1.6
222	240	372	34	1.6
222	250	374	34	1.5
222	260	374	35	1.4
222	270	375	35	1.4
222	280	376	35	1.3
222	290	376	35	1.3
222	300	374	35	1.2
222	310	371	35	1.2
222	320	369	35	1.2
222	330	367	35	1.1
222	340	365	35	1.1
222	350	363	35	1.0

Decid - all

Analysis Unit	Age	Volume	Diameter	MAI
223	0	0	0	0.0
223	10	0	0	0.0
223	20	0	0	0.0
223	30	26	19	0.9
223	40	126	25	3.2
223	50	232	29	4.6
223	60	326	32	5.4
223	70	389	34	5.6
223	80	431	36	5.4
223	90	463	38	5.1
223	100	482	39	4.8
223	110	490	40	4.5
223	120	495	41	4.1
223	130	499	41	3.8
223	140	501	42	3.6
223	150	501	42	3.3
223	160	502	43	3.1
223	170	499	43	2.9
223	180	496	43	2.8
223	190	493	43	2.6
223	200	491	43	2.5
223	210	488	43	2.3
223	220	485	43	2.2
223	230	482	43	2.1
223	240	480	43	2.0
223	250	477	43	1.9
223	260	474	43	1.8
223	270	472	43	1.7
223	280	469	43	1.7
223	290	466	43	1.6
223	300	463	43	1.5
223	310	461	43	1.5
223	320	458	43	1.4
223	330	455	43	1.4
223	340	452	43	1.3
223	350	450	43	1.3

Lw, Fd (dry)

Analysis Unit	Age	Volume	Diameter	MAI
501	0	0	0	0.0
501	10	0	0	0.0
501	20	0	0	0.0
501	30	3	15	0.1
501	40	27	19	0.7
501	50	76	22	1.5
501	60	136	24	2.3
501	70	190	27	2.7
501	80	237	29	3.0
501	90	277	30	3.1
501	100	310	32	3.1
501	110	337	33	3.1
501	120	361	34	3.0
501	130	382	35	2.9
501	140	401	36	2.9
501	150	417	37	2.8
501	160	430	38	2.7
501	170	440	38	2.6
501	180	449	39	2.5
501	190	456	39	2.4
501	200	463	40	2.3
501	210	469	40	2.2
501	220	474	40	2.2
501	230	478	41	2.1
501	240	482	41	2.0
501	250	484	41	1.9
501	260	487	42	1.9
501	270	488	42	1.8
501	280	490	42	1.8
501	290	491	42	1.7
501	300	488	42	1.6
501	310	485	42	1.6
501	320	482	42	1.5
501	330	479	42	1.5
501	340	476	42	1.4
501	350	473	42	1.4

Lw, Fd (wet)

Analysis Unit	Age	Volume	Diameter	MAI
502	0	0	0	0.0
502	10	0	0	0.0
502	20	0	0	0.0
502	30	3	15	0.1
502	40	31	19	0.8
502	50	88	22	1.8
502	60	154	25	2.6
502	70	213	28	3.0
502	80	266	30	3.3
502	90	310	32	3.4
502	100	346	33	3.5
502	110	376	35	3.4
502	120	403	36	3.4
502	130	427	37	3.3
502	140	447	38	3.2
502	150	465	39	3.1
502	160	479	40	3.0
502	170	489	40	2.9
502	180	498	41	2.8
502	190	508	42	2.7
502	200	516	42	2.6
502	210	523	42	2.5
502	220	528	43	2.4
502	230	533	43	2.3
502	240	536	43	2.2
502	250	539	44	2.2
502	260	542	44	2.1
502	270	544	44	2.0
502	280	545	45	1.9
502	290	547	45	1.9
502	300	543	45	1.8
502	310	540	45	1.7
502	320	537	45	1.7
502	330	534	45	1.6
502	340	531	45	1.6
502	350	527	45	1.5

Cw

Analysis Unit	Age	Volume	Diameter	MAI
503	0	0	0	0.0
503	10	0	0	0.0
503	20	0	0	0.0
503	30	1	15	0.0
503	40	38	20	1.0
503	50	123	24	2.5
503	60	215	28	3.6
503	70	294	31	4.2
503	80	367	34	4.6
503	90	431	36	4.8
503	100	485	38	4.9
503	110	530	40	4.8
503	120	566	42	4.7
503	130	604	43	4.6
503	140	640	45	4.6
503	150	671	46	4.5
503	160	692	47	4.3
503	170	711	48	4.2
503	180	728	49	4.0
503	190	744	49	3.9
503	200	758	50	3.8
503	210	771	51	3.7
503	220	782	51	3.6
503	230	791	52	3.4
503	240	800	52	3.3
503	250	807	53	3.2
503	260	813	53	3.1
503	270	818	53	3.0
503	280	823	54	2.9
503	290	827	54	2.9
503	300	822	54	2.7
503	310	817	54	2.6
503	320	813	54	2.5
503	330	808	54	2.4
503	340	803	54	2.4
503	350	798	54	2.3

Hw

Analysis Unit	Age	Volume	Diameter	MAI
504	0	0	0	0.0
504	10	0	0	0.0
504	20	0	0	0.0
504	30	0	13	0.0
504	40	10	17	0.3
504	50	72	22	1.4
504	60	153	25	2.6
504	70	231	29	3.3
504	80	297	31	3.7
504	90	359	34	4.0
504	100	414	36	4.1
504	110	462	38	4.2
504	120	503	39	4.2
504	130	536	41	4.1
504	140	564	42	4.0
504	150	596	43	4.0
504	160	625	44	3.9
504	170	650	46	3.8
504	180	670	46	3.7
504	190	685	47	3.6
504	200	699	48	3.5
504	210	711	49	3.4
504	220	723	49	3.3
504	230	733	50	3.2
504	240	744	50	3.1
504	250	752	51	3.0
504	260	759	51	2.9
504	270	765	51	2.8
504	280	771	52	2.8
504	290	775	52	2.7
504	300	771	52	2.6
504	310	766	52	2.5
504	320	762	52	2.4
504	330	757	52	2.3
504	340	753	52	2.2
504	350	748	52	2.1

B, S

Analysis Unit	Age	Volume	Diameter	MAI
505	0	0	0	0.0
505	10	0	0	0.0
505	20	0	0	0.0
505	30	1	14	0.0
505	40	17	18	0.4
505	50	75	23	1.5
505	60	151	26	2.5
505	70	216	28	3.1
505	80	278	31	3.5
505	90	336	32	3.7
505	100	377	34	3.8
505	110	406	35	3.7
505	120	427	36	3.6
505	130	443	37	3.4
505	140	457	37	3.3
505	150	468	38	3.1
505	160	475	39	3.0
505	170	481	39	2.8
505	180	484	40	2.7
505	190	485	40	2.6
505	200	483	40	2.4
505	210	483	41	2.3
505	220	483	41	2.2
505	230	481	41	2.1
505	240	481	41	2.0
505	250	480	42	1.9
505	260	478	42	1.8
505	270	477	42	1.8
505	280	475	42	1.7
505	290	473	42	1.6
505	300	470	42	1.6
505	310	468	42	1.5
505	320	465	42	1.5
505	330	462	42	1.4
505	340	459	42	1.4
505	350	457	42	1.3

S (mixed)

Analysis Unit	Age	Volume	Diameter	MAI
506	0	0	0	0.0
506	10	0	0	0.0
506	20	0	0	0.0
506	30	0	0	0.0
506	40	10	17	0.3
506	50	56	21	1.1
506	60	123	24	2.1
506	70	191	27	2.7
506	80	251	29	3.1
506	90	307	31	3.4
506	100	355	33	3.6
506	110	394	35	3.6
506	120	427	36	3.6
506	130	452	37	3.5
506	140	474	38	3.4
506	150	492	39	3.3
506	160	511	40	3.2
506	170	528	41	3.1
506	180	542	42	3.0
506	190	554	42	2.9
506	200	561	43	2.8
506	210	567	43	2.7
506	220	572	44	2.6
506	230	576	44	2.5
506	240	580	44	2.4
506	250	585	45	2.3
506	260	588	45	2.3
506	270	591	45	2.2
506	280	594	46	2.1
506	290	595	46	2.1
506	300	592	46	2.0
506	310	588	46	1.9
506	320	585	46	1.8
506	330	581	46	1.8
506	340	578	46	1.7
506	350	574	46	1.6

Pine

Analysis Unit	Age	Volume	Diameter	MAI
507	0	0	0	0.0
507	10	0	0	0.0
507	20	1	0	0.1
507	30	16	14	0.5
507	40	62	18	1.6
507	50	119	22	2.4
507	60	171	24	2.9
507	70	214	26	3.1
507	80	251	27	3.1
507	90	286	29	3.2
507	100	313	30	3.1
507	110	333	31	3.0
507	120	349	32	2.9
507	130	363	32	2.8
507	140	375	33	2.7
507	150	386	34	2.6
507	160	396	34	2.5
507	170	404	35	2.4
507	180	411	35	2.3
507	190	416	35	2.2
507	200	420	36	2.1
507	210	423	36	2.0
507	220	426	36	1.9
507	230	428	37	1.9
507	240	430	37	1.8
507	250	431	37	1.7
507	260	433	37	1.7
507	270	434	37	1.6
507	280	435	38	1.6
507	290	435	38	1.5
507	300	433	38	1.4
507	310	430	38	1.4
507	320	428	38	1.3
507	330	425	38	1.3
507	340	423	38	1.2
507	350	420	38	1.2

Decid - all

Analysis Unit	Age	Volume	Diameter	MAI
508	0	0	0	0.0
508	10	0	0	0.0
508	20	1	0	0.1
508	30	23	16	0.8
508	40	107	22	2.7
508	50	197	26	3.9
508	60	272	29	4.5
508	70	344	31	4.9
508	80	395	33	4.9
508	90	425	35	4.7
508	100	447	36	4.5
508	110	467	37	4.2
508	120	482	38	4.0
508	130	493	39	3.8
508	140	498	40	3.6
508	150	499	40	3.3
508	160	500	41	3.1
508	170	501	41	2.9
508	180	502	42	2.8
508	190	502	42	2.6
508	200	501	42	2.5
508	210	500	42	2.4
508	220	498	43	2.3
508	230	496	43	2.2
508	240	494	43	2.1
508	250	492	43	2.0
508	260	490	43	1.9
508	270	487	43	1.8
508	280	484	43	1.7
508	290	481	43	1.7
508	300	478	43	1.6
508	310	475	43	1.5
508	320	473	43	1.5
508	330	470	43	1.4
508	340	467	43	1.4
508	350	464	43	1.3

Backlog 1

Analysis Unit	Age	Volume	Diameter	MAI
525	0	0	0	0.0
525	0	0	0	0.0
525	20	0	0	0.0
525	30	0	0	0.0
525	40	0	0	0.0
525	50	6	16	0.1
525	60	27	19	0.5
525	70	68	24	1.0
525	80	120	27	1.5
525	90	170	30	1.9
525	100	212	32	2.1
525	110	250	34	2.3
525	120	283	35	2.4
525	130	311	37	2.4
525	140	333	38	2.4
525	150	352	39	2.3
525	160	370	40	2.3
525	170	385	41	2.3
525	180	398	41	2.2
525	190	409	42	2.2
525	200	417	43	2.1
525	210	424	43	2.0
525	220	431	44	2.0
525	230	437	44	1.9
525	240	441	44	1.8
525	250	445	45	1.8
525	260	448	45	1.7
525	270	451	45	1.7
525	280	453	46	1.6
525	290	455	46	1.6
525	300	457	46	1.5
525	310	457	46	1.5
525	320	455	46	1.4
525	330	452	46	1.4
525	340	449	46	1.3
525	350	447	46	1.3

Backlog 2

Analysis Unit	Age	Volume	Diameter	MAI
526	0	0	0	0.0
526	0	0	0	0.0
526	20	0	0	0.0
526	30	0	0	0.0
526	40	0	0	0.0
526	50	1	0	0.0
526	60	12	17	0.2
526	70	44	22	0.6
526	80	94	26	1.2
526	90	148	29	1.6
526	100	193	31	1.9
526	110	235	34	2.1
526	120	270	35	2.3
526	130	300	37	2.3
526	140	323	38	2.3
526	150	344	39	2.3
526	160	362	40	2.3
526	170	378	41	2.2
526	180	390	42	2.2
526	190	400	43	2.1
526	200	409	43	2.0
526	210	417	44	2.0
526	220	423	44	1.9
526	230	428	45	1.9
526	240	433	45	1.8
526	250	436	46	1.7
526	260	439	46	1.7
526	270	442	46	1.6
526	280	444	46	1.6
526	290	446	47	1.5
526	300	447	47	1.5
526	310	448	47	1.4
526	320	448	47	1.4
526	330	446	47	1.4
526	340	443	47	1.3
526	350	440	47	1.3

Lw, Fd (dry)

Analysis Unit	Age	Volume	Diameter	MAI
601	0	0	0	0.0
601	10	0	0	0.0
601	20	0	0	0.0
601	30	3	15	0.1
601	40	37	20	0.9
601	50	98	23	2.0
601	60	163	26	2.7
601	70	219	28	3.1
601	80	266	30	3.3
601	90	305	32	3.4
601	100	335	33	3.4
601	110	360	34	3.3
601	120	384	35	3.2
601	130	402	36	3.1
601	140	417	37	3.0
601	150	430	38	2.9
601	160	438	39	2.7
601	170	446	39	2.6
601	180	453	39	2.5
601	190	459	40	2.4
601	200	464	40	2.3
601	210	468	41	2.2
601	220	471	41	2.1
601	230	474	41	2.1
601	240	475	41	2.0
601	250	477	42	1.9
601	260	478	42	1.8
601	270	479	42	1.8
601	280	480	42	1.7
601	290	480	42	1.7
601	300	477	42	1.6
601	310	474	42	1.5
601	320	471	42	1.5
601	330	468	42	1.4
601	340	466	42	1.4
601	350	463	42	1.3

Lw, Fd (wet)

Analysis Unit	Age	Volume	Diameter	MAI
602	0	0	0	0.0
602	10	0	0	0.0
602	20	0	0	0.0
602	30	1	14	0.0
602	40	27	19	0.7
602	50	95	23	1.9
602	60	172	26	2.9
602	70	243	29	3.5
602	80	302	32	3.8
602	90	351	34	3.9
602	100	392	36	3.9
602	110	429	38	3.9
602	120	459	39	3.8
602	130	485	41	3.7
602	140	508	42	3.6
602	150	526	43	3.5
602	160	541	44	3.4
602	170	555	44	3.3
602	180	567	45	3.2
602	190	578	46	3.0
602	200	587	46	2.9
602	210	594	46	2.8
602	220	601	47	2.7
602	230	606	47	2.6
602	240	611	48	2.5
602	250	615	48	2.5
602	260	619	48	2.4
602	270	622	48	2.3
602	280	618	48	2.2
602	290	615	48	2.1
602	300	611	48	2.0
602	310	607	48	2.0
602	320	604	48	1.9
602	330	600	48	1.8
602	340	597	48	1.8
602	350	593	48	1.7

Cw

Analysis Unit	Age	Volume	Diameter	MAI
603	0	0	0	0.0
603	10	0	0	0.0
603	20	0	0	0.0
603	30	1	14	0.0
603	40	35	20	0.9
603	50	123	24	2.5
603	60	216	28	3.6
603	70	304	31	4.3
603	80	372	34	4.7
603	90	433	37	4.8
603	100	487	39	4.9
603	110	532	41	4.8
603	120	567	43	4.7
603	130	601	44	4.6
603	140	633	45	4.5
603	150	660	47	4.4
603	160	683	48	4.3
603	170	702	48	4.1
603	180	718	49	4.0
603	190	734	50	3.9
603	200	748	51	3.7
603	210	759	51	3.6
603	220	770	52	3.5
603	230	780	52	3.4
603	240	788	53	3.3
603	250	795	53	3.2
603	260	790	53	3.0
603	270	786	53	2.9
603	280	781	53	2.8
603	290	777	53	2.7
603	300	772	53	2.6
603	310	767	53	2.5
603	320	763	53	2.4
603	330	758	53	2.3
603	340	754	53	2.2
603	350	749	53	2.1

Hw

Analysis Unit	Age	Volume	Diameter	MAI
604	0	0	0	0.0
604	10	0	0	0.0
604	20	0	0	0.0
604	30	0	0	0.0
604	40	13	17	0.3
604	50	71	22	1.4
604	60	153	25	2.6
604	70	232	29	3.3
604	80	304	32	3.8
604	90	361	34	4.0
604	100	414	36	4.1
604	110	459	38	4.2
604	120	499	40	4.2
604	130	532	41	4.1
604	140	560	43	4.0
604	150	587	44	3.9
604	160	613	45	3.8
604	170	636	46	3.7
604	180	653	47	3.6
604	190	669	48	3.5
604	200	682	48	3.4
604	210	695	49	3.3
604	220	706	50	3.2
604	230	716	50	3.1
604	240	725	50	3.0
604	250	733	51	2.9
604	260	740	51	2.8
604	270	745	52	2.8
604	280	751	52	2.7
604	290	755	52	2.6
604	300	751	52	2.5
604	310	746	52	2.4
604	320	742	52	2.3
604	330	738	52	2.2
604	340	733	52	2.2
604	350	729	52	2.1

B, S

Analysis Unit	Age	Volume	Diameter	MAI
605	0	0	0	0.0
605	10	0	0	0.0
605	20	0	0	0.0
605	30	1	14	0.0
605	40	25	19	0.6
605	50	93	24	1.9
605	60	174	27	2.9
605	70	244	30	3.5
605	80	314	32	3.9
605	90	364	34	4.0
605	100	398	35	4.0
605	110	422	36	3.8
605	120	441	37	3.7
605	130	457	38	3.5
605	140	467	39	3.3
605	150	475	39	3.2
605	160	477	40	3.0
605	170	477	40	2.8
605	180	478	41	2.7
605	190	478	41	2.5
605	200	477	41	2.4
605	210	477	41	2.3
605	220	476	42	2.2
605	230	475	42	2.1
605	240	474	42	2.0
605	250	473	42	1.9
605	260	470	42	1.8
605	270	468	42	1.7
605	280	466	42	1.7
605	290	463	42	1.6
605	300	461	42	1.5
605	310	458	42	1.5
605	320	455	42	1.4
605	330	452	42	1.4
605	340	450	42	1.3
605	350	447	42	1.3

S (mixed)

Analysis Unit	Age	Volume	Diameter	MAI
606	0	0	0	0.0
606	10	0	0	0.0
606	20	0	0	0.0
606	30	11	14	0.4
606	40	54	18	1.4
606	50	110	21	2.2
606	60	162	24	2.7
606	70	206	26	2.9
606	80	243	27	3.0
606	90	276	29	3.1
606	100	303	30	3.0
606	110	322	31	2.9
606	120	337	32	2.8
606	130	350	32	2.7
606	140	362	33	2.6
606	150	371	34	2.5
606	160	380	34	2.4
606	170	387	35	2.3
606	180	392	35	2.2
606	190	396	35	2.1
606	200	400	36	2.0
606	210	402	36	1.9
606	220	405	36	1.8
606	230	407	36	1.8
606	240	408	37	1.7
606	250	409	37	1.6
606	260	411	37	1.6
606	270	411	37	1.5
606	280	412	37	1.5
606	290	412	37	1.4
606	300	410	37	1.4
606	310	407	37	1.3
606	320	405	37	1.3
606	330	402	37	1.2
606	340	400	37	1.2
606	350	398	37	1.1

Pine

Analysis Unit	Age	Volume	Diameter	MAI
607	0	0	0	0.0
607	10	0	0	0.0
607	20	0	0	0.0
607	30	16	15	0.5
607	40	69	19	1.7
607	50	130	22	2.6
607	60	184	25	3.1
607	70	229	27	3.3
607	80	268	28	3.4
607	90	301	30	3.3
607	100	324	31	3.2
607	110	343	32	3.1
607	120	359	33	3.0
607	130	372	33	2.9
607	140	384	34	2.7
607	150	394	35	2.6
607	160	402	35	2.5
607	170	409	36	2.4
607	180	414	36	2.3
607	190	417	36	2.2
607	200	420	37	2.1
607	210	422	37	2.0
607	220	425	37	1.9
607	230	426	37	1.9
607	240	427	37	1.8
607	250	428	38	1.7
607	260	429	38	1.7
607	270	430	38	1.6
607	280	430	38	1.5
607	290	431	38	1.5
607	300	428	38	1.4
607	310	426	38	1.4
607	320	423	38	1.3
607	330	420	38	1.3
607	340	418	38	1.2
607	350	415	38	1.2

Decid - all

Analysis Unit	Age	Volume	Diameter	MAI
608	0	0	0	0.0
608	10	0	0	0.0
608	20	0	0	0.0
608	30	12	17	0.4
608	40	86	23	2.2
608	50	183	27	3.7
608	60	270	30	4.5
608	70	343	33	4.9
608	80	390	34	4.9
608	90	424	36	4.7
608	100	450	37	4.5
608	110	468	38	4.3
608	120	479	39	4.0
608	130	483	40	3.7
608	140	488	40	3.5
608	150	491	41	3.3
608	160	494	41	3.1
608	170	494	42	2.9
608	180	494	42	2.7
608	190	493	42	2.6
608	200	491	42	2.5
608	210	489	42	2.3
608	220	486	42	2.2
608	230	483	42	2.1
608	240	480	42	2.0
608	250	478	42	1.9
608	260	475	42	1.8
608	270	472	42	1.7
608	280	470	42	1.7
608	290	467	42	1.6
608	300	464	42	1.5
608	310	461	42	1.5
608	320	459	42	1.4
608	330	456	42	1.4
608	340	453	42	1.3
608	350	450	42	1.3

Backlog 1

Analysis Unit	Age	Volume	Diameter	MAI
625	0	0	0	0.0
625	10	0	0	0.0
625	20	0	0	0.0
625	30	2	15	0.1
625	40	36	20	0.9
625	50	109	24	2.2
625	60	188	27	3.1
625	70	258	30	3.7
625	80	320	32	4.0
625	90	365	34	4.1
625	100	399	35	4.0
625	110	427	36	3.9
625	120	450	37	3.8
625	130	468	38	3.6
625	140	482	39	3.4
625	150	494	40	3.3
625	160	502	41	3.1
625	170	508	41	3.0
625	180	513	42	2.9
625	190	518	42	2.7
625	200	522	42	2.6
625	210	525	43	2.5
625	220	527	43	2.4
625	230	529	43	2.3
625	240	530	43	2.2
625	250	531	44	2.1
625	260	531	44	2.0
625	270	532	44	2.0
625	280	532	44	1.9
625	290	531	44	1.8
625	300	528	44	1.8
625	310	525	44	1.7
625	320	522	44	1.6
625	330	519	44	1.6
625	340	516	44	1.5
625	350	513	44	1.5

Backlog 2

Analysis Unit	Age	Volume	Diameter	MAI
626	0	0	0	0.0
626	10	0	0	0.0
626	20	0	0	0.0
626	30	4	16	0.1
626	40	54	21	1.4
626	50	141	25	2.8
626	60	222	28	3.7
626	70	299	31	4.3
626	80	355	33	4.4
626	90	397	35	4.4
626	100	430	36	4.3
626	110	457	38	4.2
626	120	477	39	4.0
626	130	494	40	3.8
626	140	505	40	3.6
626	150	514	41	3.4
626	160	521	42	3.3
626	170	527	42	3.1
626	180	532	43	3.0
626	190	536	43	2.8
626	200	538	43	2.7
626	210	541	44	2.6
626	220	543	44	2.5
626	230	544	44	2.4
626	240	545	44	2.3
626	250	545	44	2.2
626	260	545	45	2.1
626	270	542	45	2.0
626	280	539	45	1.9
626	290	536	45	1.8
626	300	533	45	1.8
626	310	529	45	1.7
626	320	526	45	1.6
626	330	523	45	1.6
626	340	520	45	1.5
626	350	517	45	1.5

Appendix C – Red and Blue Listed Species

Table 1 Listed species within the Columbia Forest District

Scientific Name	English Name	BC Status
Acipenser transmontanus pop. 2	White Sturgeon (Columbia River population)	Red
Agoseris lackschewitzii	pink agoseris	Blue
Androsace chamaejasme ssp. lehmanniana	sweet-flowered fairy-candelabra	Blue
Anemone canadensis	Canada anemone	Blue
Arabis hirsuta var. hirsuta	hairy rockcress	Red
Ardea herodias herodias	Great Blue heron, herodias subspecies	Blue
Arenaria longipedunculata	low sandwort	Red
Argia vivida	Vivid Dancer	Red
Arnica louiseana	Lake Louise arnica	Blue
Asio flammeus	Short-eared Owl	Blue
Astragalus bourgovii	Bourgeau's milk-vetch	Blue
Bartramia halleriana	Haller's apple moss	Red
Boloria alberta	Albert's Fritillary	Blue
Botaurus lentiginosus	American Bittern	Blue
Botrychium crenulatum	dainty moonwort	Blue
Botrychium hesperium	western moonwort	Blue
Botrychium montanum	mountain moonwort	Red
Botrychium spathulatum	spoon-shaped moonwort	Red
Braya purpurascens	purple braya	Red
Buteo platypterus	Broad-winged Hawk	Blue
Carex crawei	Crawe's sedge	Red
Carex incurviformis var. incurviformis	curved-spiked sedge	Blue
Carex krausei	Krause's sedge	Blue
Carex lenticularis var. dolia	Enander's sedge	Blue
Carex lenticularis var. lenticularis	lakeshore sedge	Red
Carex pedunculata	peduncled sedge	Blue
Carex petricosa	rock-dwelling sedge	Blue
Carex rostrata	swollen beaked sedge	Blue
Carex scoparia	pointed broom sedge	Blue
Carex sychnocephala	many-headed sedge	Blue
Carex tenera	tender sedge	Blue
Castilleja gracillima	slender paintbrush	Blue
Chenopodium atrovirens	dark lamb's-quarters	Red
Chlosyne whitneyi	Rockslide Checkerspot	Blue
Chrysemys picta pop. 2	Western Painted Turtle - Intermountain - Rocky Mountain Population	Blue
Colias meadii	Mead's Sulphur	Blue
Colias pelidne	Pelidne Sulphur	Blue
Coturnicops noveboracensis	Yellow Rail	Red
Cryptogramma cascadensis	Cascade parsley fern	Blue
Delphinium bicolor ssp. bicolor	Montana larkspur	Blue
Draba lactea	milky draba	Blue
Draba lonchocarpa var. vestita	lance-fruited draba	Blue
Draba porsildii	Porsild's draba	Blue
Dryopteris cristata	crested wood fern	Blue
Eleocharis elliptica	Slender spike-rush	Blue
Epilobium leptocarpum	small-fruited willowherb	Blue
Epilobium x treleasianum	Trelease's hybrid willowherb	Blue
Eupatorium maculatum ssp. bruneri	Joe-pye weed	Red
Euphagus carolinus	Rusty Blackbird	Blue
Gentianopsis macounii	Macoun's fringed gentian	Red
Grus canadensis	Sandhill Crane	Blue
Gulo gulo luscus	Wolverine, luscus subspecies	Blue
Gymnocarpium jessoense ssp. parvulum	Nahanni oak fern	Blue
Helianthus nuttallii var. nuttallii	Nuttall's sunflower	Red
Hemphillia camelus	Pale Jumping-slug	Blue
Hirundo rustica	Barn Swallow	Blue
Hypericum scouleri ssp. nortoniae	western St. John's-wort	Blue
Juncus albescens	whitish rush	Blue
Lomatium triternatum ssp. platycarpum	nine-leaved desert-parsley	Red

Listed species within the Columbia Forest District (continued)

Scientific Name	English Name	BC Status
Magnipelta mycophaga	Magnum Mantleslug	Blue
Martes pennanti	Fisher	Blue
Megalodonta beckii var. beckii	water marigold	Blue
Minuartia austromontana	Rocky Mountain sandwort	Blue
Muhlenbergia glomerata	marsh muhly	Blue
Myotis septentrionalis	Northern Myotis	Blue
Nephroma occultum	Cryptic Paw	Blue
Oeneis jutta chermocki	Jutta Arctic, chermocki subspecies	Blue
Oncorhynchus clarkii lewisi	Cutthroat Trout, lewisi subspecies	Blue
Oreohelix strigosa	Rocky Mountainsnail	Blue
Oreohelix subrudis	Subalpine Mountainsnail	Blue
Ovis canadensis	Bighorn Sheep	Blue
Papilio machaon hudsonianus	Old World Swallowtail, hudsonianus subspecies	Red
Patagioenas fasciata	Band-tailed Pigeon	Blue
Pellaea gastonyi	Gastony's cliff-brake	Blue
Pellaea glabella ssp. occidentalis	western dwarf cliffbrake	Red
Phacelia lyallii	Lyall's phacelia	Blue
Physaria didymocarpa var. didymocarpa	common twinpod	Blue
Physella columbiana	Rotund Physa	Red
Pinus albicaulis	whitebark pine	Blue
Plethodon idahoensis	Coeur d'Alene Salamander	Yellow
Poa laxa ssp. banffiana	Banff bluegrass	Red
Polites themistocles themistocles	Tawny-edged Skipper, themistocles subspecies	Blue
Rana pipiens	Northern Leopard Frog	Red
Rangifer tarandus pop. 1	Caribou (southern population)	Red
Salvelinus confluentus	Bull Trout	Blue
Scrophularia lanceolata	lance-leaved figwort	Blue
Sidalcea oregana var. procera	Oregon checker-mallow	Red
Solidago gigantea ssp. serotina	smooth goldenrod	Red
Solidago nemoralis ssp. longipetiolata	field goldenrod	Blue
Somatochlora forcipata	Forcipate Emerald	Blue
Speyeria mormonia eurynome	Mormon Fritillary, eurynome subspecies	Red
Sphaerium occidentale	Herrington Fingernailclam	Red
Stellaria obtusa	blunt-sepaled starwort	Blue
Thalictrum dasycarpum	purple meadowrue	Blue
Thermopsis rhombifolia	prairie golden bean	Red
Trichophorum pumilum	dwarf clubrush	Blue
Trifolium cyathiferum	cup clover	Red
Ursus arctos	Grizzly Bear	Blue
Vertigo elatior	Tapered Vertigo	Red

Appendix D - Acronyms

AAC	Allowable Annual Cut
Analysis	Timber Supply Analysis
AU	Analysis Unit
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Options
BGB	Biodiversity Guidebook
BL	Balsam Fir
CF	Chief Forester
CFLB	Crown Forested Land base
CORE	Commission on Resources and Environment
CW	Western Red Cedar
DBH	Diameter at breast height (1.3m)
DEO	Designated Environment Official
DFO	Department of Fisheries and Oceans
DM	District Manager
DRA	Root Disease (*Armillaria ostoyae*)
ESA	Environmentally Sensitive Area
FD	Douglas Fir
FES	Forest Ecosystem Specialist
FIP/FC1	Old Forest Cover Digital Files
FMER	Fire Maintained Ecosystem Restoration
FIZ	Forest Inventory Zone
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FSSIM	Forest Service Simulation Model
GIS	Geographic Information System
HLPO	Higher Level Plan Order
HW	Western Hemlock
IWAPS	Interior Watershed Assessment Procedure System
KBLUP-IS	Kootenay Boundary Land Use Plan – Implementation Strategy
KBHLPO	Kootenay Boundary Higher Level Plan Order
LA	Alpine Larch
LRMP	Local Resource Management Plan
LTHL	Long Term Harvest Level
LU	Landscape Unit
LW	Western Larch
MoF	Ministry of Forests
MSRM	Ministry of Sustainable Resource Management
MSY	Maximum Sustained Yield
MSYT	Managed Stand Yield Tables
MWLAP	Ministry of Water, Land and Air Protection
NCC	Non-Commercial Cover
NDT	Natural Disturbance Type
NP	Non Productive
NRL	Non-Recoverable Losses
NSR	Not Satisfactorily Restocked
NSYT	Natural Stand Yield Tables
OAF	Operational Adjustment Factor
OGMA	Old-Growth Management Areas
PA	Whitebark Pine
PEM	Predictive Ecosystem Mapping
PL	Lodgepole Pine
PSP	Permanent Sample Plot
PSYU	Public Sustained Yield Unit
PW	White Pine
PY	Ponderosa Pine (tree species) or person years (economics)
RIC	Resources Inventory Commission
RM	Regional Manager
RMZ	Riparian Management Zone
ROS	Recreation Opportunity Spectrum
RTEB	Resource Tenures and Engineering Branch
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
TFL	Tree Fam Licence
TSA	Timber Supply Area
TSR	Timber Supply Review
UREP	Use, Recreation, and Enjoyment of Public
VDYP	Variable Density Yield Predictor (growth and yield model)
VEG Ht	Visually Effective Greenup Hieght
VQO	Visual Quality Objective

Appendix E – SEA Background Material

Estimates of forest industry direct employment are based mainly upon a questionnaire administered to the holders of TSA Forest Licences. They were surveyed about their 2005 to 2007 harvesting, wood processing facility timber inputs and employment. The survey responses provide the basis for calculating direct employment per m3 in harvesting and processing.

Employment is tied to timber harvested so it is calculated as an employment (in person-years, PYs[1]) per 1 000 m3 co-efficient, which allows for a ready estimate of forest sector employment and income impacts based on timber harvest level changes.

Indirect and induced employment impacts are calculated by applying multipliers to the direct employment figures. Local area multipliers have been calculated by BC Stats, based on the BC input/output model, for all areas of the province except the Lower Mainland (Horne 2004). Indirect employment occurs in businesses supplying goods and services to forest sector companies, while induced employment occurs in businesses supported by the spending of direct and indirect employment income. Table A-1 shows the indirect and induced multipliers for the Golden TSA.

Table 1 Golden indirect/induced forest industry multipliers

Industry	Harvesting & Silviculture	Pulp & paper	Other Wood Processing
Multiplier*	1.26	NA	1.39

Source: Horne (2004)
Note: * This multiplier incorporates the assumption that employment insurance and other social safety net programs to employed and displaced workers will temporarily encourage them not to leave the community, thereby reducing the induced impacts of a lower harvest level.

Table 2 presents province-wide indirect/induced multipliers for the forestry, wood saw milling and pulp and paper processing industries. The multiplier of 1.93 indicates that each PY of direct employment is associated with an additional 0.93 PY of indirect and induced employment.

Table 2 Province-wide indirect/induced forest industry multipliers

Industry	Harvesting & Silviculture	Pulp & paper	Other Wood Processing
Multiplier	1.93	2.29	1.94

Source: author's calculations based on Horne (2007)

Forest sector employment income was estimated using Statistics Canada 2007 data on earnings by industry. Annual employment income for a PY of harvesting employment is estimated to be $53 872 and $49 036 in wood product manufacturing (other than pulp and paper making). Indirect and induced employment income per PY is obtained by multiplying the estimated indirect/induced employment by an average annual income of $39 572.

[1] Person-Year (PY) is defined as one person working the equivalent of one full year, which is defined as 180 days of work. A person working for 90 days accounts for 0.5 PYs.

The impact estimates presented in the report are intended as indicators of the magnitude of change, rather than as precise estimates. The following qualifications apply:

- In using co-efficients to calculate impacts, the employment changes are shown as immediate and in direct proportion to the change in the harvest level. While this is likely accurate for the harvesting sub-sector, it may not be the case for the sawmilling and pulp/paper sub-sectors, which have weaker links to harvest levels and where employment changes are more likely to occur at threshold levels, at which shifts are added or dropped, or mills are closed. Also, indirect and induced impacts would likely occur over a longer period of time, as business and consumer spending levels adjust.
- The co-efficients were derived from a survey, and reflect prevailing productivity, harvest practices and forest management. The co-efficients may not reflect future conditions. While there has been a long-term trend of reduced employment co-efficients due to mechanisation and increased labour productivity, increased requirements for planning and more sensitive harvesting methods could result in higher employment co-efficients.
- The employment multipliers are derived from assumptions regarding which sectors are basic to a region which sectors are non-basic; those assumptions may not always be valid. Also, multipliers are based on a static snapshot, and do not reflect the ability of communities to adjust over time to changes in the economic base.
- Economic forecasts are subject to increasing uncertainty, particularly as the time horizon extends beyond a decade.