Robson Valley Timber Supply Area
Timber Supply Review

Data Package

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BRITISH COLUMBIA

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1. Introduction

Under Section 8 of the *Forest Act* the chief forester must review the timber supply for each of British Columbia's 38 timber supply areas (TSA) and 34 tree farm licences (TFL) at least once every 10 years. Based on this review, the chief forester establishes the allowable annual cut (AAC), i.e., the maximum volume of timber that can be harvested each year. Allowable annual cut determination is one of the chief forester's most important responsibilities because it affects local and provincial economies and the environment – now and in the future.

The main objective of a timber supply review (TSR) is to provide the chief forester with the environmental, economic and social information that must be considered when making AAC decisions. In this lengthy and complex process, the chief forester considers technical reports and analyses, public input, and First Nations interests, as well as government's social and economic objectives. Although technical information is used extensively in AAC determinations, the chief forester's decision is ultimately an independent professional judgment and not a calculation.

Following the chief forester's AAC determination, the Minister of Forests, Lands and Natural Resource Operations (FLNR) apportions the volume to forest licences.

In May 2012, a Special Committee on Timber Supply was appointed by the BC Legislature to make recommendations to address the reduction of mid-term timber supply due to mountain pine beetle (MPB) in the central interior of BC. Following its review of technical information and public, stakeholder and First Nations' input, the committee issued a report entitled *Growing Fibre, Growing Value* (August 2012). As described in *Beyond the Beetle: A Mid-term Timber Supply Action Plan* (October 2012), FLNR has responded to the committee's recommendations. Key ministry responses relating to the provincial timber supply review program include:

1. Review marginally economic forest types within each timber supply area (TSA) and quantify the types and areas of forest that might be justifiably included in a partition within the timber harvesting land base (THLB), while respecting resource objectives for other values, such as wildlife and water.
2. Where feasible and appropriate, provide information from the timber supply review to enhance public discussion of resource management objectives.

Based on these FLNR commitments, the timber supply review will examine the potential of marginally-economic forest types to contribute to fibre supply and for the inclusion of more fibre in the AAC in the Robson Valley TSA.

Timber supply reviews undertaken in support of AAC determinations are based on current resource management objectives. For the purposes of the Robson Valley TSA timber supply review, resource management objectives are provided by the Robson Valley Crown Land Plan and the Robson Valley Land and Resource Management Plan (LRMP). Information to support public discussion of resource management objectives, such as the land base associated with each of the legally-established land use objectives or requirements for non-timber resource values can be made available to support land-use planning activities, as required. In the event that resource management objectives and practices change, these changes can be reflected in future timber supply reviews.

The completed data package contains those inputs that represent current performance for the TSA. For the purpose of TSR, "current performance" can be defined by:

- the current forest management regime — the productive forest land available for timber harvesting, the silviculture treatments, the harvesting systems and the integrated resource management practices used in the area;
- fully implemented land-use plans;
- land-use decisions approved by Cabinet;
- Orders issued under the *Government Actions Regulation* (*GAR*) of the *Forest and Range Practices Act* (FRPA)*;*
- the Order establishing provincial non-spatial old growth objectives and landscape units pursuant to the *Forest Practices Code of British Columbia Act;* and,
- approved higher level plans under the *Forest Practices Code of British Columbia Act.*

Each section of this data package includes:

1) a short explanation of the data required;

2) a data table or lists of modelling assumptions; and,

3) a description of data sources and other comments.

The information in this data package represents the best available knowledge at the time of publication, but it is subject to change. Following the publication of this data package, a review period provides an opportunity for public input and information sharing between the FLNR and First Nations. Any information and assumptions that have been revised to incorporate First Nations and public input will be used to determine the timber harvesting land base (THLB) - the productive Crown forest land in the TSA available for timber harvesting. Until the THLB is determined, it is not possible to finalize the values shown in some of the tables in this document. Where the final value is not yet available, the applicable columns are shaded grey. In addition, should any major changes in forest management practices occur during the next few months, the timber supply analysis will attempt to reflect these changes.

1.2 Description of the Robson Valley Timber Supply Area (TSA)

The Robson Valley TSA is situated in east-central British Columbia. The total area including parks is approximately 1.35 million hectares. The terrain in the TSA is variable. The bottomlands of the Rocky Mountain trench are flat to rolling, while the adjacent mountain ranges are rugged with steep forested slopes and deeply cut side valleys. The diversity of landscape is reflected in a diversity of tree species, including the dominant spruce, balsam and subalpine fir, as well as western red cedar, lodgepole pine, western hemlock and Douglas-fir. Forests in the TSA are dominated by mature and older types.

The largest communities in the TSA are McBride and Valemount, which are home to about 50% of the TSA's population of 1,877 people (2006 census).

The current allowable annual cut (AAC) for the TSA of 536 000 cubic metres was set in 2006.

2. Current Forest Management Considerations and Issues

2.1 Base case forest management assumptions

The assumptions described in this section reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. The harvest forecast developed from these assumptions is termed the base case harvest forecast and is used as a reference when examining the effects of uncertainties. Section 7, "Sensitivity Analyses" identifies areas of uncertainty in the data and assumptions and outlines intended sensitivity analyses.

2.2 Statement of major forest management considerations and issues

Table 1 summarizes significant forest management considerations issues and changes since the last TSR. Where possible, the issues will be assessed directly in the timber supply analysis. If the issue does not fall within the definition of current forest management as described in Section 1, the related timber supply impacts will be assessed in a sensitivity analysis. There may be significant uncertainties in defining some current management issues. In such cases, sensitivity analysis can assist in assessing the potential timber supply implications and assigning degrees of risk to timber supply during the allowable annual cut determination.

Table 1. Forest management considerations and issues

Consideration/issue	Description
Area-based tenures	Two new Community Forest Agreements have been awarded since the last TSR: • K30 – Dunster Community Forest Society; • K2T – Valemount Community Forest Co. Ltd. In order to issue new Community Forest Agreements, area is deleted from the TSA. The allowable annual cut associated with the area removed from the TSA no longer contributes to the TSA allowable annual cut.
Wildlife management	A number of approaches to ungulate conservation have been implemented since the last TSR: • Mountain Caribou Ungulate Winter Range - UWR Order U-7-003 (December 9, 2009); • Mule Deer Ungulate Winter Range – UWR Order U7-010 (March 30, 2006); • Mountain Caribou FPPR s.7 Notice – Indicators of the Amount, Distribution and Attributes of Wildlife Habitat Required for the Survival of Species at Risk (December 2004). Implemented UWR and GAR Orders represent current practice and are accounted for in the base case analysis.
Landscape-level biodiversity	A number of approaches to biodiversity management have come into effect since the last TSR: • Order Establishing Provincial Non-Spatial Old Growth Objectives (June 30, 2004); • Section 8 letter – South Trench Landscape Unit - draft Old Growth Management Areas and enhanced riparian/wildlife movement corridors (May 31, 2005); • Order to Establish the Crescent Spur, Lower Morkill Cushing, Forgetmenot, Upper Morkill, North Trench, and Goat Landscape Unit Objectives (January 30, 2006); • Order to Establish the Kiwa-Tete and Canoe Landscape Unit Objectives (January 30, 2006); • Order to Establish Landscape Unit Objectives for the Canoe Mountain Zone (April 7, 2003). These orders represent current forest management and will be accounted for in the base case. • Order to Establish the East Kinbasket, West Kinbasket, Hugh Allan, Foster and Dawson Landscape Unit Objectives (May 26, 2005).

(continued)

Table 1. Forest management considerations and issues (concluded)

Consideration/issue	Description
Mountain Pine Beetle (MPB) epidemic	Pine represented about 13% of the mature volume in the timber harvesting land base (THLB) as defined in the previous TSR. The British Columbia Mountain Pine Beetle Version 9 model will be utilized to account for current pine mortality, as well as to predict future mortality. The model predicted that annual red attack would peak in 2010 with 405 000 m^3 of pine killed. Between 1999 and 2010, the epidemic killed a total of 2.1 million m^3 of pine. This represents 34% of the total pine volume in the THLB.
Timber supply economic operability	Economic operability will be assessed using a combination of stand volume, harvest preference, and past practice. Isolated planning cells will be identified and assessed in the TSR. Sensitivity analyses will be prepared to examine the timber supply impacts of varying economic operability of assumptions. District staff may recommend that the chief forester consider a partition based on economic operability
Robson Valley Crown land plan	A legal order, pursuant to Section 93.4 of the *Land Act*, was issued on November 21, 2006 for two of the zones within the Crown Land Plan. The order prohibits logging in Agriculture Development Areas and Settlement Reserve Areas. These constraints will be accounted for in the base case.
Robson Valley Land and Resource Management Plan (LRMP)	The LRMP was approved by Cabinet in April 1999. The plan divides the area into 23 resource management zones, which fall into one of six categories: settlement and agriculture, community watersheds, resource development, general resource management, special management and protected areas. The LRMP was not approved as a Higher Level Plan; however, where licensees have committed to forest management practices consistent with the LRMP objectives, these objectives will be used in the base case. If there is uncertainty regarding implementation, sensitivity analyses may be prepared to examine the possible effect on timber supply.

3. Inventories

The forest inventory and inventories of other forest values will be used in this review to identify the land available and suitable for harvesting trees and to assess the implications of current forest management activities. The inventories to be used, their source, vintage and currency are described in Table 2.

Table 2. Inventory information

Data	Source	Vintage	Update
Administrative/planning boundaries			
Administrative boundaries: TSA, CFA, woodlots, etc.	MFLNRO FTA	2012	
Planning cells	MFLRNO Corporate Data Whse	2003	
Landscape units	BC Geographic Warehouse	2002	2008
LRMP resource management zones	MFLRNO Corporate Data Whse	2004	
Crown land plan zones	BC Geographic Warehouse (Crown Land Tenures)	2012	
Parks, protected areas, ecological reserves	BC Geographic Warehouse (Tantalis)	2008	
Reserves, UREPS	BC Geographic Warehouse (Crown Land Tenures View)	2012	
Land ownership	BC Geographic Warehouse	2006	2012
	(INTGD_CADASTRAL_FABRIC)		
First Nations territorial reserves	BC Geographic Warehouse	2010	2012
	(CBD BOUNDARY)		
Operability	MFLRNO Corporate Data Whse	2002	
Roads	TRIM Base Data/FTA	1996	2012
Community watersheds	BC Geographic Warehouse	2009	
Stream, lakes	TRIM Base Data	1996	
Fisheries sensitive watershed	BC Geographic Warehouse	2007	
Community pastures	MFLNRO FTA	2012	
Terrain hazard	MFLNRO Non-Standard Data Set	2009	
Forest cover inventory			
Forest Inventory	BC Geographic Warehouse (VRI)	1974, 1991	2012
Environmentally sensitive areas	MFLRNO Corporate Data Whse	2004	
Land ownership	BC Geographic Warehouse (F_OWN)	2012	
Disturbance update	MFLNRO FTA, RESULTS	2012, 2011	
	FAIB Harvest Change Detection	2011	
	BC Geographic Warehouse (VRI)	1974, 1991	2012
Integrated resource values			
Scenic areas and visual quality objectives	BC Geographic Warehouse	2008	

(continued)

Table 2. Inventory information (concluded)

Data	Source	Vintage	Update
Old growth management areas	BC Geographic Warehouse	2008	2009
Landscape unit aspatial			
Lakeshore classification	MFLRNO Corporate Data Whse	2004	
Stream wetland classification	MFLRNO Corporate Data Whse	2004	
Wildlife			
Caribou	BC Geographic Warehouse	2005	
Mule Deer	BC Geographic Warehouse	2005	
Recreation sites, trails, reserves	MFLNRO FTA	2012	
Commercial tourism	BC Geographic Warehouse (Crown Land Tenures)	2012	
Water licences, IPP proposals	BC Geographic Warehouse	2012	
Forest health	MFLNRO, Forest Practices Branch	2011	
Armillaria	MFLRNO Corporate Data Whse	2006	2009

MFLNRO – Ministry of Forests, Lands and Natural Resource Operations;

VRI – Vegetation Resource Inventory;

FTA – Forest Tenures Administration;

FAIB – Forest Analysis and Inventory Branch.

Data sources and comments:

Forest inventory

The Robson Valley TSA was re-inventoried in 1994-1995. The vegetation resource inventory (VRI) for the Robson Valley was clipped from the Veg Comp Poly Rank 1 Layer Dataset provincial geographic data warehouse (BCGW). Virtually all of the VRI Phase I inventory data in the Robson Valley TSA is based on the old F-type inventory standard. The 2011 update of this provincial data set will be used.

Disturbance

A non-standard dataset of disturbance (harvesting, fire, windthrow) was developed to update and deplete the inventory to the summer of 2011**.** The disturbance dataset was compiled using recent openings submitted to the corporate database warehouse through the RESULTS silviculture obligation tracking system and remote sensing change detection analysis using 2011 Landsat 5 imagery.

BC Provincial Scale Mountain Pine Beetle Model Mortality Grids

The BC Provincial Mountain Pine Beetle Model (BCMPB) was developed to assess the impacts of mountain pine beetle infestation and management interactions across the entire province. The model uses forest cover data, the Provincial Aerial Overview of Forest Health and information from a stand-level mountain pine beetle (MPB) population model to estimate the current extent of pine mortality, and to project a possible course of the infestation into the future. For each of the past five years, updated versions have been developed to incorporate new infestation data and refine mortality projections. This TSR will utilize resultant data from the BCMPB v9 model. The model generates annual and cumulative mortality grids at a 16 hectare resolution. These grids are incorporated into the timber supply analysis to help define harvest flow projections.

Riparian areas

Streams, rivers, wetlands, and lakes are represented using data derived from the Omineca Fish Passage Data Set and the stream layer on TRIM2. Riparian reserve zones and lakeshore management zones have been buffered according to *Forest and Range Practices Act* (FRPA) default standards and subsequently merged into a non-standard dataset to facilitate analysis.

Visual landscape

The 2008 visual landscape inventory has been used to identify visually sensitive areas. The physiographic boundaries of visual landscape units are a standard dataset that resides in the BCGW.

Recreation features

This dataset represents known recreation features across Robson Valley. The administrative boundaries of known recreation features within the TSA is a standard dataset that resides in the BCGW.

Ungulate winter ranges (UWRs)

An ungulate winter range (UWR) is defined as an area that contains habitat that is necessary to meet the winter habitat requirements of an ungulate species. UWR are based on our current understanding of ungulate habitat requirements in winter, as interpreted by the Ministry of Environment (MOE) regional staff from current scientific and management literature, local knowledge, and other expertise from the region. The physiographic boundaries of ungulate winter ranges within the Robson Valley are a standard dataset that reside in the BCGW.

Landtype

Ownership is a custom layer created by Forest Analysis and Inventory Branch (FAIB) using information from the Crown Land Registry and the Integrated Cadastral Information Society. It identifies Crown land for the use-recreation and enjoyment of the public (UREP) reserves, private lands, federal lands, Indian Reserves, parks and other protected areas, tree farm licences, woodlot licences and community forest licences.

Landscape unit boundaries

Landscape units are spatially identified areas of land and/or water used for long-term planning of resource management activities. Landscape units are important for designing strategies and objectives to maintain landscape-level biodiversity and for managing other forest resources. The physiographic boundaries of landscape units within the Robson Valley are a standard dataset that reside in the BCGW.

Timber supply area and supply block boundaries

A timber supply area (TSA) is a designated area established by the Minister. TSAs were originally defined by an established pattern of wood flow from management units to the primary timber-using industries. They are the primary unit for allowable annual cut (AAC) determination. Timber supply blocks (TSB) are subdivisions of the TSA for administrative purposes. The administrative boundaries of the Robson Valley TSA and its associated TSBs are a standard dataset that resides in the BCGW.

Planning cells

Planning cells are a sub-unit of a timber supply block. Planning cell boundaries are defined by physiographic and anthropomorphic features such as waterways, heights of land, and major roads. A non-standard dataset was derived utilizing TRIM2 base mapping layers.

Transportation and transmission

A non-standard dataset of transportation and transmission lines was developed utilizing a number of sources such as digital road atlas and the as-built road dataset that resides within the BCGW. All road line work was aggregated and updated to the summer of 2011 using Landsat5 imagery.

Biogeoclimatic ecosystem classification (BEC)

The Biogeoclimatic Ecosystem Classification (BEC) system forms the conceptual framework for natural resource management and scientific research in British Columbia. At a regional level (like the Robson Valley TSA) vegetation, soils, and topography are used to infer the climate and to identify geographic areas that have relatively uniform climatic conditions. These geographic areas are termed biogeoclimatic (BEC) units. These units are further subdivided into subzones and variants based on further refinements of climate (e.g., wetter, drier, snowier). The physiographic boundaries of BEC units within the RVTSA are a standard dataset that resides in the BCGW.

Physical operability and terrain stability

Physical operability is a non-standard dataset consisting of a harvest-based classification of terrain within the Robson Valley TSA. The classification was derived through photo interpretation by FLNR regional engineering staff. The dataset was originally developed in 1999 and updated in 2012 utilizing terrain stability data provided by BC Timber Sales for their operating areas in the southern portion of the TSA.

4. Division of the Area into Management Zones

4.1 Management zones, groups and multiple objectives

Management zones (see Table 3) represent areas with a distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective, or wildlife consideration. Sometimes one area of forest is subject to more than one management objective. For simulation modelling, a group function enables application of overlapping objectives or constraints. The timber supply analyst and operational staff will decide whether to put an objective into a group or a mutually exclusive management zone following data assessment. In the analysis, areas that are unavailable for timber harvesting (non-contributing) are included for consideration of achieving forest cover objectives.

Table 3. Management grouping definitions

Group	Objectives	Inventory definition	Function
Mountain Pine Beetle infestation	Salvage dead pine before sawlog quality is lost	British Columbia Mountain Pine Beetle (BCMPB) version 9 model	To present the level of current MPB infestation and facilitate the projection of future potential mortality.
Landscape biodiversity	Landscape units with spatial OGMAs Landscape units subject to the provincial aspatial order Landscape units with guidance OGMAs Landscape units with wildlife corridors		To provide a coarse filter approach to biodiversity conservation.
Ungulate winter range	Caribou corridor Caribou medium Mule deer S. 7 notice Caribou (sensitivity analysis)	Map layers showing UWRs, forest cover constraints for UWRs as per GAR Orders and s. 7 notices	To manage important habitat used by ungulates as per general wildlife measures and forest cover requirements.
Visual landscape	Established visual quality objectives Preservation Retention Partial retention Modification Maximum modification	Standard map layer for RVTSA	Use the plan to perspective ratios (P2P) and visual effective green-up heights to adjust the percent allowable alteration for VQOs.
Opportunity timber supply areas	Identification of high cost timber supply	FTA harvest data: Cable Helicopter Slope analysis Licensee input Isolated planning cells	Facilitate discussion regarding efficacy of economic operability partition.
Integrated resource management	Compliance with FPPR s 64 and 65		To conserve biodiversity at the stand level by applying a maximum cutblock size and adjacency (green-up) rule.
Sensitivity analysis: Fish habitat (see Section 7)	Proposed Milk River and Goat River fisheries sensitive watershed designations and Goat River Bull Trout wildlife habitat area		To conserve fish habitat

4.2 Analysis units

Similar forest types are grouped into an analysis unit to simplify analysis and yield table generation. An analysis unit represents a combination of stands dominated by specific tree species or a silviculture regime with a set range of timber growing capability – as indicated by BEC zone, leading species, and site index class in the forest inventory file. Each analysis unit is assigned its own timber volume projections for existing and future stands. Sixty-one analysis units have been identified for the Robson Valley TSA, comprised of three forested BEC zones, seven leading species groups, and three site index classes as depicted in Figures 1 through 3. Figure 4 depicts the top 10 resultant analysis units by area in the TSA. (All analysis units are identified in Appendix A, site index is explained in Section 6.5.3).

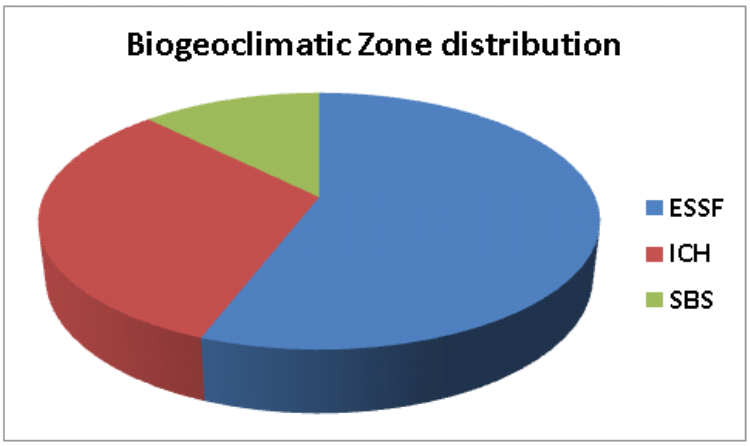

Figure 1. Biogeoclimatic zone distribution.

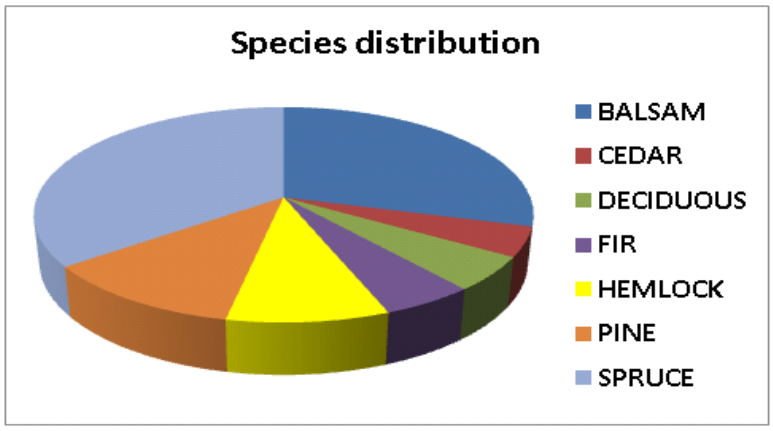

Figure 2. Species distribution.

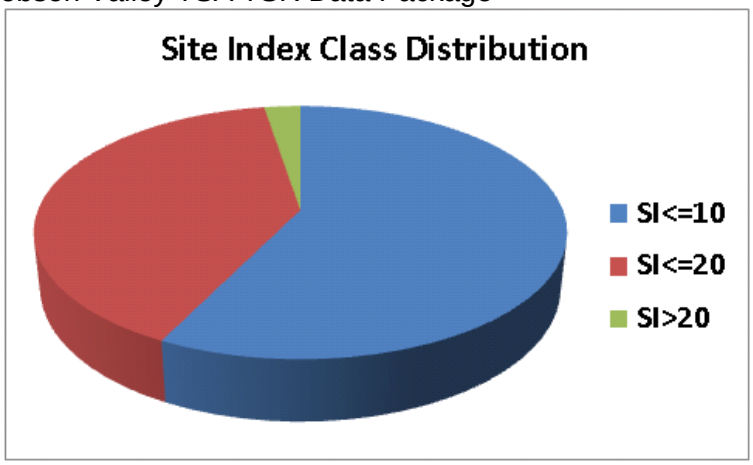

Figure 3. Site index class distribution.

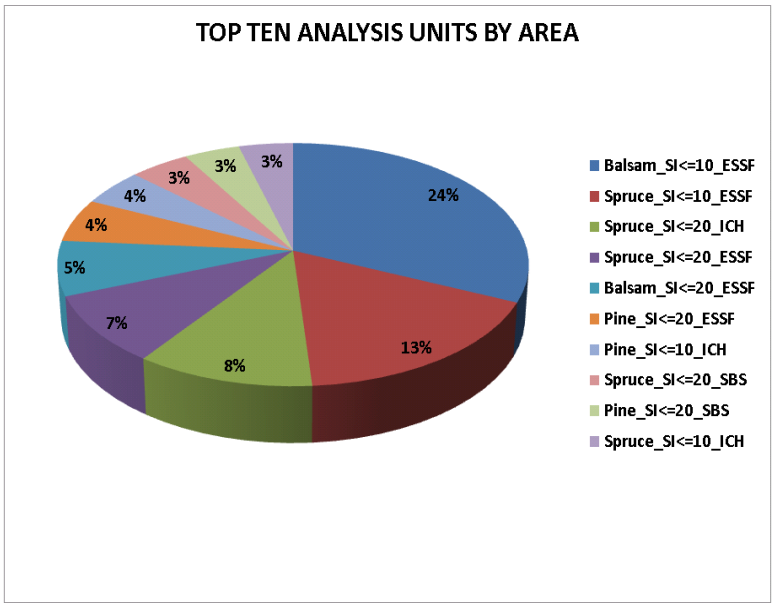

Figure 4. Top ten analysis units by area.

4.2.1 Unmanaged stands

Stands established prior to 1987 are considered to be "unmanaged". For "unmanaged" stand analysis units, yield curves have been generated for each "unmanaged" inventory polygon using the inventory attributes and the Variable Density Yield Prediction (VDYP7) model. An area weighted average yield curve is then generated for each analysis unit.

4.2.2 Managed stands

Managed stand yield curves will be generated from silviculture data derived from the Reporting Silviculture Updates and Land Status System (RESULTS) including species composition, initial stocking, stocking method, and regeneration delay. Tree species genetic worth and gain is calculated from data derived from the Seed Planning and Registry (SPAR) system for the Robson Valley. Site index for managed stands have been derived from the new Site Productivity Dataset. See Section 6.5.3, "Site Index".

5. Timber Harvesting Land Base Definition

5.1 Identification of the Crown forest and timber harvesting land base

This section outlines the steps used to identify the Crown forest land base (CFLB) and timber harvesting land base (THLB), i.e., that portion of the Crown forest land base that is available and suitable for timber harvesting.

The CFLB consists of Crown land with forest cover within the TSA, excluding community forests, woodlots and private land. The THLB is that portion of the CFLB that does not include:

- protected areas;
- areas deemed uneconomic or set aside for the protection and conservation of other forest values, such as wildlife habitat, biodiversity, recreation, etc.; and
- areas with unstable terrain, roads, etc.

The THLB is identified by a netdown process, in which areas not available or suitable for harvesting are sequentially removed from the total land base. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of netdown factors is often greater that the net area removed; a result of overlapping resource values. The order of the netdown factors order is indicated in Table 4.

Land that is currently considered unavailable for harvesting or is not producing timber may be included in the THLB by management activities that improve productivity or operability (e.g., planting land currently classified as "non-commercial brush" with commercial tree species.

Once areas that do not contribute to the THLB have been identified, any remaining areas are considered to be the current THLB.

5.1.1 Changes to the timber harvesting land base since TSR 3

A number of land use decisions have been made since the completion of TSR 3 for the Robson Valley TSA which will affect the area of THLB, including:

- two new Community Forest Agreements (area based tenures);
- a new core habitat for Mountain Caribou as a result of the Mountain Caribou Recovery initiative;
- a new old growth management areas in selected landscape units;
- an updated economic operability classification; and
- a legal Order which provided direction for two Robson Valley Crown Land Plan zones – Agricultural Development Areas and Settlement Reserve Areas.

5.2 Details on land base classification

5.2.1 Land classified as non-forest and forest with low timber growing potential

Non-forest includes areas classified as "non-treed and vegetated" as well as alpine, lake, rock and cultivated fields and roads (see Table 4). In the Robson Valley TSA, land with stands of trees that have a crown closure less that 10 percent are also considered to be non-forest. These areas, which were not previously harvested, are excluded from the THLB. Land classified as non-forest does not contribute to other management objectives such as old-growth forest for biodiversity.

Forested stands with a site index of less than five are classified as low timber growing potential forest.

Table 4. Land classified as non-forest and low timber growing potential forest

Non-forest or low timber growing potential description	Land class	Area in TSA (hectares)
Alpine	A	700,724
Alpine forest	AF	55,106
Clearing	C	11,866
Claybank	CL	156
Gravel bar	G	105
Gravel pit	GR	67
Ice	ICE	0
Lake	L	16,443
Mud flat	M	965
Low timber growing potential	NP	13,417
Non-productive brush	NPBR	6,733
Non-productive burn	NPBU	5,701
No type/species	NTA	93
Exposed land/urban	EX/UR	5,549
Open range	OR	115
Rock	R	4,502
River	RIV	5,907
Swamp	S	4,692
Urban road	U	5,135
Non-forest	nonfor:bclcs	2,301
Site index less than 5	si < 5	31,870
Totals		871,447

5.2.2 Land not administered by the Ministry of Forests, Lands and Natural Resource Operations (FLNR) for timber supply purposes

Land not administered by the FLNR for timber supply purposes within the TSA includes private land, municipal land, parks, ecological reserves and other protected areas, and area based forest tenures including community forest agreement areas and woodlot licences.

These areas do not contribute to the THLB. A spatial dataset has been developed that identifies these areas using information from the Crown Land Registry and Integrated Cadastral Information Society.

5.2.3 Operability

5.2.3.1 Physically inoperable forest stands

An operability map was originally produced for the Robson Valley TSA in 1998 and refers to the logging method that could be expected based on the slope of the land. The operability codes are A (conventional ground based equipment), C (cable), M (mixed cable and conventional), H (helicopter), and I (inoperable).

As part of a re-examination of operability slope analysis was conducted on cutblocks harvested over that past 30 years. Figure 5 depicts the historic distribution of slope classes within existing cutblocks. The analysis indicates that the historic upper threshold for harvesting has been 80% slope. For the purposes of defining operability this value has been used as an upper bound. Small areas (< 2.0 hectares) contained or contiguous to areas with less than 80% slope will be aggregated to approximate operational practice.

Physical operability mapping has been updated to incorporate new terrain stability information and better reflect new safety standards, equipment limitations and current practice. Utilizing the new operability mapping and slope analysis, areas identified as inoperable have been excluded from the THLB.

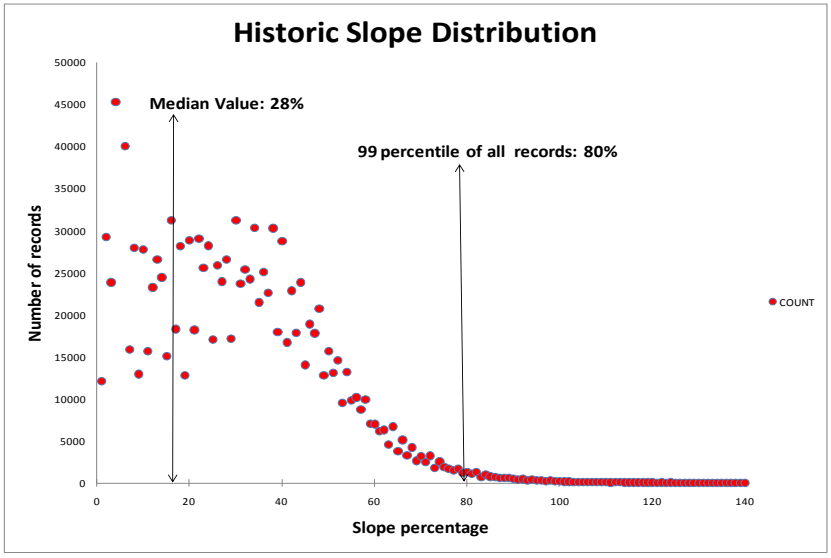

Figure 5. Historic slope distribution.

Table 5. Description of physical operability types

Operability type	Operability code	Slope %	Comment
Conventional to road	Ao	< 40	
Conventional to water	Aw	<40	Within water drop zone
Mixed	Mo	Broken*	
Mixed to water	Mw	Broken	Within water drop zone
Cable	Co	40-79	Within 200 m of potential blocks and roads
Cable to water	Cw	40-79	Within water drop zone
Helicopter to road	Ho	< 80	Within 2 km of potential road
Helicopter to water	Hw	<80	Within 2 km of Kinbasket Lake
Inoperable	I	80+	

* "Broken" – irregular or mixed-slope terrain.

Data source and comments:

Slope class thresholds in Table 5 are derived using the 25 metre resolution digital elevation model of the Robson Valley and reflect harvest equipment capability and environmental suitability. Safety guidelines for machine operability have been incorporated. Soil/parent material types have been categorized according to their sensitivity to disturbance. Generally, fine-textured aeolian, alluvial/fluvial, and lacustrine parent materials are considered to be more sensitive soil types.

Physically inoperable stands are defined as:

(1) terrain stability class V (unstable) and U (potentially unstable);

(2) environmentally sensitive areas (ESA) inventory class "S1" (highly sensitive soils) will be used where terrain stability information is not available;

(3) Physical operability class I (Inoperable) in the original 1998 operability mapping.

5.2.3.2 Economic operability

A number of approaches have been employed to help define economic operability in Robson Valley:

- All previously harvested stands will be considered economically operable.
- Analysis of the historic harvest profile as reflected in the inventory to determine historic trends in species selection and volume thresholds.
- Analysis of licensee cutting permits (CP) as reflected in the e-Commerce Appraisal Application (ECAS) issued during the past 10 years to determine current practice in terms of species preferences and minimum volume thresholds.
- Extensive consultation with major licensees and BCTS to identify operational thresholds and inoperable areas within the TSA

Table 6 depicts the operational thresholds by harvest system:

Table 6. Economic operability thresholds by harvest system

Category	TSR 3 (m^3/ha)	Licensee input (m^3/ha)	ECAS (m^3/ha)	Inventory (m^3/ha)	Approach to be used in analysis
Conventional	140	150	200	160	Inventory
Mixed	200	220	230	216	Licensee
Cable	250	220 (250 for balsam >251 yrs)	230	216	Licensee
Heli		300			Licensee

The timber supply analysis will use a combination of thresholds from the inventory (conventional harvest system) and licensee input (mixed, cable and heli-harvest systems).

In addition the analysis indicated no harvest performance in either hemlock-leading stands or deciduous-leading stands (other than some minor harvest of birch).

Table 7. Merchantability definition for the Robson Valley TSA

Species	Harvest system	Minimum age	Minimum diameter (cm)	Minimum height (m)	Minimum volume per hectare (m^3)	Maximum age to achieve MVH	Supply block
Cedar	Conventional	95% culmination age	Utilization min.	19.5	160	120	TSA
	Mixed/cable	95% culmination age	Utilization min.	19.5	220	120	Restricted
	Helicopter	95% culmination age	Utilization min.	19.5	300	120	Restricted
Pine	Conventional	95% culmination age	Utilization min	19.5	160	80	TSA
	Mixed/cable	95% culmination age	30	19.5	220	80	TSA
	Helicopter	95% culmination age	Utilization min	19.5	300	80	TSA
Douglas-fir	Conventional	95% culmination age	Utilization min	19.5	160	120	TSA
	Mixed/cable	95% culmination age	Utilization min	19.5	220	120	TSA
	Helicopter	95% culmination age	Utilization min	19.5	300	120	TSA

(continued)

Table 7. Merchantability definition for the Robson Valley TSA (concluded)

Species	Harvest system	Minimum age	Minimum diameter (cm)	Minimum height (m)	Minimum volume per hectare (m^3)	Maximum age to achieve MVH	Supply block
Balsam	Conventional	95% culmination age	Utilization min	19.5	160	100	TSA
	Mixed/cable	95% culmination age	Utilization min	19.5	220	100	TSA
	Helicopter	95% culmination age	Utilization min	19.5	300	100	TSA
Spruce	Conventional	95% culmination age	Utilization min	19.5	160	120	TSA
	Mixed/cable	95% culmination age	Utilization min	19.5	220	120	TSA
	Helicopter	95% culmination age	Utilization min	19.5	300	120	TSA
Deciduous	Conventional	95% culmination age	Utilization min	19.5	160	60	TSA

In addition to the new merchantability criterion in Table 7 above, a number of areas have been defined as historically inoperable. Figure 6 depicts a number of additional locations that, for the purpose of sensitivity analysis, will be excluded from the timber harvesting land base as inoperable.

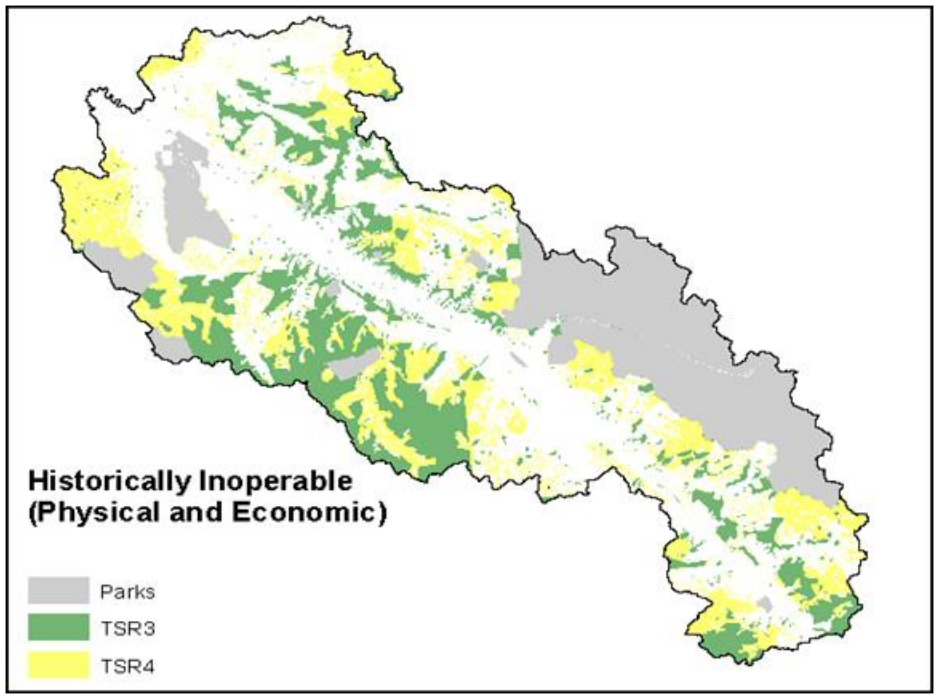

Figure 6. Historically inoperable (physical and economic).

5.2.4 Problem forest types

Problem forest types (PFT) (see Table 8) are stands that are physically operable and exceed minimum site productivity requirements but are not currently utilized or have marginal merchantability and are considered uneconomic. PFTs are excluded from the THLB.

Table 8. Problem forest types excluded from the THLB

Leading species	Inventory type group	Reduction (%)
Hemlock	12-17	100
Cedar	9-11	100% for cable operability

5.3 Wildlife management

5.3.1 Ungulate winter range

Ungulate winter range (UWR) management has been ongoing for over 20 years in some portions of the Robson Valley TSA. Formal establishment of UWRs and associated objectives began under the *Forest Practices Code Act* and continue under the *Forest and Range Practices Act* (FRPA).

UWRs contain both netdowns to the THLB and constraints on available timber volume in the THLB. UWR constraints are in Section 6. UWRs that result in a complete netdown are identified in Table 9.

Table 9. Mountain Caribou ungulate winter range Order U-7-003

Caribou habitat type	Habitat units	Gross area (ha)	Required management	Constraint
High	R-001	8,692	No harvesting or road building	100% netdown
	R-002	4,523		
	R-004	38,679		
	R-005	20,744		
	R-011	30,557		
	R-018	165		
	R-019	4,002		
	R-020	12,133		
	R-021	4,597		
	R-022	24,831		
	R-023	251		
	R-300	2,886		
	Total	152,060		

5.3.2 Forest planning and practices regulation s. 7 notice

Section 7, Notices for Species at Risk (SAR) set aside area for future wildlife habitat areas (WHA) which designate critical habitat, other than winter range, and can include calving areas, rutting ground, mineral licks and migration corridors. No WHAs, however, have been designated to date. Sensitivity analysis will assess the implications of potential designations (see Section 7.3).

5.4 Recreation and cultural heritage resources

5.4.1 Recreation sites, trails and reserves

Established recreational sites/reserves (see Table 10) will be excluded from the THLB and no harvesting will be allowed, except to address forest health and safety after consultation with the recreation officer. Trail width is 20 metres.

Table 10. Recreation sites, trails and reserves in the Robson Valley TSA

Recreation site or trail number	Name	Total area (ha)	Total length (km)	Management	Established (Y/N)
REC1001	Goat River Trail		25.6	trail	Y
REC1002	Boulder Mountain Trail		3.7	trail	N
REC1004	McBride Peak Site	285		site	Y
REC1009	Canoe Reach Marina	6		site	Y
REC1010	Swift Viewpoint	20		site	N
REC1011	Upper Canoe	14		site	Y
REC1012	Tete Jaune Spawning Grounds	59		site	Y
REC106882	McBride Mtn Bike Trails		6.8	trail	N
REC1201	Foster Creek	38		reserve	N
REC1206	Canoe Mtn	61		reserve	N
REC1210	Saddle Creek Falls	15		reserve	N
REC1234	Ptarmigan	7		reserve	N
REC1241	Grouse Creek	4		reserve	N
REC1242	Windfall Creek	5		reserve	N
REC1243	George Creek	8		reserve	N
REC1244	Blackmore Creek	3		reserve	N
REC1248	Beaver River Falls	10		site	Y
REC1249	Bell Mountain Meadow	638		site	Y
REC1253	Yellowjacket Creek	28		site	Y
REC1257	Beaver River	11		site	Y
REC1302	Tete Jaune	21		reserve	N
REC1313	Natural Arch Trail		6.1	trail	Y
REC1314	LaSalle Lakes (West)	164		site	Y
REC1336	Lucille Mountain	453		site	Y
REC1337	Dunster Trail		5.7	trail	Y

(continued)

Table 10. Recreation sites, trails and reserves in the Robson Valley TSA

Recreation site or trail number	Name	Total area (ha)	Total length (km)	Management	Established (Y/N)
REC1338	Groeneveld Trail		4.2	trail	Y
REC1339	Teare Mountain Trail		7.9	trail	Y
REC1340	Paradise Trail		6.8	trail	Y
REC1341	Mt. Terry Fox Trail		5.8	trail	Y
REC135404	Renshaw Parking Lot	4		site	N
REC135700	Crystal Ridge		16.9	trail	N
REC135706	Westridge Parking Lot	1		site	N
REC1360	Small River	28		reserve	N
REC1372	Little Lost Lake	336		site	Y
REC1373	Lower Canoe	100		site	N
REC1409	Shere Lake	26		site	Y
REC1452	Blueberry Creek Trail		6.1	trail	Y
REC1456	Westridge Snowmobile Trail		14.6	trail	Y
REC1473	Ozelenka Trailhead and Parking Area	3		site	Y
REC1474	Mt. Renshaw Alpine	7445		site	N
REC1478	Camp Creek Trails	812		site	Y
REC1493	West Ridge Cabin	1		site	Y
REC16031	Trudeau Trail (Ski Hill Mountain)		2.6	trail	N
REC16108	Small River Winter Trail		21.7	trail	N
REC164012	Griffin Sawmill Recreation Site	3		site	N
REC164470	Swift Creek Trail		5.9	trail	N
REC31806	Snowshoe Falls	48		reserve	N
REC31931	Westridge Swamp Trail		5.7	trail	N
REC31952	Westridge Recreation Trail		3.9	trail	Y
REC32196	McKirdy Meadows Trail		4	trail	Y
REC32202	Eagle Valley Trail		9	trail	Y
REC32389	Kristi Glacier Trail		15.4	trail	Y
REC4051	Upper Morkill Falls	14		reserve	N
REC5682	Forgetmenot Confluence	33		reserve	N
REC5683	Goat River Pool site	52		reserve	N
REC 5725	Blackmartin Recreation Site	124		reserve	N
REC5773	South Dore Falls	7		reserve	N

(continued)

Table 10. Recreation sites, trails and reserves in the Robson Valley TSA (concluded)

Recreation site or trail number	Name	Total area (ha)	Total length (km)	Management	Established (Y/N)
REC5774	Boreal Creek Falls	6		reserve	Y
REC5775	Horse Creek Recreation Site	16		site	Y
REC5776	North Star Creek Rec. Site	42		reserve	N
REC5777	McLeod Creek Rec. Site	15		reserve	N
REC5902	Eagle Valley Cabin	1		site	Y
REC5923	Bell Mtn Ski Trails		22.5	trail	Y
REC6462	Mica Mtn. Trail		3.8	trail	Y
REC6464	Kiwa Glacier	599		reserve	N
REC6465	Saddle Lakes	127		site	Y
REC6478	Snowshoe Lakes	853		reserve	N
REC6479	McIntosh Falls	21		reserve	N
REC6480	Avalanche Trail (Cariboo Lake)		14.3	trail	Y
REC6481	McKirdy Meadows Cabin	1		site	Y
REC6483	Franchere Creek	17		reserve	N
REC6484	Spittal Creek Site	1		site	Y
REC6821	Dore River Ski Trails		7	trail	Y
REC6822	Renshaw Snowmobile Access		27.7	trail	Y
REC6823	Bell Mountain Parking Lot (km 5)	4		site	Y
REC6824	Lucille Parking Lot and Alpine Cabin	2		site	Y
REC6825	Halfway Viewpoint	5		site	Y
REC6899	West Ridge Cabin	1		site	Y
REC97726	Bell Mountain Snowmobile Trail		17.6	trail	Y
REC97732	Lucille Snowmobile Trail		9.5	trail	Y
Total		12598	280.8		

5.4.2 Crown UREP (use, recreation and enjoyment of the public) reserves

UREPs are areas set aside for the "Use, Recreation and Enjoyment of the Public" and were established by the province to reserve a portion of land for the public interest. Other uses in the area are then restricted for a specified period of time, after which time the designation is reviewed and can be renewed for another term.

5.5 Cultural heritage resources and First Nations interests

A cultural heritage resource is an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people. Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites. Features associated with past and current human use, including aboriginal use are found throughout the Robson Valley TSA.

First Nations have expressed the importance of managing for cultural heritage resources that they have relied on for generations. Traditional diets, based on numerous plant foods and animals have sustained First Nations. In addition, plants, fungi and animals have provided a wide range of important material resources for fuel, tools, medicine, and transportation. First Nations' belief systems, art, songs and ceremonies are also reliant on the biodiversity of the landscape.

The *Heritage Conservation Act* provides for the protection and conservation of certain types of cultural heritage resources by prohibiting any disturbance, alteration or destruction. In consultation with First Nations, appropriate protection or

management measures regarding cultural heritage resources that are not automatically protected under the *Heritage Conservation Act* are developed.

Past and current aboriginal culture is often associated with networks of ancient to contemporary trails in the area. Traditional Use Studies in the Robson Valley TSA have identified general trail locations. In many cases these trails are in valley bottoms and have been overlapped with road development. There are no identified First Nations trails that require protection or special management.

Cultural heritage resources are also accounted within other sections of this data package, including existing resource management zones, protected areas, wildlife and fish habitat areas, riparian, scenic areas, and preservation visual quality zones.

5.6 Roads, trails and landings

Separate estimates are made to reflect the area of Crown forest land excluded from the THLB to account for existing and future roads, trails and landings. A disturbance dataset was developed this TSR to account for existing (see Table 11) and future roads, trails, railway and transmission lines, by utilizing corporate data, satellite image interpretation and systematic ground sampling. Roads were then categorized and grouped based on average road width as defined in TSR 3. Final road groups are major roads (public, Forest Service, logging roads as well as, rail, and transmission line cleared areas) and minor roads (trails, minor gravel and partially deactivated roads).

Table 11. Existing road summary

Road category	Average width (metres)	Length (km)	Area (hectares)
Major	30	4605	16 873
Minor	15	2195	3701

Two approaches were used to determine the area projected to be occupied by future roads, trails and landings following initial harvest in the model. In the GIS-based approach, application of a 10-metre buffer width to roaded-openings indicated that on average 7.6 percent of the area harvested was occupied by roads. In the second approach, a review of RESULTS data resulted in an area-weighted average reduction of 5.4 percent. These two values were averaged and the resultant 6.5 percent reduction will be applied to areas within the THLB outside of existing cutblocks and in excess of 200 metres from the existing road network following initial harvest in the model. Following initial harvest, the area excluded from the THLB would be re-classified as 'non-forest'.

5.7 Retention

5.7.1 Spatial landscape-level retention

A number of spatial biodiversity management provisions have come into effect since the last TSR:

- Order Establishing Provincial Non-Spatial Old Growth Objectives (see Section 6.9.3.1);
- Pursuant to Section 8 of the Order Establishing Provincial Non-Spatial Old Growth Objectives, draft Old Growth Management Areas (OGMA) and enhanced riparian/wildlife movement corridors were identified for the South Trench Landscape Unit (May 31, 2005);
- Order to Establish the Crescent Spur, Lower Morkill Cushing, Forgetmenot, Upper Morkill, North Trench and Goat Landscape Unit Objectives (January 30, 2006);
- Order to Establish the Kiwa-Tete and Canoe Landscape Unit Objectives (January 30, 2006);
- Order to Establish Landscape Unit Objectives for the Canoe Mountain Zone (April 7, 2003); and
- Order to Establish the East and West Kinbasket, Hugh Allan, Foster and Dawson Landscape Unit Objectives (May 26, 2005).

Landscape units with established OGMAs are identified in Table 12. For the purposes of timber supply analysis, OGMAs will be removed from the timber harvesting land base.

Table 12. Landscape units with spatial landscape-level retention (old-growth management areas)

Landscape unit number	Landscape unit name	Gross area in old-growth management areas (hectares)
1495	Canoe	1280
1515	Crescent Spur	5295
1524	Dawson	456
1538	East Kinbasket	2811
1558	Forgetmenot	1288
1561	Foster	3090
1578	Goat	3268
1601	Hugh Allan	2071
1627	Kiwa-Tete	932
1657	Lower Morkill/ Cushing	2851
1702	Northern Trench	4229
1767	South Trench (Draft OGMAs)	5250 (non-legal)
1803	Upper Morkill	2909
1809	West Kinbasket	784

5.7.2 Stand-level retention

Stand-level retention is intended to maintain or restore, in managed stands, important structural attributes such as wildlife trees, coarse woody debris, tree species diversity, and understory vegetation diversity. Table 13 summarizes retention on cutblocks that were sampled as part of the Forest and Range Evaluation Program (FREP).

Table 13. Forest and Range Evaluation Program (FREP) stand-level biodiversity sampling 2006 to 2011

FREP stand-level biodiversity sample details	
Number of blocks sampled	27
Number of blocks with retention	24
Total gross area sampled	482 ha
Average patch retention	0.8 ha
Average patch retention constrained	0.9 ha
Average dispersed retention (basal area equivalent)	2.6 ha
Average dispersed retention constrained	2.0 ha
Area-weighted average retention	19%*
Average # ecological anchors per hectare of retention (patch or dispersed)	3.6
Average # patches less than or equal to two hectares	0.5
Average # patches greater than two hectares	0.1
Area-weighted average windthrow	5.2%
Average # patches internal to cutblock	0.2
Average # patches on edge of cutblock	0.4
Average # patches external and non-contiguous to cutblock	0
Stratum type	Area (ha)
Clearcut	48.5
Dispersed retention reserve - other	132.5
Dispersed retention reserve - riparian	1.0
Dispersed retention reserve - temporary	19.1
Dispersed retention reserve - wildlife	226.7
Patch reserve - riparian	0.2
Patch reserve - other	0
Patch reserve - wildlife	19.8
Total area	447.8

* The area weighted average retention of 19% will be used as the basis for the stand-level retention estimate, however, additional analysis will be carried out to determine the proportion of timber harvesting land base in reserves and to avoid double accounting of riparian reserves.

5.7.3 Riparian

No ground-based stream classification or riparian reserve information is available for the Robson Valley TSA. Therefore, assumptions on stream classification and reserve/management widths were made by the FLNR. From TRIM II, large streams such as S1 and S2 streams were identified as double-line streams. The width of double line streams represents the width of the stream and hence these streams are buffered according to the *Riparian Management Area Guidebook*. It is assumed that the single line streams in TRIM represent the remaining S3-S5 streams, where the stream widths are unknown and are therefore aggregated and assumed a combined riparian reserve and management zone of 20 metres. Wetlands and lakes were buffered according to the *Riparian Management Area Guidebook*. There are no W2 and W4 wetlands or L2 and L4 lakes. The total area of the timber harvesting land base affected by riparian management is determined by applying the assumptions in Table 14 to the riparian water features through a GIS-based buffering process.

Table 14. Timber harvesting land reduction from riparian reserves and management zones

Riparian feature	Riparian class	Reserve zone width (metres) 100% reduction	Management zone width (metres)	Management zone volume reduction (%)	Combined buffer width for RZ and RMZ* (metres)	Net area removed (ha)
Streams	Fraser River	50	20	50	60	
	S1 (except large rivers ≥ 100 metre width)	50	20	50	60	
	S2 (double-line streams)	30	20	50	40	
	S3 – S4 (single-line fish-bearing streams)	20	N/A	N/A	20	
	S5 – S6	0	N/A	N/A	0	
Wetlands	W1 (> 5 ha)	10	40	25	20	
	W3 (1 – 5 ha)	0	30	25	7.5	
	W5	10	40	25	20	
Lakes	L1 <1000 ha	50	50	7	10	
	L3	0	30	25	7.5	

* The combined buffer width = reserve zone width + (management zone width x % management zone volume reduction).
Note: The Fraser River reserve and management zone widths are derived from a Robson Valley LRMP recommendation.

5.8 Crown land plans

Crown land plans are a unique type of plan in the northern interior of BC that cover rural settlement and agricultural areas around the major communities. A portion of the Robson Valley Crown Land Plan is located within the Robson Valley TSA. The plans have historically been implemented as policy and have guided land use in these areas for many years.

The process leading to completion of the plan started in 1983. A number of land use zones were designated: Integrated Forest Management Areas (IFMAs, forest resources).

Sub-land use categories include:

- IFMA - Forest management emphasis;
- IFMA - Wildlife habitat emphasis;
- IFMA - Sand and gravel emphasis;
- IFMA - Sand and gravel reserve.

The dominant use is forest production, but other activities may be permitted on an integrated basis in association with range, watershed, fish and wildlife, outdoor recreation and conservation, and sand and gravel extraction. Agricultural Development Areas (ADAs) are considered most suitable for agricultural production and provide for expansion of the agricultural industry in the Robson Valley.

Recreation and Conservation Management Areas (RCMAs). These Crown lands are considered most suitable for outdoor recreation, heritage site management, fish and wildlife management activities, camps and community recreation halls.

Settlement Reserve Areas (SRA). The purpose is to maintain land use options by reserving Crown land for future residential, commercial, industrial, institutional or recreational requirements and to eliminate conflict with resource uses.

Aggregate Management Areas (AMAs) are considered to have a high capability for sand and gravel extracting.

Wildlife Habitat Management Areas (WHMAs) provide important habitat for such wildlife species as moose, deer, elk, many bird species and furbearing animals. The dominant use of these areas is the protection and enhancement of habitat to maintain the abundance of wildlife species.

The mountain pine beetle epidemic created some uncertainty around intended land use so a legal order, pursuant to Section 93.4 of the *Land Act*, was established for two of the zones on November 21, 2006. This order prohibits logging in Agriculture Development Areas (ADA) and Settlement Reserve Areas (SRA), except for environmental/safety and forest health purposes.

Table 15 summarizes the zones in the Robson Valley Crown land plan.

Table 15. Crown Land Plan (CLP) zones and modelling assumptions

Land use category	Code	TSR modelling assumption	Gross area (ha)
Integrated forest management area	IFMA	Harvest	12,298
Aggregate management area	AMA	Harvest once then exclude from harvesting	147
Sand and gravel reserves	SGR	Harvest once then exclude from harvesting	1,044
Agricultural development area	ADA	No harvest (legal order)	1,232
Community leases and licenses	LEASE	No harvest (current practice)	230
Wildlife habitat management	WHMA	No harvest (current practice)	391
Natural environment area	NEA	No harvest (current practice)	2,452
Settlement reserve area	SRA	No harvest (legal order)	1,246
Community pasture area	CPA	Harvest remaining timber then exclude from harvesting	4
Important fish production stream	IFPS	No harvest (current practice)	473
Recreation and conservation management area	RCMA	No harvest (current practice)	748
Park (regional parks)	PARK	No harvest (current practice)	613
Total			20,878

5.9 Parks and protected areas

Table 16 identifies the provincial parks and protected areas in the Robson Valley TSA. None of these areas have been designated since the last timber supply review. Parks and protected areas will be removed from the timber harvesting land base.

Table 16. Parks, protected areas and ecological reserves

Name	Status	TSR modelling assumption
West Twin	Park	
West Twin	Protected area	
Bowron Lake (Betty Wendle portion)	Park	
Bowron Lake (Cariboo River portion)	Park	
Sunbeam Creek	Ecological reserve	
Holiday Creek Arch	Protected area	
Lower Raush	Protected area	
Small River Caves	Park	
Upper Raush	Protected area	100% netdown
Jackman Flats	Park	
Mount Robson Corridor	Protected area	
Mount Robson	Park	
Mount Robson	Protected area	
Foster Arm	Protected area	
Mt. Terry Fox	Park	
Rearguard Falls	Park	

6. Current Forest Management Assumptions

6.1 Timber supply model

The Robson Valley timber supply will be modelled using a Spatially Explicit Landscape Event Simulator (SELES) timber supply model developed by Dr. Andrew Fall and Forest Analysis and Inventory Branch. The SELES modelling environment has recently been used for timber supply reviews in the Prince George, Quesnel, and Morice TSAs.

6.2 Harvesting

This section describes the harvest systems and merchantability standards used in the timber harvesting land base.

Minimum harvestable age by analysis unit

The minimum harvestable age is the earliest age at which a stand is considered to be harvestable within the timber supply model. While harvesting in the model may occur in stands at the minimum age in order to meet forest level objectives, most stands are not harvested until well beyond the minimum harvestable ages because of management objectives for other resource values (e.g., requirements for the retention of older forest).

For the base case scenario, the age at which the stand reaches a 95% culmination mean annual increment (i.e., optimal point for volume production) will be used as the minimum harvestable age. The minimum harvestable age choice will be investigated with a sensitivity analysis.

Harvest scheduling priorities

The order in which stands are harvested can impact timber supply. Licensees select stands to harvest through consideration of many factors, predominately economic in nature. In the previous timber supply analysis the oldest available stands relative to the minimum harvestable age were harvested first. This analysis will use both the inventory and FLNR Revenue Branch databases to develop a harvest queue that will mimic (as close as possible) harvest preferences that have been observed over the past 10 years see Table 17). At this time this analysis is incomplete but the primary variables that will form the harvest preference index will include: harvest system, piece size, maximum volume per hectare, distance to road, and distance to milling centre. The general idea is that there will be a higher preference to harvest high volume stands with large piece sizes close to town than lower volume stands further away.

Data source and comments:

As operational harvesting does not always strictly follow this harvest rule, it is important to investigate the potential impacts of the harvest rule by doing appropriate sensitivity analysis.

In the Robson TSA, a priority on harvesting pine stands is expected given the current mountain pine beetle infestation. As such, a sensitivity of the mountain pine beetle infestation will include a harvesting priority on pine stands.

Table 17. Harvest history in the Robson Valley TSA (2007-2011)

Year	Total TSA harvest (m^3)	Pine harvest (%)
2007	189,582	29
2008	148,985	33
2009	50,086	56
2010	86,011	49
2011	146,179	63

* TSA only – does not include CFAs or woodlots.

6.3 Utilization standards

The utilization standards (Table 18) define the maximum stump height, minimum top diameter inside bark and minimum diameter at stump height by tree species are used in the analysis to calculate merchantable volume.

Table 18. Minimum utilization standards in the Robson Valley TSA

Species	Minimum diameter at stump height outside bark (cm)	Maximum stump height (cm)	Minimum top diameter inside bark (cm)
Lodgepole pine	15.0	30.0	10.0
All other coniferous and deciduous species	20.0	30.0	10.0

6.4 Decay, waste and breakage

The Variable Density Yield Projection (VDYP) model used to project volumes for natural stands incorporates estimates of the volumes of wood lost to decay, waste, and breakage. Decay losses are built into the volume estimates, while standard waste and breakage factors are applied to the analysis in the development of VDYP yield curves. These estimates of losses have been developed for different areas of the province based on field samples. For regenerated stands, an operational adjustment factor (OAF2) is applied to account for anticipated decay, waste, and breakage, and the value applied for OAF2 in the Robson Valley analyses increases from zero through to five percent by the time forest stands reach 100 years of age.

6.5 Silviculture

6.5.1 Silviculture systems

A silvicultural system is a planned program of treatments designed to achieve stand structure characteristics to meet site objectives during the whole life of a stand. This program of treatments integrates specific harvesting, regeneration, and stand tending methods to achieve a predictable yield of benefits from the stand over time. The names of the different silvicultural systems reflect the type of forest structure remaining after initial harvest (e.g., clearcutting, seed tree, shelterwood, selection, and retention). Table 19 provides a summary of silviculture systems in use between January 1, 2004 and April 30, 2012 based on RESULTS data.

Table 19. Silviculture systems used January 1, 2004 to April 30, 2012 – data source RESULTS

Silviculture system	Percent of total harvest area Forest licences and BCTS
Even-aged systems:	
Clearcut	7
Clearcut with reserves and group/dispersed retention	89
Shelterwood	4

Note: From a limited review of RESULTS data, it is evident that all the single tree selection is attributed to McBride Forest Industries Ltd. The company used a selection harvesting system to manage visual quality objectives on steeps slopes while harvesting Douglas-fir and beetle-infested pine. Near Mount Robson Provincial Park, the company used helicopter logging to very selectively harvest desired stems.

Although the company used a selection harvesting system, it did not employ a true single tree selection silviculture system with planned repeated harvest entries. Rather, it used just one selective partial harvest followed by underplanting with no further planned harvest entries. Therefore, the area for single tree selection silviculture system is effectively a clearcut with dispersed reserves and that area has been combined with the data for clearcut with reserves.

Table 20. Silviculture activities – area (hectares) - 2004 – 2011- data source RESULTS

Activity	2004	2005	2006	2007	2008	2009	2010	2011	Total
Surveys	1,511	2,532	1,218	647	1,539	1,451	1,596	752	11,245
Site preparation	42	20		30		66			158
Planting	812	1,433	685	1,146	653	1,530	171	607	7,038
Brushing	144	189	389	177	148	344	240	279	1,909
Juvenile spacing						103	72		175
Pruning						103	72		175
Audit	87			78		88		38	291
Total	2,596	4,174	2,292	2,000	2,418	3,685	2,151	1,676	20,991

6.5.2 Regeneration activities

Table 21. Average planting density by biogeoclimatic ecosystem classification (BEC) zone Robson Valley TSA 2002-2011

	Planting density – trees per hectare by year										
BEC zone	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Grand total**
ESSF	1,340	1,465	1,487	1,139		1,404	1,582	1,376	1,304	1,413	1,371
ICH	1,132	1,324	2,441	1,282	1,155	1,665	1,086	1,275	2,157	1,354	1,311
SBS	1,245	988	1,926	1,395	756	1,630		1,308	1,665	1,252	1,292
Weighted average density	1,250	1,358	1,670	1,255	1,048	1,584	1,168	1,307	1,717	1,331	1,328

Source: RESULTS (May 30, 2012). Note: lower average densities in some years due to fill planting projects.

6.5.3 Site index

Site index is a measure of the productive capacity of a given site to sustain the growth of trees to harvestable age. It is a key variable in predicting the growth of timber and its yield at harvest. Site index is defined as the height of a "site" tree at 50 years breast height age. Site index curves that are consistent with the accepted FLNR standards are used. Site Indices for managed stands have been derived from the new site productivity dataset, which is intended to give site index estimates province-wide for commercial tree species. The estimates of site index are based on available ecosystem data (spatial delineations and descriptions) from existing PEM (Predictive Ecosystem Mapping) and TEM (Terrestrial Ecosystem Mapping) datasets, coupled with SIBEC data. In areas like the Robson Valley where no PEM or TEM data is available, site index estimates are based on biophysical data and species ranges. The biophysical model provides site index estimates for all tree species that could potentially be growing in the BGC zone based on historical climate data, position (latitude, longitude, elevation) and topography (slope and aspect).

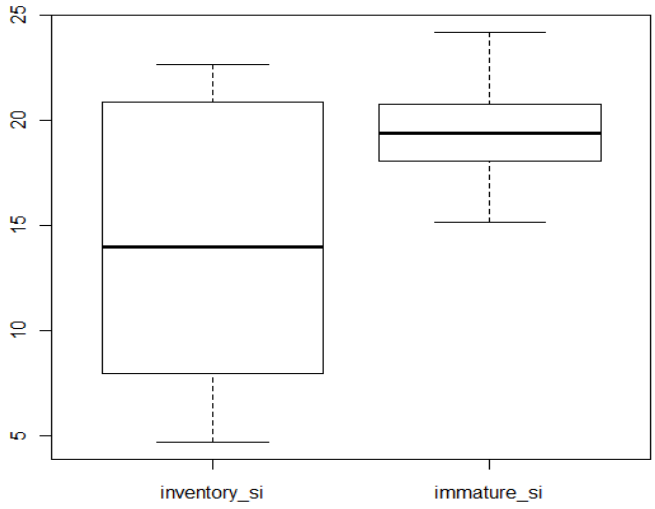

Figure 7. Comparison of the range of inventory site indices for unmanaged stands (inventory_si) and the range of biophysical model derived site indices for managed stands (immature_si).

6.5.4 Genetic gain

When reforesting Crown land, legislation requires the use of the best genetic quality seed available – also known as select seed. Planting trees grown from select seed increases the volume available for harvesting in the future. Using select seed can also affect timber supply indirectly by influencing factors that constrain timber (e.g., harvest flow requirements, green-up and minimum harvest age). The extra volume available in the future may allow a short-term increase in timber supply decades before the planted trees are ready for harvesting. This is known as the allowable cut effect and is a result of harvest flow modelling where the objective is to avoid large fluctuations in harvest levels over a harvest cycle. The potential increase in future volumes may allow early harvesting of some stands, and this may help to mitigate the anticipated mid-term deficit. Current practice in utilizing genetically improved growing stock was summarized from RESULTS regeneration survey data. The genetic gain by species was weighted by the proportion of the area regenerated with the improved stock out of the total area surveyed. Therefore, areas established with planting stock with no genetic gain or areas left to natural regeneration will reduce the overall genetic gains modelled.

6.5.5 Current not satisfactorily restocked

Not satisfactorily restocked (NSR) is a term that refers to areas of timber harvesting land base that are not covered by a sufficient number of well-spaced trees of desirable species. Stocking standards are set by the Ministry of Forest, Lands and Natural Resource Operations. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

As of March 31, 2012 there was 650 hectares of current NSR is the Robson Valley TSA. Current NSR is dealt with through existing reforestation obligations held by forest licensees and the FLNR. In most areas of the TSA, regeneration delay after harvesting is one year.

6.5.6 Backlog not satisfactorily restocked

Summary statistics were produced in June 2010 for backlog NSR areas created prior to October 1, 1987. A total of 1,255 hectares of forest cover backlog NSR were identified in the Robson Valley TSA. District staff reviewed these areas using procedures developed by the Forests for Tomorrow program (*NSR Review Procedures*, June 24, 2010) and recommended a net area of 686 hectares for further survey.

6.5.7 Silviculture analysis units

Table 22 Example silviculture analysis unit attributes for selected units in the ESSF

Attribute	Analysis unit					
	1 S_1_ESSF	2 S_2_ESSF	3 S_3_ESSF	4 S_4_ESSF	5 S_5_ESSF	6 S_6_ESSF
Regen delay	1	1	2	0	1	1
Stocking	1250	1200	1650	1200	1350	1000
Species1/%1	Sw/72	Sw/75	Sw/100	Sw/68	Pl/59	Sw/68
Species2/%2	Bl/20	Bl/16		Bl/16	Sw/32	Bl/16
Species3/%3	Pl/8	Pl/8		Pl/16	Bl/9	Pl/16
Species4/%3		Cw/1				
Species5/%5						
Species6/%6						
Site index	17.1	17.4	17.4	16.8	21.6	17.7
Species 1 Genetic worth	3.5	1.22	10	0	0	0
Species 2 Genetic worth	0	0	0	0	0	0
Regen method	Plant	Plant	Plant	Plant	Plant	Plant

See Appendix A for complete table.

6.5.8 Operational adjustment factors

Operational adjustment factors (OAF) are applied to yield curves for managed stands to reduce potential yields generated by growth and yield models to operational yields. The common default values are OAF 1 of 15% and an OAF 2 of 5%. OAF 1 accounts for openings in stands (4%), distribution of stems or clumpiness (4%), endemic pests and diseases (4%), and other risks to potential yield (3%) for a total of 15%. OAF 2 is applied to account for decay, waste and breakage. The 5% factor originates from estimates for older immature stands documented in the *1976 Metric Diameter Class Decay, Waste and Breakage Factors.* It increases linearly at this rate (10% at 200 years, 15% at 300 years etc). The default factors are used with the exception of spruce weevil and Armillaria areas notes below.

6.5.8.1 Spruce weevil

In TSR 2, the MOF used TIPSY SWAT (TIPSY with spruce weevil and brush impacts) to determine the losses caused by both brush and the spruce-leader weevil. An OAF 1 of 10% was applied to yield tables for spruce-leading stands to account for spruce weevil. This was in addition to the standard adjustment of 15%; meaning all spruce-leading regenerated stands will receive an OAF 1 of 25%. In TSR 3 spruce-leader weevil damage to spruce-leading stands in the ICH and SBS zones was estimated to account for up to a 200 m^3/hectare loss in volume over the rotation of a spruce stand. It was agreed upon by the TSA licensees that these OAFs still reflect current growth reductions.
For this review, a spatial OAF will be developed using RESULTS data, elevation thresholds and input from licensees. The OAF will be applied to spruce-leading analysis units.

6.5.8.2 Armillaria

Mapping of Armillaria root disease was updated from aerial surveys carried out in 2006 and ground validation in 2007-2009. The main purpose of these surveys was to assess conditions in plantations less than 10 years old. In areas identified as moderate and severe incidence of Armillaria root disease, the Prince George regional pathologist confirmed that OAF 2 adjustments of 10% and 20% for moderate and severe incidence, respectively were acceptable.

6.6 Unsalvaged losses

Unsalvaged losses result from the volume of timber killed due to insect and disease epidemics, fire and blowdown and not recovered by harvesting operations. In modelling timber supply, these loss estimates are typically taken out of the forecasted timber volume that is reported by the model. The following sections describe the reductions for unsalvaged losses that will be applied in the Robson Valley TSA analysis.

6.6.1 Mountain pine beetle

The BCMPB v.9 model will be used to calculate existing and future mortality in pine stands greater than 60 years of age. Unsalvaged losses due to mountain pine beetle are dependent on the potential shelf-life of the pine to produce various forest products and the amount of merchantable volume attributed to the affected land base. Shelf-life is discussed in further detail in Section 6.6.2.

Table 23 summarizes the BCMPB v. 9 projected cumulative mortality within the RVTSA assuming no management activities (i.e., salvage of dead pine) were to occur. The annual volumes of dead pine for the years between 2005 and 2011 are based on Provincial Aerial Overview of Forest Health. The volumes for the years between 2012 and 2014 are projected by the model.

Table 23. Observed (2005-2012) and projected (2012-2014) annual volumes and projected cumulative volumes (2012, 2017, 2022) in millions of m^3 of mature merchantable red-attack pine for the Robson Valley TSA

Source of estimate	Year	Annual volume of red-attack pine (millions m^3)	Projected cumulative volume of red-attack pine (millions m^3)	Percentage of mature pine on the 1999 THLB projected to be killed (%)*
Observed from Aerial overview surveys	2005	0.1		
	2006	0.2		
	2007	0.3		
	2008	0.4		
	2009	0.4		
	2010	0.4		
	2011	0.4		
	2012	0.3	2.8	45
Projected	2013	0.2		
	2014	0.1		
	2017		3.2	51
	2022		3.2	51

* Note: the THLB has changed since 1999 due to new area based tenures and land-use decisions.

6.6.2 Shelf-life

There is significant uncertainty regarding the length of time that a MPB-killed tree is usable as a sawlog to make lumber. Some licensees in MPB-impacted areas of BC report that it is as short as three years while others suggest that sawlogs may be harvested from forests that have been dead for up to 40 years. Traditionally the chief forester's allowable annual cut (AAC) has been set for sawlogs, with lumber being the end product. New initiatives have seen interest in non-sawlog based end products increasing. This includes the production of bio-energy from "waste" wood. The methodology that will be employed for shelf-life in this TSR will allow the chief forester the flexibility to determine an AAC that considers all of the standing dead pine, regardless of end use.

This TSR will employ the Spatially Explicit Landscape Event Simulator (SELES) model to forecast harvest flows for the Robson Valley TSA. SELES allows the reporting of the time since death for MPB-killed pine. The forecast produced by the model will indicate how much of the timber supply is dependent on 1 to 3, 4 to 5, 6 to 10 and 10 to 15 "years since death" stands. The latter categories are only used as a possible example and may be refined based on further comment. Although there is a general consensus that once pine trees have fallen over they no longer contribute to timber supply, there is still uncertainty with respect to when attacked trees actually begin to fall over, which is believed to be closely related to local soil moisture conditions. Recent studies indicate that on average MPB-killed trees fall over approximately 15 years after death. In wetter sites in the Prince George District some MPB-killed trees have already begun to fall (only five years after attack), while in dry areas in the Chilcotin, which experienced a MPB-epidemic in the mid-1980s, many trees have yet to fall. The base case assumption will be that trees begin to fall over 15 years after initial attack and a sensitivity analysis will examine the implications of using 20 years to falldown.

6.6.3 Other insects, fire and wind losses

Loss estimates for other bark beetles (Spruce Beetle, Balsam Bark Beetle, Douglas-fir Beetle) were estimated for the TSR 3 timber harvesting land base and polygonal data from the provincial forest health aerial overview surveys for a 12 year period (2000 – 2011). Mid-point mortality percentages were assumed for each mortality class and are summarized in Table 24.

Table 24. Bark beetle mortality classes

Mortality class	Mid-point mortality (%)
Trace	0.5
Light	5.0
Moderate	20.0
Severe	40.0
Very severe	75.0

Cumulative mortality was calculated for overlapping polygons resulting from repeated years of attack. Harvest history was derived from Forest Tenures Administration (FTA) and RESULTS data, overlaid onto the forest health data and unsalvaged loss estimates were determined for each tree species.

Unsalvaged losses due to forest fires were estimated from fire mapping information for the period 2004- 2011.

No recent studies have assessed losses due to disease and wind damage, therefore estimates from the last timber supply review are summarized.

Average losses per year are summarized in Table 25.

Table 25. Average unsalvaged losses - other bark beetles, fire, disease and wind damage

Bark beetle species	Tree species	Average unsalvaged volume (m^3/year) TSR 3 THLB
Balsam bark beetle	Sub-Alpine Fir	21,000
Spruce bark beetle	Spruce	51,000
Douglas-fir beetle	Douglas-fir	200
Fire	All conifers	4,600
Disease	All conifers	1,100
Wind damage	All conifers	1,000
Total annual losses		78,900*

* This estimate of unsalvaged losses will be recalculated during timber supply analysis to account for the change in timber harvesting land base.

6.7 Scenic areas and visual quality objectives (VQOs)

The management of visually sensitive areas is a significant objective for large areas of the Robson Valley TSA to keep visible evidence of forest harvesting within acceptable limits. Under the *Forest Practices Code*, on January 14, 1998 the District Manager legally established 614 858 hectares of scenic areas, and within the scenic areas 220 381 hectares of visual quality objectives (VQOs) primarily in the core valley area. These established VQOs were incorporated in TSR 3. In 2004 VQOs were legally established for the balance of the scenic areas, primarily in side drainages, upon the coming into force of Section 17 of the *Government Actions Regulation* under the *Forest and Range Practices Act*. These VQOs were not modelled as part of the TSR 3 base case but a sensitivity analysis showed no effect on the projected timber supply from these additional VQO areas. All the legally established VQOs will be used in the base case..

In 2003, an extensive visual landscape inventory update was completed for the Highway 16 and five viewshed corridors and visual quality classes (VQCs) recommended for the updated polygons. For a variety of reasons, the updated inventory data has not been legally enacted yet so the recommended VQCs will be the basis for a sensitivity analysis in TSR .

On December 12, 2003, the MOF released a bulletin titled *Modelling Visuals in TSR III*. This bulletin updates Step 4a of the recommendations outlined in *Procedures for Factoring Visual Resources into Timber Supply Analyses* (the Procedures) released in 1998. The updated procedures include a new approach for calculating percent denudation at the VQO polygon level, and recommendations for modelling the effect of retention harvesting systems on VQOs. The Robson Valley TSR will incorporate these procedures where possible, including:

- modelling VQO constraints individually for each scenic polygon;
- customizing allowable alteration values (percent denudation in perspective) that reflect the visual effect of demonstrated retention harvesting in scenic areas, which will account for some variability within the percent alteration by including visual absorption capacity (VAC) as a modifier;
- calculating polygon-specific percent denudation values using plan-to-perspective (P2P) factoring; and
- calculating visually effective green-up (VEG) on a polygon-specific basis.

The rationale and methodology for each of these approaches are outlined below.

6.7.1 Polygon-specific VQO constraints

District and provincial FLNRO staff has indicated that visual constraints should be applied at the polygon level. This means that the maximum allowable alteration cannot be exceeded within any polygon delineated by the visual landscape inventory.

6.7.2 Percent denudation

The MoF bulletin *Modelling Visuals in TSR III* identifies a range of allowable percentage alteration in perspective view for each visual quality objective (Table 26).

Table 26. Range of allowable percent alteration by VQO class

VQO	Permissible percent alteration in perspective view
Preservation	0
Retention	0–1.5
Partial retention	1.6–7.0
Modification	7.1–18.0
Maximum modification	18.1–30.0

Percent denudation is the permissible percent alteration in plan view, and is the value used for timber supply analysis. Percent denudation applies to the crown forested land base, not the productive or timber harvesting land base. For visual quality analysis, the crown forested land base will include roads and as well as any forested non--productive (NP) land.

To convert from perspective view to plan view, a plan-to-perspective (P2P) ratio is calculated based on the average slope of the polygon, as identified in *Modelling Visuals in TSR III* and shown in Table 27. Since VQOs will be modelled on a polygon-specific basis, the P2P ratio and the percent denudation will be different for every polygon. The P2P ratio for visual polygons in the Robson Valley TSA is 2.2 on average, and ranges from 1.04 to 4.68.

Table 27. Predicted P2P ratios for slopes for all visual designs, based on average slope

Slope	0%	10%	20%	30%	40%	50%	60%	70%
P2P	4.68	3.77	3.04	2.45	1.98	1.6	1.29	1.04

6.7.3 Visually effective green-up

Allowable percent denudation refers to the proportion of a visual polygon that can be less than the visually effective green-up (VEG) height. As noted in the *Procedures for Factoring Visual Resources into Timber Supply Analyses*, VEG height is highly dependent on slope. To account for this effect, the *Procedures* specify VEG tree heights for seven slope classes. This timber supply analysis will use the area-weighted average of these slope classes to calculate VEG height for each visual quality polygon.

Table 28. Associated visually effective green-up heights by slope class

Slope class (%)	0-5	6-10	11-15	16-20	21-25	26-60	31-35	36-45	46-50	51-55	56-60	60+
Associated VEG (m)	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5

6.7.4 Integrated resource management

The *Forest and Range Practices Act* includes provisions for maximum cutblock size (60 hectares) and harvesting adjacent to an existing cutblock (three-metre green-up on existing cutblock). The implications of these will be assessed in the timber supply analysis.

6.8 Community watersheds and water licences

6.8.1 Community watersheds

There are four community watersheds within the boundaries of the Robson Valley TSA (Dominion Edand, Martinson and Swift), however, all are within community forest agreement areas and, therefore, are not relevant to the timber supply for the TSA.

6.8.2 Water licences (points of diversion)

There are 357 water licences (includes 32 licences for irrigation and stock watering) or points of diversion. In the timber supply analysis each licence will be given a 100-metre radius buffer for a total of 1200 hectares. Some of these buffers will overlap with existing riparian reserves.

6.9 Fish and wildlife

6.9.1 Ungulate winter range

Table 29 identifies Mountain Caribou and Mule Deer ungulate winter ranges that require modified harvesting methods. A forest cover constraint will be applied in the timber supply analysis for these areas.

Table 29. Mountain Caribou (Order U-7-003) and Mule Deer (Order U-7-010) ungulate winter ranges in the Robson Valley TSA that require modified harvesting methods

Ungulate winter range type	Habitat units	Gross area (ha)	General wildlife measures*
Caribou corridor	R-003	3,622	> 20% of corridor >100 years old
	R-008	1,644	
	R-009	1,984	< 20% < 3 m green-up
	R-010	1,642	
	R-014	772	
	R-016	1,083	
		10,747	
Caribou medium	R-015	1,163	< 30% volume removed every 80 years
	R-017	11	
		1,174	Openings < 1 ha with mean < 0.5 ha
Mule Deer snow interception and thermal cover	RVD-001	107	> 50% in age class 8 or 9 with > 66% canopy closure
	RVD-002	249	
	RVD-003	134	
		490	

* See Orders U-3-007 and U-7-010 for complete list of General Wildlife Measures.

6.9.2 Wildlife movement corridors

The *Order to Establish the East Kinbasket, West Kinbasket, Hugh Allan, Foster and Dawson Landscape Unit Objectives* - Objective 3.0 requires the maintenance of additional wildlife movement corridors along specific creeks, as indicated in Table 30.

Table 30. Wildlife movement corridors in the Robson Valley-Canoe area

Waterbody	Applied enhanced riparian (m)	Original Forest Practices Code riparian management area (m)	Total wildlife corridor width (m)	Corridor harvesting constraints (see Order for complete list)
Yellowjacket Creek	50	50	100	
Dave Henry Creek	50	50	100	Outside the reserve zone: < 30% in < 3 m green-up
Bulldog Creek	0	50	50	No clearcuts > 200m long
Ptarmigan Creek	30	70	100	
Hugh Allan Creek	30	70	100	> 40% basal area retention in non-clearcut systems
Blackman Creek	0	50	50	
Iroquois Creek	10	30	40	
East Iroquois Creek	10	30	40	
Foster Creek	0	70	70	

6.9.3 Landscape level retention

6.9.3.1 Landscape units

A number of landscape units have aspatial old forest targets pursuant to the *Order Establishing Provincial Non-Spatial Old Growth Objectives* (June 30, 2004) and are identified in Table 31.

Table 31. Landscape unit with aspatial landscape-level retention

Landscape unit number	Landscape unit name	Biodiversity emphasis	NDT	BEC zone	Old forest retention %	Age of old forest
1501	Castle	Low	1	ESSFwcw	>19	250
			2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	ESSFwcp	Na	
			5	IMAun	Na	
1530	Dore	Low	2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			2	SBSvk	>9	250
			5	ESSFmmp	Na	
			5	ESSFwcp	Na	
			5	IMAun	Na	
1542	East Twin-McKale	Low	1	ICHwk3	>13	250
			2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			5	ESSFmmp	Na	
			5	IMAun	Na	
1597	Holmes	Intermediate	2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			2	SBSvk	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	IMAun	Na	
1598	Horsey-Small	Low	2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	IMAun	Na	
1666	McBride-Dunster	Low	1	ICHwk3	>13	250
			2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			2	SBSvk	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	IMAun	Na	
1671	Milk	Low	1	ESSFwc3	>19	250
			1	ESSFwk1	>19	250
			1	ICHwk3	>13	250
			2	SBSvk	>9	250
			5	BAFAun	Na	
			5	ESSFmmp	Na	
			5	ESSFwcp	Na	

(continued)

Table 31. Landscape unit with aspatial landscape-level retention (concluded)

Landscape unit number	Landscape unit name	Biodiversity emphasis	NDT	BEC zone	Old forest retention %	Age of old forest
1739	Raush	Intermediate	1	ESSFwcw	>19	250
			2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	ESSFwcp	Na	
			5	IMAun	Na	
1767	South Trench (Draft OGMAs and aspatial target)	Intermediate	2	ESSFmm1	>9	250
			2	ICHmm	>9	250
			3	SBSdh1	>11	140
			5	ESSFmmp	Na	
			5	IMAun	Na	

NDT – Natural disturbance type;
BEC – Biogeoclimatic ecosystem classification.

For landscape units with a low biodiversity emphasis, the old forest retention percent may be reduced by up to 2/3, to the extent necessary to address the impacts on timber supply.

The implications of aspatial old forest targets will be assessed in the timber supply analysis.

6.9.3.2 Disturbance of the Non-timber harvesting land base

Objectives to retain a specified amount of area in old forest condition apply to the entire Crown forest area (both THLB and non-THLB). As a result, non-THLB areas must be factored into the analysis. Various modelling assumptions have been used in the past to simulate the role of natural disturbance in altering non-THLB forest conditions. The model used to forecast timber supply for the Robson Valley allows the non-THLB to be either frozen in time or aged (disturbed over time). Freezing the non-THLB was not an option because economic operability will be treated dynamically within the model. Therefore the model will disturb these stands based on Table 32 from the following document *Natural Disturbance Units of the Prince George Forest Region: Guidance for Sustainable Forest Management*, by Craig DeLong, 2002, Northern Forest Region, MoFR. URL http://www.for.gov.bc.ca/hfd/library/documents/bib90746.pdf

Table 32. Disturbance of the non-timber harvesting land base

Natural disturbance unit	Max stand age	% forest area > 250 years (upper bound)	Initial adjusted max stand age Calculation = (250 (1+%> 250))	Final adjusted max stand age Calculation = max(Initial max. age, mean cycle age)
Moist Trench Mtn	300	50	375	375
Moist Trench Valley	150	25	312.5	312.5

6.10 Grizzly bear

There are no legal objectives in place at this time related to Grizzly bear habitat. The species is, however, on the "Blue List" (vulnerable and sensitive to disturbance) and habitat needs have received attention in previous timber supply reviews and forest development planning.

Avalanche paths provide habitat for all bears, and especially grizzly bears. Warm aspect facing avalanche paths are the first areas where vegetation leafs out in the spring. To reflect current management in some parts of the Robson Valley TSA, the model will apply a 50-metre reserve on avalanche paths on south-east to south-west facing slopes.

7. Sensitivity Analyses

Sensitivity analysis provides a measure of the timber supply impact if uncertainty in management assumptions and/or data integrity exists. The magnitude of the increase or decrease in a particular variable should reflect the degree of uncertainty surrounding the assumption. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results. Issues that are particular to the Robson Valley TSA are shown in Table 33 along with a list of standard sensitivity analysis that are generally carried out in all TSAs.

Table 33. Proposed sensitivity analyses

Factor	Issue to be investigated
Natural stand volumes	VRI Phase 2 adjustments will be applied to natural stand yield curves
Managed stand volumes	All volume tables will be changed by +/– 10%
Minimum harvestable age	Minimum harvestable age constraints will be removed
THLB	The THLB will be varied by +/– 10%
Management for visual quality	Low and high disturbance levels will be used
Regeneration assumptions	Fertilization will be applied to managed stands post 2012
Harvest priorities	Alternative harvest priorities will be explored within the timber supply model
Operability	Additional inaccessible/inoperable areas will be removed from the THLB
OAFs	potential spruce terminal weevil losses will explored
Minimum volume per hectare	+/- 50 m^3 for all harvest systems
Regeneration delay	+ 5 years
Green-up	Remove green-up constraint
Block size	Remove block size constraint
*Proposed fishery sensitive watersheds (FSW)	Assess implications of equivalent clearcut area and other constraints
*Proposed Goat Bull Trout wildlife habitat area (WHA)	Assess implication of WHA constraint
Grizzly bear	Assess implication of constraint removal
Mountain Caribou FPPR s. 7 Notice	Assess implication of 5600 hectares budget
Forest Health	Sensitivity analyses to be determined following base case analysis.

* FSW and WHA Orders approved prior to the new AAC determination would constitute 'current practice'. This analysis will allow the chief forester to account for these new requirements, if required.

7.1 Forest inventory volume estimates

A statistical analysis was completed on the inventory mature volume estimates in 2011. The analysis indicated that the average inventory volumes were consistently underestimated across all strata in the Robson Valley TSA. It suggested that the magnitude of the volume underestimation ranged from 14 percent in spruce-leading stands to nearly 30 percent in balsam-leading stands. Since spruce- and balsam-leading forest types make up over 60 percent of the TSA the analysis suggests that revision to the current volume estimates based on the 2011 field sampling could yield a significant upward pressure on short-term timber supply, forestall the transition to the long term sustainable harvest level, and potentially partially offset the impacts of CFA withdrawals from the TSA. Sensitivity analysis will be used to explore the implications of using the adjusted yield estimates in the base case.

7.2 Proposed fisheries sensitive watersheds (FSW)

FSW are established pursuant to the *Forest and Range Practices Act* for an area of land in a watershed that has both significant downstream fisheries values and significant watershed sensitivity. FSWs require conserving natural hydrological conditions, natural stream bed dynamics, stream channel integrity, and the quality and quantity of water flow. Objectives are developed that describe the desired watershed condition, for example:

- Amount of harvesting;
- Maintenance of large woody debris;
- Water quality management; and,
- Stream crossing management etc.

FSW orders are pending for the Goat and Milk River watersheds. Table 34 summarizes some of the proposed objectives for these watersheds.

Table 34. Proposed fisheries sensitive watersheds in the Robson Valley TSA

Fisheries sensitive watershed name	Fisheries sensitive watershed number	Gross area (ha)	Objectives (see draft Order for complete list)
Milk River	F-7-003	18,800	1. Maintain the ECA below 25% for each of the Milk River sub-basin (units #2 to #11 inclusive). 2. Within sensitive sites (units #12 to #31 inclusive). Within a harvesting unit, maintain 90% of the area located within 15 m of the edge of the stream channel on all S4 streams and S6 streams that flow directly into fish streams and are greater than 0.5 m in width, to maintain long-term large woody debris (LWD) recruitment into stream channels.
Goat River	F-7-004	42,545	1. Maintain an ECA less than 25% within unit #1, #3, #4, and #6 to #11 inclusive. 2. Within each sensitive sites, units #12 to #30 inclusive: a. Maintain long-term large woody debris (LWD) recruitment to the stream channel by retaining at least 90% of the riparian area in a state undisturbed by primary forest activities.

7.3 Proposed wildlife habitat area (WHA)

WHAs are established under the *Forest and Range Practices Act* for an area deemed necessary to meet the habitat requirements of a category of Species at Risk (Table 35). A wildlife habitat area includes the spatial identification of an area with corresponding "general wildlife measures", whichmay prohibit or partially limit activities within the area.

Table 35. Proposed wildlife habitat area

Location	WHA number	Species	Gross area (ha)	General wildlife measures (see draft Order for complete list)
Goat River	7-001	Bull Trout	800	Do not harvest within the WHA. Do not construct roads and excavated or bladed trails within the WHA. Do not build stream crossings within the WHA

7.4 Forest planning and practices regulation s.7 notice

Species at risk habitat elements for mountain caribou are generally distributed in locations as described below:

Table 36. Mountain caribou habitat elements

Locations				Habitat attributes				
SAR elements	**BEC unit**	**Size (ha)**	**Comments**	**Slope**	**Forest cover**	**Stand age**	**Elevation (metres)**	**Other**
Calving range	AT, ESSF	50-300	There may be overlap between calving and rutting ranges and late winter range	<35%	Sub-alpine forest	N/A	>1100	Convex rather than concave topography.
Rutting range	AT,ESSF	50-300		<35%	Sub-alpine forest	>120	>1100	Alpine, open subalpine forest
Connectivity	All		Heights of land, ridgelines and cross valley movements	0-80%	Mature/old forest	>120	all	Large contiguous patches of mature/old forest
Mineral lick	Any	50						

The Section 7 Notice dated December 30, 2004 stated that the amount of mature timber harvesting land base impacted by any future WHA designations must not exceed 5600 hectares. The implications to timber supply from possible WHA designations will be assessed during this review.

8. Community Forest Agreements (CFAs)

CFAs are area-based, replaceable licences and give communities exclusive rights to harvest timber, as well as the opportunity to manage forest resources such as timber and plant products, recreation, wildlife, water and scenic viewscapes, to meet local needs, in accordance with the Province's forestry legislation and regulations.

There are three CFAs within the boundaries of the Robson Valley TSA, two of which were issued since the last timber supply review (Valemount and Dunster). Separate AACs are determined for CFAs and that timber supply contributes to the local economy. Being area-based tenures, these new CFAs will be removed from the TSA.

Table 37 summarizes the CFAs within the boundaries of the Robson Valley TSA.

Table 37. Community forest agreements

Licence number	Name of licensee	Total area of CFA (ha)	Allowable annual cut (m^3/year)	Date licence issued
K1H	McBride Community Forest	62,406	50,000	2003-07-30
K2T	Valemount Community Forest Co. Ltd	70,182	190,000*	2007-12-28
K3O	Dunster Community Forest Society	20,009	15,000	2009-12-31

* This AAC includes an uplift to expedite the salvage of pine killed by the Mountain Pine Beetle. This uplift expires in December 2012. A process is currently underway to determine a new AAC for the Valemount Community Forest Agreement.

Appendix A Silviculture Analysis Units – Robson Valley TSA

au	unit	regen delay	stocking	spc1	pct1	spc2	pct2	spc3	pct3	spc4	pct4	site index	spc1_gw	spc2_gw	util	oaf1	oaf2	regen method
1	S_1_ESSF	1	1250	SW	72	BL	20	PL	8			17.1	3.5	0	17.5	0.85	0.95	P
2	S_2_ESSF	1	1200	SW	75	BL	16	PL	8	CW	1	17.4	1.22	0	17.5	0.85	0.95	P
3	S_3_ESSF	2	1650	SW	100							17.4	10	0	17.5	0.85	0.95	P
4	P_1_ESSF	0	1200	SW	68	BL	16	PL	16			16.8	0	0	17.5	0.85	0.95	P
5	P_2_ESSF	1	1350	PL	59	SW	32	BL	9			21.6	0	0	12.5	0.85	0.95	P
6	P_3_ESSF	1	1000	SW	68	BL	16	PL	16			17.7	0	0	17.5	0.85	0.95	P
7	B_1_ESSF	1	1200	SW	66	BL	25	PL	9			15.7	2.79	0	17.5	0.85	0.95	P
8	B_2_ESSF	1	1400	BL	43	SW	39	PL	18			16.3	0	2.3	17.5	0.85	0.95	P
9	B_3_ESSF	1	1200	SW	68	BL	16	PL	16			16	0	0	17.5	0.85	0.95	P
10	C_1_ESSF	1	1200	SW	68	BL	16	PL	16			16.5	0	0	17.5	0.85	0.95	P
11	C_2_ESSF	1	1200	SW	68	BL	16	PL	16			17.7	0	0	17.5	0.85	0.95	P
12	F_1_ESSF	1	1200	SW	68	BL	16	PL	16			15.8	0	0	17.5	0.85	0.95	P
13	F_2_ESSF	1	1200	SW	68	BL	16	PL	16			17.3	0	0	17.5	0.85	0.95	P
14	F_3_ESSF	1	1200	SW	68	BL	16	PL	16			15.9	0	0	17.5	0.85	0.95	P
15	H_1_ESSF	1	1200	SW	68	BL	16	PL	16			17.7	0	0	17.5	0.85	0.95	P
16	H_2_ESSF	1	1200	SW	68	BL	16	PL	16			16.8	0	0	17.5	0.85	0.95	P
17	D_1_ESSF	1	1500	SW	74	BL	26					15.7	0	0	17.5	0.85	0.95	P
18	D_2_ESSF	2	1750	SW	82	BL	14	PL	3	FD	1	17.3	8.62	0	17.5	0.85	0.95	P
19	D_3_ESSF	1	1200	SW	68	BL	16	PL	16			16.4	0	0	17.5	0.85	0.95	P
20	S_1_ICH	1	1200	SW	70	PL	14	BL	10	CW	6	20.7	0.37	0	17.5	0.85	0.95	P
21	S_2_ICH	1	1250	SW	63	PL	15	BL	11	FD	11	20.9	0.11	0	17.5	0.85	0.95	P
22	S_3_ICH	1	1300	SW	72	PL	10	CW	10	FD	8	21.2	4.3	0	17.5	0.85	0.95	P
23	P_1_ICH	1	1200	SW	63	PL	16	BL	15	CW	6	21.3	0	0	17.5	0.85	0.95	P
24	P_2_ICH	1	1200	PL	58	SW	14	FD	17	BL	11	21.7	0.47	1.9	12.5	0.85	0.95	P
25	P_3_ICH	1	1200	PL	55	CW	18	FD	17	BL	10	22.1	0	0	12.5	0.85	0.95	P
26	B_1_ICH	1	1150	SW	82	PL	10	BL	6	FD	1	20.3	0.59	1.5	17.5	0.85	0.95	P
27	B_2_ICH	0	1250	PL	36	SW	34	BL	27	HW	3	21.6	0.38	0.1	12.5	0.85	0.95	P
28	B_3_ICH	1	1400	PL	50	BL	30	SW	20			22	0	0	12.5	0.85	0.95	P
29	C_1_ICH	1	1100	SW	56	HW	19	CW	14	PL	11	21.8	1.06	0	17.5	0.85	0.95	P
30	C_2_ICH	2	1250	CW	37	SW	26	FD	20	PL	9	16.3	0	2.1	17.5	0.85	0.95	P
31	C_3_ICH	1	1150	CW	36	SW	24	FD	21	PL	19	16.3	0	0	17.5	0.85	0.95	P
32	F_1_ICH	0	1200	SW	37	PL	29	FD	24	CW	10	20.9	0	0	17.5	0.85	0.95	P
33	F_2_ICH	1	900	FD	34	PL	32	SW	30	BL	4	22	0	0	17.5	0.85	0.95	P
34	F_3_ICH	0	1200	FD	41	SW	36	BL	15	PL	8	24.2	0	2.3	17.5	0.85	0.95	P
35	H_1_ICH	1	1350	PL	33	CW	26	SW	20	FD	14	21.9	0	0	12.5	0.85	0.95	P
36	H_2_ICH	1	1150	SW	50	PL	21	CW	11	HW	10	21.3	1.6	0	17.5	0.85	0.95	P

au	unit	regen delay	stocking	spc1	pct1	spc2	pct2	spc3	pct3	spc4	pct4	site index	spc1_gw	spc2_gw	util	oaf1	oaf2	regen method
37	H_3_ICH	1	1200	SW	49	PL	19	FD	17	CW	15	21.6	0	0	17.5	0.85	0.95	P
38	D_1_ICH	1	1200	SW	49	PL	19	FD	17	CW	15	20.1	0	0	17.5	0.85	0.95	P
39	D_2_ICH	1	1400	SW	47	PL	30	FD	12	BL	11	21.8	3.46	0	17.5	0.85	0.95	P
40	D_3_ICH	1	1150	PL	53	SW	30	FD	13	CW	4	21.9	0	0.2	17.5	0.85	0.95	P
41	S_1_SBS	1	1150	SW	69	PL	18	BL	13			19.1	3.88	0	17.5	0.85	0.95	P
42	S_2_SBS	0	1150	SW	73	BL	14	PL	10	FD	3	19.3	11.3	0	17.5	0.85	0.95	P
43	S_3_SBS	1	1150	SW	64	FD	17	PL	12	BL	7	19.8	5.78	0	17.5	0.85	0.95	P
44	P_1_SBS	1	1200	SW	30	FD	31	PL	24	BL	15	18.6	0	0	17.5	0.85	0.95	P
45	P_2_SBS	1	1200	PL	49	SW	23	FD	15	BL	13	21.8	0	0.5	12.5	0.85	0.95	P
46	P_3_SBS	1	1200	PL	45	FD	30	SW	15	CW	10	22.1	0.38	0	12.5	0.85	0.95	P
47	B_1_SBS	1	1400	SW	95	BL	5					18.7	12	0	17.5	0.85	0.95	P
48	B_2_SBS	1	1100	BL	40	SW	29	FD	17	PL	14	18.9	0	0	17.5	0.85	0.95	P
49	B_3_SBS	0	1400	BL	70	CW	10	SW	10	PL	10	18.8	0	0	17.5	0.85	0.95	P
50	C_1_SBS	1	1200	SW	30	FD	36	PL	24	BL	10	20.5	0	0	17.5	0.85	0.95	P
51	C_2_SBS	1	1350	CW	50	FD	30	BL	10	SW	10	15.9	0	0	17.5	0.85	0.95	P
52	C_3_SBS	1	1200	SW	30	FD	36	PL	24	BL	10	20.4	0	0	17.5	0.85	0.95	P
53	F_1_SBS	2	1250	PL	62	FD	30	SW	8			23.1	0	0	12.5	0.85	0.95	P
54	F_2_SBS	1	1200	FD	43	PL	25	SW	20	CW	12	24.3	0	0	17.5	0.85	0.95	P
55	F_3_SBS	1	1100	FD	40	PL	35	CW	14	BL	11	24.1	0	0.1	17.5	0.85	0.95	P
56	H_1_SBS	1	1200	SW	30	FD	36	PL	26	BL	8	19.1	0	0	17.5	0.85	0.95	P
57	H_2_SBS	1	1200	SW	30	FD	36	PL	26	BL	8	19.5	0	0	17.5	0.85	0.95	P
58	H_3_SBS	1	1200	SW	30	FD	36	PL	26	BL	8	19.5	0	0	17.5	0.85	0.95	P
59	D_1_SBS	1	1200	SW	30	FD	36	PL	26	BL	8	19.3	0	0	17.5	0.85	0.95	P
60	D_2_SBS	1	1200	SW	55	PL	35	FD	9	BL	1	19.8	0.22	0	17.5	0.85	0.95	P
61	D_3_SBS	1	1200	FD	58	SW	23	PL	10	BL	9	19.9	0	0	17.5	0.85	0.95	P