DATA PACKAGE

TIMBER SUPPLY REVIEW
2004

Lillooet Timber Supply Area

Prepared for:
The Ministry of Forests

Prepared by:
Timberline Forest Inventory Consultants Ltd.
Victoria, B.C.

Project Number: 4041016

First Draft
March 2004

Timberline
Forest Inventory Consultants

ACKNOWLEDGEMENTS

We would like to acknowledge the support and contributions made by the following organizations:

Ainsworth Lumber Company Ltd. - Savona	
Ministry of Forests *Cascades Forest District* *Southern Interior Forest Region* *Forest Analysis Branch*	
Ministry of Sustainable Resource Management	
Ministry of Water, Land and Air Protection	
Lytton Lumber Ltd. - Lytton	
J.S. Jones Timber Ltd. - Vancouver	

EXECUTIVE SUMMARY

A timber supply review process has been initiated for the Lillooet Timber Supply Area. Timberline Forest Inventory Consultants Ltd., on behalf of the Ministry of Forests (MoF), is preparing timber supply information for the analysis. These reviews are conducted every five years and assist the B.C. Forest Service's Chief Forester in re-determining allowable annual cuts (AACs). For the Lillooet Timber Supply Area, the Chief Forester will determine a new AAC by January 2007.

The allowable annual cut (AAC) for the Lillooet TSA was temporarily set in 1982 at 800,000 m^3 per year to allow for the control of mountain pine beetle. After the expiry of the temporary increase (1988), the AAC was reduced to 650,000 m^3 per year and maintained at that level until 1995. Following the implementation of the Forest Practices Code the AAC was reduced by 1% to 643,500 m^3 per year in 1996. The current AAC for the Lillooet TSA, effective 1 January 2002, is 635,900 m^3 per year, a reduction of 1% from the previous AAC.

This *Lillooet TSA Data Package* is provided to the public and First Nations for review prior to initiation of the analysis to support allowable cut determination for Timber Supply Review (TSR) 3. Although it is a technical document for a technical audience, every effort has been made to ensure that it is self-explanatory.

The data package allows the reader to consider the inputs and assumptions to be used in the timber supply analysis. This includes:

- The documentation of inventory data and sources;
- Classification of the land base according to each hectare's contribution to management (harvest, resource management for wildlife, *etc.*;
- Land productivity estimates and prediction of stand growth and timber yield;
- Silviculture and harvesting regimes;
- Action taken to model multi-resource requirements;
- Modelling structures to address the proposed *Lillooet Land and Resource Management Plan* (Consultation Draft No. 3, MSRM, March 2003); and
- Timber supply scenarios to be investigated.

During and after the public and First Nations review process, this document will evolve and be finalized when published as an appendix to the timber supply analysis report. There will be another public review opportunity at that time.

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1.0 INTRODUCTION

INTRODUCTION TO THE FIRST DRAFT DATA PACKAGE

This document is provided to the public for review prior to initiation of the analysis to support allowable cut determination. Readers should keep in mind that it is a technical document for a technical audience.

If clarification is required, or if you wish to provide written comments, please forward them to Brent Turmel prior to Monday June 7, 2004. You may provide comments by mail to the address provided below or email to Brent.Turmel@gems9.gov.bc.ca.

Brent Turmel
Cascades Forest District
PO Box 4400 Station Main
Merritt, BC V1K1B8
250-378-8404

Timberline Forest Inventory Consultants Ltd. (Timberline), on behalf of the Ministry of Forests (MoF, Cascades Forest District and Southern Interior Forest Region), is preparing timber supply information for the Provincial timber supply review. These reviews are conducted every five years and assist the B.C. Forest Service's Chief Forester in re-determining the allowable annual cut (AAC). For the Lillooet Timber Supply Area (TSA), the Chief Forester will determine a new AAC by January 2007.

Timberline and MoF will complete the steps leading up to, and including the delivery of, timber supply analyses as follows:

- Collecting data and preparation of a data package which summarizes the data assumptions—land base, growth and yield, forest management practices, statement of management strategies, and analysis methods—that will be used, and the critical issues that will be examined in the timber supply analysis;
- Completing the timber supply analysis and report; and
- Providing the necessary information for public and First Nations reviews.

After the completion of these steps, the analysis report is submitted to the Chief Forester. The AAC is then set by the Chief Forester using the analysis report as one of the many factors required as part of the determination process.

1.1 PURPOSE

The purpose of the data package is to provide a clear description of information sources, assumptions, issues, and any relevant data processing or adjustments related to the land base, growth and yield, and management objectives and practices.

The following principles and standards will apply to the data sources and data package:

- The data package must describe, and where appropriate summarize, all data and information to be used in the timber supply analysis;
- The data package must contain descriptions of how current forest management, or reasonable extrapolations of current management will be modelled;
- The most current and best available data must be used;
- More detailed discussion should be provided in the package for data for which there is a high degree of uncertainty;
- The data package must contain a summary of plans for examining the potential impacts of important uncertainties in information (*e.g.*, planned sensitivity analysis);
- The evidentiary basis for information used in analyses must be available on request, and to the extent possible be included in the data package. Evidence could include the following:
    - A description of data sources;
    - The source data itself;
    - A description of sampling and data analysis methods or standards;
    - Digital or analog maps of the land base (*e.g.*, forest cover, ownership, habitat areas);
    - Results of any reviews or audits of source information or inventories; and
    - Any acceptances by appropriate professionals (*e.g.*, terrain stability mapping).
- When collecting or analyzing data to include in the data package, existing standards should be followed, unless justification is provided for diverging from standards. Such justification should demonstrate that although standards were not followed, the information is the best available that could be obtained for the timber supply review;
- Where possible, the implications to the timber supply analysis (*e.g.*, increased uncertainty) of diverging from the standards should be examined and reported; and
- The choice of a particular timber supply model is at the discretion of MoF.

1.2 BACKGROUND

This section provides background information to the third Timber Supply Review (TSR 3) process and describes the various processes which have shaped the analyses and within which the analyses fit.

The AAC for the Lillooet TSA was temporarily set in 1982 at 800,000 m^3 per year to allow for the control of mountain pine beetle. After the expiry of the temporary increase (1988), the AAC was reduced to 650,000 m^3 per year and maintained at that level until 1995. Following the implementation of the Forest Practices Code the AAC was reduced by 1% to 643,500 m^3 per year in 1996. The current AAC for the Lillooet TSA, effective 1 January 2002, is 635,900 m^3 per year, a reduction of 1% from the previous AAC. The removal of woodlot licences is the only significant factor that changed between TSR 1 and TSR 2.

In 2003, the Lillooet Timber Supply Area Association (the Association) completed a *Timber and Economic Recovery Plan* (TERP; Timberline, 2003) that explored and addressed the impacts of the proposed *Lillooet Land and Resource Management Plan* (Consultation Draft No. 3, MSRM, March 2003).

As of March 31, 2004, a higher level plan order has not been derived from the proposed *Lillooet Land and Resource Management Plan*. If such an order is established prior to the completion of the timber supply review, relevant components of the order will be incorporated into the analysis. This *Lillooet TSA Data Package* documents the inventory and forest management issues incorporated in the TSR 3, as well as the sources of information used to model the timber supply.

1.3 PROCESSES

This *Lillooet TSA Data Package* fits within a long continuum of processes all working towards ensuring the sustainability of management practices in the Lillooet TSA. The data package outlines the processes to be followed from collection of existing information through to completion of the timber supply analysis reports. These processes are detailed in Figure 1.1.

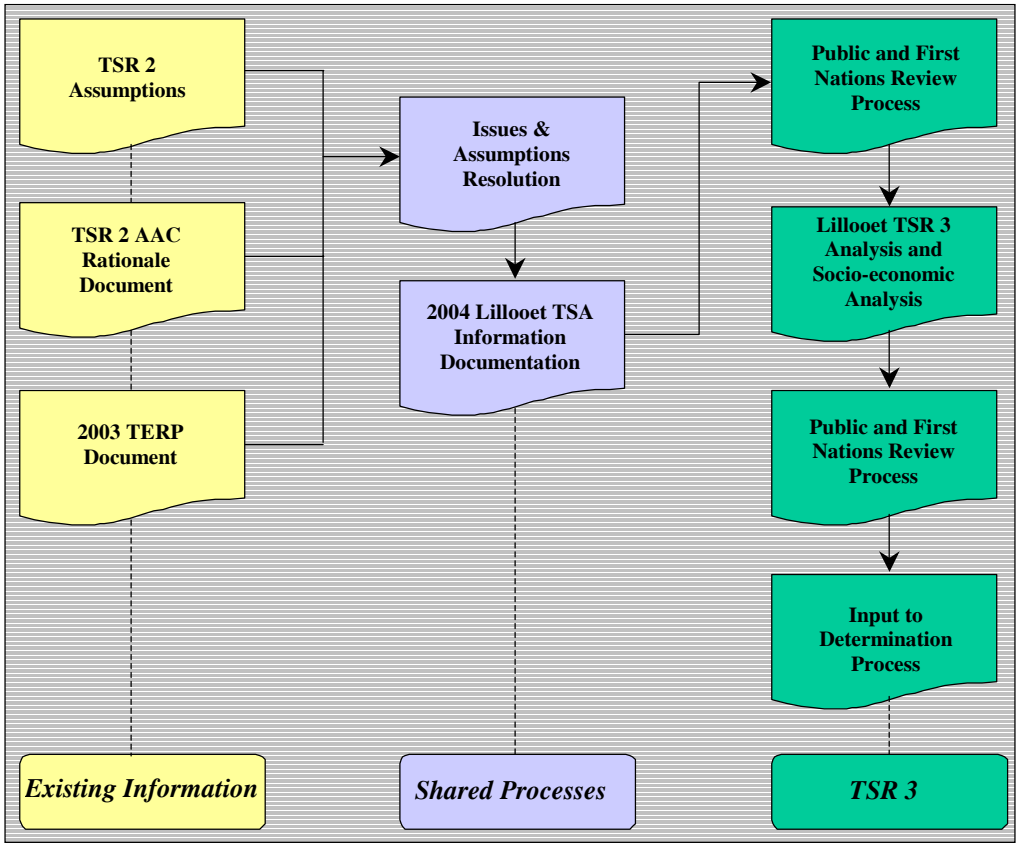

Figure 1.1. Analysis project flow

1.3.1 Timber Supply Review Process

The Timber Supply Review process has 3 main stages: (1) data package preparation, (2) timber supply analysis and revised data package, and (3) AAC determination. First Nations and the public are formally offered an opportunity to review and comment on the draft documentation prepared for the first 2 steps. Comments and information obtained from First Nations and the public during the formal review processes will be documented in a summary as well as be considered in the revision of documents. The summary document is presented to the Chief Forester for his consideration in the AAC determination.

Specifically for the data package, there will be 2 opportunities for First Nations and the public to formally comment. The first is the current 60-day opportunity for the review of this draft data package. The second opportunity will be for the review of the timber supply analysis report, which includes the revised data package as an appendix.

To facilitate the data package review process, a web site dedicated to the TSR 3 analyses was established at <http://www.for.gov.bc.ca/hts/tsa/tsa15>. The draft data package and background documents were placed on this site. This provides individuals with the opportunity to download these materials for review.

1.3.2 Timber and Economic Recovery Plan

The Lillooet TSA Association completed a *Timber and Economic Recovery Plan* (TERP), which explored and addressed the potential impacts of the proposed *Lillooet Land and Resource Management Plan* (LLRMP) on timber availability. One component of the TERP was a *Short Term Timber Assessment* (STTA). This analysis evaluated how current management, including allowance for management of non-timber resources, affected the supply of harvestable timber over the short and long-term. The analysis used existing inventory and growth-and-yield information from the recent TSR.

1.3.3 Lillooet Land and Resource Management Plan Process

The proposed Lillooet Land and Resource Management Plan (*Consultation Draft No. 3, MSRM, March 2003*) covers more than one million hectares on the TSA. The LRMP provides strategic direction for the management and use of both timber and non-timber resources. Its primary purpose is to promote economic development, foster stable communities and protect major ecosystems in the Lillooet TSA.

Only certain aspects of the LRMP have measurable timber supply impacts. For example, while recreation and tourism resources (trails, known tourism features, *etc*.) may require consideration at the operational level in the design or layout of blocks, accommodating these interests is unlikely to result in a timber supply impact. Issues like visuals and wildlife habitat protection, however, have measurable impacts that must be considered in both the short and long-term timber supply.

However, due to the current draft status of the LRMP, the inputs and assumptions incorporated in the spatial and prescriptive elements of the LRMP that are anticipated to have potential timber supply impacts are only explored in sensitivity analyses. The LRMP scenarios identified in the data package reflect Consultation Draft No. 3 (MSRM, March 2003) and may not reflect current proposals submitted to cabinet. These scenarios will be modified to reflect a higher level plan order (HLPO) when it becomes known.

1.3.4 Forest and Range Practices Act

The Forest and Range Practices Act (FRPA) came into force January 31, 2004 and for the most part, will replace the Forest Practices Code (FPC) by December 31, 2005. The FPC was introduced in 1995. This move from the FPC to the FRPA represents a transition from a primarily plan and process-based regime under FPC to a results-based regime under FRPA. Prior to December 31, 2005 there will be a transition period where licensees will work under either a Forest Development Plan (as per FPC) or a Forest Stewardship Plan (as per FRPA).

Under FRPA FPC guidelines will no longer be within the legal framework but will move to the non-legal realm. To meet the objectives set by government either through land use, regulation, or enabled by regulation, greater emphasis will be placed upon professional reliance in the preparation of operational plans to ensure such objectives will be met. The licensee may propose results and strategies in their operational plan (i.e., Forest Stewardship Plan) or in some cases may select default results and strategies identified in the Forest Planning and Practices Regulation (FPPR).

For this current timber supply review, the expectation is that current practice is best represented by the current FPC based practices. Nevertheless, the analysis will be structure such that default results and strategies under FPPR can be investigated in a sensitivity scenario.

2.0 INVENTORY AND GENERATED DATA

Many sources of data were compiled to provide input into the TSR 3 timber supply analyses. These are documented in Table 2.1. The use of these data sources is noted in the following sections describing landbase and management assumptions. Details about the data source are available from the data source contacts. Further information specific to each inventory category will be made available with the final data package included with the timber supply analysis report.

There are three major new or updated sources of data that were not included in the previous timber supply review or TERP investigation. These data are the recently completed PEM, VRI statistical attribute adjustment report and draft old growth management areas.

Table 2.1. Data sources

Inventory Category	Data Source: Contact	Inventory Date (day/month/yr)	Analysis Use[1]		
			N	T	R
Archaeological site buffers	MSRM: Kevin Eskelin	05/11/2002	✓	✓	✓
Biodiversity emphasis options	MSRM: Kevin Eskelin	15/01/2003		✓	✓
Biogeoclimatic ecosystem classification	MSRM: Dennis Lloyd	16/03/2003		✓	✓
Community watersheds	MSRM: Kevin Eskelin	31/12/2002		✓	✓
Forest development plan	Timberline: David Myers	03/02/2003		✓	✓
Economic operability zones	Timberline: David Myers	14/11/2002			✓
Elk distribution	MSRM: Kevin Eskelin	07/10/2002		✓	✓
Existing protected areas	MSRM: Kevin Eskelin	04/09/2001	✓	✓	✓
Forest Inventory	MSRM: Kevin Eskelin	20/01/2004			✓
Future Road Network	Timberline: David Myers	31/01/2003			
Grizzly bear watershed habitat	MSRM: Kevin Eskelin	10/11/2002			
Landscape units	MSRM: Kevin Eskelin	24/09/2002		✓	✓
Moose range and management units	MSRM: Kevin Eskelin	02/10/2002		✓	✓
Mountain goat escape terrain	Timberline: David Myers	15/01/2003		✓	✓
Mule deer winter range	MSRM: Kevin Eskelin	02/10/2002		✓	✓
OIC Spruce Lake Park	MSRM: Kevin Eskelin	15/12/2003	✓	✓	✓
Predictive ecosystem mapping	Shamaya: Colleen Jones	01/03/2004			
Proposed protected areas	MSRM: Kevin Eskelin	15/12/2003	✓	✓	✓
Old growth management areas	Timberline: Dave Myers	30/01/2004			
Operability classification	MSRM - Kevin Eskelin	15/10/2002	✓	✓	✓
Ownership	MSRM - Kevin Eskelin	08/10/2002	✓	✓	✓
Pulpwood agreement boundaries	MSRM: Kevin Eskelin	08/10/2002		✓	✓
Roads	Timberline: Dave Myers	09/01/2003	✓	✓	✓
Sheep wintering areas	MSRM: Kevin Eskelin	08/10/2002		✓	✓
Slope classes	Timberline: Dave Myers	01/12/2002			
Spotted owl distribution	MSRM: Kevin Eskelin	18/06/2003		✓	✓
Streams and lake riparian	Timberline: David Myers	10/11/2002	✓	✓	✓
Terrain stability mapping	MSRM: Kevin Eskelin	18/10/2002	✓	✓	✓
Visual management polygons	MSRM: Kevin Eskelin	25/09/2002	✓	✓	✓
Watershed points of diversion	MSRM: Kevin Eskelin	09/10/2002	✓	✓	✓

(1) N = netdown, T = treatment unit mapping (Section 6.5), R = resultant

3.0 ANALYSIS AND MODELLING PROCEDURES

The British Columbia Timber Supply Review process has utilized forest estate modelling techniques to identify timber supply characteristics of major management units. Such models require that the land base be summarized by management objectives.

In this section we provide an overview of the landbase on which harvesting is permitted (Section 3.1 Timber harvesting land base determination) and other management objectives (Section 3.2 Resource Management Emphasis). We also describe Timberline's proprietary spatial timber supply model CASH6 (**C**ritical **A**nalysis of **S**chedules for **H**arvesting) that is used in the analysis.

Management objectives are described by 2 methods within the forest estate modelling framework. The first method is by considering that the management objective results in exclusion of the land base for the purposes of timber harvesting. This is often referred to as defining the timber harvesting land base or the netdown process. The second method is through the use of forest cover or adjacency constraints. An example of a forest cover constraint is requiring a specific percentage of a specified zone to be above a certain age.

Details about the individual factors determining the timber harvesting land base and management are found in Section 4. Details about regeneration and growth and yield assumptions are discussed in Section 5. Further assumptions specific to the timber supply model are discussed in Section 6.

3.1 TIMBER HARVESTING LAND BASE DETERMINATION

This section describes factors that influence management of the Lillooet TSA land base and the methodology used to determine the way in which land contributes to timber supply. Some portions of the productive landbase, while not contributing to harvest, may be available to meet other resource needs.

Table 3.1 presents the determination of the timber harvesting land base for the Lillooet TSA. Each factor in the table is described in Section 4. It should be noted that there is overlap in area among each factor as such the total area less the sum of factor areas do not result in the net timber harvesting land base area. The classification of land base for contribution to analysis described in this section is based on the procedure outline in the *Supplemental Guide for Preparing Timber Supply Analysis Data Packages* (BC MoF, 2003).

All of the land base classification steps performed during TSR 2 remain in the current classification. However, the following additions or modifications have been made since TSR 2:

- Existing road losses are now explicitly (spatially) identified and removed from the landbase contributing to timber supply;
- Existing forest inventory age and height values were adjusted (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003*);
- Existing forest inventory has been updated for disturbance to 2002;
- Spruce Lake Order in Council (OIC) protected area is explicitly identified and removed from the landbase contributing to timber supply; and
- Archaeological sites and culturally modified trees are now explicitly identified and removed from the landbase contributing to timber supply.

The final classification indicates a current timber harvesting land base of 292,357 ha which is slightly more than a 1% reduction of the current timber harvesting land base (296, 311 ha) documented in the previous timber supply review analysis report.

Table 3.1. Timber harvesting land base determination

Land Classification	Reference Section	Land Base		Eligible[(1)]
		Area (ha)	Volume (m^3)	Area (ha)
Total Area		**1,125,025**	**124,906,601**	
Not administered by MoF Service	4.1.1	166,313	20,190,889	166,313
Total TSA		**958,712**	**104,715,712**	
Non-forest / Non-productive	4.1.2	453,534	6,449,728	546,904
Productive Forest		**505,178**	**98,265,984**	
Inoperable	4.2	97,964	20,272,528	97,964
Operable Forest		**407,214**	**77,993,456**	
Non-commercial	4.2.2	404	427	523
Environmentally sensitive – terrain mapping	4.3.1	18,032	3,695,483	23,838
Environmentally sensitive – forest cover	4.3.1	25,831	4,534,726	129,376
Sites with low growing potential	4.2.3	41,046	6,055,369	75,316
Unmerchantable	4.2.4	4,302	545,492	23,896
Community watershed intakes	4.3.2.2	6	1,256	8
Riparian	4.3.3	6,961	2,033,867	9,651
Existing roads, trails, and landings	4.1.3.1	4,380	615,908	5,331
Spruce Lake protected area OIC	4.3.4	12,912	4,171,145	20,811
Cultural heritage resources	4.3.5	984	235,667	1,770
Total Reductions		*114,858*	*21,889,340*	
Current Timber Harvesting Land Base		**292,357**	**56,104,116**	
Less future roads	4.1.3.2	18,207		
Future Timber Harvesting Land Base		**274,150**		

(1) These values represent the total area of the land base that meets the criteria for the removal at each step, regardless of area removed previously

3.2 RESOURCE MANAGEMENT ZONES AND EMPHASIS

The Lillooet TSA supports a complex set of competing resource demands that are expressed in analysis of timber supply as forest cover objectives. These objectives are applied to subsets of the land base and are often overlapping.

Forest cover objectives are applied to specific resource emphasis zones within the Lillooet TSA. These resource emphasis zones are used by the forest level model to ensure that the objectives are met over the modelled time horizon.

The resource emphasis zones used in TSR 3 are listed in Table 3.2. These zones were also identified and modelled in TSR 2. The resource emphasis zones are not mutually exclusive so their areas are not necessarily additive.

Table 3.2. Base case resource emphasis zones

Zone	Landbase Area (ha)	
	Productive[1]	THLB[2]
Integrated resource management	505,178	274,150
Visual quality objectives	148,997	76,506
Community watersheds	41,377	23,777

(1) Includes all forested area that is productive but not necessarily harvestable
(2) Includes all forested area that is productive and harvestable

The management of the resource emphasis zones as identified under the draft Lillooet LRMP (Consultation Draft No. 3, MSRM, March 2003) and in Table 3.3 will be modelled in sensitivity analyses. Specific mapping and management objectives are available for all resource emphasis zones except grizzly bear habitat. The impact of grizzly bear habitat management will be assumed to be proportional to the landbase allowance noted in Section 4.3.8.6.

Table 3.3. LRMP resource emphasis zones

Zone	Reference Section	Landbase Area (ha)	
		Productive	THLB
Integrated resource management	4.3.6	505,178	274,150
Elk winter range	4.3.8.2	23,448	10,716
Moose habitat	4.3.8.3	14,357	10,130
Mountain goat – escape terrain	4.3.8.4	42,842	13,033
Mule deer winter range	4.3.8.1	124,321	70,518
Grizzly bear habitat[1]	4.3.8.6	N/A	N/A
Spotted owl LTAC	4.3.8.7	17,931	8,622
Visual quality objectives – Zone A	4.3.7.1	106,395	51,612
Community watersheds	4.3.2	41,377	23,777

(1) There is no grizzly bear habitat currently mapped on the TSA

The implicit resource management areas proposed in the Lillooet LRMP that have a potential impact on timber supply are discussed in the following sections. If a cabinet decision is made on the Lillooet LRMP, the LRMP options will reflect such decisions.

Current forest resource management practices are modelled using forest cover requirements. These have been defined in the recent TSR and the proposed Lillooet LRMP (*Consultation Draft No. 3, MSRM, March 2003*). Table 3.4 provides a summary of the forest cover objectives to be employed in the TSR 3 analyses.

Table 3.4. Resource emphasis zone forest cover requirements

Zone	Disturbance Limits		Retention Requirements		Application Land Base
	Min Height (Age)	Max %	Min Age	Min %	
Integrated resource management	3(20)	33			THLB
Community watersheds	6.6(33)	20			Productive
Visual quality objective[3]					Productive
R Low	5(26)	3.8			
PR Low	5(26)	10.0			
M Low	5(26)	17.5			
R Intermediate	4(22)	5.5			
PR Intermediate	4(22)	14.0			
M Intermediate	4(22)	22.5			
R High	3(20)	7.2			
PR High	3(20)	18.0			
M High	3(20)	27.5			
Mule deer - shallow snow pack[1]			140	33	Productive
Mule deer - moderate snow pack[1]			140	15	Productive
Elk[1]	3(20)	30	90	30	Productive
Moose[1]	3(20)	33	22	67	Productive
Mountain goat - escape terrain[1]			40	67	Productive
Grizzly bear[1][2]					Productive
Spotted owl[1]			100	67	Productive

(1) These proposed LRMP zones will be not be modelled in the base case but in separate sensitivity analyses
(2) Modelled as an implicit landbase removal, no spatial data available
(3) As directed under the proposed LRMP, a subset (Zone A) of these visuals will be modelled in a sensitivity analysis

Notes:

R: retention	Low: low visual absorption capacity
PR: partial retention	Intermediate: intermediate visual absorption capacity
M: modification	High: high visual absorption capacity

3.3 TIMBER SUPPLY MODEL

All analyses were undertaken using Timberline's proprietary spatial timber supply model CASH6. CASH6 has several features that enhance spatial analyses. These include spatial analysis features that can be employed to demonstrate explicit spatial aspects of the timber supply.

With CASH6, maximum depletion and minimum disturbance constraints on forest cover are explicitly implemented. Resource management at a landscape level is modelled and future states predicted. The characteristics of all land within the study area contribute to the analysis allowing comprehensive modelling of forest structure.

CASH6 is a sequential forest inventory projection simulation model with the following characteristics:

- Spatial - the locale of management activities is used to capture the spatial consequences of changes in management policy;
- Disaggregate - forest inventory need not be aggregated beyond mapable contiguous blocks;
- Discrete - separately identified management blocks are the basic spatial unit for simulation; and
- Sequential - interaction of harvest and regeneration rules as modified by constraints results in a sequential progression of the forest state from current status into the future.

Key features of CASH6 are:

- Operates in either spatial or aspatial mode;
- Adjacency and distribution of forest structure are explicitly modelled;
- Area or volume management may be practiced on different parts of a forest simultaneously;
- Using a unique implementation of forest cover constraints methodology, harvesting can be directed to locales which will produce the least deviation from desired structural goals;
- A range of post-establishment silviculture treatments are available;
- Stand tending goals may be specified by either area or volume;
- A wide variety of types of constraints on harvesting are implemented; and
- Forest cover constraints can be either age or height based.

4.0 LAND BASE AND MANAGEMENT ASSUMPTIONS

4.1 ADMINISTRATIVE, NON-FOREST, AND NON-PRODUCTIVE

4.1.1 Land Not Administered by the Ministry of Forests

All land ownerships not contributing to timber supply area harvests are reclassified non-contributing (Table 4.1). This is achieved by excluding all areas except for those coded ownership 61C, 62C (Crown forest management unit) and 69C (Crown miscellaneous reserves) in the MoF ownership layer. There are currently no timber licences (ownership 70N) in the Lillooet TSA.

Table 4.1. Land not administered by MoF

Ownership Code	Description	Eligible Area (ha)
40N	Private – crown grant	25,191
52N	Indian reserve	21,484
60N	Crown ecological reserve	40
63N	Crown – provincial park	4
77N	Crown and private woodlot licence	7,607
99N	Crown miscellaneous lease	58
Park[(1)]	Duffey Lake	2,094
Park	Goldpan	4
Park	Marble Canyon	321
Park	Marble Canyon - addition	215
Park	Seton Portage – historic	1
Park	Skihist	25
Park	Skihist – ecological reserve	49
Park	Skwaha Lake – ecological reserve	822
Park	Stein Valley	108,398
Total		**166,313**

Mgmt info description:	**Non-MOF Administered Land**
Mgmt info source:	Based on accepted definition in previous Timber Supply Review
Data sources used:	Ownership
Modelling assumptions:	Only OWN {61C, 62C, 69C), otherwise excluded from crown land base
Mgmt issues:	There has been some argument as to the contribution of parks to various other non-timber objectives
Sign-off:	

4.1.2 Non-forest and Non-productive Forest

All land classified as non-forest and non-productive (lakes, swamps, rock, alpine, *etc*.) was excluded from the net timber harvesting land base. The non-forest and non-productive areas are listed in Table 4.2.

Table 4.2. Non-forest and non-productive area

Code	Description	Eligible Area (ha)
A	Alpine	323,986
AF	Alpine forest	65,486
C	Clearing	4,858
CL	Clay bank	296
G	Gravel bar	53
ICE	Icefield	30,134
L	Lake	16,832
M	Meadow	1,555
NP	Non-productive	38,335
NPBR	Non-productive brush	6,671
NPBU	Non-productive burn	4,827
OR	Open range	25,458
R	Rock	18,818
RIV	River	4,057
SAND	Sand	14
SWAMP	Swamp	1,185
U	Urban	4,339
Total		**546,904**

Mgmt info description:	**Non-productive & Non-forest**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Forest Inventory (FC1)
Modelling assumptions:	FC1 “npforestdesc” excluded from crown productive forest land base
Mgmt issues:	No issues identified
Sign-off:	

4.1.3 Roads, Trails and Landings

Forest operations create roads, trails, and landings that can reduce the productivity of growing sites, and reduce the area available for growing trees. Many existing roads and trails are identified as line features in the digital inventory. For input to modelling, areas and volumes associated with existing roads, trails, and landings must be estimated and removed from the timber harvesting landbase. In addition, there are changes in available growing area and productivity for future stands due to road building disturbance.

4.1.3.1 Existing Roads, Trails and Landings

Existing road features for the Lillooet TSA are stored in the GIS database as line features. In the Rationale and LRMP analyses, the area degraded by roads is calculated based on current operating practices[1] by applying buffer widths to each line feature as shown in Table 4.3.

Table 4.3. Existing road area reductions

Road Description	Road Measurements	
	Width (m)	Eligible Area (ha)
Paved, divided, provincial highway (Hwy. 1)	20	47
Paved, divided, regional primary access (Hwy. 99)	20	277
Gravel, undivided, local resource access (logging roads)	12	4,361
Four wheel drive rough roads and trails	6	646
Total		**5,331**

Mgmt info description:	**Existing Road Loss**
Mgmt info source:	Don Brown
Data sources used:	Spatial road buffers compiled by Timberline
Modelling assumptions:	Area excluded from crown productive forest land base as described in Table 4.3
Mgmt issues:	MOF Cascades Forest District believe that the RTL study that was conducted by MOF may provide a better data set. However, study seems to have been misplaced
Sign-off:	

4.1.3.2 Future Roads, Trails and Landings

Upon harvesting, a component of each stand is placed into a category that will remain in a disturbed state in perpetuity. If the area harvested is included in an area associated with forest cover constraints relating to integrated resource management, the road area will become part of the disturbance area permanently.

Generally these stands will provide harvest volume on the first entry but not on further entries. The area contributing to the long-term sustainable harvest is net of this amount. In CASH6, a percentage reduction will be applied to reduce the area of each forest class the first time it is harvested. In these cases, area reductions were made in the timber supply analysis *after the volume is credited to the harvest*. To account for future roads, trails and landings all stands greater than 40 years will have a 7.5% reduction applied upon the first entry.

Mgmt info description:	**Future Road Loss**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Replicates implicit removal identified in previous TSR
Modelling assumptions:	All first pass harvested stands greater than 40 years will have reduction applied
Mgmt issues:	The reduction is 5,000 ha larger than in TSR2
Sign-off:	

[1] Don Brown – Ainsworth; in consultation with other Licencees; email November 14, 2002

4.2 ECONOMIC FACTORS

4.2.1 Areas Considered Inoperable

The MoF in concurrence with licensees delineated operability lines for the Lillooet TSA in 1995. Operability mapping as accepted by these agencies was utilized.

The productive forest has been assessed for physical operability and for broad classes of logging methods. Three classes have been identified, specifically:

- Physically inoperable timber
  - Timber on productive land that is so steep and/or rocky, that it cannot be safely felled or yarded or a significant proportion of the volume could not be recovered.
- Conventional harvest systems
  - Includes timber on productive, physically operable land that is harvestable by conventional methods, *i.e.* long line cable systems, grapple, high-lead, hoe-chuck, skidder, *etc*.
- Non-conventional harvest systems
  - Includes timber on productive, physically operable land that is harvestable only by non-conventional methods. These include helicopter, balloon, or "Wissen" cable system.

All land classified as inoperable was excluded from the net timber harvesting land base as shown in Table 4.4.

Table 4.4. Operable areas

Operability Attribute	Eligible Area (ha)
Inoperable	97,964

Mgmt info description:	**Areas Considered Inoperable**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	TSA operability mapping
Modelling assumptions:	Operability type "I" excluded from crown productive forest land base
Mgmt issues:	No issues identified
Sign-off:	.

4.2.2 Non-commercial Forest

Productive land currently occupied by non-commercial brush was excluded from the net timber harvesting land base (523 ha).

Mgmt info description:	**Non-commercial Forest**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Forest inventory (FC1)
Modelling assumptions:	"PRJTYPEID" = 5 excluded from crown productive forest land base
Mgmt issues:	No issues identified
Sign-off:	

4.2.3 Low Timber Growing Potential

These areas are removed from the timber harvesting landbase because the site is either not fully occupied by commercial tree species or the productivity of the site limits timber growth. The criteria for exclusion are listed in Table 4.5.

Table 4.5. Low productivity criteria

Analysis Unit	Site Index (breast height age 50 years)	Reduction Percent	Eligible Area (ha)
Douglas-fir	< 8.6	100	14,220
Spruce/balsam/cedar	< 7.5	100	26,579
Lodgepole pine	< 9.6	100	34,517
Total			**75,316**

Mgmt info description:	**Low Timber Growing Potential**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Forest Inventory (FC1)
Modelling assumptions:	Area excluded from crown productive forest land base as described in Table 4.5
Mgmt issues:	No issues identified
Sign-off:	

4.2.4 Unmerchantable Forest Types

These are forest types currently not utilized in the Lillooet TSA. These areas are physically operable and exceed low site criteria but because of the inherent low economic opportunity within these stands they are not currently utilized. The criteria are listed in Table 4.6.

Table 4.6. Unmerchantable type criteria

Leading Species	Criteria	Eligible Area (ha)
Deciduous	All deciduous stands not part of PA16	2,290
All coniferous except fir	All stands classified as residual stocking class	18
Douglas-fir	All stands > 100 yrs, height class 1 stands	297
Douglas-fir	All stands > 80 yrs, height < 18 m, crown closure class 2 stands	1,152
Balsam/spruce/cedar/hemlock	All stands > 100 yrs, height class 1 stands	681
Cedar/hemlock	All stands > 100 yrs, height class 2 stands	8
Whitebark pine	All stands > 100 yrs, height < 14 m stands	904
Lodgepole pine	All stands > 80 yrs, height < 14 m, stocking class = 4	7,024
Lodgepole pine	All stands > 80 yrs, height < 14 m, cc < 5, stocking class <> 4	40
Ponderosa pine	All stands > 80 yrs, crown closure class < 5 stands	11,482
Total		**23,896**

Mgmt info description:	**Unmerchantable Forest Types**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Forest Inventory (FC1)
Modelling assumptions:	Area excluded from crown productive forest land base as described in Table 4.6
Mgmt issues:	Concerns that the criteria for Ponderosa Pine exclusion of crown closure class < 5 probably excludes all Ponderosa Pine as these stands are probably always less than 50%
Sign-off:	

4.2.5 Not Satisfactorily Restocked Areas - Backlog

NSR areas are stands that originally contained operable timber, were harvested or recently disturbed and have not yet regenerated to commercial species. For every stand scheduled for harvest there is a target period for regeneration following harvest. Land that fails to regenerate during this period is considered backlog. Under the *Silviculture Regulation*, land that is harvested is not permitted to become backlog. It must be planted within the regeneration delay period if it has not regenerated naturally before then. There is currently no backlog NSR.

Mgmt info description:	**NSR Backlog**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Forest Inventory (FC1)
Modelling assumptions:	
Mgmt issues:	District has identified some existing backlog and recent fire backlog
Sign-off:	

4.2.6 Pulpwood Agreement 16

Overlapping the Lillooet TSA is pulpwood agreement 16 (PA 16) established in April 1990 and assumed to expire in 2015 (25-year non-replaceable licence). This is an agreement applying to a fixed area that allows harvesting of timber below conventional merchantability limits if mill residues suitable for the facility under the agreement are not available. If area is harvested within the PA 16 boundaries, it is expected that regeneration of this land base would result in a managed stand, as would a harvested area outside of the PA 16 boundary.

Currently no volume has been billed under the PA 16 agreement in the Lillooet TSA. As such, current practice would suggest that no volume under PA 16 is expected. The base case will exclude PA 16 from the timber harvesting land base but a sensitivity analysis will include PA 16.

Mgmt info description:	**Pulpwood Agreement 16**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Pulpwood agreement boundary, analysis unit definition
Modelling assumptions:	Area remains in THLB but is partitioned to direct priority harvesting
Mgmt issues:	No issues identified
Sign-off:	

4.3 NON-TIMBER MANAGEMENT OBJECTIVES FACTORS

4.3.1 Environmentally Sensitive Areas and Unstable Terrain

Two sources of information were used to identify environmentally sensitive areas (including soils):

- ESA1 designations in the MoF forest cover (FC1) files; and
- Terrain stability mapping.

Areas were reclassified as non-contributing to harvest as shown in Table 4.7. For each polygon, only one reclassification was made. Deductions are listed and applied in descending order of priority. Terrain stability mapping was used in place of ESA1 designations where it was available.

Table 4.7. ESA and unstable terrain criteria

Environmentally Sensitive Area	Description	Reduction Percent	Eligible Area (ha)
Terrain stability – class V	Terrain mapping	100	23,838
Es1	Soils – high	90	125,948
Er1	Recreation – high	100	598
Ea1	Avalanche – high	100	2,830
Total			**153,214**

Mgmt info description:	**Unstable Terrain**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Terrain mapping and forest inventory (FC1)
Modelling assumptions:	Area excluded from crown productive forest land base as described in Table 4.7
Mgmt issues:	No issues identified
Sign-off:	

4.3.2 Watersheds

In TSR 2, regionally significant streams had specific management requirements identified. The watersheds associated with these streams were identified and a forest cover constraint was applied to the entire watershed (Table 3.4). The watershed level constraint was designed to approximate all riparian management considerations within the watershed.

4.3.2.1 Community Watershed Equivalent Clearcut Values

Twenty-three community watersheds have been identified within the Lillooet TSA. The watersheds were used to define management zones to which harvesting constraints were applied. Disturbance limits for the community watersheds were set in order to maintain a disturbance level below the recommended maximum equivalent clearcut area (ECA) proposed during hydrological surveys. The maximum ECA values for each surveyed watershed was intended to be applied as the maximum disturbance constraint for the watershed. However, with the current data this is not currently possible. Therefore, community watersheds were modelled using a default constraint value calculated as the average of the surveyed watershed values. The default value was calculated to be a maximum of 20% of the watershed that can be less than 6.6 m in height.

4.3.2.2 Community Watershed Intakes

Community watershed intakes within defined community watersheds are excluded from the timber harvesting landbase. An allowance of 1.57 hectares (100 metre reserve zone) is made for each community watershed intake within the TSA. A total of 8 ha were removed from the net timber harvesting land base.

Mgmt info description:	**Community Watersheds**
Mgmt info source:	Based on accepted definition in previous TSR
Data sources used:	Community watershed intake zones, buffered by Timberline
Modelling assumptions:	Area excluded from crown productive forest land base
Mgmt issues:	In TSR2 there was 100% overlap on community watershed intakes and here there are still 6 of the 8 ha removed in sequential netdown
Sign-off:	

4.3.3 Riparian Zones

Riparian zones along waterways are required by the Forest Practices Code to protect aquatic and terrestrial habitat. Riparian management areas were generated as buffer polygons around these features based on their classifications.

4.3.3.1 Streams and Rivers

Stream classification ("S Class") is based on that prepared for and submitted with Forest Development Plans. This inventory is updated as operational inventories are completed for planned cutblocks. Stream reaches that are currently not inventoried are classified according to local knowledge (for example of stream gradients) and by relating to inventoried stream reaches. The number of mapped smaller streams has increased with the application of enhanced TRIM map data.

The netdowns for riparian management areas are the maximum values defined in the Riparian Guidebook. The classifications and associated stream buffer widths are summarized in Table 4.8.

Table 4.8. Landbase reductions for streams

Stream Class	Reserve Zone (RRZ) (m)	Management Zone (RMZ) (m)	RMZ Basal Area Retention (%)	Combined Riparian Zone Width[(2)] (m)	Eligible Area (ha)
S1[(1)]	0	100	50	50	227
S1	50	20	50	60	1,366
S2	30	20	50	40	1,760
S3	20	20	50	30	3,366
S4	0	30	25	8	1,308
S5	0	30	25	8	86
S6	0	20	5	0	0
Total					**8,113**

(1) Fraser River
(2) Combined riparian zone width = reserve zone + (management zone * (basal area retention / 100))

4.3.3.2 Lakes and Wetlands

Buffers and management area netdowns are consistent with the Riparian Guidebook for wetlands and smaller lakes. Buffers have been created adjacent to mapped lakes and wetlands and netdowns applied as described in Table 4.9.

Table 4.9. Landbase reductions for lakes and wetlands

Lake/Wetland Class	Reserve Zone (RRZ) (m)	Management Zone (RMZ) (m)	RMZ Basal Area Retention (%)	Combined Riparian Zone Width[(1)] (m)	Eligible Area (ha)
L1 (> 1000 ha)	0	0	0	0	0
L1	10	0	25	10	211
L2	10	20	25	15	1
L3	0	30	25	8	20
L4	0	30	25	8	3
Subtotal					*235*
W1	10	40	25	20	656
W2	10	20	25	15	0
W3	0	30	25	8	334
W4	0	30	25	8	2
W5	10	40	25	20	311
Total					**1,538**

(1) Combined riparian zone width = reserve zone + (management zone * (basal area retention / 100))

Mgmt info description:	**Riparian Zones**
Mgmt info source:	Based on accepted definition in previous TSR, proposed draft LRMP
Data sources used:	Spatial riparian buffers provided by MSRM
Modelling assumptions:	Area excluded from crown productive forest land base as described in Table 4.8 and Table 4.9
Mgmt issues:	No issues identified
Sign-off:	

4.3.4 Protected Areas Strategy – Spruce Lake OIC

The Spruce Lake area in the Southern Chilcotin Mountains is now designated (through an order-in-council) as protected under the *Environmental Land Use Act*. The Spruce Lake protected area (20,811 ha) was excluded from the net timber harvesting landbase.

4.3.4.1 Protected Areas (LRMP)

As outlined in Table 4.10, the proposed LRMP (*Consultation Draft No. 3, MSRM, March 2003*) identifies eight additional protected areas within the TSA. The proposed protected areas are excluded from the net timber harvesting landbase in a sensitivity analysis.

Table 4.10. Proposed protected areas

Protected Area	Description	Eligible Area (ha)
Arthur Seat		1,574
Bridge Delta		653
Cayoosh Goats		439
Cerise Creek		457
Fred Antoine		7,178
French Bar		387
Gwyneth Lake		115
Marble Canyon		871
Skihist	Park extension	107
Spruce	Park extension	18,101
Yalakom		4,802
Total		**34,684**

Mgmt info description:	**Proposed Protected Areas**
Mgmt info source:	Proposed Lillooet LRMP
Data sources used:	Spatial description of park boundaries
Modelling assumptions:	Area excluded from crown productive forest land base as noted in Table 4.10
Mgmt issues:	Protected areas not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.5 Cultural Heritage Resources

The Chief Forester's Rationale accepted that TSR 2 had underestimated the impact of cultural heritage resources. Since that time and based on archaeological assessments, archaeological sites and culturally modified trees (CMT) have been identified. As input to this analysis, these features were buffered and removed (1,770 ha) from the timber harvesting landbase.

Mgmt info description:	**Community Watersheds**
Mgmt info source:	Based on accepted definition in AAC rationale
Data sources used:	Spatial location of cultural heritage site, buffered by Timberline
Modelling assumptions:	Area excluded from crown productive forest land base
Mgmt issues:	No issues identified
Sign-off:	

4.3.6 Integrated Resources Management Zones

All area within the timber harvesting land base was assigned to the integrated resources management (IRM) zone. To ensure that a reasonable distribution of harvest occurs across the land base similar to current practice, a spatially explicit cutblock adjacency (i.e., adjacent stand must reach a specific height) is applied for the first two decades. Under a spatial analysis, a block may not be harvested until the adjacent block reaches the oldest estimated green-up age for the management zones within which it is located. Adjacency information was included in the model input data in order to apply adjacency constraints on harvesting.

As future harvest block distribution cannot be well predicted, a more general maximum disturbance objective is applied beyond two decades at the IRM zone within each landscape unit. The maximum disturbance objective is similar to that applied during the TSR2 process, i.e. only 33% of the timber harvesting landbase can be below 3 meters at any one point in time.

For the purposes of this analysis the height growth of the trees was modelled directly (rather than as a green-up age) and constraints (Table 3.4) were applied accordingly. The stand heights were identified in the growth and yield model TIPSY.

Mgmt info description:	**IRM Zone**
Mgmt info source:	Based on accepted definition in TSR
Data sources used:	Timber harvesting landbase
Modelling assumptions:	Aspatial and spatial green-up within each landscape unit
Mgmt issues:	No issues identified
Sign-off:	

4.3.7 Visual Resources

Scenic areas have been officially made known by the district manager in the Lillooet TSA. To meet visual quality objectives, limits to the visual disturbance with visual sensitive zones are established. In the base case, the modelled constraints are identified in Table 4.11. As was used in the previous timber supply reviews these are mid-point values identified from the *Kamloops Land and Resource Management Plan VQO Matrix* and which are repeated in the Lillooet Land and Resource Management Plan (*Consultation Draft No. 3, MSRM, March 2003*). In TSR 2, disturbance requirements were applied to all individual visual polygons with established visual quality objectives. These objectives and disturbance requirements were also employed to each individual polygon in the TSR 3 analysis.

4.3.7.1 Visual Quality Objectives (LRMP)

The LRMP states as a goal with respect to visual management:

> *"Attractive landscapes that promote enjoyment of the natural surroundings, while balancing visual design with economic and environmental considerations."*

The proposed Lillooet LRMP (*Consultation Draft No. 3, MSRM, March 2003*) identifies two visual management zones, *i.e.* Zone "A" and Zone "B". Based on the recommendations outlined in the LRMP, Zone "A" areas were tested under a sensitivity analysis as known scenic areas. Only those areas with an identified visual quality objective within Zone "A" were included (Table 4.11). The disturbance requirements, however, replicate those employed in TSR 2.

Table 4.11. Modelled visual management forest cover requirements for base case and Zone "A" of LRMP sensitivity analysis

VQO (VAC[1]: Objective)	Landbase Application (Each Polygon)	Area (ha)		Disturbance Objectives		
		Productive	THLB	Maximum Age	Minimum Height	Maximum %
Low: R	Productive forest	3,860	533	26	5	3.8
Low: PR	Productive forest	22,317	11,655	26	5	10
Low: M	Productive forest	5,146	3,020	26	5	17.5
Intermediate: R	Productive forest	4,687	1,352	22	4	5.5
Intermediate: PR	Productive forest	47,976	24,623	22	4	14
Intermediate: M	Productive forest	15,299	7,045	22	4	22.5
High: R	Productive forest	44	27	20	3	7.2
High: PR	Productive forest	3,916	1,731	20	3	18
High: M	Productive forest	3,149	1,628	20	3	27.5

(1) VAC = visual absorption capacity, R = retention, PR = partial retention, M = modification

Mgmt info description:	**Visual Quality Zones**
Mgmt info source:	From previous TSR and proposed Lillooet LRMP
Data sources used:	Spatial VQOs, zone "A" and zone "B" polygons. As directed under the LRMP, only zone "A" polygons are tested under the sensitivity analysis
Modelling assumptions:	Green-up objectives within each visual polygon as described in Table 4.11
Mgmt issues:	The LRMP visual management not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.8 Wildlife

TSR 2 and the proposed Lillooet LRMP (*Consultation Draft No. 3, MSRM, March 2003*) provide resource management direction for larger animals (elk, moose, mountain goat and mule deer). Management of these ungulates was modelled using forest cover constraints as described in the following sections.

4.3.8.1 Mule Deer

The Lillooet TSA does not currently have any officially designated mule deer winter range. Licensees and the MOF, however as was identified in previous timber supply review, do manage for mule deer winter range through operational practices (e.g., partial harvesting). In the base case mule deer winter range management will be considered to be addressed operationally and not by a forest cover constraint.

Under the proposed LRMP, critical range requirements were revised to increase the distribution and abundance of mule deer through improved quality and quantity of habitat, particularly in areas with deeper snow packs. In order to meet this objective, forest cover retention requirements (Table 3.4) were applied in both moderate and shallow snow pack critical habitat areas in a sensitivity analysis.

Mgmt info description:	**Mule Deer**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	Spatial mule deer winter ranges, (MD_SHELTER = "YES")
Modelling assumptions:	Green-up objectives within winter range as described in Table 3.4
Mgmt issues:	LRMP UWR not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.8.2 Elk

Elk habitat areas were mapped as part of the LRMP. Specific disturbance and retention requirements (Table 3.4) for these areas were also provided by the LRMP. The management constraints were applied to the crown forested land within the critical range in a sensitivity analysis only and not to the base case analysis.

Mgmt info description:	**Elk**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	Spatial elk habitat ranges
Modelling assumptions:	Green-up objectives within habitat areas as described in Table 3.4
Mgmt issues:	LRMP elk habitat areas not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.8.3 Moose

Moose habitat areas were mapped as part of the LRMP due to a reduction in the quality, abundance and distribution of essential habitat. In order to maintain essential habitat, the LRMP mapped and provided specific disturbance and retention requirements (Table 3.4). These requirements were applied to the crown forested land within the critical range in a sensitivity analysis only and not to the base case analysis.

Mgmt info description:	**Moose**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	Spatial moose habitat areas
Modelling assumptions:	Green-up objectives within habitat areas as described in Table 3.4
Mgmt issues:	LRMP moose habitat not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.8.4 Mountain Goat

Mountain goat habitat areas were mapped as part of the LRMP and were not included in TSR 2. The management assumptions within these areas primarily focused on winter and kidding ranges. The LRMP provided specific disturbance and retention requirements to the crown forested land within 200m of escape terrain. The disturbance and retention requirements (Table 3.4) required to maintain the viability of their habitat were employed in a sensitivity analysis.

Mgmt info description:	**Mountain Goat**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	Spatial mountain goat habitat ranges
Modelling assumptions:	Green-up objectives within habitat areas as described in Table 3.4
Mgmt issues:	LRMP mountain goat areas not finalized as no HLPO decision for Lillooet LRMP
Sign-off:	

4.3.8.5 Identified Wildlife Management Strategy

The Identified Wildlife Management Strategy (IWMS) is one tool used for the management of species at risk (red or blue listed plant or animal species). The IWMS enables the establishment and management of wildlife habitat areas. In the Lillooet TSA no wildlife habitat areas have been established, though there is an expectation that wildlife habitat areas will be defined in the future.

In the draft Lillooet LRMP two identified wildlife (grizzly bear and spotted owl) receive further consideration. The management implications of these species are addressed in the following sections.

In the timber supply review of other management areas, the Chief Forester has often considered a 1% planning threshold for IWMS. This planning threshold is not modelled in this analysis but will be a consideration for the Chief Forester.

Mgmt info description:	**Identified Wildlife Management Strategy**
Mgmt info source:	John Surgenor, MWLAP and http://wlapwww.gov.bc.ca/wld/identified/wha_areas.htm
Data sources used:	None
Modelling assumptions:	Not modelled
Mgmt issues:	Need to consider 1% provincial planning threshold
Sign-off:	

4.3.8.6 Grizzly Bear

The Lillooet LRMP identifies a conservation and recovery management area (identified watersheds for grizzly bear management). During plan implementation, critical habitats will be identified using predictive ecosystem mapping (PEM) and further fieldwork as needed to locate critical habitat features on the ground. A timber harvesting landbase planning allowance of 8,000 hectares has been allotted to conserve critical grizzly bear habitats and stabilize landscape-level food supply (forage/berry production).

At the time of the analysis, PEM was not completed so further work is required before critical habitat can be mapped throughout the plan area. Consequently, this sensitivity analysis will not quantitatively measure the timber supply impacts associated with grizzly bear habitat, *i.e.* it will simply assume that the harvest level is expected to be reduced in proportion to the landbase planning allowance.

Mgmt info description:	**Grizzly Bear**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	No data available
Modelling assumptions:	Currently not modelled
Mgmt issues:	Management areas have not been explicitly identified, consequently landbase reduction may not correctly reflect timber supply impacts
Sign-off:	

4.3.8.7 Spotted Owl

Spotted Owl long term activity centres (LTACs) have been drafted in the Lillooet TSA (Nelson Grant, MSRM 2003). Prior to the development of a Spotted Owl recovery strategy and prior to the a higher level order for the Lillooet LRMP, licencees and the MOF have drafted a memorandum of understanding that harvesting in these areas will not reduce the structural value of these LTAC.

In the proposed LRMP (*Consultation Draft No. 3, MSRM, March 2003*) a timber harvesting landbase allowance of 3,000 hectares was proposed. However, further LTACs have been identified since that time.

Mgmt info description:	**Spotted Owl**
Mgmt info source:	From proposed Lillooet LRMP
Data sources used:	Spatial spotted owl long-term activity centers
Modelling assumptions:	Retention objectives within habitat areas as described in Table 3.4
Mgmt issues:	Unclear how the 3000 ha THLB allowance would be determined/tracked, spotted owl are not finalized as no HLPO decision yet for Lillooet LRMP
Sign-off:	

4.3.9 Landscape Biodiversity

Within the Lillooet TSA, biodiversity is primarily managed through old-seral forest retention. Eighteen landscape units are modelled for the Lillooet TSA. Old-growth seral stage requirements are established within each landscape unit (LU) at the biogeoclimatic ecosystem classification (BEC) variant level. The productive forest within each LU-BEC contributes to the old growth seral stage requirement. The forest cover requirements used to model landscape biodiversity are based on the *Landscape Unit Planning Guide* (March 1999). Requirements are based on low, intermediate and high biodiversity emphasis options (BEOs).

In TSR 3, landscape level biodiversity will be implicitly modelled at the LU-BEC variant level. Old growth requirements (based on BEO assignments) will be assigned to each LU-BEC variant in order to address landscape level biodiversity. Seral stage targets are summarized in Table 4.12.

Table 4.12. BEC/NDT old growth seral stage requirements

NDT	Biogeoclimatic Zone	Minimum Age (years)	Biodiversity Emphasis Option (% of Forest Area within the Landscape Unit)		
			Low(1)	Intermediate	High
2	CWH	250	9	9	13
2	ESSF	250	9	9	13
3	ESSF	140	14	14	21
3	MS	140	14	14	21
4	PP	250	13	13	19
4	IDF	250	13	13	19
4	BG	n/a	n/a	n/a	n/a

(1) In low Biodiversity emphasis units the requirement is to achieve at least one third of the target percentage now and to meet the full target by the end of three rotations (approximately 240 years)

4.3.9.1 Old Growth Management Areas

Landscape level biodiversity will also be explicitly modelled with draft old growth management areas (OGMAs). The OGMAs are currently under review and are not currently approved for use in TSR by MSRM. As a result, timber supply impacts associated with the explicit delineation of OGMAs will only be explored in a sensitivity analysis.

Draft OGMAs were defined within each landscape unit (LU), biogeoclimatic ecosystem classification (BEC), and variant combination by selecting those areas as prescribed in the Landscape Unit Planning

Guide (LUPG). In order to meet these landscape level objectives two broad categories were characterized:

- Objectives specific to the LUPG; and
- Objectives specific to the current operational planning requirements.

Under the first objective, the LUPG requires that OGMAs be representative of the various ecosystems, where each ecosystem has a representative percentage of productive area that must be retained in older age classes. Under the second objective, the selection process was designed to reflect the operational commitments currently on the TSA. Primarily, this required placing OGMAs outside of approved FDP blocks and in the non-contributing land base.

Overall, if a representative percentage that is required for a specific LU/BEC/Variant cannot be attained a recruitment strategy must be employed. The recruitment strategy used in this process was based on the selection process hierarchy approved by MSRM (*Susan Omelchuk, December 2003*). The selection and recruitment hierarchy is depicted in Table 4.13.

Table 4.13. OGMA selection and recruitment hierarchy

NDT[4] 1			NDT 2			NDT 3		
Selection Order	**Land Base**	**Age Range (years)**	**Selection Order**	**Land Base**	**Age Range (years)**	**Selection Order**	**Land Base**	**Age Range (years)**
1	PARK[1]	>= 400	1	PARK	>= 400	1	PARK	>= 400
2	NCLB[2]	>= 400	2	NCLB	>= 400	2	NCLB	>= 400
3	THLB[3]	>= 400	3	THLB	>= 400	3	THLB	>= 400
4	PARK	301-399	4	PARK	301-399	4	PARK	301-399
5	NCLB	301-399	5	NCLB	301-399	5	NCLB	301-399
6	THLB	301-399	6	THLB	301-399	6	THLB	301-399
7	PARK	251-300	7	PARK	251-300	7	PARK	251-300
8	NCLB	251-300	8	NCLB	251-300	8	NCLB	251-300
9	PARK	221-250	9	PARK	221-250	9	PARK	221-250
10	NCLB	221-250	10	NCLB	221-250	10	NCLB	221-250
11	THLB	251-300	11	PARK	181-220	11	PARK	181-220
12	PARK	181-220	12	NCLB	181-220	12	NCLB	181-220
13	NCLB	181-220	13	PARK	141-180	13	THLB	251-300
14	THLB	221-250	14	NCLB	141-180	14	PARK	141-180
15	THLB	181-220	15	THLB	251-300	15	NCLB	141-180
16	PARK	141-180	16	THLB	221-250	16	THLB	221-250
17	NCLB	141-180	17	THLB	181-220	17	THLB	181-220
18	PARK	121-140	18	THLB	141-180	18	PARK	121-140
19	NCLB	121-140	19	PARK	121-140	19	NCLB	121-140
20	THLB	141-180	20	NCLB	121-140	20	THLB	141-180

(1) PARK = existing and Spruce Lake OIC parks
(2) NCLB = landbase not contributing to timber supply
(3) THLB = landbase contributing to timber supply
(4) NDT = natural disturbance type

4.3.9.2 Disturbance of Inoperable Land Base

A special harvest profile was designed to allow the model to more realistically model natural disturbance in the areas outside of the timber harvesting land base. In previous analyses, the productive non-contributing land base was not available for harvest so it was continuously aged in the timber supply model. This is of concern because it eventually becomes old and over contributes to the fulfillment of certain forest cover requirements. In reality there will be some level of natural disturbance within the non-contributing land base component

For the TSR 3 analyses a procedure was designed that allowed the timber supply model to disturb the productive non-contributing land base. The methodology used is documented in the report "*Disturbing the Productive Non-Contributing Land Base"* (Timberline, 2003).

The procedure imposed within the model is an annual disturbance to the productive non-contributing (to harvest) component of each BEC zone. The disturbance is likely to be determined based on past disturbance patterns within the Lillooet TSA and from the expected disturbance frequency given in the FPC *Biodiversity Guidebook*. A seral requirement was also imposed on the productive non-contributing of each BEC variant, which forced the productive non-contributing to achieve a seral zone distribution similar to the natural range of variation from the FPC *Biodiversity Guidebook*.

It should also be noted that post disturbance stands may still contribute biodiversity values. For example old growth trees may survive a fire and still provide important habitat values. Therefore it is important to consider that the disturbance values can be viewed as more conservative.

A sensitivity analysis to investigate the impact of not disturbing the inoperable areas will also be performed. In this analysis areas outside of the THLB are not disturbed and are allowed to continually grow.

Mgmt info description:	**Landscape Level Biodiversity**
Mgmt info source:	Forest Practices Code, Landscape Unit Planning Guide
Data sources used:	Landscape unit, BEC, Variant classifications
Modelling assumptions:	Minimum retention within biodiversity zone as described in Table 4.12
Mgmt issues:	No issues identified
Sign-off:	

4.3.10 Stand Level Biodiversity – Wildlife Tree Retention

Biodiversity planning is a requirement under the Forest Practices Code and is done in accordance with the LUPG, and the definition of "priority biodiversity" planning described within. This priority biodiversity planning is the current focus of landscape unit planning and consists of two objectives: "*retention of old growth forest; and stand structure through wildlife tree retention (WTR)*".

The practice of leaving wildlife tree patches (WTPs) will be modelled in the timber supply analysis. WTPs will be modelled by reducing the average volume per hectare that is harvested, to account for trees that must be left in cutblocks. To allow for the retention of these patches, a volume reduction of 5.8% is applied to the harvested volume (5.3% for patches and 0.5% for single tree).

Mgmt info description:	**Stand Level Biodiversity**
Mgmt info source:	Form previous timber supply review (TSR 2)
Data sources used:	Timber harvesting landbase
Modelling assumptions:	Volume reduction to harvested stands
Mgmt issues:	Current documentation may not be sufficient to determine the amount of wildlife tree retention
Sign-off:	

4.4 LILLOOET LAND AND RESOURCE MANAGEMENT PLAN PROVISIONS

This section summarizes the modelling considerations noted in above sections used to address the requirements of the proposed Lillooet LRMP (*Consultation Draft No. 3, MSRM, March 2003*) as they relate to landbase withdrawals on the TSA. However, the LRMP has not been approved to date (12 February 2004) and therefore cannot be included in the calculation of base case timber supply.

Only those LRMP sections with expected timber supply implications were examined. However, due to the draft status of the LRMP, these issues were only explored in a sensitivity analysis only.

While Table 4.14 provides an overview of the issues identified under the LRMP, Table 3.4 provides the specific resource emphasis areas and associated forest cover constraints that are expected to have an impact on timber supply. The LRMP sensitivity analysis will also employ the landbase definition developed from the netdown protocol described in Section 4.0 with the following exception:

- Old growth management areas will be removed from the timber harvesting landbase.

Table 4.14 provides an overview of proposed Lillooet LRMP issues and their applicability to this review of timber supply.

Table 4.14. LRMP issues

Resource Issue	Applicability to TSR 3 Sensitivity Analysis
Tourism and Recreation	No timber supply analysis impact
Agriculture and Range	No timber supply analysis impact
Energy and Minerals	No timber supply analysis impact
Protected Areas Strategy (PAS)	Eight additional protected areas have been identified, which will be removed from the timber harvesting landbase, but will still contribute to non-timber resource objectives
Visual Quality Objective (VQO)	Zone A visuals (areas of high importance) replace previously mapped visual quality objectives. Forest cover constraints as defined in the TSR 2 timber supply analysis. Zone B visuals (areas of moderate importance) have no timber supply impact
Lake Management	Areas will be buffered and removed from timber harvesting landbase as classified under the FPC
Stream Management	Areas will be buffered and removed from timber harvesting landbase as classified under the FPC

Table 4.14 (cont.). LRMP issues

Resource Issue	Applicability to TSR 3 Sensitivity Analysis
Cultural Heritage Resources	Areas will be buffered and removed from timber harvesting landbase. Classified under archaeological assessments, archaeological sites and culturally modified trees
Community Watersheds	Forest cover constraints applied to the forested land base at watershed level
Mule Deer Winter Range	Retention requirements will be applied. Replaces TSR 2 mule deer winter range
Moose Habitat	Disturbance limits and retention requirements will be applied
Mountain Goat Habitat	Retention requirements will be applied
Elk Habitat	Disturbance limits and retention requirements will be applied
Bighorn Sheep Habitat	Retention targets for early and late seral cover will be applied
Grizzly Bear Habitat	No mapping currently available, impact assumed to be proportional to landbase allowance
Stand Level Biodiversity (WTPs)	Addressed through yield curve reductions (Section 4.3.10)
Landscape Level Biodiversity	Modelled as a minimum required percentage of productive area to be greater than the minimum age at the landscape unit, BEC variant level. Explicit area targets for old growth retention through explicit placement of old growth management areas (OGMAs)

LRMP goals with respect to timber supply impacts were the motivation for conducting these analyses. Area allowances, or areas to be reserved from harvesting, are allocated for resource protection as depicted in Table 4.15.

Table 4.15. LRMP timber harvesting landbase allowances

Resource	Maximum Area (ha)	Percentage of THLB
Mule deer winter range	6 000	2.0
Grizzly bear	8 000	2.7
Spotted owl	3 000	0.9
Total	**17 000**	**5.6**

Source: Consultation Draft No. 3, MSRM (March 2003)

The landbase allowances are maximum areas and are in addition to areas identified in the provincial timber supply analysis (*TSR 2, MoF 2002*). For the LRMP sensitivity analysis, mule deer winter range, grizzly bear and spotted owl were modelled using implicit forest cover objectives (Table 3.4).

Mgmt info description:	**LRMP**
Mgmt info source:	Lillooet LRMP - Consultation Draft No. 3, MSRM, March 2003, see individual descriptions
Data sources used:	All available spatial data
Modelling assumptions:	Landbase withdrawals and forest cover disturbance and retention requirements
Mgmt issues:	Proposed only
Sign-off:	

5.0 REGENERATION AND GROWTH AND YIELD

This section describes the assumptions used to determine volume projections for both natural and managed stands. This includes inventory, silviculture treatments and harvesting utilization factors. Growth and yield modelling factors are also discussed.

5.1 GENERAL CONSIDERATIONS

5.1.1 Silviculture History

For growth and yield application, stands are classified into two categories based on their silviculture regime: natural stands and managed stands. Natural stands have no prior silviculture treatments and were regenerated naturally. Managed stands have had previous silviculture treatments and are assumed to be artificially regenerated. For simplicity, all stands less than 28 years old are assumed to be managed. These values have been increased by 7 years from TSR 2 (January 2002) values to represent the seven years that have passed since the timber supply analysis was completed under TSR 2. The area considered managed and natural is summarized in Table 5.1.

Table 5.1. Managed and natural area

Silviculture Regime	Definition	THLB (ha)
Natural	Douglas-fir, spruce and pine > 27 yrs	249,893
Managed	Douglas-fir, spruce and pine 0 - 27 yrs	42,464
Total		**292,357**

Mgmt info description:	**Silviculture History**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Areas less than 28 years considered existing managed, follow managed yields
Mgmt issues:	No issues identified
Sign-off:	

5.1.2 Analysis Unit Definition

Stands with similar biological, management, and silviculture regimes are grouped to reduce modelling complexity. It is also important to ensure that analysis units are consistent with current management performance on the management unit. The following criteria were used to define the analysis unit aggregations:

- Species mix (inventory type group);
- Site productivity (site index range);
- Slope break (40%);
- Pulpwood agreement 16;
- Biogeoclimatic zone; and
- Stand age.

The analysis units depicted in Table 5.2 represent existing natural stands, existing natural stands in pulpwood agreement 16 and existing managed stands that will be assigned to both natural and managed stand yield tables in the analysis. Forest inventory attributes were used to develop the natural and managed stand yield tables prior to aggregation into yield tables.

Table 5.2. Analysis unit definitions

Analysis Unit	Description	Slope Break (%)	Site Type	Biogeoclimatic Classification and Height Criteria	Site Index Range	Age
Existing Natural Stands						
1	Douglas-fir (dry belt) selection	<= 40	All	IDFxh,IDFdk2b,PP,BG	All	All
2	Douglas-fir (wet-belt)	<= 40	G/M	All except IDFxh,IDFdk2b,PP,BG	≥ 17.0	28-141
3	Douglas-fir (wet-belt)	<= 40	P	All except IDFxh,IDFdk2b,PP,BG	< 17.0	28-141
4	Douglas-fir (wet-belt)	<= 40	G/M	All except IDFxh,IDFdk2b,PP,BG	≥ 17.0	≥ 141
5	Douglas-fir (wet-belt)	<= 40	P	All except IDFxh,IDFdk2b,PP,BG	< 17.0	≥ 141
6	Spruce/balsam/cedar/hemlock	<= 40	G/M	All	≥ 15.0	28-141
7	Spruce/balsam/cedar/hemlock	<= 40	P	All	< 15.0	28-141
8	Spruce/balsam/cedar/hemlock	<= 40	G/M	All	≥ 15.0	≥ 141
9	Spruce/balsam/cedar/hemlock	<= 40	P	All	< 15.0	≥ 141
10	Lodgepole pine	<= 40	G/M	All	≥ 16.0	28-141
11	Lodgepole pine	<= 40	P	All	< 16.0	28-141
12	Lodgepole pine	<= 40	G/M	All	≥ 16.0	≥ 141
13	Lodgepole pine	<= 40	P	All	< 16.0	≥ 141
101	Douglas-fir (dry belt) selection	> 40	All	IDFxh,IDFdk2b,PP,BG	All	All
102	Douglas-fir (wet-belt)	> 40	G/M	All except IDFxh,IDFdk2b,PP,BG	≥ 17.0	28-141
103	Douglas-fir (wet-belt)	> 40	P	All except IDFxh,IDFdk2b,PP,BG	< 17.0	28-141
104	Douglas-fir (wet-belt)	> 40	G/M	All except IDFxh,IDFdk2b,PP,BG	≥ 17.0	≥ 141
105	Douglas-fir (wet-belt)	> 40	P	All except IDFxh,IDFdk2b,PP,BG	< 17.0	≥ 141
106	Spruce/balsam/cedar/hemlock	> 40	G/M	All	≥ 15.0	28-141
107	Spruce/balsam/cedar/hemlock	> 40	P	All	< 15.0	28-141
108	Spruce/balsam/cedar/hemlock	> 40	G/M	All	≥ 15.0	≥ 141
109	Spruce/balsam/cedar/hemlock	> 40	P	All	< 15.0	≥ 141
110	Lodgepole pine	> 40	G/M	All	≥ 16.0	28-141
111	Lodgepole pine	> 40	P	All	< 16.0	28-141
112	Lodgepole pine	> 40	G/M	All	≥ 16.0	≥ 141
113	Lodgepole pine	> 40	P	All	< 16.0	≥ 141

Table 5.2 (cont.) Analysis unit definitions

Analysis Unit	Description	Slope Break (%)	Site Type	Biogeoclimatic Classification and Height Criteria	Site Index Range	Age
Existing Natural Stands – Pulpwood Agreement 16						
21	Douglas-fir (dry belt) selection	<= 40	All	IDFxh,IDFdk2b,PP,BG, < 17m	All	> 80
22	Douglas-fir (wet-belt)	<= 40	All	All except IDFxh,IDFdk2b,PP,BG,< 17m	All	> 80
23	Spruce/balsam/cedar/hemlock	<= 40	All	< 17 m	All	> 80
24	Lodgepole pine	<= 40	All	< 17 m	All	> 80
25	Deciduous	<= 40	All	All	All	> 60
121	Douglas-fir (dry belt) selection	> 40	All	IDFxh,IDFdk2b,PP,BG, < 17m	All	> 80
122	Douglas-fir (wet-belt)	> 40	All	All except IDFxh,IDFdk2b,PP,BG,< 17m	All	> 80
123	Spruce/balsam/cedar/hemlock	> 40	All	< 17 m	All	> 80
124	Lodgepole pine	> 40	All	< 17 m	All	> 80
125	Deciduous	> 40	All	All	All	> 60
Existing Manged Stands						
52	Douglas-fir (wet-belt)	<= 40	G/M	All except for IDFxh,IDFdk2b,PP,BG	≥ 17.0	< 28
53	Douglas-fir (wet-belt)	<= 40	P	All except for IDFxh,IDFdk2b,PP,BG	< 17.0	< 28
56	Spruce/balsam/cedar/hemlock	<= 40	G/M	All	≥ 15.0	< 28
57	Spruce/balsam/cedar/hemlock	<= 40	P	All	< 15.0	< 28
60	Lodgepole pine	<= 40	G/M	All	≥ 16.0	< 28
61	Lodgepole pine	<= 40	P	All	< 16.0	< 28
152	Douglas-fir (wet-belt)	> 40	G/M	All except for IDFxh,IDFdk2b,PP,BG	≥ 17.0	< 28
153	Douglas-fir (wet-belt)	> 40	P	All except for IDFxh,IDFdk2b,PP,BG	< 17.0	< 28
156	Spruce/balsam/cedar/hemlock	> 40	G/M	All	≥ 15.0	< 28
157	Spruce/balsam/cedar/hemlock	> 40	P	All	< 15.0	< 28
160	Lodgepole pine	> 40	G/M	All	≥ 16.0	< 28
161	Lodgepole pine	> 40	P	All	< 16.0	< 28

Analysis units 52 through 61 and 152 through 161 represent existing managed stands that were established after harvesting. These include all stands currently less than 28 years of age. The species and density attributes used to develop the base managed stand yield tables are those identified under TSR 2.

5.1.3 Utilization Levels

Utilization levels that were used in the development of all polygon volumes and yield tables (VDYP natural and TIPSY managed) are documented in Table 5.3. The indicated level is the utilization level applied operationally.

Table 5.3. Utilization levels

Stand Types	Utilization		
	Minimum DBH(1) (cm)	Stump Height (cm)	Top DIB(2) (cm)
Lodgepole pine	12.5	30	10.0
All other coniferous species	17.5	30	10.0
Deciduous	12.5	30	10.0

(1) Diameter breast height
(2) Diameter inside bark

Pulpwood agreement 16 has different utilization standards than those documented above. However, as prescribed under TSR 2 they will not be incorporated into the analysis as they result in only a negligible impact on stand volumes within PA 16.

Mgmt info description:	**Utilization Level**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all natural stand yields
Mgmt issues:	Utilization standards of PA 16
Sign-off:	

5.1.4 Unsalvaged Losses

Fire, insects, disease and other natural factors can cause catastrophic losses of whole stands of trees. Over the long-term the probability of losses to natural causes can be predicted. Where losses occur in merchantable stands some of the dead or dying timber may be salvageable. Expected unsalvaged losses are summarized in Table 5.4. In the TSR 3 analyses, this volume was added to the annual harvest target to reflect total volume depletion.

Table 5.4. Unsalvaged losses

Cause of Loss	Annual Unsalvaged Loss (m^3)
Insects	4,134
Fire	12,746
Windthrow	8,200
Miscellaneous	1,000
Total	**26,080**

These values are the same as those used in TSR 2. They have been verified with MoF as still appropriate for use in TSR 3.

Mgmt info description:	**Unsalvaged Losses**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvested stands
Mgmt issues:	No issues identified
Sign-off:	

5.2 MANAGED STAND YIELD TABLE DEVELOPMENT

5.2.1 Silviculture Management Regimes

The silviculture management regimes were exclusively modelled as using clear cutting followed by planting. The one exception not included within these regimes was within Douglas-fir dry belt stands. In these areas, all Douglas-fir leading stands in the IDFxh, IDFdk2b, PP and BG biogeoclimatic zones were prescribed to be partially harvested. This exception was modelled using a special analysis unit designated for these stands.

For the purposes these analyses, licensees identified the current silviculture practices used in the Lillooet TSA. With the exception of the partially harvested stands noted above clearcutting was used almost exclusively across the TSA.

The planting species mixtures and densities prescribed by the licencees for each analysis unit were used as input for the yield model.

Existing and future managed stand yields were developed using MoF BatchTIPSY (Version 3.3d). TIPSY incorporates the following inputs to derive a yield curve for each analysis unit:

- Species mix;
- Initial density - based on current stocking objectives;
- Regeneration method (planting);
- Area-weighted average site index;
- Area-weighted genetic gains (Section 5.2.5);
- Operational adjustment factors (OAF1 = 15%, OAF2 = 5%); and
- No regeneration delay (delays are incorporated in forest level modelling).

Mgmt info description:	**Silviculture Regimes**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvested stands
Mgmt issues:	No issues identified
Sign-off:	

5.2.2 Managed Stand Volume Projections

The planted species composition used as input for TIPSY are presented in Table 5.5.

Table 5.5. TIPSY regeneration composition inputs

Existing Analysis Unit	Existing Species Composition w/ Site Type and Age	THLB (ha)	Future Analysis Unit	Average Site Index	Average Genetic Gain (%)	Stems/ Hectare (S1[1]/S2[2])	Regenerated Species Composition %			
							S1	P1	S2	P2
52	Fd (wet-belt) G/M < 28	2,194	52	17.5	2.2	1000/1400	Fd	80	Pl	20
53	Fd (wet-belt) P < 28	3,517	53	12.5	4.3	1000/1200	Fd	60	Pl	40
56	Sx/Bl/Cw/Hw G/M < 28	8,319	56	15.6	14.2	1200/1400	Sx	70	Pl	30
57	Sx/Bl/Cw/Hw P < 28	2,199	57	9.8	13.9	1000/1200	Sx	70	Pl	30
60	Pl G/M < 28	10,434	60	16.4	11.1	1400/1200	Pl	90	Sx	10
61	Pl P < 28	7,179	61	12.0	10.7	1200	Pl	100		
152	Fd (wet-belt) G/M < 28	1,337	152	17.5	3.4	1000/1400	Fd	80	Pl	20
153	Fd (wet-belt) P < 28	1,571	153	12.5	4.4	1000/1200	Fd	60	Pl	40
156	Sx/Bl/Cw/Hw G/M < 28	2,536	156	15.7	15.9	1200/1400	Sx	70	Pl	30
157	Sx/Bl/Cw/Hw P < 28	854	157	10.1	15.0	1000/1200	Sx	70	Pl	30
160	Pl G/M < 28	1,051	160	16.3	11.0	1400/1200	Pl	90	Sx	10
161	Pl P < 28	1,274	161	12.7	10.8	1200	Pl	100		
2	Fd (wet-belt) G/M < 141	2,103	202	19.0	5.0	1000/1400	Fd	80	Pl	20
3	Fd (wet-belt) P < 141	8,998	203	13.3	5.3	1000/1200	Fd	60	Pl	40
4	Fd (wet-belt) G/M ≥ 141	790	204	18.3	4.1	1000/1400	Fd	80	Pl	20
5	Fd (wet-belt) P ≥ 141	14,772	205	12.5	4.8	1000/1200	Fd	60	Pl	40
6	Sx/Bl/Cw/Hw G/M < 141	1,104	206	17.7	14.3	1200/1400	Sx	70	Pl	30
7	Sx/Bl/Cw/Hw P < 141	2,865	207	11.4	13.7	1000/1200	Sx	70	Pl	30
8	Sx/Bl/Cw/Hw G/M ≥ 141	912	208	17.0	14.3	1200/1400	Sx	70	Pl	30
9	Sx/Bl/Cw/Hw P ≥ 141	12,592	209	10.2	14.3	1000/1200	Sx	70	Pl	30
10	Pl G/M < 141	3,880	210	17.9	11.4	1400/1200	Pl	90	Sx	10
11	Pl P < 141	26,796	211	12.7	10.1	1200	Pl	100		
12	Pl G/M ≥ 141	848	212	17.8	10.7	1400/1200	Pl	90	Sx	10
13	Pl P ≥ 141	10,650	213	12.1	10.6	1200	Pl	100		

(1) S1: Species 1
(2) S2: Species 2

Table 5.5 (cont.). TIPSY regeneration composition inputs

Existing Analysis Unit	Existing Species Composition w/ Site Type and Age	THLB (ha)	Future Analysis Unit	Average Site Index	Average Genetic Gain (%)	Stems/ Hectare (S1/S2)	Regenerated Species Composition %			
							S1	P1	S2	P2
102	Fd (wet-belt) G/M < 141	2,468	302	19.2	2.2	1000/1400	Fd	80	Pl	20
103	Fd (wet-belt) P < 141	12,965	303	13.4	4.6	1000/1200	Fd	60	Pl	40
104	Fd (wet-belt) G/M ≥ 141	1,479	304	18.6	2.3	1000/1400	Fd	80	Pl	20
105	Fd (wet-belt) P ≥ 141	29,671	305	12.4	4.3	1000/1200	Fd	60	Pl	40
106	Sx/Bl/Cw/Hw G/M < 141	705	306	17.2	15.0	1200/1400	Sx	70	Pl	30
107	Sx/Bl/Cw/Hw P < 141	3,397	307	11.1	13.5	1000/1200	Sx	70	Pl	30
108	Sx/Bl/Cw/Hw G/M ≥ 141	724	308	16.8	13.6	1200/1400	Sx	70	Pl	30
109	Sx/Bl/Cw/Hw P ≥ 141	10,805	309	10.2	16.4	1000/1200	Sx	70	Pl	30
110	Pl G/M < 141	2,919	310	17.9	10.6	1400/1200	Pl	90	Sp	10
111	Pl P < 141	15,336	311	12.6	10.1	1200	Pl	100		
112	Pl G/M ≥ 141	671	312	17.5	10.8	1400/1200	Pl	90	Sp	10
113	Pl P ≥ 141	6,519	313	12.1	10.1	1200	Pl	100		
22	Fd (wet-belt)	1,161	222	8.7	4.4	1000/1200	Fd	60	Pl	40
23	Sx/Bl/Cw/Hw	676	223	4.6	14.4	1000/1200	Sx	70	Pl	30
24	Pl	19,756	224	8.7	10.8	1200	Pl	100		
122	Fd (wet-belt)	3,098	322	8.9	4.4	1000/1200	Fd	60	Pl	40
123	Sx/Bl/Cw/Hw	627	323	4.8	14.2	1000/1200	Sx	70	Pl	30
124	Pl	9,046	324	8.3	10.3	1200	Pl	100		

Mgmt info description:	**Managed Stand Volume Projections**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvested stands
Mgmt issues:	No issues identified
Sign-off:	

5.2.3 Regeneration Delay

A regeneration delay is the maximum time allowed in a silviculture prescription, between the start of harvesting in the area to which the prescription applies, and the earliest date by which the prescription requires a minimum number of acceptable well-spaced trees per hectare to be growing in that area (*MoF, Glossary of Forestry Terms*). Regeneration delays are deployed separately from yield prediction in the forest level analysis. A 2-year delay was applied in all cases.

Mgmt info description:	**Regeneration Delay**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvested stands
Mgmt issues:	No issues identified
Sign-off:	

5.2.4 Not Satisfactorily Restocked - Current

Land that has been harvested recently, for which the regeneration delay period has not yet expired, is current NSR. Current NSR is part of the working forest and is expected to be regenerated on schedule. In the case of the TSA, all NSR is considered to be current.

In the timber supply analysis, the current not satisfactorily restocked (NSR) area identified in the forest cover inventory file as updated with licensee information is listed in Table 5.6. However, this includes stands that have since been declared satisfactorily restocked. The Cascades Forest District indicates that there are only 2,144 ha of NSR lands. This suggests that regeneration following harvest is in line with the proposed regeneration delay of 2 years.

Table 5.6. NSR classification and reductions

NSR Category	THLB (ha)
Inventory Type ID 4	7,138
Inventory Type ID 9	1,392
Total	**8,530**

Mgmt info description:	**Current NSR**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvested stands
Mgmt issues:	NSR to be verified based on harvesting date the Districts numbers
Sign-off:	

5.2.5 Genetic Gain

The Forest Practices Code requires use of Class "A" seed from tree improvement programs where it exists. The analyses utilized the most current genetic gain information available from the MoF Research Branch and the Forest Genetics Council.

Assumptions for managed stands will include genetic gains from tree improvement. The Forest Practices Code requires use of improved seed where it is available. On direction from the Chief Forester's AAC rationale document, the analyses reflect the use of improved seed through adjustments to yield projections.

Seed planning units (SPUs) are the organizational units that form the basis for breeding and seed production planning carried out by the Forest Genetics Council and the Tree Improvement Branch of the MoF. SPUs are polygon features that geographically delineate the extent of biologically feasible seedling use for stock originating from specific seed orchards throughout the province. Each SPU identifies the area throughout which seedlings of a given species originating from orchards within a specific region of the province may be used in regeneration. Note also that each SPU lies within a prescribed elevation band.

Estimates of future genetic worth and seedling availability are provided at the SPU level. Consequently these features must be incorporated into the resultant database in order to georeference the genetic gain estimates for subsequent yield curve construction.

The individual SPUs overlap each other in various combinations such that each unique combination of SPUs identifies a specific supply of seedlings of a certain species originating from specific orchards, each with a particular genetic gain factor. Therefore it is these unique combinations of overlapping SPUs that act as the common denominator for targeting genetic gain factors in the timber supply analysis.

The following information is used in applying genetic gains to the managed stand yields:

- Elevation bands defined from the TRIM digital terrain model based on SPU elevation band definitions;
- Provincial seed planning zone boundaries and underlying BEC definitions; and
- Species plans including genetic gain estimates.

Table 5.7 lists the Provincial seed planning zones (SPZ) within which the TSA falls.

Table 5.7. Provincial seed planning zones

Species	Genetic Class "A" Seed Planning Zone
Spruce	Thompson Okanagan (TO)
Douglas-fir	Submaritime Coastal (SM)
Lodgepole pine	Thompson Okanagan (TO)

All genetic gains are geo-referenced based on MoF provincial SPZs and SPUs. Table 5.8 lists the applicable seed planning units on the Lillooet TSA.

Table 5.8. Provincial seed planning units

Species	Genetic Class "A" Seed Planning Zone	Seed Planning Unit	Elevation Band
Spruce	Thompson Okanagan (TO)	Sx TO High	High (> 1300 m)
		Sx TO Low	Low (< 1300 m)
Douglas-fir	Submaritime Coastal (SM)	Fd SM Low	Low (< 1300 m)
Lodgepole pine	Thompson Okanagan (TO)	Pli TO High	High (> 1400 m)
		Pli TO Low	Low (< 1400 m)

As indicated in Table 5.8, SPUs are defined by tree species, SPZ and elevation band. Rather than using provincial SPZs to spatially define SPUs, it is recommended that the zones be redefined with finer resolution data. This involves remapped elevation bands derived from the TRIM digital elevation model. Table 5.9 lists the final seed planning units for the TSA.

Table 5.9. Lillooet TSA seed planning units

Species	Zone A (< 1000 m)	Zone B (1000- 1300 m)	Zone C (1300 – 1400 m)	Zone D (> 1400 m)
Lodgepole pine	Pli TO Low	Pli TO Low	Pli TO Low	Pli TO High
Douglas-fir	Fdi SM Low	none	none	none
Interior spruce	Sx TO Low	Sx TO Low	Sx TO High	Sx TO High

Table 5.10 provides the published genetic gains for the applicable SPUs found on the Lillooet TSA. These were compiled from MoF Tree Improvement Branch species plans.

Table 5.10. Tree improvement gains and seed availability

Planted Species	Seed Planning Unit	Short Term Gain(1) (%)	Short Term Availability (2)	Long Term Gain (%)	Long Term Availability (1)
Spruce	Sx TO High	8	100%	15	100%
	Sx TO Low	8	100%	19	100%
Douglas-fir	Fd SM Low	2	45%	8	100%
Lodgepole pine	Pli TO High	11	15%	11	15%
	Pli TO Low	9	27%	10	41%

(1) Percent gain in primary trait (stem volume)
(2) Percent of seed planning unit requirement

For strategic analysis it is appropriate to use long-term genetic gain values. Modelling takes place over extended time frames (250 years) which means that the short-term values are usually of little importance. An exception to this is the case in which timber availability is very sensitive to specific height based short-term constraints, which could be significantly affected by the genetic gains.

For timber supply analysis and resource sustainability modelling, managed stand yields should reflect long-term genetic worth values. This will result in an overestimate for the first few years only. Although the Lillooet TSA has been using improved seed since 1990 (*Dwayne Eastman, MoF, personal communication*), no genetic worth inputs to yield estimation would be appropriate for existing managed

stands because the majority of those stands would not have been established with improved seed. This assumption will result in a small underestimation to the extent that improved materials have been used.

Genetic gains factors were calculated for each stand based on the values listed above. These factors were area-weight averaged as stands were aggregated to form analysis units. When the managed stand yield curve was generated for the analysis unit the average genetic gain factor was input into TIPSY. An example is given for the hypothetical "analysis unit X" in Table 5.11.

Table 5.11. Example implementation of genetic gains factor

Analysis Unit	Planted Species	Elevation Band	Area (ha)	Genetic Gain
X	Spruce	A	750	12
	Spruce	B	250	16
Total for X			**1000**	**13**

In the above example, the genetics gain factor of 13% would be applied in TIPSY when creating the yield curve for analysis unit "X". This would increase expected future managed stand yields for analysis unit "X" by 13%.

Mgmt info description:	**Genetic Gains**
Mgmt info source:	From previous AAC Rationale
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all future managed stands only
Mgmt issues:	The use of long-term gain values rather than the short-term, verify
Sign-off:	

5.2.6 Site Index

The growth potential of modelled stands is quantified using site index. Site index is defined as the potential height of a site tree at breast age 50 grown on the site. All site index values are based on the standard set of site index curves used in the MoF software *Site Tools*. The site index values in this analysis came from two different sources:

- Forest inventory attribute adjusted age and height values (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003*); and
- Site index correlated to biogeoclimatic ecological classification (SIBEC).

5.2.6.1 Forest Inventory Site Index

In the base case, the attribute adjusted forest inventory age, height and site index values will be used to predict the yield of all natural and managed stands.

5.2.6.2 SIBEC Productivity Estimates

Site index estimates produced using the MoF SIBEC system will be used to test the growth of managed stands. SIBEC site index estimates were assigned to a stand based on the BEC site series classification. For the sensitivity analysis, the BEC site series information required to use SIBEC was derived from the recently completed PEM project (*Shamaya Consulting - Ecological Services, December 2003*).

A predictive ecosystem mapping (PEM) process was used to inventory ecosystems within the Lillooet TSA. The Lillooet TSA PEM is an important inventory for management of the Lillooet TSA, particularly as the TSA moves forward with Sustainable Forest Management (SFM) planning. To date, an accuracy assessment has not been completed and approved for the PEM. As a result, the Ministry of Forests has not accepted it for use in TSR. However, the ecosystem inventory and the prediction of future stand yields will be tested in a sensitivity analysis

In instances where no SIBEC values were available for a BEC site series and leading species combination, the inventory site index was used.

Mgmt info description:	**Site Index Use**
Mgmt info source:	BC MoF – 2002 Site Index Estimates by Site Series (*SIBEC – Second Approximation, Research Branch*)
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all managed stands only
Mgmt issues:	PEM mapping does not meet MOF standards, as it has not had an independent accuracy assessment completed. As such it's use in deriving SIBEC productivity estimates can not be used in the TSR base case
Sign-off:	

5.2.7 Operational Adjustment Factors – Managed Stands

Standard operational adjustment factors (OAF) were used to model managed stands. OAF1 was set to 0.85 (15% reduction) and OAF2 was set to 0.95 (5% reduction).

Mgmt info description:	**OAF**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all managed stands
Mgmt issues:	No issues identified
Sign-off:	

5.3 NATURAL YIELD TABLE DEVELOPMENT

5.3.1 Natural Stand Volume Projections

The MoF VDYP model (Version 6.6d) was used to develop natural stand yields at the analysis unit level. A yield curve was first generated for each stand using the species composition, crown closure and site index of the stand. These yield curves were then area-weighted averaged to produce one yield curve for each analysis unit. Forest stand growth and yield modelling for TSR 3 will follow standard MoF methodologies, using established tools and processes.

As discussed in Section 4.3.10, all yield estimates were reduced by a further 5.8% to reflect the anticipated impact of wildlife tree patches.

The average inputs to VDYP are presented in Table 5.12 but do not represent the actual inputs used, as it was the yield curves that were averaged, not the inputs.

Table 5.12. VDYP analysis unit inputs

Analysis Unit	Analysis Unit Description w/ Site Type and Age	THLB (ha)	Average SI50(1)	Average CC(2)	Species Composition							
					S1	P1	S2	P2	S3	P3	S4	P4
1	Fd (dry belt) - selection	15,327	12.2	41	Fd	89	Py	9	Pl	1	Ep	1
2	Fd (wet-belt) G/M < 141	2,103	19.0	50	Fd	81	Pl	14	Py	3	Se	2
3	Fd (wet-belt) P < 141	8,998	13.3	46	Fd	82	Pl	15	At	2	Se	1
4	Fd (wet-belt) G/M ≥ 141	790	18.3	49	Fd	81	Se	10	Pl	7	Py	2
5	Fd (wet-belt) P ≥ 141	14,772	12.5	45	Fd	86	Pl	11	Se	3		
6	Sx/Bl/Cw/Hw G/M < 141	1,104	17.7	50	Se	51	Bl	24	Pl	17	Fd	8
7	Sx/Bl/Cw/Hw P < 141	2,865	11.4	51	Bl	44	Se	40	Pl	14	Fd	2
8	Sx/Bl/Cw/Hw G/M ≥ 141	912	17.0	54	Se	62	Bl	25	Pl	9	Fd	4
9	Sx/Bl/Cw/Hw P ≥ 141	12,592	10.2	53	Se	45	Bl	44	Pl	9	Pa	2
10	Pl G/M < 141	3,880	17.9	62	Pl	85	Fd	8	Se	5	Bl	2
11	Pl P < 141	26,796	12.7	63	Pl	90	Fd	6	Se	3	Bl	1
12	Pl G/M ≥ 141	848	17.8	59	Pl	75	Se	12	Fd	7	Bl	6
13	Pl P ≥ 141	10,650	12.1	58	Pl	80	Se	11	Fd	5	Bl	4
101	Fd (dry belt) - selection	20,695	12.4	46	Fd	91	Py	7	Pl	1	Ep	1
102	Fd (wet-belt) G/M < 141	2,468	19.2	62	Fd	80	Pl	13	Se	5	Py	2
103	Fd (wet-belt) P < 141	12,965	13.4	58	Fd	84	Pl	14	Se	2		
104	Fd (wet-belt) G/M ≥ 141	1,479	18.6	53	Fd	85	Se	8	Pl	5	Bl	2
105	Fd (wet-belt) P ≥ 141	29,671	12.4	49	Fd	88	Pl	8	Se	3	Py	1
106	Sx/Bl/Cw/Hw G/M < 141	705	17.2	55	Bl	43	Se	42	Pl	9	Fd	6
107	Sx/Bl/Cw/Hw P < 141	3,397	11.1	54	Bl	54	Se	31	Pl	11	Pa	4
108	Sx/Bl/Cw/Hw G/M ≥ 141	724	16.8	56	Se	60	Bl	28	Fd	6	Pl	6
109	Sx/Bl/Cw/Hw P ≥ 141	10,805	10.2	56	Bl	47	Se	41	Pl	8	Fd	4
110	Pl G/M < 141	2,919	17.9	66	Pl	83	Fd	10	Se	5	Bl	2
111	Pl P < 141	15,336	12.6	65	Pl	83	Fd	11	Se	3	Bl	3
112	Pl G/M ≥ 141	671	17.5	68	Pl	71	Se	14	Fd	8	Bl	7
113	Pl P ≥ 141	6,519	12.1	60	Pl	75	Se	10	Fd	9	Bl	6

(1) CC: Crown closure
(2) SI50: Site index breast height age 50 years

Table 5.12 (cont.). VDYP analysis unit inputs

Analysis Unit	Analysis Unit Description w/ Site Type and Age	THLB (ha)	Average SI50	Average CC	Sxecies Composition							
					S1	P1	S2	P2	S3	P3	S4	P4
21	Fd (dry belt) - selection	1,607	8.2	38	Fd	65	Py	34	Pl	1		
22	Fd (wet-belt)	1,161	8.7	43	Fd	84	Pl	14	Se	2		
23	Sx/Bl/Cw/Hw	676	4.6	60	Se	56	Bl	24	Pl	15	Pa	5
24	Pl	19,756	8.7	60	Pl	92	Se	4	Pa	2	Fd	2
25	Deciduous	289	12.8	63	At	80	Fd	13	Pl	4	Se	3
121	Fd (dry belt) - selection	3,105	7.8	33	Fd	60	Py	38	Pl	1	At	1
122	Fd (wet-belt)	3,098	8.9	48	Fd	87	Pl	10	Se	2	Py	1
123	Sx/Bl/Cw/Hw	627	4.8	61	Se	55	Bl	26	Pl	13	Pa	6
124	Pl	9,046	8.3	62	Pl	84	Se	6	Pa	6	Fd	4
125	Deciduous	61	11.2	65	At	72	Fd	23	Ac	4	Ep	1

Mgmt info description:	**Natural Stand Volume Projections**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all existing natural stands
Mgmt issues:	No issues identified
Sign-off:	

5.3.2 Deciduous Exclusion

Deciduous species are not currently utilized in the Lillooet TSA. However, there is an expectation that deciduous species would be used if harvesting was to occur with respect to PA 16.

Stands not part of PA 16 where the leading species is deciduous were excluded under "Unmerchantable Forest Types" (Section 4.2.4). In the base case, PA 16 is excluded. As such, deciduous stands within PA 16 do not currently contribute to timber supply.

In mixed species stands the deciduous component of the stand is not harvested. For the analysis, all stand volumes are reduced by the amount represented by the deciduous component of the stand.

Mgmt info description:	**Deciduous Volume Exclusion**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all unmerchantable and deciduous stands
Mgmt issues:	No issues identified
Sign-off:	

5.3.3 Forest Cover Inventory

The forest cover inventory was completed in four separate re-inventory projects between 1988 and 1990. The present forest cover inventory for the Lillooet TSA is updated to 2002 to account for changes in denudation through harvesting. All forest cover inventory information has been converted from North American Datum (NAD) 27 to NAD 83 base.

The current forest cover inventory is projected to 31 December 2003. The forest cover inventory data has been prepared using a geographic information system (GIS). Use of GIS ensures that spatial relationships between the various inventory attributes are maintained throughout the analysis process.

5.3.4 Forest Cover Inventory – Statistical Adjustment

The phase 2 vegetation resource inventory (VRI) statistical attribute adjustment study for the Lillooet TSA was completed by MSRM in April 2003 (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003*). The attribute adjustment is the process of correcting aerial photo-based inventory data from the estimation phase using ground sample observations. The purpose of the adjustments is to obtain unbiased overall averages and totals for the TSA by major species groups and to adjust the existing estimation data to obtain individual stand values (*Vegetation Resources Inventory, Attribute Adjustment Procedures, Draft Version 4.4, April 2002*). This analysis indicated that the volume in the timber harvesting landbase was underestimated by approximately 13% based on a sampling error (at the 95% probability level) of 9.9%.

For the purposes of TSR 3, the *Fraser Protocol* (MSRM, 2001) was employed to adjust the inventory attributes. The steps in the adjustment process were as follows:

1. Perform analysis on VRI ground sample inventory data and develop inventory file adjustment factors for age, height, and volume;
2. Using the factors derived in step one, adjust height and age in the inventory database files;
3. Based on the adjusted inventory file height and age, use Variable Density Yield Predictor (VDYP Version 6.6d) to compute an "attribute-adjusted" inventory volume; and
4. Using the volume adjustment factors derived in step one, adjust the "attribute-adjusted" inventory volume derived in step three. The adjusted volumes are based on net factoring with the net volume adjustment factor (NVAF) applied. This volume is referred to as the final adjusted inventory volume.

The timber harvesting landbase determination (Section 3.1) was conducted using the attribute-adjusted forest cover inventory. The forest cover inventory has also been updated for disturbance to 2002. In preparation for this analysis process, the forest cover inventory was projected to 31 December 2003 and volumes were populated using VDYP version 6.6d.

Mgmt info description:	**VRI Phase 2 Adjustment**
Mgmt info source:	Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all existing natural stands
Mgmt issues:	No issues identified
Sign-off:	

5.3.5 Existing Timber Volume Check

An existing timber volume check was performed in order to ensure that all of the growth and yield inputs were correctly established in the model. The initial volume at time zero calculated by the model was output and compared to the current inventory volume from the adjusted forest cover inventory. The results are presented in Table 5.13.

Table 5.13. Aggregate volume check

	Polygon Volume Derived Using		Percent Difference
	Inventory Volume	Yield Table Volume	
THLB Volume (m^3)	56,104,116	55,127,827	1.7%

5.3.6 Decay Waste and Breakage – Natural Stands

Volume estimates are net of decay, waste and breakage. Ministry of Forests Forest Inventory Zones (FIZ) "C" and "D" loss factors were used for the entire area. Existing natural stands greater than 27 years of age will be grown during the analysis on yield curves developed with VDYP. Loss factors are those specified for Public Sustained Yield Units (PSYU) 142, 143 and 144.

Mgmt info description:	**Decay, Waste, and Breakage**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all existing natural stands
Mgmt issues:	No issues identified
Sign-off:	

6.0 MODELLING CONSIDERATIONS

This section describes all of the assumptions used to model the timber harvesting systems employed in the Lillooet TSA.

6.1 MINIMUM HARVEST AGE

Minimum harvest ages are necessary for timber supply modelling to ensure the model does not, at times of low timber availability, select young stands unlikely to be harvested. TSR 2 minimum harvest ages (MHA) for existing natural stands were based on regional standards. Minimum harvest ages for future managed stands, on the other hand, were based on 90% of the culmination of mean annual increment (CMAI). Culmination age is defined as the age at which stand volume, less decay, waste and breakage, is maximized to a precision of one decimal place. This criterion will be employed in all analyses. Culmination values and minimum harvest ages are presented in Table 6.1.

Table 6.1. Minimum harvest ages

Existing Natural Stands			Regenerated Stands		
Analysis Unit	**Description**	**MHA**	**Analysis Unit**	**Description**	**MHA**
1	Douglas-fir(selection)	100	201	Douglas-fir (selection)	80
2	Douglas-fir(wet-belt)	80	202	Douglas-fir(80)/pine(20)	80
3	Douglas-fir(wet-belt)	80	203	Douglas-fir(60)/pine(40)	100
4	Douglas-fir(wet-belt)	80	204	Douglas-fir(80)/pine(20)	80
5	Douglas-fir(wet-belt)	80	205	Douglas-fir(60)/pine(40)	100
6	Sp/Bl/Cw/Hw	100	206	Spruce(70)/pine(30)	80
7	Sp/Bl/Cw/Hw	100	207	Spruce(70)/pine(30)	110
8	Sp/Bl/Cw/Hw	100	208	Spruce(70)/pine(30)	80
9	Sp/Bl/Cw/Hw	100	209	Spruce(70)/pine(30)	130
10	Lodgepole pine	80	210	Pine(90)/spruce(10)	60
11	Lodgepole pine	80	211	Pine(100)	80
12	Lodgepole pine	80	212	Pine(90)/spruce(10)	60
13	Lodgepole pine	80	213	Pine(100)	80
101	Douglas-fir(selection)	100	301	Douglas-fir (selection)	80
102	Douglas-fir(wet-belt)	80	302	Douglas-fir(80)/pine(20)	80
103	Douglas-fir(wet-belt)	80	303	Douglas-fir(60)/pine(40)	100
104	Douglas-fir(wet-belt)	80	304	Douglas-fir(80)/pine(20)	80
105	Douglas-fir(wet-belt)	80	305	Douglas-fir(60)/pine(40)	110
106	Sp/Bl/Cw/Hw	100	306	Spruce(70)/pine(30)	80
107	Sp/Bl/Cw/Hw	100	307	Spruce(70)/pine(30)	120
108	Sp/Bl/Cw/Hw	100	308	Spruce(70)/pine(30)	80
109	Sp/Bl/Cw/Hw	100	309	Spruce(70)/pine(30)	120
110	Lodgepole pine	80	310	Pine(90)/spruce(10)	60
111	Lodgepole pine	80	311	Pine(100)	70
112	Lodgepole pine	80	312	Pine(90)/spruce(10)	60
113	Lodgepole pine	80	313	Pine(100)	80

Table 6.1 (cont.). Minimum harvest ages

Existing Natural Stands			Regenerated Stands		
Analysis Unit	**Description**	**MHA**	**Analysis Unit**	**Description**	**MHA**
21	Douglas-fir(selection)	100	221	Douglas-fir(selection)	80
22	Douglas-fir(wet-belt)	80	222	Douglas-fir(60)/pine(40)	160
23	Sp/Bl/Cw/Hw	80	223	Spruce(70)/pine(30)	250
24	Lodgepole pine	80	224	Pine (100)	110
25	Deciduous	60	225	Deciduous	60
121	Douglas-fir(selection)	100	321	Douglas-fir(selection)	80
122	Douglas-fir(wet-belt)	80	322	Douglas-fir(60)/pine(40)	160
123	Sp/Bl/Cw/Hw	80	323	Spruce(70)/pine(30)	250
124	Lodgepole pine	80	324	Pine (100)	120
125	Deciduous	60	325	Deciduous	60
			52	Douglas-fir(80)/pine(20)	80
			53	Douglas-fir(60)/pine(40)	100
			56	Spruce(70)/pine(30)	80
			57	Spruce(70)/pine(30)	130
			60	Pine(90)/spruce(10)	60
			61	Pine(100)	80
			152	Douglas-fir(80)/pine(20)	80
			153	Douglas-fir(60)/pine(40)	110
			156	Spruce(70)/pine(30)	80
			157	Spruce(70)/pine(30)	130
			160	Pine(90)/spruce(10)	60
			161	Pine(100)	70

It should be recognized that the application of cover constraints in particular zones may delay stand entry well beyond these minimum ages. Areas are often harvested well beyond their "merchantability" ages, depending on the availability of "merchantable" timber and cover class constraints.

A sensitivity analysis investigating the impact of increasing or decreasing the minimum harvest age by ten years was also performed.

Mgmt info description:	**Minimum Harvestable Ages**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvestable stands
Mgmt issues:	No issues identified
Sign-off:	

6.2 HARVEST SYSTEMS

An investigation of the current management practices within the Lillooet TSA revealed that the majority of harvesting is performed using a clearcut silviculture system. The one exception was within Douglas-fir dry belt stands. In these areas, all Douglas-fir leading stands in the IDF xh, IDF dk2b, PP and BG biogeoclimatic zones were prescribed to be partially harvested. This exception was modelled using a special analysis units designated for these stands.

Mgmt info description:	**Harvesting Systems**
Mgmt info source:	From previous TSR
Data sources used:	Landbase classification
Modelling assumptions:	Applied to all harvestable stands
Mgmt issues:	No issues identified
Sign-off:	

6.3 HARVEST FLOW OBJECTIVES

The overall strategy employed in the TSA is to gradually adjust harvest levels towards our best estimate of the long-term harvest level (LTHL) for the forest. In all timber supply analyses, the choice(s) of harvest flow will reflect the following objectives:

- Achieve an acceptable short-term harvest level;
- Decrease the periodic harvest level in acceptable steps (<= 10%) when declines are required to meet all objectives associated with the various resources on the landbase;
- Do not permit the mid-term harvest level to fall below a level reflecting the productive capacity of the TSA (based on VDYP yield estimates); and
- Achieve a long-term stable harvest level over a 400-year time horizon reflecting the productive capacity of the TSA (based on TIPSY yield estimates).

6.3.1 Initial Harvest Level

Initial harvest levels for the Lillooet TSA and Pulpwood Agreement 16 portions of the forest are the projected harvest levels for the analysis. The current AAC for the Lillooet TSA is 635,900 m^3/yr, which excludes Pulpwood Agreement 16 (Table 6.2). In addition, an allowance must be made for non-recoverable losses. As the timber supply analysis is based on the net harvest plus NRLs, the initial gross harvest level for the TSR 3 base option was set to 661,980 m^3/yr, providing a starting point for the analysis.

Table 6.2. Initial harvest levels

	Volumes (m^3/yr)		
Management Unit	**Net Harvest**	**NRLs**	**Gross Harvest**
Lillooet TSA (Outside PA 16)	635 900	26 080	661 980
Pulpwood Agreement 16	N/A	N/A	N/A
Total	**635 900**	**26 080**	**661 980**

These "initial harvest rates" provide a starting point for the analysis. However, the timber harvesting landbase and cover constraints have changed since the TSR 2 analysis. Therefore, the initial harvest levels may subsequently be adjusted to achieve harvest flow objectives over the entire planning period.

6.3.2 Long Run Sustained Yield

Long run sustained yield (LRSY) values calculated on the basis of both natural and managed stand yield curves are shown in Table 6.3.

Table 6.3. LRSY values for natural and managed stands(1)

Description	Natural	Managed
THLB, including NSR (ha)	292,357	292,357
- Future roads (ha)	0	18,207
= Long term THLB (ha)	292,357	274,150
* Average MAI at culmination (m^3/ha)	1.62	1.81
= Theoretical Gross LRSY (m^3/yr)	**473,618**	**496,212**
- Wildlife tree patch retention (m^3/yr)	27,470	28,780
- Non-recoverable losses (m^3/yr)	26,100	26,100
= Theoretical Net LRSY (m^3/yr)	**420,048**	**441,331**

(1) Includes Pulpwood Agreement 16

6.4 HARVEST RULES

In the previous TERP analyses, the timber supply model was set to harvest the oldest stands first. This deviated from the TSR 2 analysis, which used relative oldest first. In the AAC Rationale the Chief Forester contends that a more realistic approach would be somewhere between relative oldest first and a random ordering approach.

A relative oldest first harvest pattern was selected. Under this harvest pattern stands that have the largest difference between their minimum harvest age and their current age are prioritized first.

6.5 SPATIAL ANALYSIS

The TSR 3 analyses were conducted as spatial analyses. Although a fully spatial analysis is not required under the current regulations a spatial analysis was performed to reduce uncertainty around the operational realism of the modelled harvest. The future harvest blocks identified in the current forest development plan were input to the model to be selected first for harvest. This ensures an even higher degree of realism. Block to block adjacency information was also included in the model input data in order to apply green-up adjacency constraints on harvesting. The spatial analysis was only maintained for twenty years. The harvest pattern modelled spatially over longer time frames increasingly deviates from a reasonable operational pattern and can have unreasonable impacts on timber supply.

Treatment unit mapping (TUM) was also utilized to model a more realistic pattern of harvesting across the land base. Treatment unit mapping provides a pattern of blocks across the land base that define the units of harvest or retention.

Predictably, when constructing a block resultant with abundant Arc/Info™ GIS overlays (Table 2.1), a large number of undersized polygons (stand area < 2.0 hectares) result. Undersized polygons significantly reduce the efficiency of the analysis by increasing the number of blocks to be processed and creating blocks that are, in effect, operationally infeasible.

To reduce the complexity of the data set, and perhaps more importantly, in order to move towards more favourable block size distributions, these areas are targeted and merged into adjacent polygons. An undersized polygon is considered a candidate for merging if, for example:

- It does not share a legal boundary, or legislated reserve;
- It does not define a break between the harvestable and non-harvestable land base;
- It does not define a break between age classes; and
- It is not a forest development plan block.

The boundaries of the above features were considered to be hard lines. Other boundaries are generally interpreted, and therefore, were considered soft lines (Table 6.4). Polygon merging was permitted across soft line boundaries only.

Table 6.4. Treatment unit mapping definitions

Module	Data Description	Status(1)
Administration	Landscape units	H
	Slope class	H
	Ownership	H
	Forest development plan	H
	Regionally significant fish streams	H
	Scenic areas	S
	Mule deer	S
Classification	Netdown	H
Forest Cover	Species groupings	H
	Age class groupings	H
Ecological	BEC variants	S
Water	Community watersheds	H
	Rivers and streams	H
	Lakes	H

(1) Defines nature of linework:
H = hard lines - linework will be coded as –1 and will not be impacted by a merge; and
S = soft lines - linework will potentially be impacted by a merge.

A merging procedure was employed to remove undersized polygons. Merging is a polygonal based operation, therefore, it does not assess area to perimeter ratios of resultant pseudo-blocks. Consequently, there are no attempts to "square-up" pseudo-blocks during the merging process. Upon completion of the merging process, these "*pseudo-block"* boundaries are permanent[2].

Mgmt info description:	**TUM**
Mgmt info source:	Timberline treatment unit mapping
Data sources used:	Landbase classification
Modelling assumptions:	Applied to productive forest landbase
Mgmt issues:	No issues identified
Sign-off:	

[2] For analysis purposes, these pseudo-blocks constitute the harvest block and become the atomic unit administered in the CASH6 timber supply model

7.0 TIMBER SUPPLY FORECASTS

A TSR 3 base cases analysis was completed to support an AAC determination process made by the Chief Forester, which is legislated under Section 8 of the Forest Act. The TSR 3 analysis used the 'best available information'. In this case the best available information included the information collected by the Lillooet TSA Association in order to complete the *Short Term Timber Assessment – Lillooet Timber and Economic Recover Plan* (Timberline, 2003).

The issues and assumptions that are expected to have an immediate impact on timber supply in the TSA in the proposed Lillooet LRMP (*Consultation Draft No. 3, MSRM, March 2003*) were also included in a sensitivity analysis.

7.1 TSR 3 BASE CASE

The base case analysis was built from the TERP analysis completed in March 2003. The details of this analysis are documented in *Short Term Timber Assessment – Lillooet Timber and Economic Recover Plan* (Timberline, 2003). These analyses took direction from the comments made by the Chief Forester in the January 2002 TSR 2 AAC rationale for the Lillooet TSA.

The TSR 3 base case used the best available information and was fully spatial. It included the following data sources:

- New attribute adjusted inventory (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003*);
- Improved terrain stability mapping;
- Use of tree improvement program seed;
- Updated spatially explicit road buffers;
- Updated cultural heritage sites;
- Disturbing the non-timber harvesting land base;
- Consolidate forest development plan;
- Relative oldest first harvest rule; and
- Fully spatial for 20 years.

Mgmt info description:	**Base Case**
Mgmt info source:	Extrapolated from previous TSR
Data sources used:	Productive forest landbase classification
Modelling assumptions:	Maximize harvest while meeting non-forest cover objectives
Mgmt issues:	No issues identified
Sign-off:	

7.2 SENSITIVITY AND ISSUE ANALYSES

A series of sensitivity and issue analyses were required for the TSR 3 analysis. This analysis provides a measure of the reasonable upper and lower bounds of the harvest forecast that reflects the uncertainty of assumptions made in the base case. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that given variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most influence results.

To allow meaningful comparison of these analyses, they are usually performed using the base case (*i.e.* current performance) and varying only the assumption being tested (*i.e.* all other assumptions remain the same as in the base case). Each scenario was fully documented with respect to the data and assumptions employed. The sensitivity analyses to be conducted around the Lillooet TSA TSR base case are listed in Table 7.1.

Table 7.1. Sensitivity analyses

Issue	Sensitivity Levels Tested
Harvest flow	Establish highest initial harvest level Establish non-declining even flow (NDEF) harvest level
Harvest rule	Use oldest first
Land base	Adjust timber harvesting landbase by +/- 10%
Growth and yield	Adjust existing yields by +/- 10% Adjust managed yields by +/- 10%
Visual landscape	Adjust green-up ages +/- 5 years
Green-up	Adjust all green-up ages +/- 5 years
Minimum harvest ages	Adjust minimum harvest ages +/- 10 years

Note: These sensitivities may include the use of alternate sets of yield curves, minimum harvest age and green-up estimates

The issue analyses to be conducted around the Lillooet TSA TSR base case are listed in Table 7.2.

Table 7.2. Issue analyses

Issue	Sensitivity Levels Tested
Growth and yield	Exclude VRI phase 2 adjustment
SIBEC	Apply adjusted site indices to managed stands
Proposed LRMP	Include assumptions under the proposed LRMP (if the HLPO is not in place at the time of analysis separate runs for each factor will be done, if HLPO is in place a composite run will be done)
Spotted Owl	Use Spotted Owl Management Plan management guidelines within proposed Long Term Activity Centres and do not utilize proposed LRMP allowances
Ungulate Winter Range	Turn off UWR management objectives to investigate UWR management objective impact
Economic operability	Apply the different levels of economic operability identified in the Timber Economic Recovery Plan analysis to see impact of reducing land base
Pulpwood Agreement No. 16	Include PA16 landbase and yield (limited to 25,000 cubic metres per year)
Exclude disturbance of inoperable areas	Do not disturb inoperable component of the productive forest landbase (calculated based on past disturbance history within each BEC)
Landscape biodiversity	Remove OGMAs from timber harvesting landbase, remove implicit landscape biodiversity requirements

Note: These sensitivities may include the use of alternate sets of yield curves, minimum harvest age and green-up estimates

8.0 REFERENCES

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