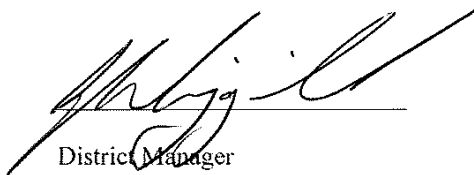


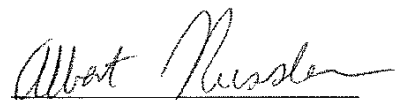
# Boundary Timber Supply Area Timber Supply Review

## Data Package

June 2011



District Manager  
Selkirk Resource District  
Ministry of Forests, Lands and  
Natural Resource Operations



Director  
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# 1. Introduction

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This data package summarizes the information and assumptions that are used to conduct timber supply analysis for the Boundary Timber Supply Area (TSA). The information and assumptions represent current performance, which is 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, including objectives and practice requirements contained in the *Forest and Range Practices Act*;
- land-use plans approved by Cabinet (i.e., Kootenay Boundary Higher Level Plan Order);
- legal objectives established under the *Forest and Range Practices Act* and the *Land Act* (e.g., Arrow Boundary visual quality objectives, wildlife habitat areas, and ungulate winter ranges).

Analysis within the timber supply review models “what is” as opposed to “what if.” Changes in forest management objectives and data, when and if they occur, are captured in future timber supply analyses.

Each section of this data package contains:

- 1) a short explanation of the data required;
- 2) a data table or list of modelling assumptions;
- 3) a description of data sources and other comments.

This data package is a draft released for public review in June 2011. If developments occur that change the assumptions used in the timber supply analysis, they will be noted in a post-analysis version of the data package.

Please submit comments about the data package to:

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Castlegar, BC

or via email at

[tara.decourcy@gov.bc.ca](mailto:tara.decourcy@gov.bc.ca)

## 2. Current Forest Management Considerations and Issues

### 2.1 Base case management assumptions

The assumptions described in this data package reflect current performance and knowledge with respect to the status of forest land, forest management practices, and timber growth and yield. The harvest forecast developed from these assumptions is called the base case harvest forecast.

### 2.2 Major forest management considerations and issues

Table 1 lists major forest management issues that where possible are considered directly in the timber supply analysis. Issues that fall within the definition of current management are modelled as best possible within the base case harvest forecast. Other issues that may infer significant uncertainties in current management may be assessed in a sensitivity analysis as outlined in Section 7. In such cases, sensitivity analysis assess the timber supply implications and can assist in assigning degrees of risk during the allowable annual cut (AAC) determination.

Table 1. Major forest management considerations

Consideration/issue	Description
Land use zones	The Kootenay Boundary Higher Level Plan Order (HLPO) was established January 31, 2001 (updated October 26, 2002). The HLPO establishes resource management zones and objectives for these zones. Resource management zones correspond to old district boundaries. Objectives for the zones include biodiversity, connectivity, consumptive use streams, green-up and enhanced resource development.
Biodiversity	The Kootenay Boundary HLPO (October 26, 2002) establishes legal objectives and targets for old forest retention, old and mature forest retention, temporal and spatial distribution of cutblocks, and landscape connectivity.
Old growth management areas	While the only legal requirements for biodiversity define target amounts but not specific areas to retain, it is generally agreed that larger contiguous areas of old growth are preferable for biodiversity. Licensees have worked on developing mutually agreed upon non-legalized old growth management areas (OGMA) in order to satisfy the old forest retention requirements in the Higher Level Plan Order. Licensees use these OGMA to meet the legal requirements and generally do not harvest therein.
Wildlife habitat	Ungulate winter ranges (UWR) were established under the Government Action Regulation (GAR) for Mule Deer, Moose, Mountain Goat and Bighorn Sheep on May 8, 2006. Numerous wildlife habitat areas have been established under the <i>Forest Practices Code Act</i> and the Government Action Regulation for the protection of Identified Wildlife such as: Grizzly Bear, Williamson's Sapsucker, Lewis's Woodpecker and Badger. Additional protection was provided for Grizzly Bear through general wildlife measures (GWM) established under the GAR.
Visual resources	Scenic areas and visual quality objectives were established December 31, 2005.
Site productivity	The site productivity of old-growth stands has been shown to underestimate the productivity of regenerated stands. The licensee has completed a site index adjustment project in an attempt to better estimate the growth of managed stands.

(continued)

*Table 1. Major management considerations (concluded)*

<b>Consideration/issue</b>	<b>Description</b>
Problem forest types	Dense pine stands on poor sites were identified in previous timber supply reviews (TSR) as a problem forest type generally considered not suitable for harvesting.
Ecosystem restoration	Work has been done to establish an ecosystem restoration program, although to date few treatments have been completed. The future of the program is uncertain due to reorganization in the Selkirk Resource District.
New woodlots	Woodlots have increased in the timber supply area (TSA) since the previous timber supply review. These new woodlots are excluded from the land base of the TSA, for the purpose of the TSA AAC determination.
Insects and diseases	Mountain pine beetle projections show a significant increase in the number of infestations in coming years although the rate of expansion has been slower than expected. Due to the high risk of the mountain pine beetle epidemic and the low current level of infestation, the analysis will address the impact of this damaging agent through sensitivity analysis.

### 3. Inventories

Table 2 lists the main data sets that have been used to determine the timber harvesting land base (THLB) and to model forest management activities either in the base case management scenario or sensitivity scenarios.

Table 2. Inventory information

Data	Source	Currency of file
Timber supply area boundary	LRDW <sup>1</sup>	2003-03-04
Ownership	LRDW	2010-04-01
Community forest	TBD	TBD
Vegetation resource inventory	FLNR FAIB	2011-03-11
Depletion layer	FLNR FAIB <sup>2</sup>	TBD
Biogeoclimatic ecosystem classification	LRDW	2008-05-15
Predictive ecosystem mapping	MOE Information Ecosystem Section <sup>3</sup>	2003-05-29
Environmentally sensitive areas	FLNR Selkirk RD <sup>4</sup>	Pre-1995
Terrain stability mapping	FLNR Selkirk RD	2000-02-01
Operability	FLNR Selkirk RD	2005-04-28
Roads	FLNR K/B <sup>5</sup>	2011-04-18
Landscape units	LRDW	2010-01-10
Old growth management areas (non-legal)	LRDW	2009-07-16
Protected areas strategy goal 2 areas (not established)	FLNR Selkirk RD	2011-02-24
Wildlife habitat areas	LRDW	2010-09-02

(continued)

<sup>1</sup> LRDW – BC Land and Resource Data Warehouse SDE.

<sup>2</sup> FLNR FAIB – Ministry of Forests, Lands, and Natural Resource Operations, Forest Analysis and Inventory Branch.

<sup>3</sup> MOE Information Ecosystem Section – Ministry of Environment Information Ecosystem Section.

<sup>4</sup> FLNR Selkirk RD – Ministry of Forests, Lands, and Natural Resource Operations, Selkirk Resource District Office.

<sup>5</sup> FLNR K/B – Ministry of Forests, Lands, and Natural Resource Operations, Kootenay/Boundary Regional Office.



Table 2. Inventory information (concluded)

Data	Source	Currency of file
Ungulate winter ranges	LRDW	2006-11-05
Riparian buffer layer	Ecorra <sup>6</sup>	Pre-2000
Community watersheds	LRDW	2009-07-15
Visual landscape inventory	LRDW	2010-10-28
Forest recreation sites and trails	LRDW	2008-02-15
Research installations	LRDW	2005-09-06
Growth and yield permanent sample plots	LRDW	2009-02-17
Archaeological sites	FLNR Archaeological Branch	2011-03-17
CPR timber reserves	FLNR Selkirk RD	2010-08-23
Transmission lines	FLNR	2004-05-17
MPB percent volume losses	FLNR FAIB	TBD

**Data source and comments:**

The Currency of File is the date of the latest file update as indicated either by meta-data, by attributes within the data set, by the date received from the data custodian, or by other documentation. An update of a file does not necessarily imply that a new inventory was completed, it may simply reflect a small change or verification that this is the most up-to-date information.

The timber supply area boundary is extracted from a provincial layer. The boundary polygon includes all ownership and administrative types within its bounds. File name: WHSE\_ADMIN\_BOUNDARIES.FADM\_TSA

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 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. File name: WHSE\_FOREST\_VEGETATION.F\_OWN

The vegetation resource inventory (VRI) for the Boundary TSA was clipped from the Provincial VRI Veg Comp Poly Rank 1 Layer Dataset. The reference year for individual polygons vary from 1954 to 2008. The 2011 update of this provincial data set will be used. File name: WHSE\_FOREST\_VEGETATION.VEG\_COMP\_LYR\_R1\_POLY

A forest cover depletion layer is used to update the forest cover for recent harvesting and other disturbances. An updated layer will be created by FAIB staff from a recent remote sensing change detection layer and silvicultural reporting information (RESULTS). This file will be created after the 2011 update of the above Veg Comp Poly Rank 1 Dataset becomes available. File name: To be determined.

<sup>6</sup> Ecora – Ecora Resource Group Ltd.

Biogeoclimatic ecosystem classification for the Boundary TSA was extracted from the provincial data set. File name: WHSE\_FOREST\_VEGETATION.BEC\_BIOGEOCLIMATIC\_POLY

Predictive ecosystem mapping for the Boundary TSA was obtained from the Ministry of Environment. This data set was approved conditionally for strategic timber supply analysis purposes by Ministry of Forests Research Branch staff on 25 June 2003. File name: pem\_4019.ecp.e00 and tecp\_bnd.csv

Environmentally sensitive area (ESA) mapping was generated as part of the forest cover inventory. ESAs are no longer collected nor maintained in the current vegetation resources inventory. FLNR district staff provided an archived copy of the ESAs. File name: bndry\_ESA.shp

Terrain stability mapping (TSM) does not yet have a readily available provincial data source. Forest district staff provided a local data file that was created from combining Level C and D terrain mapping coverages created in 2000. File name: terrain\_c\_polygon.shp and terrain\_d\_polygon.shp

Harvesting operability mapping for the Boundary TSA was provided by FLNR District staff. This data was used in the previous timber supply review in 2000. File name: topr\_bd.shp

A consolidated roads layer was constructed by FLNR regional geomatics staff. The compilation is comprised of several data sources including: TRIM transportation (LRDW), BC Timber Sales roads, a data set for TSR 2 roads, Digital Roads Atlas, FTEN roads, and manual digitization. This line data set will be buffered with assigned road widths. File name: tsa02\_roads\_final.gdb

Landscape units with Biodiversity Emphasis Options (BEO) for the Boundary TSA were clipped from the provincial layer. This data set was compared and found to be reasonably similar to data sets created for the HLPO analysis, thus allowing it to be satisfactory for strategic level timber supply review analysis. File name: WHSE\_LAND\_USE\_PLANNING.RMP\_LANDSCAPE\_UNIT\_SVW

Old growth management areas (OGMAs) for the Boundary TSA were clipped from the non-legal OGMA provincial layer. File name:

WHSE\_LAND\_USE\_PLANNING.RMP\_OGMA\_NON\_LEGAL\_CURRENT\_SVW

The Goal 2 areas of the Protected Area Strategy that have not been established as parks or have not been deleted from consideration were compiled by FLNR Selkirk Resource District geomatics staff. A hard copy of an exhibit A of the Goal 2 parks (with route tag March 2009) was used as the base of the Goal 2 parks. File name: nbndryTSA\_PAS2\_notinPrks.shp

Wildlife habitat areas for the Boundary TSA were extracted from the provincial layer. File name: WHSE\_WILDLIFE\_MANAGEMENT.WCP\_WILDLIFE\_HABITAT\_AREA\_POLY

Ungulate winter ranges that were approved on May 8, 2006 for the Boundary TSA were extracted from the provincial layer. File name:

WHSE\_WILDLIFE\_MANAGEMENT.WCP\_UNGULATE\_WINTER\_RANGE\_SP

The buffered riparian data set as described in the previous 2001 timber supply analysis was obtained from Ecora Resource Group Ltd. File name: ftrip\_dbo

Community watersheds within the Boundary TSA were extracted from the provincial data set. File name: WHSE\_WATER\_MANAGEMENT.WLS\_COMMUNITY\_WS\_PUB\_SVW

The visual landscape inventory in the Boundary TSA is based on a 1995 Government Actions Regulation (GAR) order. The data set is extracted from the provincial visual landscape inventory. File name: WHSE\_FOREST\_VEGETATION.REC\_VISUAL\_LANDSCAPE\_INVENTORY

Forest recreation sites and trails within the Boundary TSA were extracted from provincial data sets. A listing of sites and trails established under FRPA Section 56 and a summary of objectives was provided by FLNR Sites and Trail Branch. File names:

WHSE\_FOREST\_TENURE.FTEN\_RECREATION\_POLY\_SVW,  
WHSE\_FOREST\_TENURE.FTEN\_RECREATION\_LINES\_SVW

A buffered layer of forest research installations for the Boundary TSA was extracted from the provincial layer. The data custodian identified that the data set had not been recently updated. File name: WHSE\_FOREST\_VEGETATION.RESPROJ\_RSRCH\_INSTN\_GVT\_SVW

A point data set of active growth and yield permanent sample plots for the Boundary TSA was extracted from the provincial data set. File name: WHSE\_FOREST\_VEGETATION.GRY\_PSP\_STATUS\_ACTIVE

A shapefile of currently known archaeological sites within the Boundary TSA was provided by FLNR Archaeological Branch. This file is extracted from the Remote Access to Archaeological Data (RAAD) database. File name: Arch\_sites\_within\_Boundary\_TSA

Canadian Pacific Railway (CPR) timber reserves were mapped by FLNR Kootenay Boundary geomatics staff. This data set is an unofficial assessment of CPR lands and the potential presence of a timber reserve on those lands. This file was made available from FLNR Selkirk Resource District geomatics staff. File name: railway\_areas\_of\_concern\_10Mar2010

Power transmission lines within the Boundary TSA were extracted from an unsourced data set used by regional FLNR geomatics staff. This file is believed to have been provided by BC Hydro and offers a more complete data set of transmission lines than currently is present within the TRIM files found on the LRDW. File name: TRIM\_Transmission\_And\_Communication\_Lines.shp

Current and projected percentages of volume loss due to the current Mountain Pine Beetle epidemic are created by FLNR FAIB. Projections are based on the provincial level model BCMPB. Maps updated in the Spring of 2011 will be used. Filename: N/A

## 4. Land Base Definition

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This part of the data package outlines the steps used to identify the Crown forested land base (CFLB) and the timber harvesting land base (THLB). These are land base simplifications used for analysis purposes.

The CFLB consists of provincial Crown land with forest cover that is managed by the Ministry of Forests, Lands, and Natural Resource Operations (FLNR) for timber supply and/or other forest management objectives that impact timber supply within the TSA. The CFLB excludes:

Non-provincial lands that are not within the decision land base such as:

- private lands;
- lands under federal jurisdiction (e.g., National Parks and Indian Reserves).

Provincial lands not included in TSA AAC:

- community forests;
- tree farm licences;
- controlled recreation areas;
- woodlot licences; and
- non-forested and unproductive lands with no impact on forest management objectives.

The THLB is that portion of the CFLB that is available for timber harvesting. Any area in which some timber harvesting will occur remains in the THLB, even if the area is subject to other management objectives such as wildlife habitat and biodiversity that limits timber harvesting. These non-timber objectives may be modelled in the timber supply analysis and may restrict timber supply. The THLB excludes:

- parks and protected areas;
- areas that are not suitable for timber production; and
- areas where timber harvesting is fully incompatible with management objectives for other resource values.

The above definition for THLB and its complement, non-THLB, are model simplifications.

Operationally, areas classified as non-THLB are sometimes harvested and areas classified as THLB may never be harvested.

Table 3, which is known as the netdown table, summarizes the classification of the CFLB and THLB. This table will be completed and included in the final data package that is released following the timber supply analysis. Each factor in this table is further described in following sections.

Table 3. Crown forested and timber harvesting land base determination for the Boundary TSA

Factor	Gross land base (ha)	Within CFLB (ha)	Unique area excluded from THLB
<b>Boundary TSA gross</b>	659 000		
Non-provincial Crown lands	59 918	0	TBD
Not managed for TSA AAC	95 743	0	TBD
Non-forest and non-productive	205 724	0	TBD
Roads, trails, landings and transmission lines	8 641	0	TBD
<b>Crown forested land base</b>		TBD	
Parks & misc reserves	79 499	TBD	TBD
Recreation sites and trails	4 373	TBD	TBD
Terrain stability (U & V)	7 760	TBD	TBD
Environmentally sensitive area – regeneration	14 831	TBD	TBD
Inoperable	113 347	TBD	TBD
Low timber productivity	15 567	TBD	TBD
Problem forest types	7 818	TBD	TBD
Wildlife habitat areas	3 129	TBD	TBD
Riparian management	16 545	TBD	TBD
Research installations	24	TBD	TBD
Growth and yield permanent sample plots	1 054	TBD	TBD
Archaeological sites	207	TBD	TBD
<b>Timber harvesting land base</b>		<b>TBD</b>	

**Data source and comments:**

Gross land base is the total land base of a factor. For some factors (e.g. wildlife habitat areas) the value does not include areas that remain within the timber harvesting land base.

“Within the CFLB” indicates that amount of area for a factor that is considered to be potentially applicable to management objectives such as landscape biodiversity seral requirements.

“Unique area excluded from THLB” shows the area for each factor that was uniquely excluded from the THLB due to this factor. This table does not show the sequential netdown of each factor as is often shown in netdown tables in previous timber supply reviews.

The terrain stability mapping does not fully cover the area within the TSA but does cover the expected timber harvesting land base. For example, terrain stability in areas such as parks was not mapped because these areas are excluded from the calculation of the THLB.

The gross land base for problem forest types does not include the gross area associated with the “dense pine” type. This value will be determined later when yield tables are derived for the analysis.

## 5. Timber Harvesting Land Base Definition

### 5.1 Land not administered for TSA timber supply

Land not administered by the FLNR for timber supply in the TSA includes “Non-provincial Crown lands” (e.g., private land, municipal land, federal land, Indian Reserves) and tenures that are “Not managed for TSA AAC” (e.g. tree farm licences, community forest agreements, woodlot licences). These areas are all excluded from both the CFLB and the THLB and do not contribute to objectives for wildlife habitat or biodiversity as modelled within the timber supply analysis.

Parks and protected areas within the core TSA are part of the CFLB and contribute to objectives for biodiversity and wildlife. However, they are not administered by the FLNR for timber supply and thus are excluded from the THLB.

A spatial data set of land ownership has been developed using information from the Crown land registry and the Integrated Cadastral Information Society. Table 4 shows the contribution of each ownership category to the CFLB and the THLB.

*Table 4. Ownership in Boundary TSA and inclusion in modelled land base*

Ownership code	Gross land base (ha)	Crown forested land base	Timber harvesting land base
40 Private – Crown Grant	59 918	No	No
60 Crown Ecological Reserve	1	Yes	No
61 Crown Use, Recreation and Enjoyment of the Public (UREP) Reserves	1 567	Yes	Yes
62 Crown Forest Management Unit (TSA) or Crown Timber Agreement Lands	417 196	Yes	Yes
63 Crown Provincial Park Class A	79 102	Yes	No
67 Crown Provincial Park equivalent or Reserve	158	Yes	No
69 Crown Miscellaneous Reserves	5 336	Yes	Partial
72 Crown and Private Schedule “A” and “B” Lands in a TFL	77 006	No	No
77 Crown and Private Woodlot Licence	18 714	No	No
79 Community Forest	0	No	No
99 Crown Misc. Lease (Fairground, R&G Club site, recreation cottage site)	23	No	No

#### Data source and comments:

The Boundary TSA does not contain any federal reserves, national parks, or Indian Reserves. For the purposes of the netdown table (Table 3) the private lands ownership code 40 is considered non-provincial Crown land.

For the purposes of the netdown table (Table 3) tree farm licences, woodlots, community forests, and Crown miscellaneous leases, (respective ownership codes 72, 77, 79, and 99) are considered “Not managed for TSA AAC”. These are land bases that are excluded from contributing to all forest management objectives considered in determining the AAC for the TSA. Except for Crown miscellaneous leases, these excluded tenures have their own AAC determinations.

UREPs are reserves without legal objectives or resource feature status created under the *Land Act*. For this analysis UREPs are not removed from CFLB or THLB. However, many of the overlapping recreation sites or trails have been designated under FRPA Section 56 and if objectives have been established that would result in no harvesting, these sites and trails are removed from the THLB.

Lands identified as Crown miscellaneous reserves (ownership code 69) include recreational, fish and wildlife, and watershed reserves. Recreational reserves are specifically considered elsewhere in the analysis. The remaining Crown miscellaneous reserves occupy 192 hectares. These reserves are included in the CFLB but excluded from the THLB. In the netdown table (Table 3) this is shown as “Parks and miscellaneous reserves”.

Discussions are underway with the Midway and Greenwood Community Forest Association to create a new community forest agreement in the vicinity of Midway. As this licence has not yet been awarded, it is not modelled in the base case. The impact of awarding this tenure will be explored as a sensitivity analysis if a specific area is identified.

The Canadian Pacific Railway (CPR) holds potential timber reserves on 3571 hectares within the Boundary TSA. On some sites, the CPR may have the right to harvest the mature timber after which the harvesting rights revert to the Crown. The government is working to resolve the question of ownership of this timber. Since the outcome of this work is unknown, CPR reserve lands are not modelled in the base case and are presented for information only.

## **5.2 Non-forest, non-productive forest and non-commercial cover**

Table 5 shows the criteria used to remove non-forested areas, non-productive forest, and non-commercial cover from the THLB.

Table 5. Description of non-forest, non-productive forest and non-commercial areas

Attributes	Gross land base (ha)	Description
<b>Non-forest</b>		
BCLCS level 1 equal 'N'	32 973	Non-vegetated
BCLCS level 2 = 'N' AND BCLCS level 4 not equal to 'ST' or 'SL'	34 681	Vegetated but non-treed, excluding shrub areas
BCLCS level 2 = 'N' AND BCLCS level 3 = 'W'	1 752	Non-treed wetlands
BCLCS level 3 = 'A'	9 609	Alpine
<b>Non-productive forest</b>		
FMLB indicator = "N"	195 635	Land base that is not considered forested and not productive
<b>Non-commercial forest</b>		
VRI: BCLCS level 2 = 'T' AND BCLCS level 3 = 'W'	2	Treed wetlands
VRI: BCLCS level 4 = 'ST or 'SL' AND no logging history	9 633	Shrub and not already logged

**Data sources and comments:**

The Boundary TSA forest inventory consists of Forest Inventory Planning (FIP) data converted to a Vegetation Resource Inventory (VRI) format. The criteria listed in the table above are more specific to identifying a productive forest land base than are the criteria used to identify the more generalized forest management land base within the VEG\_COMP\_POLY layer in the LRDW.

BC land classification system (BCLCS) attributes identify non-vegetated and various classes of vegetated areas. Non-forested areas include water and non-vegetated land such as rock, ice and bare land. It is assumed that non-forested areas are not capable of growing forests. Non-commercial areas are generally covered by brush species and are also not considered suitable for timber production. All of these areas are excluded from both the CFLB and the THLB; they do not contribute to modelled objectives for wildlife habitat or biodiversity.

The forest managed land base (FMLB) excludes non-productive forest but also other areas such as water bodies, roads, non-forest, and low-sites. FLMB is coded as "NO" for areas of non-productive forest, if the land base has no harvest history, and if the site index < 5 m. These areas of low site productivity are considered non-productive and do not contribute to modelled objectives for wildlife habitat and biodiversity. By contrast, areas classified as having low timber growing potential (see Section 4.6) still contribute to modelled objectives for wildlife habitat and biodiversity.

**5.3 Environmentally sensitive areas – terrain stability**

Terrain stability mapping (TSM) provides a more accurate assessment of slope stability than environmentally sensitive areas (ESA) mapping for sensitive soils (Es). TSM may be conducted to various standards. In 2003, Pope and Talbot contracted terrain stability mapping for the TSA at C and D levels.



Environmental sensitivity may reduce or preclude harvesting on identified sites. Areas with a high risk of landslide are less likely to be harvested, while areas with a moderate risk of landslide may prove to be harvestable when operationally reviewed and managed. Table 6 shows the proportion of terrain stability polygons in various categories that are excluded from the THLB.

Table 6. Description of environmentally sensitive areas

ESA category	Gross land base (ha)	ESA description	Reduction (%)
TSM class U or V	7 760	Unstable slopes – high likelihood of landslide initiation following timber harvesting or road construction	100
TSM class P or IV	53 681	Potentially unstable slopes – moderate likelihood of landslide initiation following timber harvesting or road construction	0

#### Data sources and comments:

ESAp1 (areas having severe regeneration problems) are no longer maintained in the forest inventory, and are therefore not considered as reliable information. A cursory review by ministry staff showed that only 393 hectares (one percent of harvested area) have been harvested in previously identified ESAp1 areas. The ESAp1 designation will be evaluated as to whether it is reasonable to exclude areas with this classification from the timber harvesting land base. The gross land base in ESAp1 is 14 831 hectares.

Land base exclusions for ESAs for watersheds (H), recreation (R), and wildlife (W) are not used because they are also outdated. They are replaced by mapping for community watersheds, recreation reserve mapping, and specific mapping of wildlife habitat areas.

Terrain Stability Mapping (TSM) has been completed for the entire TSA to either level C or level D except within areas such as provincial parks.

Areas classified in TSM as U (*unstable*) or Class V (*five; very unstable*) terrain, are generally unsuitable for harvest. However, TSM tends to overestimate the amount of class U or V terrain because of limited field sampling for some levels of survey intensity. TSM is inherently conservative to ensure that all unstable areas are identified and subjected to field assessment. Terrain class U or V is modelled as 100% unharvestable, even though it is known that this deduction is likely too high.

Areas classified in TSM as P (*potentially unstable*) or Class IV (*four; moderate instability*) terrain are generally suitable for harvesting. These areas often require more expensive road construction techniques to mitigate the potential for subsequent landslides. Where construction costs are prohibitive and alternative road locations are not available (i.e., either above or below the Class IV terrain), areas may become unavailable for harvesting due to access limitations. Terrain class P or IV is modelled as 100% harvestable (no reduction), even though it is known that these deductions are likely not large enough to reflect actual operational conditions.

In the Boundary TSA the amount of area classified as P or Class IV (53 681 hectares) is much larger than the area classified as U or Class V (7760 hectares). In the timber supply calculation no deduction is made for P or Class IV terrain but it is reasonable to assume that some of these areas cannot actually be harvested. If 20% of the P or Class IV area was not available for timber land base, this would equate to 10 736 hectares of overestimated land base.

Similarly, a 100% deduction is made for all of the U or Class V terrain (7760 hectares) when in reality, some of these areas may be available for harvesting. If 20% of the U or Class V area can be harvested, this would equate to an underestimation of the land base of 6208 hectares. Therefore, the difference between 10 736 hectares overestimation and 6208 hectares underestimation indicates that the base case potentially overestimates the harvestable area within the TSA by 4528 hectares.

## 5.4 Areas with high recreation values

BC's protected areas strategy identified numerous 'Goal 2' areas for the protection of natural, cultural and recreational features. Within the last year, the Kootenay Boundary Manager's Committee approved the list of Goal 2 areas, and recommended their establishment as protected areas. The instrument establishing each of these parks has not yet been created; however, there is a high degree of certainty that they will be established in the near future. Licensees have not been harvesting in these areas and for this reason Goal 2 areas are not included in the THLB. In the netdown table (Table 3) Goal 2 areas are included with "Parks & miscellaneous reserves".

Areas designated as Crown Use, Recreation and Enjoyment of the Public (UREPs) fall under *Land Act* reserves, but without having designation under other legislation they are not reserved from harvest. UREPs are not modelled in this analysis.

The Recreation Sites and Trails Branch of FLNR administers forest recreation sites and trails. Recreation sites and trails can be legally established. The objectives for these sites typically identify the maintenance of a recreational feature such as a campsite or trail and the conservation of natural vegetation. Although the objectives do not preclude industrial activity or harvesting, some loss of forest productivity is expected. For this analysis, FLNR recreation staff suggest that a land base reduction of 20-40% of the gross area within an established site would be appropriate. This reduction may overlap with other existing retention objectives (e.g., riparian management).

For this analysis 40% of the land base will be considered unavailable for harvesting where an appropriate objective is identified for an established recreation site. For trails, a 200 metre buffer will be assumed on the Dewdney heritage trail and 20 metre on other established trails with relevant objectives.

Table 7. Recreation sites and trails

Category	Gross land base (ha)	Reduction (%)
Recreation sites	3 901	40
Dewdney heritage trail	370	100
Recreational trails	204	100

## 5.5 Inoperable areas

Areas in the Boundary TSA are considered inoperable where there are physical barriers or limitations to harvesting, where appropriate logging methods (e.g., cable) are not available or deemed to be too costly, or where stands are not merchantable (low value or high cost). Technology and economic conditions affect the inoperability definition.

For the analysis, all areas classified "I" (Inoperable) or "unclassified" are removed from the THLB. There are 113 347 hectares identified as inoperable within the Boundary TSA.

### Data sources and comments:

Operability mapping has not been revised since 1991 when it was mapped by the Ministry of Forests. In preparation for the previous TSR, the licensee, Pope and Talbot, reviewed the operability mapping and found it to underestimate the size of the THLB. In 1994 the Ministry of Forests compared the Pope and Talbot review to the Ministry mapping, and found the differences to be minimal. The Ministry of Forests mapping was used for TSR in 2000 but the chief forester requested a review of the mapping in his instructions.

The operability mapping has not been fully reviewed. It is generally agreed by the licensees and the Ministry that the mapping is adequate as a strategic planning tool. Although monitoring shows some inoperable areas are harvested, it is less straightforward to identify areas that are classified as accessible that are not harvested due to physical or economic impediments.

The FLNR compared cutblock information in the Land and Resource Data Warehouse with the mapped inoperable area. In total, 930 hectares of mapped inoperable has been harvested, which equates to 1.5% of the inoperable area and represents 2.4% of the area harvested. This review confirms that only a small amount of inoperable is harvested, and that it is reasonable to use the existing operability mapping.

Areas classified as inoperable are sometimes harvested. For this analysis, these harvested areas that were classified inoperable are not re-classified as operable. To add operable areas to the THLB without some corresponding reduction for the inoperable areas would be overly optimistic.

## 5.6 Sites with low timber growing potential

Sites may have low productivity because of inherent site factors such as nutrient availability, exposure, excessive moisture, etc. These stands are unlikely to grow a merchantable crop of trees in a reasonable amount of time. Typically, these stands are inter-mixed with other stands within the forested land base. As these stands are not considered to be harvestable, they are removed from the timber harvesting land base using the criteria listed in Table 8.

*Table 8. Description of sites with low timber growing potential*

Leading species	Qualification	Site index (m @ 50 years)	Gross land base (ha)	Reduction percent (%)
PL		< 7.5	398	100
FD, PY		< 8.5	421	100
L	< 80%, Fd second	< 8.5	14	100
L	> 80%	< 7.5	0	100
CW, HW, PW		< 9.0	1 132	100
S, B		< 8.0	13 602	100

### Data source and comments:

The site indices that define low site in the previous table are derived from the TSR 2 determination definition based on the inventory type groups identified in the previous forest inventory. The above definitions explicitly identify the leading and secondary species.

The district did a review of the overlap of harvesting with the low sites as defined above. In total, 267 hectares of low sites were harvested, representing less than one percent of the cutblocks. This review confirms that very few of the low sites have been harvested and the netdown for these sites is appropriate.

## 5.7 Problem forest types

Problem forest types are stands that are physically operable but that because of very low site indices are not currently utilized or have marginal merchantability. Currently, deciduous-leading stands and low volume dense Lodgepole pine stands are not targeted for harvest in this TSA and are therefore excluded from the timber harvesting land base according to the criteria listed in Table 9.

Table 9. Problem forest types criteria

Description	Age	Volume	Gross land base (ha)	Reduction (%)
Deciduous-leading stands	All	All	7 818	100
Dense Pine (>70 PI)	at 120	has < 100 m <sup>3</sup>	TBD	100

**Data source and comments:**

For TSR 2, extensive work was done to identify dense pine stands that were unlikely to be harvested. A population was identified using site, age, height and stocking criteria. The population was then sampled to determine what proportion would be incapable of growing 100 cubic metres in volume in less than 120 years. This ratio was then applied to the entire stand population to calculate the area that would not be harvested. For TSR 3 this definition was simplified by identifying the sample population as all stands having greater than 70% pine and the same low volume criterion.

Currently new licensees are looking at harvesting smaller diameter types in the Boundary TSA. The district is also pursuing funding to harvest dense lodgepole pine stands and then to rehabilitate these sites with plantations of more productive species. To date, neither of these initiatives is operational. Consequently, for the base case it is assumed that dense pine is not harvested.

**5.8 Wildlife habitat reductions**

Wildlife habitat may be identified and managed through several processes including the *Identified Wildlife Management Strategy*, identification and approval of ungulate winter range (UWR), and management practices specified in plans that establish legal objectives, such as the Kootenay Boundary Higher Level Plan order.

Numerous Wildlife Habitat Areas (WHA) have been established under the Government Actions Regulation (GAR) or grandparented under the *Forest Practices Code Act* for the protection of identified wildlife. Species and plant communities with established WHAs include Williamson's sapsucker, Lewis's woodpecker, grizzly bear, badger, ponderosa pine, black cottonwood, snowberry and data sensitive species. Management of these areas can exclude, limit or permit timber harvesting. The below table describes the WHAs to be removed from the THLB. WHAs that do not have a timber supply impact are not excluded from the THLB.

Ungulate winter range established in the Boundary TSA restricts but does not exclude harvesting. UWR is therefore modelled as a constraint to timber supply but not removed from the THLB.

Table 10. Wildlife habitat area exclusions

Wildlife species and communities	Inventory description	Gross land base (ha)	Reduction (%)
Ponderosa pine – Black cottonwood-snowberry	WHA # 8-001	12	100
Williamson's Sapsucker	WHA # 8-203, 204, 205, 208, 210, 213	217	100
Lewis's Woodpecker	WHA # 8-299, 300, 301	65	100
Badger	WHA # 8-329, 330	29	100
Grizzly Bear	WHA # 8-139 to 8-148, 4-095	2 778	100
Data sensitive	WHA # 8-239, 8-374 – Core Area	28	100

**Data source and comments:**

Wildlife habitat areas are available on the LRDW as a single provincial data set. Individual wildlife habitat area information (spatial data set, approved order and general wildlife measures) is available from <http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html>. To date, WHA #8-243 had not been incorporated into the provincial data set. However because the general wildlife measures for this WHA are expected to have minimal impact on timber supply, the data set was not updated to include WHA #8-243.

General Wildlife Measures Order #8-373 provides additional protection for the conservation of grizzly bear. The requirements under this order are assumed not to restrict timber supply above other existing objectives or current management practices. This wildlife measure was therefore not modelled in the current analysis.

**5.9 Cultural heritage resources**

Archaeological sites identified under the *Heritage Conservation Act* are not harvested and as such are excluded from the timber harvesting land base. Current data indicates a total of 187 sites covering 207 hectares. In practice, retention requirements for other management objectives (e.g. wildlife tree patches and riparian management) may also protect archaeological sites.

To address the possibility of unknown archaeological sites, an archaeological overview assessment (AOA) was completed for the Boundary TSA. The AOA used a predictive model to delineate areas where the potential for finding archaeological sites is medium or high. Licensees are responsible for using the AOA to determine where more detailed field assessments are required prior to harvesting.

If a new cultural heritage resource is identified that is not managed within existing retention areas (e.g. riparian areas and wildlife tree patches), the licensee operationally assesses the identified areas and where appropriate, may acquire site alteration permits under the *Heritage Conservation Act*. These potential areas are not modelled in the current analysis but would be expected to be captured in future timber supply reviews.

**Data sources and comments:**

FLNR Archaeological Branch provided a data layer of archaeological sites extracted from the Remote Access to Archaeological Data (RAAD) database on March 17, 2011.

## 5.10 Riparian reserve and management areas

Table 11 lists the area reductions to be applied to account for riparian reserve zones and riparian management zones along streams and around lakes and wetlands.

Table 11. Riparian management area buffer determination

Stream, wetland or lake class	Reserve zone width (metres)	RRZ reduction (%)	Management zone width (metres)	RMZ reduction (%)	Buffer width (metres)
S1	50	100	20	50	60
S2	30	100	20	50	40
S3	20	100	20	50	30
S4	0	N/A	30	25	7.5
S5	0	N/A	30	25	7.5
S6	0	N/A	20	0	0
W1	10	100	40	25	20
W3	0	N/A	30	25	7.5
W5	10	100	40	25	10
L1-A (area ≥ 1000 ha)	0	N/A	0	N/A	0
L1-B (area < 1000 ha)	10	100	0	N/A	0
L3	0	N/A	30	10	3

### Data sources and comments:

Full retention of riparian reserves is required under the *Forest Planning and Practices Regulation*. Riparian management zone requirements are placed appropriately on the land base. Forest Stewardship Plans (FSP) define the minimum standard for RMZ retention. The percentages shown above are higher than the commitments in the Interfor FSP, and about the same as commitments made by Weyerhaeuser.

Licensees will often locate wildlife tree patches (WTP) on riparian areas where possible; therefore some portion of the riparian retention will be located in areas that are non-contributing. The poor quality of the WTP data in RESULTS makes it impossible to conduct a mapped review of the overlap between WTP and RMZ. The district has not conducted any other review of riparian retention practices. Licensees agree that the stream widths approximate current management.

The base case includes the buffered stream data used in TSR 2. This was based on the Ministry of Environment, Lands, and Parks Fisheries Stream Atlas data available in 1996, and the Forest Practices Code guidelines for reserves and management zones (format is similar to Table 11 above).

District staff compared the buffered stream data to the modelled fish passage data which is TRIM based. The TSR 2 data set was found to significantly underestimate stream length of small order streams. Information related to this underestimation will be provided for the AAC determination but no adjustments will be incorporated into the timber supply analysis.

## 5.11 Wildlife tree patches

The *Forest and Range Practices Act* (FRPA) establishes an objective to maintain structural diversity in managed stands by retaining wildlife tree patches in each cutblock. The default value under FRPA is a minimum of 7% retention in each block. Licensees may vary from this requirement by specifying an acceptable alternative in their Forest Stewardship Plan but to date, no licensees have chosen to retain less than 7%.

Based on 23 Forest and Range Evaluation Program (FREP) Stand Level Biodiversity surveys conducted in the Boundary TSA between 2005 and 2009, 8% of stands are retained in wildlife tree patches. Although the sample size is small, it is based on a systematic random sample and the data collection is quality assured.

Wildlife tree patches (WTP) are often located within areas that are otherwise constrained, such as riparian areas, sensitive or inoperable terrain and therefore the impact to the THLB is likely less than 7% minimum retention requirement. District staff compared an overlay of constrained areas and WTP obtained from the silviculture database RESULTS. Approximately 70% of the WTPs are within the THLB.

Wildlife tree patches are modelled as yield table reduction 5.5% (70% of 8%) based on the information above.

**Data sources and comments:**

Older RESULTS data has poor quality WTP data for overall summaries. Licensees are not required to submit spatial data for WTPs until free growing is declared. Therefore at any given time there may be a number of blocks with no corresponding WTP reported. Additionally, numerous blocks have been identified with WTPs incorrectly coded in the database.

## **5.12 Roads, trails, landings and transmission lines**

Productive forest land is lost due to permanent roads, trails and landings (RTL). Existing estimates of the area occupied by RTL are applied as reductions to the current THLB. Table 12 shows the length of road types within the Boundary TSA and reductions to be made for existing RTL.

No further work on the impacts of past landings has been completed. The assumption of 1770 hectares of THLB loss used in the previous timber supply review will be assumed. This area will be applied as a THLB loss in polygons, proportional to the area of spur road present.

As development occurs in the TSA, further RTL reductions will occur. Typically, the volume from the area occupied by the new roads and trails would be assumed available for an initial harvest and not available for later harvests. As the forest estate model to be used in this analysis cannot accommodate this temporal change of timber harvesting land base, future roads, trails, and landings will not be accounted for directly. The chief forester will be presented information on the likely impact of future RTL for consideration in making his allowable annual cut determination.

Vegetation management occurs on transmission lines. BC Hydro has identified that a 60-metre buffer for right-of-ways along transmission lines would be an appropriate provincial standard. As was applied in the previous timber supply review a 49-metre buffer along the 251 kilometres of transmission lines is excluded from the THLB.

*Table 12. Summary of existing roads, trails, landings and transmission lines*

<b>Roads type</b>	<b>Length (km)</b>	<b>Modelled buffer (m)</b>	<b>Gross land base (ha)</b>
Highway	231	60	1 386
Main	571	14	799
Operational	2 636	8.5	2 241
Spur	3 215	3	964
Trail	5 387	0	
Landings	N/A	N/A	1 770
Transmission lines	252	49	1 481

**Data sources and comments:**

FLNR regional geomatics staff built a consolidated road layer using available data sources. A qualitative judgment was made of each road as to the classification and width. Main roads consist of community roads and major Forest Service roads. Operational roads are permanent access roads that provide continuity to multiple cutblocks and access for potential future harvesting. Spur roads are characterized by in-block roads that do not provide continuity between blocks. Trails are the numerous very small roads that appear to be partially brushed in and likely not drivable.

Work was done during and subsequent to the previous TSR to measure the impact of RTLs on the existing productive land base. In the 2002 AAC determination rationale, the chief forester considered a buffer of 14 metres on a Forest Service Road (now called Main), and 8.5 metres on a Spur road (now labeled Operational) as appropriate.

The line work for trails was taken directly from the Digital Road Atlas; not all were reviewed individually. These non-status roads are in varying states of revegetation, and many are impassable due to brush. The non-status roads may be narrow enough that they likely will not constitute a gap in the canopy of a mature forest. As well, some of the trail area will be captured in the calculation of future roads, trails and landings. For these reasons, they are not modelled in the base case harvest forecast.

For existing landings, a volume table reduction of 1.05% was applied in the previous TSR. Practices have changed somewhat, in that licensees tend to do more roadside harvesting where the terrain permits. Thus in current operations, landings may be somewhat smaller while roads may be slightly wider. As updated information is not available, the current analysis assumes an impact of 1770 hectares as identified in the previous TSR. This impact will be distributed proportionately to the length of roads within each forest polygon.

The timber supply model to be used has a road planning module to approximate the location of future roads. The sequence of “building” these future roads identifies the timing of harvest blocks but the model does not remove the area of these future roads from the THLB. Projected future harvest flows will therefore be overestimated when these future roads are built and the area is removed from the productive land base.



The Boundary TSA is well roaded and the proportion of roads for new development will be decreasing over time. In the 2002 AAC determination rationale where it was assumed that roads created a 6% loss to the land base; equal to 14 568 hectares. For this determination, the chief forester assumed that estimates were lower than this previous amount, but were higher than an estimate of 2875 hectares provided by BCTS.

The source of the transmission line data is unclear. However when the data set used was compared to the imagery and TRIM data within the LRDW, it appears to be the best available data.

### **5.13 Research installations**

Several forest research installations are present within the Boundary TSA. Objectives for these installations have not been established under FRPA. However, harvesting within active research installations is currently avoided.

Within the Boundary TSA, documented research installations occupy 60 hectares of which 24 hectares are active installations. The active installations are not included within the THLB.

### **5.14 Growth and yield permanent sample plots**

The FLNR maintains a network of growth and yield permanent sample plots (PSPs) across the province for the purposes of understanding forest growth through the calibration of growth and yield models. Objectives for these plots have not been established under FRPA. However, harvesting within the plot and within a buffer area of active PSPs is currently avoided. FLNR FAIB staff identified that a 68 metre buffered area would be reasonable to exclude from the THLB.

In the Boundary TSA, growth and yield PSPs occupy 1054 hectares assuming a 68-metre buffer.

### **5.15 Timber licence reversions**

Timber licences are a form of timber tenure that gives the holder exclusive right to harvest merchantable timber from defined areas of Crown land. After the area is harvested and reaches a free-growing condition the land reverts to Forest Service jurisdiction. The timber cut from timber licenses is not part of the allowable annual cut of a TSA.

There are no longer any timber licences in the Boundary TSA.

## 6. Current Forest Management Assumptions

### 6.1 Harvesting

#### 6.1.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter (inside bark) and minimum diameter (at breast height) by species. Table 13 shows the utilization levels used in the analysis to calculate merchantable volume.

Table 13. Utilization levels

Analysis unit	Utilization		
	Corresponding minimum DBH (cm)	Maximum stump height (cm)	Minimum top DIB (cm)
Pine	12.5	30	10
Cedar	17.5	30	15
All other	17.5	30	10

#### Data sources and comments:

The Interior Timber Merchantability Specifications of the *Provincial Logging Residue and Waste Measurement Procedures Manual* (Table 1-2) specifies the utilization levels for billing of harvested timber and are also used in assessing cut control for license AACs.

For yield table projections in the timber supply analysis, the specifications for minimum stump diameter are converted to a corresponding breast height diameter. The specification for minimum top diameter inside bark is assumed to be 10 cm due to limitations of the growth and yield models.

#### 6.1.2 Mixed deciduous

Deciduous species are not typically utilized within the Boundary TSA. For the analysis, the deciduous component of mixed stands is excluded from the yield tables. Deciduous-leading stands are excluded from the timber harvesting land base.

#### 6.1.3 Log grade changes

On April 1, 2006 new log grades were implemented for the BC Interior. Under this system, grades are based on a log's size and quality at the time it is scaled without regard to whether it was alive or dead at harvest. Standard yield tables generated by both VDYP and TIPSYS do not incorporate the now included grade 3 endemic and grade 5 log volumes. Information will be presented to the chief forester for use in his AAC determination from several studies including inventory audits about these dead potential grades.

#### Data sources and comments:

Ministry of Forests and Range. 2006. Summary of dead potential volume estimates for management units within the Northern and Southern Interior Forest Regions.

#### **6.1.4 Minimum harvestable ages**

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 unless the stand has not yet reached 100 cubic metres per hectare. The minimum harvestable age choice will be investigated with a sensitivity analysis.

##### **Data sources and comments:**

Criteria are based on minimum harvestable ages reported in the 2001 TSR 2 analysis report.

#### **6.1.5 Harvest scheduling priorities**

The order in which stands are harvested can impact timber supply. Licensees select stands to harvest through consideration of many factors.

In the previous TSR 2 timber supply analysis the oldest available stands relative to the minimum harvestable age were harvested first. In this analysis, the same relative oldest first harvest priority is used in the base case.

##### **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 Boundary 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.

#### **6.1.6 Silvicultural systems**

Most harvesting within the Boundary TSA involves a clearcut silviculture system. Ninety-two percent of the area is harvested using clearcut, clearcut with reserves, patch cut or seed tree systems. The remaining 8% is harvested using selection (4.2%) or shelterwood (4.2%) systems.

For the current timber supply analysis, only clearcut harvesting will be used with assumptions that retention is addressed through various netdowns and management constraints. Our ability to model partial harvesting is limited by our knowledge of and the variability of partial harvesting. Further, the forest estate model to be used is not able to incorporate partial harvesting as thoroughly as possible.

An insignificant amount of commercial thinning has been completed in the Boundary TSA in the last 10 years. New licensees may be operating within the TSA in the near future, for which the operations may need to be considered in future determinations. Commercial thinning is not modelled in this determination.

##### **Data sources and comments:**

Disturbance reporting for the silviculture database RESULTS for January 1, 2000 to December 31, 2009 was used to summarize the silviculture systems. The data may slightly over represent the use of clearcut systems, since some licensees report their permanent access structures as a separate disturbance. Patch cuts were classified as small clearcuts, and may also be over reported due to some inaccuracies around area reporting.

In the previous TSR analysis all silvicultural systems were modelled as clearcut. Alternatively, in the Type 2 silviculture strategy all *Open Forest* and *Open Range*, which constitutes roughly 5% of the THLB, was modelled as partial harvest. For the purpose of this analysis, the entire area is modelled as clearcut. Modelling this very small percentage of partial harvest on the TSA will have minimal timber supply impact.

## 6.2 Unsalvaged losses

Table 14 shows the estimated average annual unsalvaged volume loss to insect and disease epidemics, fires, wind damage or other agents on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume is not recovered or salvaged.

Table 14. *Unsalvaged losses*

Cause of loss	Annual unsalvaged loss (m <sup>3</sup> /year)
Mountain Pine Beetle	24 090
Spruce Bark Beetle	4
Douglas-fir Bark Beetle	837
Balsam Bark Beetle	1 528
Blowdown and Landslides	2 500
Wildfire	614
<b>Total</b>	<b>29 572</b>

### Data sources and comments:

Unsalvaged losses are calculated using cumulative years of District Overview flight information. Each disturbance polygon within the timber harvesting land base that is not salvaged is tallied only once. Polygons that intersect with a harvesting unit do not contribute to the tally. The volume loss is determined using only the tree species volume that is susceptible to the disturbance type. Volumes are adjusted based on local knowledge of disturbance severity and likelihood of future salvage.

The previous analysis included retention tree mortality as a non-recoverable loss. Since retention trees generally do not contribute to the harvest forecast in the first rotation, retention tree mortality is not included.

The small scale salvage program issues an average of 14 600 cubic metres per year in the Boundary TSA. Because small scale salvage openings are less than a hectare they are generally not tracked, and therefore would not have been subtracted from the gross area of the infestation.

## 6.3 Mountain pine beetle

The mountain pine beetle has been active in the Boundary TSA for decades. Infestation levels have steadily increased since 2000, and are projected to increase until most of the Lodgepole pine in the Boundary TSA is killed. To date, the infestation is still considered to be local and endemic. For this reason it was considered to be most appropriate to not include MPB in the base case.

The BCMPB model is used in a sensitivity analysis. The current model has not been able to accurately reflect the spread of MPB in the Boundary TSA, although an updated version of the model is currently being developed. If an improved version is available for the analysis it will be used.

Sensitivities will explore different harvest priority rules for the harvest of MPB.

**Data sources and comments:**

Documents and data sets for the provincial level projection of the current mountain pine beetle outbreak developed by the Ministry of Forests, Lands and Natural Resource Operations are found at <http://www.for.gov.bc.ca/hre/bcmap/>

**6.4 Silviculture**

Since 1987 major licensees have had a legal responsibility for basic silviculture. To enable assessment of this responsibility, licensees conduct surveys of the regeneration on a cutblock and report this information in the FLNR database RESULTS. Summary information from RESULTS will be the basis for regeneration assumptions in the base case analysis (Table 21).

The licensees within the Boundary TSA have also identified their expected prescription for species composition, initial densities, and distributions. These values are reported and were used in timber supply analyses completed by Timberline Natural Resource Group to assess the Kootenay Boundary Higher Level Plan and silviculture options of the Boundary TSA. A sensitivity analysis will be performed using the licensee expected prescriptions.

**6.4.1 Regeneration delay**

Harvested stands are required to be reforested. Operationally there may be a delay between the harvest of a stand and when the site is in a fully regenerated state.

Using RESULTS data available for declared regeneration, the average difference between harvesting and new stand establishment was calculated to be 3.1 years. Assuming that stock is at least one year old when planted, this is a two-year average regeneration delay.

In the base case, a regeneration delay will be calculated from RESULTS data for each managed stand analysis unit.

**Data sources and comments:**

Average regeneration delay was summarized based on milestone reporting of regeneration from the silviculture database RESULTS for January 1, 2000 to December 31, 2009 and supplemented by Weyerhaeuser and BCTS data.

Regeneration of individual managed stand analysis units is derived from RESULTS summary file created in February 2011 for openings with even-aged management.

**6.4.2 Immature plantation history**

Over the last 10 years 1526 hectares were spaced in the Boundary TSA, roughly 150 hectares per year. This small amount of spacing is not modelled in the base case.

Areas of immature forest where the density (stems per hectare) has been reduced through spacing are assigned to a managed stand yield table.

**6.4.3 Not satisfactorily restocked (NSR) areas**

The total area classified as not satisfactorily restocked (NSR) land as of December 31, 2009 from RESULTS data is 4262.3 hectares. 4067.9 hectares of this area is either Major Licensee or BC Timber Sales area under obligation and presumably from recent harvesting and planned for upcoming reforestation. Only 194.4 hectares of land is currently listed as backlog NSR land. This area is relatively insignificant and is not modelled separately.

**Data sources and comments:**

RESULTS land status data based on reporting to March 31, 2009 and due by May 31, 2010 was used to summarize NSR area totals. It is assumed that all data for 2009 would have been reported when this data was summarized in November 2010. It was also assumed that 2010 reporting had not been completed by the licensees to date and/or would not have a significant impact on the NSR totals.

**6.5 Integrated resource management**

Forest cover requirements may be examined at a number of different levels, including landscape units, ungulate winter ranges, and visual quality areas. With the requirement to retain different forest characteristics across the landscape, it is important to identify how forest outside of the THLB may be considered in the forest cover requirements (i.e. maximum allowable disturbance or minimum area retention). Table 15 describes the forest cover requirements to be applied.

*Table 15. Forest cover requirements*

Resource objective	Area target (%)	Condition target	Affected land base
Patch size distribution	Maximum 35%	Height ≤ 3 m	THLB by landscape unit outside community watersheds, mule deer winter range and visual areas
Community watersheds	Maximum 30%	Height ≤ 5 m	Crown forested land base by community watershed for watersheds
Domestic watersheds	Not modelled		
Grizzly bear	Not modelled		
Visual quality objectives	See Table 18	Height ≤ visually effective green-up height in Table 19	Crown forested land base for each visual unit
Seral stage distributions	Old and mature targets applied		Crown forested land base by landscape unit and BEC variant
Ungulate winter range	See Table 17	See Table 17	Planning unit definition

**6.5.1 Patch size distribution**

Patch size distribution expectations are modelled using a proxy. Integrated resource management (IRM) areas are generally large contiguous areas of harvestable forest. The application of a maximum disturbance of 35% adequately describes the cutting pattern in use on the TSA at this time.

This constraint is applied to the integrated resource management area outside of mule deer winter range, community watersheds and areas with VQOs.

**6.5.2 Community watersheds**

There are five community watersheds within the Boundary TSA. Under the *Forest and Range Practices Act*, licensees are required to specify results and strategies that meet the objective set by government for water quality. In general, licensees have committed in their FSPs to complete hydrologic assessments, similar to what was done under the *Forest Practices Code Act*. While maximum Equivalent Clearcut Areas (ECA) recommended in these assessments is specific to each watershed, in general a 'red flag' value is set near the ECA limit specified in the *Forest Practices Code Community Watershed Guidebook*.

Table 16. Community watersheds within the Boundary TSA

Community watershed	Gross land base (ha)
Brides	279
McKinny	808
Moody	2 039
Overton	371
Sutherland	9 181

### 6.5.3 Domestic watersheds

Water intakes for human consumption occupy minimal area and are not modelled nor is the overall management of the watershed modelled.

BCTS feels that this is overly optimistic; they recommend a 40% cap on harvesting in watersheds licensed for human consumption.

### 6.5.4 Grizzly bear

General Wildlife Measures (GWM) were established for grizzly bear habitat on August 20, 2010 under the *Government Actions Regulation*. Provisions include restricted timing of road use and silviculture adjacent to avalanche chutes, retention of large woody debris and maintenance of huckleberry production. The Order does not restrict the amount of harvest or road building activities, and is therefore not modelled in the base case harvest forecast.

### 6.5.5 Ungulate winter range

*Government Actions Regulations* were established on May 8, 2006 for the protection of Mule Deer, Moose, Bighorn Sheep and Mountain Goat winter habitat. Order U-8-001 for Mule Deer is primarily applicable to the Okanagan TSA. Criteria appropriate to the predominant planning unit will be applied to this area.

Order U-8-008 for Mule Deer establishes objectives for the retention of snow interception cover for each UWR planning cell, limits the amount of disturbance in planning cells, and limits road densities to 3 km / km<sup>2</sup>. This analysis applies the snow interception cover (SIC) hectares required in the Order, as well as maximum disturbance. It is recognized that the actual planning within ungulate winter range is significantly more difficult than simply applying the SIC percentages. This Order is currently under review by the Ministry of the Environment.

Order U-8-007 establishes Snow Interception Cover and Forage requirements for Moose. These requirements are modelled as stated in the Order. If overlap with U-8-008, the objectives for U-8-008 take precedence.

Order U-8-009 establishes objectives for the maintenance of winter habitat for Mountain Goats. Because Mountain Goat habitat is generally characterized by steep, rocky terrain, there is little overlap with the timber harvesting land base. For this reason GAR Order U-8-009 is not modelled.

Order U-8-010 establishes general wildlife measures for Bighorn Sheep that prevents permanent road development. As there are no specific harvest restrictions this order is not modelled.

The objectives for the various orders are modelled as minimum retention or maximum disturbance constraints (Table 17). To model such requires simplifying the interpretation in the order more than is

done operationally. The simplification may result in lessened or increased constraints to timber supply. Guidance with respect to the possible difference will be provided to the chief forester for his consideration in the AAC determination.

Table 17. Modelled constraints for ungulate winter range objectives

Ungulate winter range	Gross land base (ha)	Constraint		
		Estimated requirements	Unit applied to	Qualification
8-001	562	59% <sup>a</sup>	UWR 8-001 zone present in TSA	140 years
		< 30%	UWR 8-001 zone present in TSA	< 20 years
8-007	97 015	> 20%	Planning unit	> 16 m height <sup>b</sup>
		> 60%	Planning unit	> 30 years
8-008	65 897	Table 1 in Order <sup>c</sup>	Net planning unit	Table 2 and 3 in Order
		> 67%	Net planning unit	> 20
8-009	287	Not modelled		
8-010	1 988	None		

<sup>a</sup> This value is a simplification of the requirement for 33% of no harvest and 20% removal of stems every 40 years.

<sup>b</sup> Height will be translated to an age value during modelling process.

<sup>c</sup> Tables refer to tables found within the ungulate winter range order.

#### Data sources and comments:

Ungulate winter range orders are available on the Ministry of Environment web page at [http://www.env.gov.bc.ca/wld/frpa/uwr/approved\\_uwr.html](http://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html)

#### 6.5.6 Visual quality objectives

Scenic areas and visual quality objectives (VQO) have been legally established under the *Government Actions Regulation*. Table 18 shows the maximum allowable percent alteration for each VQO in perspective view. Percentages are taken from the Timber Supply Analysis Bulletin “*Modelling Visuals in TSR III*”.



Table 18. Assignment of visual quality objectives

Recommended VQO	Gross land base (ha)	% alteration by VAC <sup>a</sup> (perspective view)		
		Low	Medium	High
Retention	5 336	0.1	0.7	1.5
Partial retention	43 338	1.6	4.3	7.0
Modification	41 089	7.1	12.5	18.0

<sup>a</sup> VAC = visual absorption capacity.

The percent alteration in perspective view from Table 18 must be converted to a measure in plan view for use in timber supply analysis. A Plan to Perspective (P2P) ratio is calculated for each visual unit by area weighting the P2P for each slope class within the visual unit, using the data in Table 19. The percent alteration in perspective view is multiplied by the area weighted P2P ratio to calculate the percent alteration in plan view.

An area weighted visually effective green-up (VEG) height is determined for each visual unit using the data in Table 19. VEG height refer to top height (average height of tallest 10% of trees) but in current model use will refer to the stand age at which this height is reached based on height-age relationships for site index.

Table 19. Slope classes for calculating P2P ratio and VEG height

	Slope classes <sup>1</sup> (%)														
	0 - 5	5.1 - 10	10.1 - 15	15.1 - 20	20.1 - 25	25.1 - 30	30.1 - 35	35.1 - 40	40.1 - 45	45.1 - 50	50.1 - 55	55.1 - 60	60.1 - 65	65.1 - 70	70.1+
P2P ratios <sup>2</sup>	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.6	1.45	1.29	1.17	1.04
VEG height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.5	8.0	8.5	8.5	8.5

<sup>1</sup> Adapted from *Procedures for Factoring Visual Resources into Timber Supply Analysis* (1998) and *Modelling Visuals in TSR III* (2003) by Luc Roberge, Visual Resource Specialist, NIFR – December 2007.

<sup>2</sup> A recent study shows a first approximation of the predicted P2P ratios for absolute slope classes in 10% increments. Although P2P ratios and slope classes did not show a linear relationship, the median value was used in this table to determine the ratios for slope classes in 5% increments.

### Data sources and comments:

Information and documents on visual resource management is available on the FLNR Resource Practices Branch website at <http://www.for.gov.bc.ca/hfp/values/visual/index.htm>

### 6.5.7 Seral stage requirements

Seral stage requirements are made legal under the Kootenay Boundary HLPO. The HLPO has legal requirements for *old forests* and *mature + old forests*. Targets are expressed as a percentage of the Crown forested land base for each biogeoclimatic zone.

Although there is no legal requirement to spatially locate old and mature forests, it is generally agreed that larger contiguous patches of old forests are beneficial to biodiversity. Although the licensees and government worked together to locate old growth management areas (OGMAs), no single set of OGMAs has yet been agreed upon and therefore not all licensees have committed to using OGMAs in their FSP. Licensees have agreed, however, that it is reasonable to model OGMAs in the base case, since the draft OGMAs are largely respected to address legal requirements. Aspatial targets without OGMA will be modelled as a sensitivity.

The HLPO allows for old requirements to be reduced to one-third of the required amount in low biodiversity emphasis areas. The full target for old forests must be met by the end of the third rotation. At this time a recruitment strategy has not been developed. The proposed timber supply model does not permit temporal changes in constraints so the step up to the full target cannot be modelled. A sensitivity analysis will investigate applying the full old-seral targets from initiation.

Seral requirements are currently calculated and monitored based on the Biogeoclimatic Ecosystem Classification (BEC) information that was in place at the time of the establishment of the HLPO. For the purpose of this timber supply analysis, the seral targets are applied using current landscape unit and BEC information. This use simplifies the analysis and is expected to have minimal timber supply or seral target implications at this strategic level.

Table 20. Old and mature seral requirement

LU	BEC variant	NDT <sup>a</sup>	Biodiversity emphasis	Old requirement	Mature + old requirement (%)
B01 Rock	ESSFdc1, ICHmk1, MSdm1	3	Intermediate	14	N/A
	IDFdm1, IDFxh1	4	High	19	N/A
	PPdh1	4	Intermediate	13	N/A
B02 Gilpin	ESSFwc4, ICHmw2	2	Intermediate	9	N/A
	ICHdw1, ICH mk1	3	Intermediate	14	N/A
	IDFdm1, IDFxk1, PPdh1	4	Intermediate	13	N/A
B03 Lynch	ESSFdc1, ICHmk1, ICHdw	3	Intermediate	14	N/A
	ESSFwc4, ICHmw2	2	Intermediate	9	N/A
	IDFdm1	4	Intermediate	13	N/A
B04 Christina	ESSFwc4, ICHmw2	2	Intermediate	9	N/A
	ICHdw1, ICH mk1	3	Intermediate	14	N/A
	IDFdm1, IDFxk1, PPdh1	4	Intermediate	13	N/A
B05 Kelly	ESSFdc1, ICHmk1, MSdm1	3	Low	4.7	N/A
	IDFdm1	4	Low	4.3	N/A
B06 Kettle	ESSFdc1, ICHmk1, MSdm1	3	Low	4.7	N/A
	IDFdm1	4	Low	4.3	N/A
B07 Boundary	ESSFdc1, ICHmk1, MSdm1	3	Low	4.7	N/A
	IDFdm1	4	Low	4.3	N/A
	ICHmw2	2	Low	3	N/A
B08 Trapping	ESSFdc1, ICHmk1, MSdm1	3	Low	4.7	N/A
	IDFdm1	4	Low	4.3	N/A
B09 Gable	ESSFdc1, ICHmk1, ICHdw	3	Intermediate	14	N/A
	ESSFwc4, ICHmw2	2	Intermediate	9	N/A
B10 Burrell	ESSF wc4	2	High	13	54
	ICHmk1, ICHdw	3	Intermediate	14	N/A
	IDFdm1	4	Intermediate	13	N/A
B11 Rendell	ESSF dc1	3	High	21	34
	ICHmk1, MSdm1	3	Intermediate	14	N/A
	ESSF wc4	2	Intermediate	9	N/A

(a) Natural disturbance type.

#### Data sources and comments:

Kootenay Boundary Higher Level Plan Order is available at

[http://ilmbwww.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/legaldocuments/higher\\_level\\_order.html](http://ilmbwww.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/legaldocuments/higher_level_order.html)

#### 6.5.8 Connectivity

Objective 7 of the HLPO requires that, where mature and old requirements exist, they must be preferentially located inside mapped connectivity corridors. If possible, old and mature targets must be retained within connectivity corridors. There are very little mature requirement in the Boundary TSA,

and old requirement is spatially modelled in the base case. Based on this, there is minimal impact expected due to modelling connectivity. Additionally, because connectivity requirements are met with the modelled OGMA, connectivity is not modelled in the base case.

**Data sources and comments:**

Kootenay Boundary Higher Level Plan Order is available at  
[http://ilmbwww.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/legaldocuments/higher\\_level\\_order.html](http://ilmbwww.gov.bc.ca/slrp/lrmp/cranbrook/kootenay/legaldocuments/higher_level_order.html)

**6.5.9 Disturbance outside of the timber harvesting land base**

Most of the forest cover requirements identified in the previous sections apply to the Crown productive forest, which includes THLB and forest outside of the THLB. Forest outside of the THLB undergoes natural disturbance that affects its age class distribution and its contribution to forest cover requirements. This natural disturbance outside the THLB must be accounted for to prevent this forest from aging continuously and contributing inappropriately to forest cover requirements.

The proposed timber supply model does not yet have the ability to directly model disturbances in forest outside of the THLB. For the base case harvest forecast, static OGMAs are used as a surrogate for the areas outside of the THLB so there is no need to explicitly model disturbance outside of the THLB. However, for sensitivity analysis, other potential surrogate methods will be considered to account for natural disturbance including adjusting seral constraints based on expected contribution from the non-THLB in each landscape unit and BEC subzone.

## 7. Growth and Yield

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### 7.1 Analysis units

In a timber supply analysis, the use of analysis units simplifies the model either for both computational requirements and user understanding. An analysis unit is typically composed of forest stands with similar tree species composition, timber growing potential, treatment regimes, and other management considerations. Each analysis unit is assigned its own timber volume projection (yield table).

For this analysis, the analysis units will be divided into two general forest management classes (i.e., existing natural and managed stands) to reflect the different growth and yield models used to project the timber volume in British Columbia.

In 1987 legislative changes placed legal responsibility for basic silviculture obligations on major licensees. As seen in the previous timber supply review analysis, it was felt that stands post-1987 have had sufficient density management to be considered managed. For this analysis however, stands regenerated post-1987 will be assumed to be managed stands, and stands regenerated earlier will be considered existing natural stands.

The timber volume projections for existing natural stands are created for each forest inventory polygon. These yield tables are not aggregated; as such the individual forest inventory polygon is considered the analysis unit.

The timber volume projections for managed stands are created based on analysis units classified on the biogeoclimatic subzone and the leading species as identified in the inventory as of 2011.

In the Boundary TSA about 10% of the stands are not clearcut but are partially harvested. The modelling options for partial harvesting are limited within the proposed forest estate model to be used. As such, partial harvesting will not be modelled and separate analysis units for partial harvesting are not identified. Sensitivity analysis may be explored to identify the implications of this modelling simplification.

### 7.2 Natural stand yield tables

Yield tables for existing natural stands are derived using the Variable Density Yield Prediction (VDYP7 console) model. Input information for the VDYP7 model will be based on the vegetation resources inventory attributes of individual polygons.

#### Data sources and comments:

Information on VDYP is available at <http://www.for.gov.bc.ca/hts/vdyp/>

#### 7.2.1 Decay, waste, and breakage

Default values in VDYP7 are used and are based on past survey work.

### 7.3 Managed stand yield tables

Yield tables for managed stands are derived using the Table Interpolation Program for Stand Yields (TIPSY).

#### Data source and comments:

Information on TIPSY is available at <http://www.for.gov.bc.ca/hre/gymodels/TIPSY/index.htm>

### 7.3.1 Initial regeneration conditions

The regeneration assumptions for the initial species composition and density will be based upon summaries from FLNR silviculture database RESULTS (Table 21). These summaries are based upon regeneration surveys or free-to-grow surveys for openings identified as non-unevenaged. Where information was not available for an analysis unit, average information from the most similar analysis unit was used.

In recent forest estate analyses for assessing the implications of the Kootenay Boundary Land Use Plan and silvicultural options, silviculture management regimes prescribed by the licensees for biogeoclimatic subzones were used as regeneration assumptions. The implications of applying the regeneration assumptions of these management regimes rather than the observed survey regeneration information will be investigated in a sensitivity analysis.

Cattle, grass and drought are operational considerations that have been hampering successful regeneration in drier ecosystems in Interfor's chart area of the Boundary TSA. Within the past year FLNR district staff have received over 100 requests to lower stocking standards and minimum inter-tree distance on blocks that are nearing the early free-growing milestone. This information will be brought to the chief forester's attention but will not be modelled.

Table 21. Regeneration assumptions for managed stand analysis units

Analysis unit	Site index	Regen delay	Well spaced stems per hectare	Species composition (%)								
				Fd	Cw	Hw	B	S	P	Lw	Decid	
ESSFdc1_FL	14.1	1.9	1333	4			30	13	43	10		
ESSFdc1_P	14.4	1.9	1248	1			21	15	60	3		
ESSFdc1_SB	13.5	1.4	1160				29	21	49	1		
ESSFdc1_O	13.5	1.4	1160				29	21	49	1		
ESSFdcw_FL	14.1	1.9	1333	4			30	13	43	10		
ESSFdcw_P	19.5	2.0	631				18	9	73			
ESSFdcw_SB	13.3	1.1	1158				42	11	48			
ESSFwc1_FL	15.4	2.0	1382				12	50	38			
ESSFwc1_P	15.3	1.2	363				34	22	44			
ESSFwc1_SB	15.9	1.7	739				17	51	32			
ESSFwc1_O	15.9	1.7	739				17	51	32			
ESSFwc4_FL	14.1	1.9	1333	4			30	13	43	10		
ESSFwc4_P	15.3	1.5	124				70	10	30			
ESSFwc4_SB	14.7	1.5	1252				17	54	30			
ESSFwcw_P	15.3	1.5	124				69	6	25			
ESSFwcw_SB	14.7	1.5	1252				17	54	30			
ICHdw1_FL	20.9	2.4	803	24	9	1		12	35	15	3	
ICHdw1_P	18.8	0.4	300	26	31			8	20	11	5	
ICHdw1_SB	20.4	4.8	724	10	1		6	1	59	19	4	
ICHdw1_O	23.6	1.1	1092	1	3	1		18	30	29	19	
ICHdw2_FL	20.9	1.8	1093	17	2		1	6	42	26	6	
ICHdw2_P	20.8	2.1	1154	13	2		1	6	48	23	8	
ICHdw2_SB	20.4	4.8	724	10	1		6	1	59	19	4	
ICHdw2_O	22.1	1.9	1175	1	2			12	42	19	23	

(continued)

Table 21. Regeneration assumptions for managed stand analysis units (concluded)

Analysis unit	Site index	Regen delay	Well spaced stems per hectare	Species composition (%)							
				Fd	Cw	Hw	B	S	P	Lw	Decid
ICHmk1_FL	20.6	2.7	1082	11	3		3	9	38	26	9
ICHmk1_P	20.2	1.9	1163	9	2		3	8	45	26	7
ICHmk1_SB	19.3	2.0	1117	4	5		5	28	31	25	2
ICHmk1_O	20.2	2.3	891	25	9			21	12	28	4
ICHmw2_FL	20.9	2.0	1042	19	11	1	4	6	29	23	7
ICHmw2_P	20.4	1.8	1214	13	2		9	15	38	22	
ICHmw2_SB	21.3	2.0	268	7	12		14	22	31	14	
ICHmw2_O	22.3	1.1	807	6	7	4	21	22	28	11	1
IDFdm1_FL	17.3	1.7	871	38				4	31	24	3
IDFdm1_P	18.0	1.7	1061	18				4	47	27	4
IDFdm1_SB	17.0	0.1	827	11				68	11		10
IDFdm1_O	16.5	0.1	570	63					31	5	1
IDFhx4_FL	19.3	2.3	586	48			1	3	31	17	
IDFhx4_P	17.6	2.3	627	49	1				34	16	
IDFhx4_SB	17.9	0.1	827	11				68	11		10
IDFhx4_O	16.5	0.1	570	63					31	5	1
MSdm1_FL	19.1	2.1	1553	10				6	47	33	3
MSdm1_P	19.4	2.1	1084	6			1	6	61	24	2
MSdm1_SB	19.1	3.0	1155	6			10	8	59	17	
MSdm1_O	21.4	1.4	805	3				9	39	20	28
MSdm1a_FL	19.1	2.1	1553	10				6	47	33	3
MSdm1a_P	19.4	2.1	1084	6			1	6	61	24	2
MSdm1a_SB	19.1	3.0	1155	6			10	8	59	17	
PPxh3_FL	19.1	2.1	1553	10				6	47	33	3
PPxh3_O	21.4	1.4	805	03				9	39	20	28

**Data sources and comments:**

The above table shows analysis units with a species label that are present in the TSA. Where no opening information for stands identified as having even-aged management is present, the information for a similar analysis unit was substituted.

The silviculture management regimes prescribed by the licensees are presented in Table 6.1 of Timberline Natural Resource Group. Undated. Enhanced Type 2 Silviculture Analysis Boundary TSA Information Package.

### 7.3.2 Site index

Site indices that best reflect the potential productivity will be utilized as input for TIPSY generated yield tables.

In British Columbia, studies have shown that inventory based site indices may underestimate potential site indices within younger and older stands. Several methods have been developed to provide improved estimates of potential site index.

For the base case in the Boundary TSA, site index for managed stands will be based on the results of a Site Index Adjustment (SIA) project. The SIA uses sample based field estimates of site index to adjust predicted site indices generated based on biogeographical attributes and expert opinion. SIA was not completed for the ESSF biogeoclimatic zone, therefore inventory site indices will be used for this zone.

A sensitivity analysis will compare the timber supply implications of using another method, SIBEC, rather than SIA for managed stand site index. SIBEC is based on field collected estimates of site index for specific site series. Predictive Ecosystem Mapping (PEM) is available in the Boundary TSA to provide predicted site series across the TSA. The Boundary PEM has an overall accuracy of slightly less than the required 65% but has been approved for use in TSR with reservations.

#### **Data sources and comments:**

Potential site indices are only used as input to TIPSY. For natural stand yield projections the model VDYP has been calibrated to use forest inventory based estimates of site index.

TECO Natural Resource Group Limited. 2011. Site index adjustment of the Boundary Timber Supply Area. Prepared for International Forest Products Limited, Grand Forks, BC. March 23, 2011.

### 7.3.3 Tree improvement

Licensees are obliged to use the best available seed source when regenerating sites with planted stock. Planted stock may have faster growth than natural trees that may regenerate on the site. The faster growth may be due to either use of high-quality genetically improved seed from seed orchards or use of seed harvested from superior wild trees.

Information on the use of select seed in the TSA and the associated genetic gains are available from the Tree Improvement Branch of FLNR. Current information is incorporated as a weighted average within the managed stand yield curves. The weighted average is based upon genetic worth and relative use of improved seeds. In the base case, the average is derived for the analysis unit. Table 22 shows the most recent 5 year average genetic worth of the Boundary TSA.



Table 22. TSA average genetic worth

Species	Percent select seed used (5 year average of annual percent)	Genetic worth (5 year weight average across all SPU)	Proportionate genetic worth to percent select seed use
BL	0		
CW	0		
FDI	8	29	2.3
LW	81	25	20.4
PLI	53	12	6.4
PW	100		
PY	0		
SX	92	11	10.1

**Data sources and comments:**

Seed use and genetic worth values provided by Leslie McAuley, Tree Improvement Branch, FLNR. Data derived from Seed Planning and Registry Application (SPAR). February 2011.

Timberline Forest Inventory Consultant Limited. 2002. Spatially explicit genetic gain estimates in operationally applied timber supply analysis. Prepared for Ministry of Forests, Tree Improvement Branch. Revised September 3, 2002.

**7.3.4 Operational adjustment factors**

Yield projections in TIPSYP are based upon potential yields where a site is fully occupied. As a stand may not fully occupy a site or be able to reach its potential growth (e.g., due to forest health issues) TIPSYP enables two different operational adjustment factors (OAF) to be applied.

For the timber supply review, the typical standard OAF of 15% for OAF1 and 5% for OAF2 will be applied generally. These OAFs were based on a general assessment on differences of actual yields and potential yields on managed sites.

Ideally, OAFs that have been localized to the managed area are desirable. However, these OAFs are difficult to determine.

For the current analysis the standard OAFs will be applied except in Douglas-fir leading stands in the ICH subzone. In these stands the presence of Armillaria root rot is known to reduce potential yields. TIPSYP provides an option to supplement the OAFs in consideration of Armillaria in the ICH. For the base case Armillaria will be considered at a moderate level.

**Data sources and comments:**

Stearns-Smith, S., G. Neinaber, M. Cruickshank, A. Nussbaum. 2004. Demonstrating Growth and Yield Adjustments (TIPSYP OAFs) for Armillaria root disease in a timber supply analysis. Forestry Canada, Pacific Forestry Centre, Victoria, B.C. 9 p.

Mitchell, K.J., M. Stone, S.E. Grout, M. Di Lucca, G.D. Nigh, J.W. Goudie, J.N. Stone, A.J. Nussbaum, A. Yanchuk, S. Stearns-Smith. R. Brockley. 2000. TIPSYP version 3.0. Ministry of Forests, Research Branch, Victoria B.C.

## 8. Sensitivity Analysis

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Sensitivity analysis can help to assess the timber supply impact of uncertainty in data and management assumptions and be used to determine which variables have the greatest influence on harvest forecasts. Issues can also be investigated to enhance understanding of possible impacts on timber supply. Table 23 lists the base sensitivity analyses to be performed.

*Table 23. Sensitivity analyses to assess influence and issue analyses*

Issue to be tested	Sensitivity levels
Natural stand volumes	All volume tables will be changed by +/- 10%.
Managed stand volumes	All volume tables will be changed by +/- 10%.
Minimum harvestable age	Change minimum harvest able ages by +/- 10 years.
THLB	The THLB within all polygons will be changed by +/-10%.
Management for visual quality	Low and high disturbance levels will be used.
Regeneration assumptions	Licensee prescribed species composition, initial density, and OAFs will be used.
Harvest priorities	Alternative harvest priorities available within the timber supply model.
Mountain pine beetle	The FLNR BCMPB model results will be incorporated and a range of MPB assumptions will be examined.
Site productivity for older stands	A SIBEC approach to determining site indices will be used.
Old growth management areas	Old growth management areas will be incorporated into the land base in lieu of old-seral objectives.
Community forest	The area of the community forest will be removed from the THLB.

### Data source and comments:

Further sensitivity analyses will be completed as needs are identified.