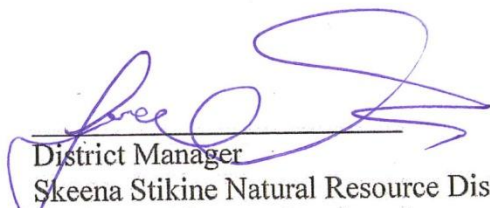



Cassiar Timber Supply Area Timber Supply Review

Data Package

September 2013



District Manager
Skeena Stikine Natural Resource District
Ministry of Forests, Lands and
Natural Resource Operations



Director
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Executive Summary

The Cassiar Timber Supply Area (TSA) is situated in the north-west corner of the province of British Columbia (BC). The TSA is approximately 13.1 million hectares in size, and the majority is characterized by mountains and plateaus separated by wide valleys and lowlands. The western part of the TSA consists of rugged mountains dissected by several major river valleys.

Approximately 81 percent of the TSA is comprised of non-forest (e.g., icefields), non-productive and non-commercial forests, parks and ecological reserves, and as such is not managed for timber production. The remaining Crown forest is approximately 2.5 million hectares, and is managed for multiple values (e.g., wildlife habitat, timber production, visual quality). The area of focus for timber management is bounded within a district-defined “operable corridor” containing approximately 210 000 hectares of timber harvesting land base, which is 8.4 percent of the Crown forested area or 1.6 percent of the total TSA.

The TSA is sparsely populated, with First Nations people accounting for 55 to 65 percent of the permanent population. There are limited economic opportunities due to a lack of transportation infrastructure. However, the TSA supports an abundance of fish and wildlife species.

The current allowable annual cut (AAC) for the TSA is 305 000 cubic metres, effective January 1st, 2002. The AAC is partitioned geographically into three timber supply blocks: Iskut: 120 000 cubic metres, Dease-Liard: 153 000 cubic metres and Atlin Taku: 32 000 cubic metres. The Minister has apportioned 135 000 cubic metres for harvest, with the majority of the volume allocated to a non-replaceable licence (120 000 cubic metres) in the Iskut supply block and small allocations to BC Timber Sales (2500 cubic metres) and the Forest Service Reserve (12 500 cubic metres) in the Atlin block. The Dease-Liard supply block AAC has not been apportioned, pending completion of land use planning processes and lack of demand for timber supply.

Early in 2011, Ministry of Forests, Lands and Natural Resource Operations (FLNR) staff assessed that a new timber supply review (TSR) was warranted for Cassiar TSA given the significant changes that have occurred since the last AAC determination in 2001, including the completion of planning processes and forest management practises. The TSR is being conducted using a four-stage process: 1) release of a fully documented Data Package (DP) and Public Discussion Paper (PDP) that outlines the results of the timber supply analysis; 2) First Nation consultation and public review of the Data Package and PDP; 3) chief forester’s AAC determination considering input from stage 2; and, 4) release of the Rationale for AAC Determination.

Figure 1 shows an overview of Cassiar TSA, including the location of the “operable corridor” which defines the extent of Crown forested land base (CFLB) that is accessible from current transportation infrastructure. The timber harvesting land base is a subset of this corridor, and is comprised of stands of economically viable timber that are eligible for timber management.

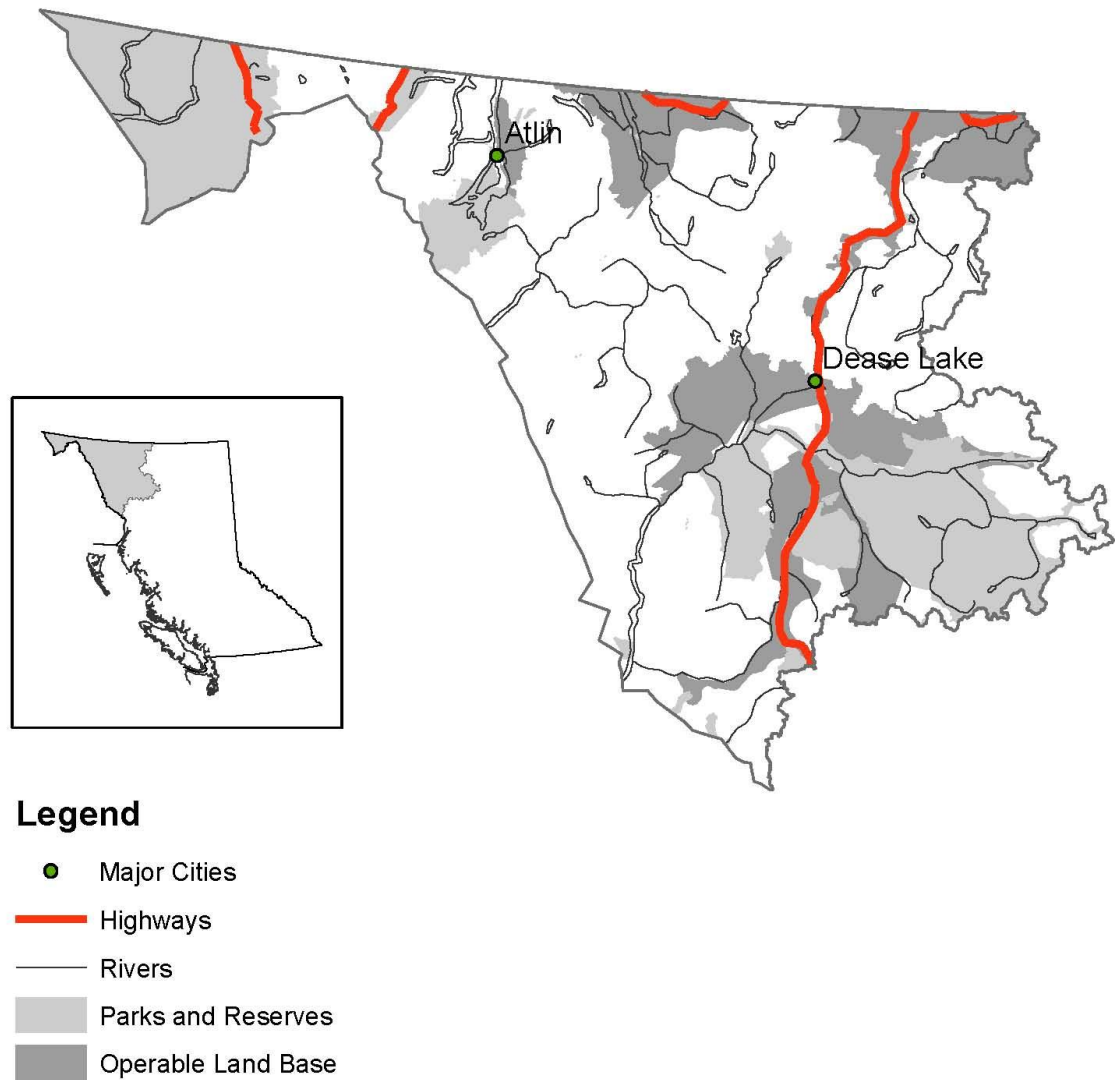


Figure 1. Overview of the Cassiar TSA.

1. Overview of the Cassiar TSA Timber Supply Review

This data package summarizes the basic information and assumptions required for the Cassiar Timber Supply Area (TSA) timber supply analysis.

The data package contains those inputs that represent current performance for the TSA. For the purpose of the Cassiar timber supply review (TSR), "current performance" can be defined by:

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

The primary purpose of the timber supply review program is to model “what is”, not “what if”. Changes in forest management objectives and data, when and if they occur, will be captured in future timber supply analyses.

Each section of this data package includes:

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

The information in this data package represents the best available knowledge at the time of publication. A First Nation consultation and public review period has been established to allow submission of comments and concerns about the data package to the Ministry of Forests, Lands and Natural Resource Operations (FLNR). If any input or update in current management practices occur during the next few months, the timber supply analysis will be amended and the results will be presented to the chief forester for consideration in his AAC determination. The chief forester's AAC determination will be documented through the public release of his AAC determination rationale.

1.1 Overview of the Cassiar Timber Supply Area (TSA)

The Cassiar TSA is located in the north-western corner of BC and is the largest TSA in the province, covering approximately 13.1 million hectares or one-sixth of the province. It is the least populated TSA and includes the communities of Dease Lake, Atlin, Telegraph Creek, Iskut, Good Hope Lake and Lower Post. The Cassiar TSA is administered by the Skeena Stikine Natural Resource District in Smithers.

First Nations people comprise approximately 55 to 65 percent of the population living within the TSA. The Tahltan, Taku River Tlingit, Kaska Dena, Teslin Tlingit, Carcross Tagish and Champagne-Aishihik First Nations all have asserted traditional territories within the Cassiar TSA.

The majority of the Cassiar TSA is characterized by mountains and plateaus separated by wide valleys and lowlands, while the western part of the TSA consists of rugged, ice-capped mountains, dissected by several major river valleys. Approximately 81 percent of the TSA is not managed for timber production (e.g., rock, tundra, provincial parks, and ecological reserves). The remaining area of approximately two million hectares is forested. Forests in the Cassiar TSA range from areas of coastal forest in the west, to extensive areas of boreal forest in the majority of the TSA. The dominant tree species are lodgepole pine, white and black spruce, western hemlock and subalpine fir. White spruce and Lodgepole pine forests dominate about 32 and 30 percent, respectively of the productive forest and 32 and 54 percent, respectively of the timber harvesting land base. Western hemlock, spruce and subalpine fir forests dominate the southern portion of the TSA, with the majority of the trees greater than 150 years old. Conversely, interior species such as lodgepole pine forests tend to be less than 100 years old given the high frequency of wildfires.

The Cassiar TSA supports an abundance of wildlife species. Moose are the most abundant ungulate, but thimhorn sheep, caribou and mountain goats are also plentiful. Grizzly bears, black bears, wolverines, lynx and wolves are common throughout the valleys of the TSA. Many bird species also occur, and several breed nowhere else in BC. A wide variety of fish species are found in the Cassiar TSA, particularly because the TSA's watersheds drain into both the Pacific and the Arctic oceans and, therefore, fish species vary. Five salmon species are found in the Stikine, Taku and Tatshenshini watersheds, while freshwater fish are found throughout the TSA and include rainbow trout, Arctic grayling, Dolly Varden char, lake char, white sucker, whitefish and northern pike.

The Cassiar TSA is valued for large expanses of pristine wilderness that permit multi-day trips into remote backcountry areas, especially along the rivers. Several provincial parks—Atlin Lake, Stikine River, Spatsizi Plateau, Mount Edziza and Tatshenshini-Alsek—offer internationally-recognized backcountry wilderness opportunities. The Cassiar TSA is also one of the finest big-game trophy hunting areas in North America. Other recreational activities include canoeing, rafting, kayaking, fishing and wildlife viewing.

Limited economic opportunities exist in the TSA due to the lack of transportation networks, hydroelectric power, distance to markets, inclement climate and a small and scattered population. Highway 37 traverses the central and eastern portions of the TSA, with secondary roads providing access outside of the immediate travel corridor. Air transport is an alternate means of travel for people, products and supplies. Mining is the predominant industrial activity in much of the TSA and is a major component of the local economy. The area contains numerous known mineral deposits with potential for more discoveries, although development is limited due to the isolation and remoteness. The majority of tourist revenues are generated by guiding and hunting, and camp accommodation services. Forestry employment is supported by harvesting and silviculture activities.

The current allowable annual cut (AAC) for the TSA is 305 000 cubic metres, and was set at the last timber supply determination in 2001. The current AAC is partitioned geographically into timber supply blocks: 120 000 cubic metres in the Iskut Supply Block; 150 000 cubic metres in the Dease-Liard Supply Block; and 32 000 cubic metres in the Atlin Taku Supply Block. Following the 2001 determination, the Minister of Forests elected to apportion all AAC volumes within the Iskut and Atlin Supply Blocks, but no volumes within the Dease-Liard Supply Block until such time as strategic planning was completed and timber supply demand increased.

1.2 Land use planning

There are three strategic plans covering three planning areas within the Cassiar TSA. They are:

- Cassiar Iskut-Stikine Land and Resource Management Plan;
- Dease-Liard Sustainable Resource Management Plan; and,
- Wooshtin wudidaa / Atlin Taku Land Use Plan (LUP).

1.2.1 Cassiar Iskut-Stikine land and resource management plan (LRMP)

The Cassiar Iskut-Stikine Land and Resource Management Plan (LRMP) plan area covers approximately 5.2 million hectares of the Cassiar TSA, roughly corresponding to the Stikine River watershed and the Canadian portion of the Unuk River watershed. The planning process provided an opportunity for the public, interest groups, the Tahltan Nation and government to make recommendations regarding proposed protected areas and future management of public forest lands in the plan area.

The LRMP was approved as Ministerial Policy in October 2000. Intent was to quickly proceed to more detailed landscape-level strategic planning, but this process is still pending. Although LRMP approval did not result in legal objectives set by government, LRMP recommendations ultimately led to establishment of additional protected areas totalling greater than 200 000 hectares which have been incorporated into the timber supply analysis.

1.2.2 Dease-Liard sustainable resource management plan (SRMP)

The Dease-Liard plan area covers approximately 2.4 million hectares within the Dease-Liard Timber Supply Block. Plan area extends south-to-north from Dease Lake and the upper Turnagain watershed to the Yukon Border and west-to-east, from the Little Rancheria watershed to Tatisno Mountain and Tatisno. The majority of the plan area falls within the traditional territory of the Kaska Dena First Nation, although there is an overlap with the Tahltan First Nation in the southwest and with the Teslin Tlingit in the west. There are three communities within the plan area: Dease Lake, Good Hope Lake, and Lower Post. Watson Lake is 20 kilometres north of the plan area, across the Yukon border.

The 2004 Dease-Liard Sustainable Resource Management Plan (DLSRMP) addressed sustainable management of land and resources within the plan area, primarily with a forest management focus. Forest management objectives, indicators, and targets were developed for wildlife, biodiversity, cultural heritage, visual quality, community use, and timber values. Many were legally established through a higher level plan order, and will be considered in the base case forecast for the timber supply analysis. Additional draft chapters created in 2010 addressed resource values not covered in the 2004 SRMP – the 2010 process did not lead to additional legal objectives set by government, but did recommend protection of the Ne'ah'-Horseranch/Deadwood Area.

1.2.3 Wooshtin wudidaa Atlin Taku land use plan

The Atlin Taku Land Use Plan (LUP) was signed in July 2011 by the Premier of BC and representatives of the Taku River Tlingit. The plan did not establish legal objectives set by government, but it did set the stage for future decision making. The plan assists in resolving access, protection, and mineral development issues, and provides clarity with respect to the values and objectives to be considered in future resource management decision making. The plan also sets the stage to increase the total protected area up to 26.2 percent of the land use plan area (800 000 hectares). Until it this area formerly protected, the intent of the plan is to exclude timber harvesting activities and as such it has been excluded from the timber harvesting land base.

The total size of the Atlin Taku LUP area is 3.04 million hectares, and includes those portions of the Taku, Whiting and Yukon watersheds within the province of BC. The western boundary of the plan area abuts the Alaska Panhandle, and the northern boundary follows the border with the Yukon Territory. The

Atlin Taku planning area is geographically complex, comprised of mountainous terrain with broad river floodplains, large glacial fields and extensive plateaus. The plan area is the ancestral home of the Tlingit First Nation. Atlin is the only sizable community and commercial centre in the plan area, other than the Tlingit reserve on the eastern shores of Atlin Lake. The number of year-round residents in the town is around 500. The population increases in the summer months due to seasonal residents and workers. Informal land based activities—such as hunting, fishing, gathering of plants for food and medicine, and trading in goods and services associated with these activities—are important for the Tlingits and other members of the community. Most local businesses are summer operations including mineral exploration, tourism, home building, commercial fishing, trapping and guide outfitting.

The allowable annual cut (AAC) for the Cassiar TSA was determined in 2002, at which time the AAC for the Atlin Timber Supply Block was set at 32 000 cubic metres. There has been limited forest development in the area to date due to the lack of road access, and the low timber volumes and value. Much of the land base is classified as inoperable. There are no major licensees or major timber processing facilities in the Atlin Timber Supply Block. All forestry activities are small-scale, with timber being used locally for log house building, rough cut timber and mine development.

A 2008 Ministerial order established geographic areas of no commercial harvest. Cabinet is expected to approve an OIC under the *Environment and Land Use Act* to permanently establish the non-commercial harvest areas in the fall of 2013. As such these areas are excluded from the timber harvesting land base. The 2011 LUP sets the stage for prohibiting commercial forestry in a large proportion of the plan area in order to conserve critical caribou habitat, and only allowing for commercial forestry within the commercial forest harvest zone (CFHZ).

1.3 Changes since the last TSR: background information

- Strategic land-use planning has been undertaken in Dease-Liard and Atlin supply block areas.
- Cassiar Forest Corporation Ltd. (Licence A64561) has a non-replaceable forest licence (NRFL) for 120 000 cubic metres per year in the Iskut Supply Block. Approved Forest Stewardship Plan results/strategies now define “current” forest management within the Iskut Supply Block.
- Work was completed to improve site index by biogeoclimatic ecosystem classification (SIBEC) site index estimates by site series for lodgepole pine in the ICH BEC zone.
- Cassiar biogeoclimatic ecosystem classification (BEC) line work and coding has been significantly refined by Forest Analysis and Inventory Branch staff, in a 2011 BEC update.
- The Cassiar visual landscape inventory (2013) has been significantly refined and made available for use in the base case.
- The District’s operable corridor has been revisited for this round of TSR.
- A 2011 assessment indicated a need to conduct a new timber supply review rather than an AAC postponement given legislative requirements governing periodicity of AAC determinations, progress made with land-use planning, and significant increases to timber harvest levels in the Iskut Supply Block.
- The forest inventory has been updated to the vegetation resource inventory format (‘FIP rollover’).

- VDYP 7 growth and yield model for existing natural stands has been used in this analysis. Previous analyses used VDYP 6.
- Natural disturbance has been modelled in the base case.
- Pulp stands within the Iskut blocks are included in the base case.
- Previous analysis employed aspatial timber supply models whereas the current analysis employs FLNR's spatial model named FSSAM.
- Fire history has been updated using RESULT and FTEN data as well as satellite photography.

2. Determination of the Timber Harvesting Land Base

2.1 Determination of the timber harvesting land base

The land base information used in the analysis represents the land base for the entire TSA. Information includes land that does not contain forest or area suitable for growing commercial forests, area where harvesting is not permitted such as parks, community watersheds and no harvest zones for wildlife habitat. Within the remaining area there are areas not suitable for harvesting for economic reasons such as slow growing stands or non-commercial species. The remaining area may be eligible for timber management activities albeit with restrictions to rate of harvest due to constraints to integrate activities for other values such as visual quality or wildlife habitat management objectives.

The following table summarizes the factors used to derive the timber harvesting land base (THLB) for the analysis. Section 6, "Timber Harvesting Land Base Assumptions" describes the inputs or assumptions used to derive the figures shown in Table 1.

Table 1. Determination of the timber harvesting land base for the Cassiar TSA, 2013

Land base description	Total area on file ¹ (hectares)	Area sequentially removed from land base (hectares)	Percent of TSA (%)	Percent of productive forest (%)
Total Cassiar TSA area	13 131 876	13 131 876	100	
Not managed by FLNR	2 768 260	2 768 260	21.1%	
Non-forest	7 537 074	5 687 231	43.3%	
Non-productive forest	9 924 496	2 048 874	15.6%	
Non-commercial forest	1 592 496	123 423	0.9%	
Total reductions		10 627 787	80.9%	
Total Crown forest land base managed by FLNR		2 504 089	19.1%	100.0%
Outside of operable blocks	10 738 467	1 553 151	11.8%	62.0%
Recreation (UREP)	179 894	5 636	<0.1	0.2%
Community watersheds	3 858	2 425	<0.1	0.1%
Geographically defined areas	418 292	6 661	0.1%	0.3%
Caribou habitat(no harvesting zone)	27 697	3 499	<0.1	0.1%
Bull Trout habitat (no harvesting zone)	1 216	652	<0.1	<0.1%
Non-commercial species	875 919	89 521	0.7%	3.6%
High slope sites	1 338 804	30 836	0.2%	1.2%
Low productivity stands	3 846 292	544 649	4.1%	21.8%
Pulp stands not in Iskut blocks	49 772	3 794	<0.1	0.2%

(continued)

Table 1. Determination of the timber harvesting land base for the Cassiar TSA, 2013 (concluded)

Land base description	Total area on file ¹ (hectares)	Area sequentially removed from land base (hectares)	Percent of TSA (%)	Percent of productive forest (%)
Slow growing stands	585 807	37 283	0.3%	1.5%
Preservation visual quality objective area	25 152	2 300	<0.1	0.1%
Cultural trails	9 610	2 195	<0.1	0.1%
Current roads, trails and landings ¹	2 633	307	0.0%	<0.1%
Riparian habitat ²	415	105	<0.1%	<0.1%
Wildlife tree patch	10 391	10 391	0.1%	0.4%
Current timber harvesting Land base (THLB)		210 681	1.6%	8.4%
Future roads, trails and landings		8 217	0.1%	0.3%
Long-term timber harvesting land base		198 161	1.5%	7.9%

¹ Land base may fall into several categories therefore some figures may seem extremely large. For example, an area may be non-forested thereby it is also non-productive.

² The table only accounts for roads, riparian reserves and riparian management zones within the operable blocks. Area outside of the operable blocks has been accounted for by other land base reduction factors.

The order of the land base determination reductions was derived using the following logic: Step 1 – report the total area of the Cassiar TSA; Step 2 – reduce the land base to present the Crown forested area; Step 3 – reduce the land base to present the remaining operable land base; Step 4 – reduce the operable land base for non-timber values; Step 5 – reduce operable land base for timber management considerations (e.g., low productivity); Step 6 – present the current THLB, and Step 7 – reduce current THLB for future roads and present long-term THLB.

The Cassiar TSA is predominantly (84.5 percent) area not managed by FLNR including rock, glaciers, brush, parks and private lands. Within the remaining forested land base (15.5 percent of the TSA), district staff applied current knowledge of the higher level land use plan objectives and general location to the current transportation infrastructure and excluded 55.9 percent of the area as it is considered to be not economically operable forest land base. After removing forests constrained for other values such as recreation, wildlife habitat and unsuitable growing conditions for economic timber, 1.6 percent of the TSA or 10.2 percent of the CFLB is considered THLB. Harvesting within the THLB is constrained by the length of time it takes for trees to become merchantable and restrictions to rate of harvest. Examples of the latter are constraints to integrate timber harvesting activities with the management of other values such as wildlife habitat and visual quality objectives. The THLB is located within six operable blocks dispersed throughout the TSA.

The primary product for the THLB is sawlog timber. Pulpwood stands in the Iskut operable blocks have been identified and the opportunity for their harvest is considered in the base case. The following table shows the delineation of the operability within the Crown forested land base.

Table 2. Breakdown of crown forested land base by operability land base, Cassiar TSA 2013

Operable block	THLB (hectares)	NON_THLB (hectares)	Total (hectares)
Sawlog stands			
ATLIN	4 091	29 035	33 126
DEASE - LIARD	83 881	247 124	331 005
ISKUT A	41 060	74 809	115 870
ISKUT B	27 795	119 301	147 096
SWAN TESLIN	35 832	179 836	215 668
OUTSIDE	-	1 553 151	1 553 151
Total sawlog	192 659	2 203 257	2 395 916
Pulpwood stands			
ISKUT A	7 465	47 865	55 330
ISKUT B	10 556	42 287	52 843
Total pulpwood	18 022	90 151	108 173
Total all	210 681	2 293 408	2 504 089

The following map shows the generalized location of the timber harvesting land base within the operable blocks in the Cassiar TSA.

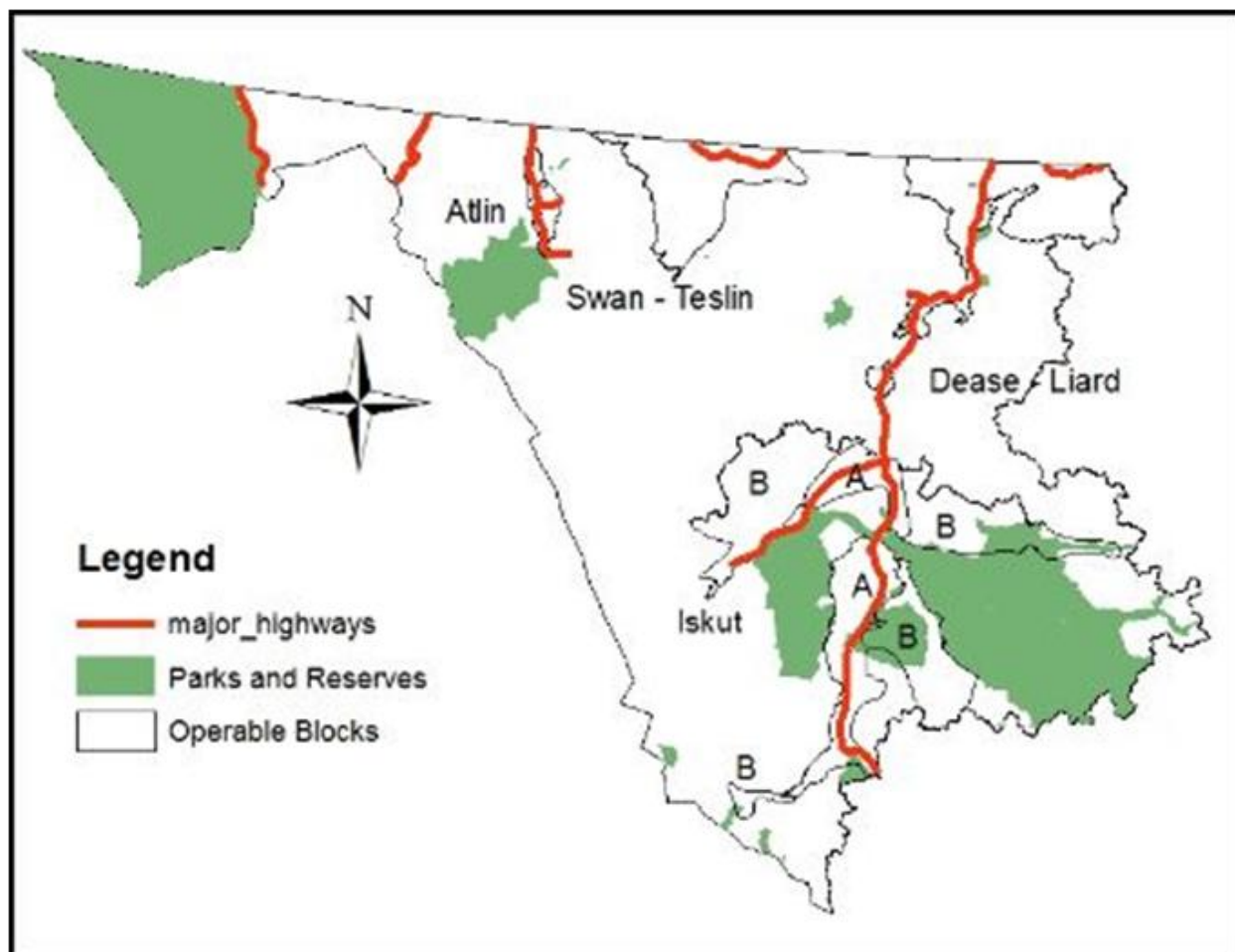


Figure 2. Location of operable blocks within the Cassiar TSA, 2013.

Forests in the Cassiar TSA occur across two broad zones, coastal forest in the west and boreal forest in the east, with boreal forest comprising that majority of the TSA. Ecologically the forests can be grouped by coastal/transitional and interior biogeoclimatic ecosystem classification (BEC) zones. This zonal grouping provides better modelling of regeneration assumptions and growth and yield prediction. For the analysis the coastal/transitional groupings are the Coastal Western Hemlock (CWH), Engelmann Spruce-Subalpine Fir (ESSF), Interior Cedar-Hemlock (ICH), Sub-Boreal Spruce (SBS) and Mountain Hemlock (MH) zone. The interior groupings are the Boreal White and Black Spruce (BWBS), Spruce-Willow Birch (SWB) zones. Coastal zones comprise 20 percent of the CFLB while interior zones comprise the other 80 percent of the CFLB. The percentage of each BEC zone is shown in Figure 3.

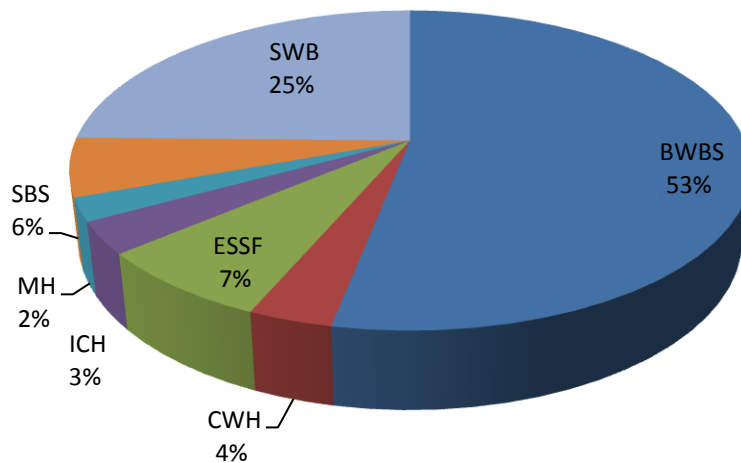


Figure 3. Biogeoclimatic ecosystem classification zones within the Cassiar TSA crown forested land base 2013.

Figure 4 shows the composition of the Crown forest land base by analysis unit (tree species groups) which is 38 percent pine, 22 percent white spruce, 19 percent balsam, 14 percent other species such as birch, larch and black spruce and 7 percent hemlock. Figure 5 shows the composition of the forest within the Cassiar TSA. Section 4.2, “Analysis units” provides more detailed information of the area and criteria of the analysis units.

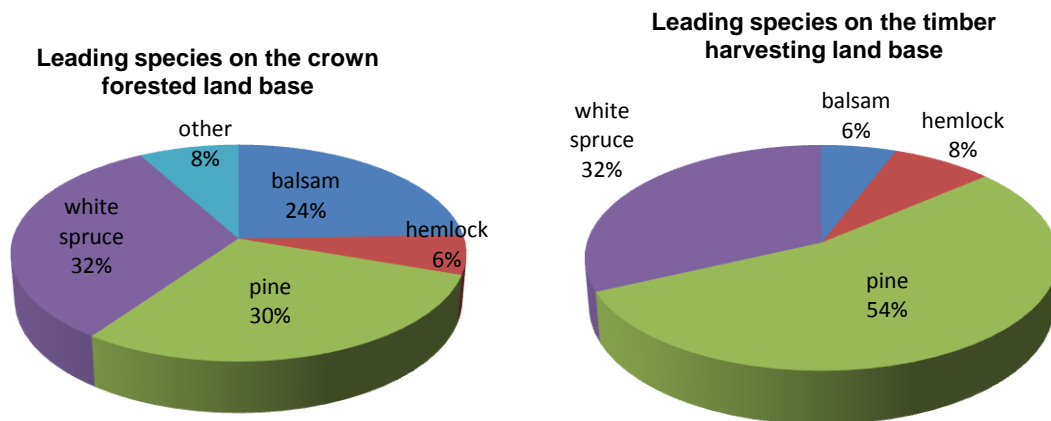


Figure 4. Proportion of leading species for the crown forested land base and timber harvesting land base of the Cassiar TSA.

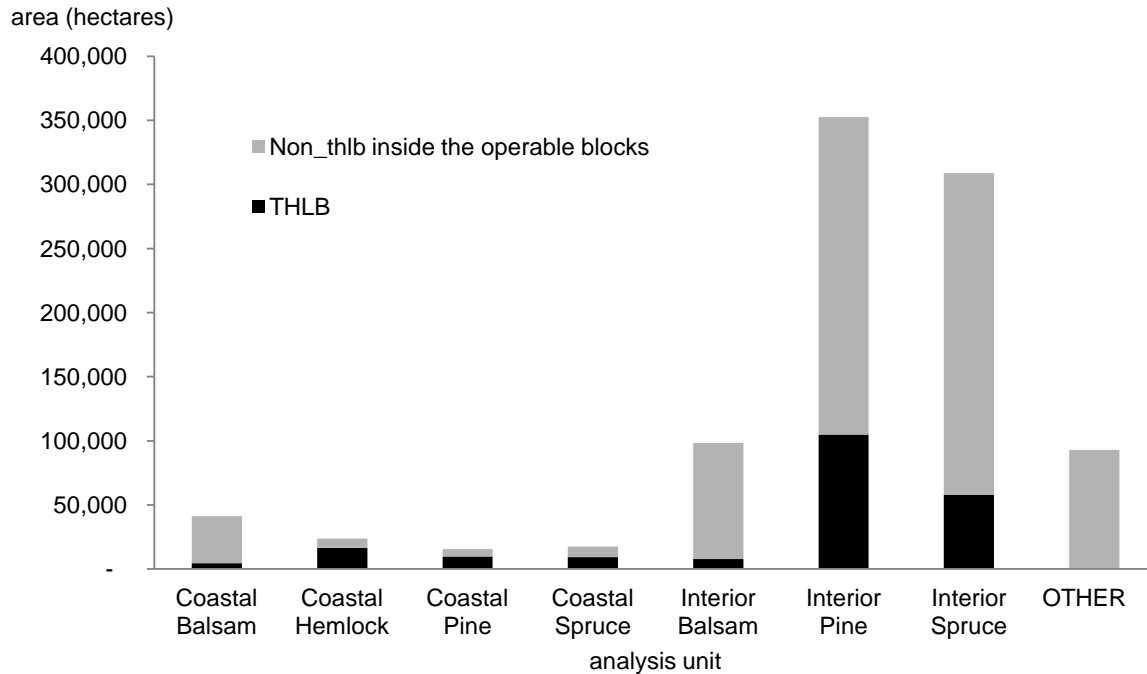


Figure 5. Composition of the operable forest land base by analysis unit, Cassiar TSA 2013.

Figure 6 shows the age class distribution of the timber harvesting land base. While little harvesting has occurred in the Cassiar TSA disturbances such as fire have played the key role in maintaining the population of young stands in the interior BEC zone. Fire is less prevalent in coastal stands so many of these stands tend to be older than 100 years.

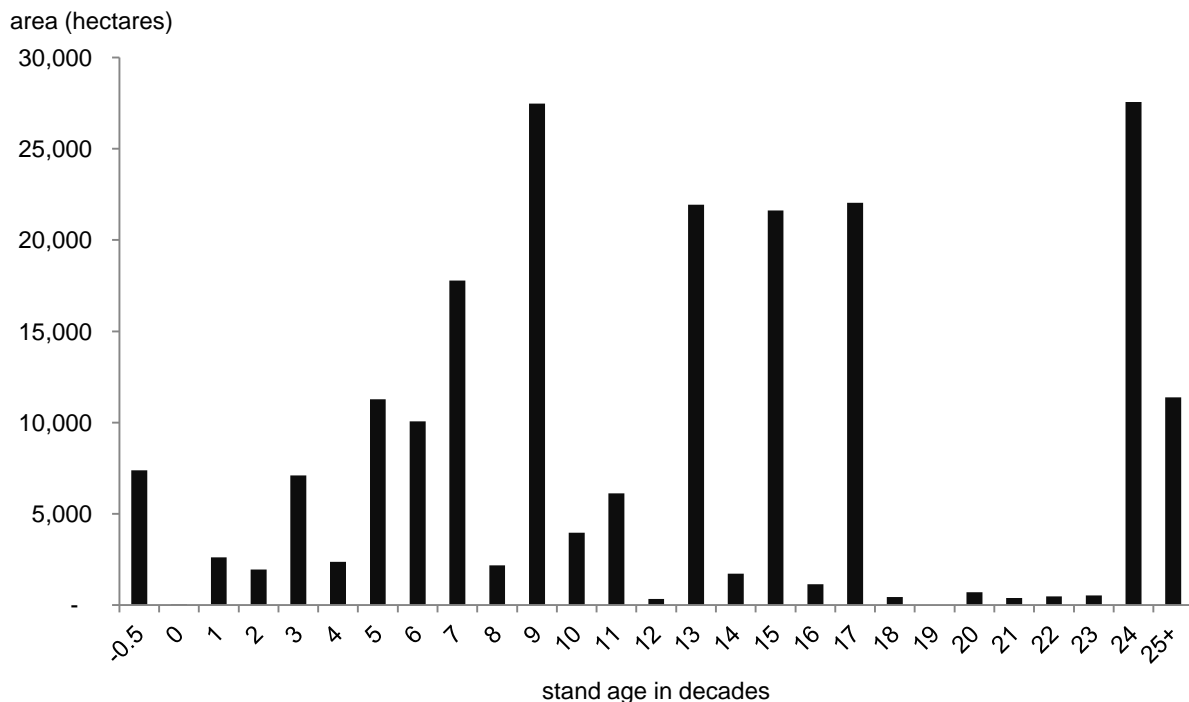


Figure 6. Age class distribution of the timber harvesting land base, Cassiar TSA 2013.

Figure 7 shows the timber harvesting land base by analysis unit by productivity groupings (Good/Medium/Poor) and age class interval. For more detail of the site productivity groupings see Section 5.2, “Analysis units”. The horizontal axis label ‘analysis unit’ has abbreviated labels. The description of the labels follows: 1st abbreviation C/I = Coastal/Interior, 2nd abbreviation B/H/PL/SW = Balsam/Hemlock/Lodgepole pine/White Spruce, and 3rd abbreviation G/M/P = site index intervals of Good/Medium/Poor.

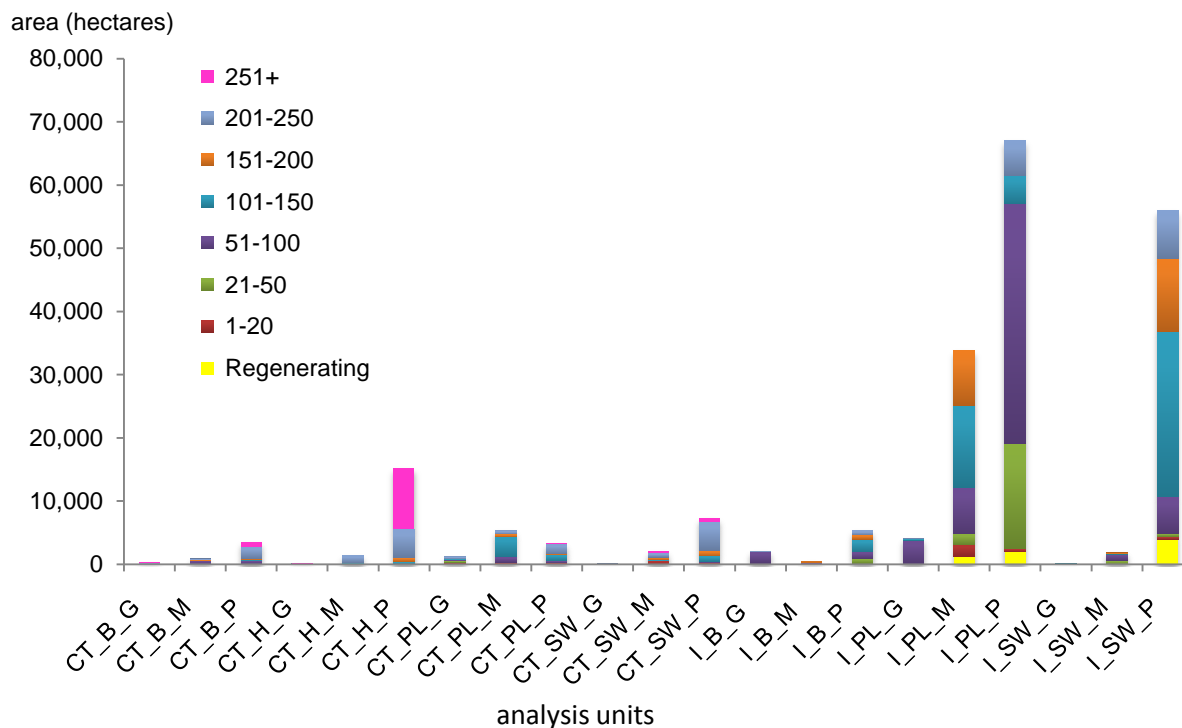


Figure 7. Timber harvesting land base by analysis unit and age class interval, Cassiar TSA 2013.

Minimum harvestable age is the age where stands attain sufficient size to harvest for products such as sawlogs or pulpwood. Figure 8 shows the proportions of the THLB by analysis units that is above or below minimum harvestable age (See Section 6.1.3, “Minimum harvestable age” for more information).

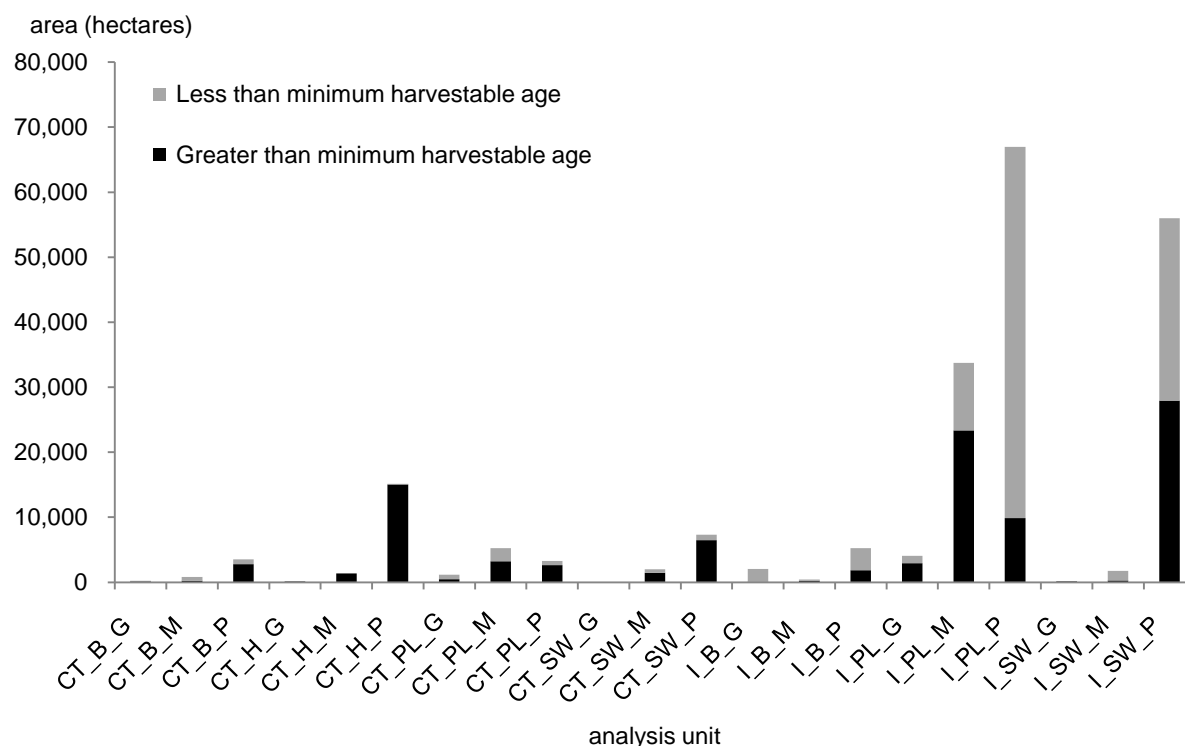


Figure 8. Minimum harvestable age of stands within the timber harvesting land base.

2.2 Comparison of the timber harvesting land base with the last timber supply review

The 2001 timber supply analysis utilized a non-spatial database while the 2013 database is spatially referenced. Because of this the THLB classified in the two analyses cannot be compared spatially. Known differences in the land base definition used in the two analyses is shown in the following table.

Table 3. Comparison of the 2001 and 2013 Cassiar TSA land base classification

Land class	Description	Change - 2012
Total land base	The total area in the March 2001 Cassiar TSA analysis report is 14 800 323 hectares whereas the current total area is 13 131 876 hectares. Just after the release of the 2001 report 1 668 447 hectares were transferred from the Cassiar TSA to the Fort Nelson TSA. The 2002 AAC determination reflects the transfer of the land base.	Smaller overall land base.
Non-forest, non-productive forest and non-commercial forest	The 2001 analysis used the Forest Inventory Planning (FIP) file attributes to define these factors. The FIP file relies heavily on defining these factors by timber attributes. The current analysis uses the Vegetation Resource Inventory (VRI) which includes the BC Land Classification System which is used to define these factors based on ecological attributes.	CFLB is larger.
Operable land base	Forest considered economically viable from the existing transportation infrastructure has been updated.	Smaller operable land base.
Environmentally sensitive area (ESA)	ESAs are not used in the 2012 analysis. More specific information was used to account for values previously defined by ESAs.	Less reduction to THLB.
Riparian habitat	The 2001 analysis applied a percent reduction factor to the land base. The current analysis used spatially explicit reductions.	Less reduction to the THLB.
Current roads	The 2001 analysis applied a percent reduction factor to the land base. The current analysis used spatially explicit reductions.	greater reduction to the THLB
Low site productivity	Low productivity site index criteria has lower minimum 'cut offs' in the current analysis.	Less reduction to the THLB
Slow-growing stands	Reductions in the current analysis are stand based. The previous analysis based the reductions on the average attributes of stands.	Less area available to the THLB
Pulpwood stands	The current analysis includes pulpwood stands in the Iskut blocks in the base case timber harvesting land base.	More area available to the THLB.
Minimum harvestable volume criteria for all species	The current definition of minimum volume is 150 cubic metres for all interior analysis units and 220 cubic metres for all coastal analysis units. Minimum coastal volume of 220 cubic metres was not applied to the pine analysis units in the 2001 analysis.	Less area available to the THLB.

The timber harvesting land base in the 2001 analysis was 198 550 hectares solely based on sawlog timber. The comparable 2012 timber harvesting land base is 188 868 hectares. However, the total 2012 timber harvesting land base is 206 608 hectares which includes 17 740 hectares of pulpwood stands in the Iskut operable blocks.

3. Current Forest Management Considerations and Issues

3.1 Base case management assumptions

The assumptions described in this data package reflect current performance with respect to the status of forest land, forest management practices and knowledge of timber growth and yield. The harvest forecast developed from these assumptions is the base case harvest forecast and is used as a baseline for assessing the impacts of uncertainties. Section 8, “Sensitivity Analysis” identifies areas of uncertainty in the data and assumptions and outlines sensitivity analyses that are carried out.

3.2 Statement of major forest management considerations and issues

Table 4 lists major forest management issues and considerations in the Cassiar TSA. Table 5 lists direction statements provided by the chief forester in the January 2002, *Cassiar TSA Rationale for AAC Determination*, and any government actions undertaken to address this direction since the previous determination.

Where management considerations are defined within legislation, regulations or standards, they will be included in the timber supply analysis (the “base case”). If the consideration does not fall within the definition of current management as described in Section 1, “Introduction”, the related timber supply impacts are assessed in a sensitivity analysis. There may be significant uncertainties in defining some current management considerations. In such cases, sensitivity analysis can assist in assessing the timber supply implications and assigning degrees of risk to timber supply during allowable annual cut determination.

The Cassiar timber supply analysis is meant to be a “streamlined TSR” – as such it will focus on updating the base case for most key issues. A few key sensitivity analyses and critical issue analyses will be conducted, but not the full range usually done for TSRs.

Table 4. Major forest management considerations, Cassiar TSA 2013

Consideration/issue	Description
Strategic planning	New objectives set by government have been established since previous TSR – these shall be considered in the base case.
Unsalvaged losses	Unsalvaged loss estimates, in particular those resulting from wildfire, have been fully revisited for better consistency with current science.
Vegetation resources inventory (VRI)	Cassiar TSA vegetation resource inventory (VRI) is primarily a roll-over of forest cover inventory. Nine key mapsheets in the Iskut-Stikine area were retro-fitted to Phase 1 VRI standard. VRI attribute uncertainties will be examined through a critical issues analysis based on 1997 Inventory Audit results. NSR classification uncertainties will be examined, through a sensitivity analysis that considers results of backlog NSR surveys scheduled for March 2013 completion.
Protected areas	Areas proposed for protection by the Dease-Liard SRMP (2010 revision) and the Atlin Taku Land Use Plan (LUP) are assumed to be protected areas in the base case, where protection is known to be imminent.

(continued)

Table 4. Major forest management considerations, Cassiar TSA 2013 (concluded)

Consideration/issue	Description
Landscape and stand level biodiversity	The 2004 Non-Spatial Old Growth Order established landscape units and biodiversity emphasis, and set non-spatial objectives for old seral. Order objectives are applied to all landscape units outside of the Dease-Liard SRMP area. Dease-Liard SRMP objectives for early, mature+old, and old seral are followed within the plan area.
New operability blocks	The District's operable corridor has been refined and split into five operability blocks to facilitate application of a new approach for geographic partitioning of the Cassiar AAC – i.e., based on operability block <i>versus</i> timber supply block.
Pulp-quality stands	The timber profile for the Cassiar TSA includes a significant component of pulp-quality stands, which has not historically been harvested in the Cassiar TSA. To quantify the contribution of pulp to overall timber supply even-flow pulp and sawlog harvest are modelled.
Wildlife	Forest management implications of aspatial Wildlife Habitat Notices created under Section 7(2) of the Forest Planning and Practices Regulation are considered in the base case, where linked to achievement of Forest Stewardship Plan results/strategies.
"Current management" within Iskut Supply Block	District staff maintain that "current management" is defined by licensee results/strategies from approved Forest Stewardship Plans (FSP) and this will be reflected in the base case
Community watershed	There is one community watershed in the Cassiar TSA. As it is within a no-harvest zone it has been excluded from the timber harvesting land base.
Recreation sites	There are recreation sites that are also managed for timber. A partial land base removal from the timber harvesting land base has been applied in the base case.
Riparian management	Management riparian features have been identified and buffered with reserve and management zones. The corresponding areas have been removed from the timber harvesting land base.
Site productivity	Provincial Site Index – Biogeoclimatic Ecosystem Classification (SIBEC) estimates studies suggest that site productivity is underestimated for regenerating stands. Since localized information is not available the impact of using the provincial SIBEC adjustments will be assessed in a sensitivity analysis.

Table 5. *Response to the Chief Forester's TSR 2 direction for future data improvements, Cassiar TSA 2013*

2001 implementation direction	Response
"Review the economic and physical operability of timber within the TSA"	The extent of economic timber has been revisited through strategic planning processes and fibre opportunity studies. The District's operable corridor has undergone significant revisions as a result.
"Clarify site productivity issues and associated issues of green-up age by reviewing SIBEC and inventory data"	A sensitivity analysis will be performed using the provincial SIBEC inventory with links to site index estimates from a biophysical model developed by the ministry.
"Review cutblock adjacency and green-up issues"	A three-pass, three-metre green-up will continue to be modelled to represent cutblock adjacency requirements.
"Proceed with establishing and approving VQOs across the TSA"	The Cassiar visual landscape inventory (VLI) has been thoroughly revised. visual quality objectives (VQOs) have either been grandparented under FRPA Section 181, or newly established in reference to FPPR Section 9.2.
"Better define riparian management of wildlife tree patches"	No work specifically to integrate the spatial riparian zones with expected wildlife tree patches. The base case assumes a non-spatial percent reduction for wildlife tree patches to the timber harvesting land base.
"Better define management of wildlife tree patches"	Assumptions for defining the area of wildlife tree patches are now consistent with current forest management practices.
"Explore methods to more accurately predict unsalvaged losses due to fire"	Spatially defined fire history has been incorporated into the analysis and has been used to improve the prediction of unsalvaged losses due to fire.

4. Inventories

4.1 Inventories

Table 6 lists the inventories and themes that will be used to determine the timber harvesting land base (THLB), and to model forest management activities.

Table 6. *Inventory information*

Data	Source	Vintage	Update
Biogeoclimatic ecosystem classification	FAIB	2011	-
Community watersheds	LRDW	1993	2011
Cultural heritage resources – archeological sites, areas	RAAD	2010	2010
Cultural heritage resources – trail buffers	FLNR-DSS	2004	2011
Environmentally sensitive area mapping	FAIB	1975	-
First Nations consultative areas	LRDW	2011	2011
Forest development units	LRDW	2011	-
Harvest depletions	LRDW	Various	2011
Landscape units	LRDW	2004	-
No commercial forest harvest zones - Atlin	LRDW	2008	-
Operable corridor - TSR2	FLNR-DSS	2001	-
Operable corridor - new	FLNR-DSS	2011	-
Ownership	LRDW	2008	2010
Parks, eco-reserves	LRDW	2011	-
Provincial forest	LRDW	1999	-
Recreation sites, reserves	LRDW		2011
Research installations, growth and yield plots	LRDW	2011	-
Riparian areas	FLNR-DSS	2011	-
Roads, trails, landings	FLNR-DSS	2011	-
Slopes < and > 35%	FAIB	1999	-
Strategic plans – areas with legal objectives	LRDW	2011	-
Strategic plans – areas with non-legal objectives	LRDW	2011	
TSA, timber supply blocks	LRDW	2001	2011
Vegetation resources inventory	LRDW	2011	2011
Visual landscape inventory/ VQO's	BCGOV FOR	2007	2011
Wildfires, current and historic	BCGW	2011	-
Wildfires, 1998-2011 internal structure	FAIB	2011	-
Wildlife high-value habitat: bull trout	FLNR-DSS	2011	-
Wildlife high-value habitat: candidate Grizzly WHA areas	MOE-Skeena	2008	-
Wildlife high-value habitat: proposed Goat and Sheep UWR	MOE-Skeena	1999	-
Wildlife high-value habitat: Goat and Sheep Natal areas	MOE-Skeena	1999	-
Wildlife high-value habitat: proposed Moose UWR	MOE-Skeena	1999	-
Wildlife management areas	LRDW	2011	-

Data source and comments:

Biogeoclimatic ecosystem classification - a BEC file with 2011 revisions has been made available by FLNR, Forest Analysis and Inventory Branch. The current data is described as BGC version 8.

Community watersheds - the one established community watershed (Telegraph Creek) has been excluded from the timber harvesting land base (THLB).

Cultural heritage resources – known archeological sites protected under the *Heritage Conservation Act*, and trails with heritage status or with objectives set by government, have been spatially identified and buffered, and are excluded from THLB.

Environmentally sensitive area (ESA) mapping - not used in the analysis as more specific information sources have been used to protect the associated values.

Forest development units (FDU) – certain Forest Stewardship Plan commitments that represent “current management” are spatially restricted to FDU areas.

Harvest depletions – multiple stand-alone and Land and Resource Data Warehouse (LRDW) sources were used to represent historic and current harvest depletions, including RESULTS openings, RESULTS forest cover, VRI openings, and a specialized satellite imagery-based harvest depletion file.

Landscape units (LU) - Cassiar LU and biodiversity emphasis options were established in June 2004 via the *Order Establishing Provincial Non-Spatial Old Growth Objectives*. The Dease-Liard SRMP (2004) established a new LU comprising the full SRMP area that replaced nine LU's previously established under the Order.

No commercial forest harvest zones – a 2008 Ministerial Order established two “no commercial forest harvest zones” in the Atlin area, as an interim measure for the Atlin Taku strategic planning process.

Operable corridor – TSR 2, new – the District previously defined an “operable corridor” comprising the extent of TSA area considered feasible for forestry operations. Its extent considers factors of physical accessibility (e.g., terrain limitations) and economic feasibility (e.g., distance to markets and wood quality).

The operable corridor was refined for this analysis. In the Atlin and Dease-Liard timber supply blocks, the corridor extent now coincides with boundaries of “commercial timber harvest” zones established under the Dease-Liard Sustainable Resource Management Plan (DLSRMP) and recommended by the Atlin Taku Land Use Plan. It has also been divided into five operability blocks to facilitate reasonable geographic partitioning of the Cassiar AAC.

Ownership - a customized data layer was produced in 2010 by Forest Analysis and Inventory Branch. Ownership coding is reflective of that used for the previous forest cover inventory “f_own” file. District staff reviewed and verified reasonable accuracy and presence of current information. The file includes UREP/recreation reserves, private lands, federal reserves, Indian Reserves, other miscellaneous reserves and leases, and most parks and ecological reserves.

Parks, eco-reserves – this LRDW layer is used to represent all parks and eco-reserves, including any not captured on the ownership data layer.

Recreation sites, reserves - these areas administered by FLNR Recreation Sites and Trails Branch (formerly Ministry of Tourism, Culture and the Arts) will be fully or partially removed from THLB.

Research installations, growth and yield plots - forest within growth and yield plots is representative of the natural or managed forest. Because forested area of plots could potentially be included in WTP or other reserve, it is retained in the THLB. Research installations are managed for research purposes so may or may not be characteristic of the natural forest over a rotation. Their area is removed from the THLB, but their protective buffer areas contribute to THLB.

Riparian areas - District staff derived a spatial riparian management area reduction file, using Freshwater Atlas (FWA) rivers, wetlands, lakes and stream network files from the *BC Geographic Warehouse* (BCGW) as primary source files. Features have been spatially mapped within the operable blocks. Area outside of the operable blocks has been accounted for within other reduction factors.

Roads, trails, landings – District staff aggregated roads and trails from all LRDW sources, then buffered with GIS-measured right-of-way widths to create a spatial reduction file.

Steep slopes - a 35 percent slope cut off is used to spatially differentiate reasonably feasible ground-based harvest opportunities (“operable” land base) from poor feasibility opportunities (“inoperable” land base). Slopes >35 percent are excluded from the THLB.

Strategic plans – areas with legal objectives, areas with non-legal objectives – completed Cassiar TSA strategic plans include the Cassiar Iskut-Stikine LRMP (2000, Ministerial policy), Dease-Liard SRMP (2004, legal objectives established via HLP Order), Dease-Liard SRMP (2010, no legal objectives), and the Atlin Taku LUP (2011, no legal objectives). An Order-in-Council is currently before the Minister of Forests, Lands and Natural Resource Operations to establish two no-harvest areas in the Atlin area as part of the completion of Atlin Taku LUP process. These areas have been excluded from the THLB.

Vegetation resources inventory (VRI) – the VRI for the Cassiar TSA is primarily a roll-over of the previous forest cover inventory. Nine mapsheets in the Bob Quinn area are a retro-fit from a 1999 Phase 1 VRI project. Time dependent attributes have been re-projected to January 1, 2011.

The forest cover inventory is primarily 1970’s vintage, although a 1989-1991 wildfire reconciliation project reclassified major wildfires occurring to that point via aerial survey (minimum 40 hectare polygon size; broad aerially-called attributes). Also, District inventory staff updated forest cover with spatial and attribute information from 1988-1996 silviculture surveys.

Major wildfires occurring 1997-2011 have not been captured in the VRI. Wildfire layers will be used as a tool for updating VRI attributes for the analysis.

Visual landscape inventory/ VQOs - Branch and Regional Landscape Inventory Specialist staff recently completed Cassiar TSA updates to the LRDW Visual Landscape Inventory (VLI) file. Updates include: consolidation of all previous VLI’s, spatial capture of previous and new visually sensitive areas referenced in strategic plans; and capture of grandparented, assigned, or recommended visual quality objectives (VQOs).

Wildfires – current and historic – these LRDW current and historic fire boundaries will be used to support a revisit to non-recoverable wildfire loss calculations.

Wildfires – 1998-2011 internal structure – FAIB staff sourced satellite imagery to spatially capture “burnt” versus “unburnt” areas of major wildfires occurring 1998-2011 in the operable corridor (i.e., the period of time during which the VRI was not updated for wildfires). “Burnt areas” will be used for purposes of adjusting time-dependant attributes for underlying VRI polygons.

Wildlife - high-value habitat – these areas of high-value habitat for bull trout, moose, goat, sheep, and grizzly have legal objectives set by government, or are non-legal but referenced in Forest Stewardship Plans with forest cover constraints, or have been flagged for intentional exclusion from licensee Forest Development Units.

4.2 Vegetation resource inventory update for the analysis

Disturbance update

Excepting nine mapsheets the current VRI is a forest cover roll-over from the original forest resource inventory. There have been no updates for fires occurring in the 1997-2011 period. To ensure fire and logging history has been incorporated into the analysis data set the following supplemental procedures were performed:

- Ministry RESULTS and FTEN databases provided disturbance (e.g., logging) information not captured in the VRI (TSR database field name DISTURBA_1).
- Forest Analysis and Inventory Branch used satellite imagery to update the fire history from 1997 to 2011. This data supplemented information from the RESULTS database. Some fire openings were considered still merchantable or lightly burned and were excluded from the update. The TSR database field names are: fire_yr_c (2010-2011), fire_yr_h (1980-2009) and fire_class (not burnt).
- Stand age was reset to the year of disturbance minus the regeneration period which was 10 years for fire and two years for logging disturbances.
- The most recent type of disturbance was recorded as ‘fire’ or ‘harvest’ in the TSR database field called ‘nsr_flag’.

Missing data

After harvest some stands have been reclassified as non-commercial or non-productive forest due to the removal of standing trees. Further, some the stand attributes, such as species composition and site index, may not have been retained in the VRI. Any area with ‘logging history’ have been retained in the CFLB for the analysis. These stands were assigned missing values using the following procedures:

- No species: The average species composition of the BEC zone/variant was determined for the CFLB and THLB, and assigned accordingly.
- Harvest history with no/low site index: Assigned the average site index of the corresponding lowest productivity group for the analysis unit (e.g., Interior Pine Poor).
- Stands qualifying as THLB with no volume curve or a volume curve that did not meet minimum harvestable criteria by age 200: Assigned a volume curve of a stand within the THLB that met minimum volume criteria within a similar analysis unit, similar species composition and site index.

5. Division of the Area into Management Zones

5.1 Management zones

Management zones are used to differentiate areas with distinct management emphasis. For example, a zone may be based on a harvesting system, silviculture system, visual quality objective or wildlife consideration. An area of forest may be subject to more than one management objective. Each objective can be tracked separately in the timber supply model. Land considered unavailable for timber harvesting can contribute to the achievement of other forest management objectives.

Table 7 outlines the zones or objectives incorporated in the timber supply model. Further information on the forest cover requirements to be applied to these areas can be found in Section 7, “Integrated Resource Management”.

Table 7. Objectives to be tracked

Objectives	Inventory definition
Operability blocks	Even-flow harvest by individual operability block
Seral stage distributions	Crown forested land base by landscape unit and BEC variant
Patch size distribution	Number of THLB harvest passes by landscape unit and natural disturbance type (NDT)
Cutblock adjacency	Number of harvest passes on the THLB by landscape unit
Wildlife habitat	Crown forested land base by habitat polygon by wildlife species
Visual quality objectives	Crown forested land base by visually sensitive area polygon
Natural disturbance	Non-THLB by natural disturbance type (NDT)

Data source and comments:

See Section 4, “Inventories”, for the sources of mapping and zones referenced above. Information on the forest cover requirements to be applied to these areas can be found in Section 7, “Integrated Resource Management”.

Operability blocks – the intent is to model even-flow sawlog harvest for each of Atlin, Swan Lake-Teslin, and Dease-Liard operability blocks, and even-flow pulp and sawlog harvests for the Iskut-A and Iskut-B operability blocks.

5.2 Analysis units

An analysis unit is composed of forest stands with similar tree species composition, timber growing potential and treatment regimes. Each analysis unit is assigned its own timber volume projection (yield table) for existing and future stands. Yield tables for existing “natural stands” are derived using the Variable Density Yield Prediction (VDYP version 7.1) model. Yield tables for “managed stands” (i.e., recent plantations and future stands) are derived using the Table Interpolation Program for Stand Yields (TIPSY version 4.2).

Forest stands remain in the same groupings for existing natural stand and managed stand analysis units given that there are no localized post harvest site adjustment studies for the Cassiar TSA. Sensitivity analysis will be performed using the provincial SIBEC inventory with links to site index estimates from a biophysical model developed by the ministry. This will be used to evaluate the potential impact of post-harvest site index adjustments on mid- to long-term timber supply.

Table 8 shows the criteria used for defining analysis units for existing natural and managed stands.

Table 8. *Definition of analysis units*

Analysis unit by leading species	Timber harvesting land base ¹ (hectares)	Site index range (height in metres at age 50 years)	Average site index
1 Coastal - Spruce — good sites (G)	29	> = 25.1	33.9
2 Coastal - Spruce — medium sites (M)	2 006	17.1 – 25.0	20.9
3 Coastal - Spruce — poor sites (P)	7 132	< 17.1	12.7
4 Coastal - Pine — good sites (G)	1 171	> = 19.1	20.8
5 Coastal - Pine — medium sites (M)	5 255	14.6 – 19.0	16.3
6 Coastal - Pine — poor sites (P)	3 296	< 14.6	12.5
7 Coastal - Balsam — good sites (G)	220	> = 16.1	18.6
8 Coastal - Balsam — medium sites (M)	824	13.1 – 16.0	14.8
9 Coastal - Balsam — poor sites (P)	3,502	< 13.1	9.4
10 Coastal - Hemlock - good sites (G)	162	> = 17.1	19.7
11 Coastal - Hemlock - medium sites (M)	1 361	14.1 – 17.0	16.1
12 Coastal - Hemlock - poor sites (P)	15 138	< 14.1	10.4
21 Interior - Spruce — good sites (G)	113	> = 25.1	30.8
22 Interior - Spruce — medium sites (M)	1 769	17.1 – 25.0	18.8
23 Interior - Spruce — poor sites (P)	55 983	< 17.1	11.0
24 Interior - Pine — good sites (G)	4 085	> = 19.1	19.7
25 Interior - Pine — medium sites (M)	33 771	14.6 – 19.0	16.0
26 Interior - Pine — poor sites (P)	66 977	< 14.6	12.5
27 Interior - Balsam — good sites (G)	2 039	> = 16.1	16.7
28 Interior - Balsam — medium sites (M)	429	13.1 – 16.0	14.4
29 Interior - Balsam — poor sites (P)	5 252	< 13.1	9.5
Total area and average site index	210 681		12.9

¹ Area rounded to the nearest integer.

Appendix A and B present the growth and yield tables for the existing natural and managed stands.

Data source and comments:

The forests of the Cassiar TSA can be grouped into coastal/transitional and interior biogeoclimatic ecosystem classification (BEC) units. This zonal grouping provides better modelling of regeneration

assumptions and growth and yield prediction. The coastal/transitional groupings are the CWH, ESSF, ICH, SBS, and MH zones, while the interior groupings are the BWBS and SWB zones.

Analysis units have been developed for stands of similar characteristics. Ranges of site index have been assigned to good, medium and poor site productivity classes within the forest.

The site index criteria for each analysis unit in Table 8 was determined as follows:

- use site index of eight metres as the lower boundary of the poor site class, and
- use the same site index groupings (classes) as the previous timber supply analysis.

Growth and yield curves have been developed for each existing or natural stands. Managed stand yield curves were developed for each analysis units (See Section 7.3.1, “Regeneration assumptions for managed stands”).

In the timber supply model volume and area statistics are reported by analysis units or average species contribution of analysis units. Other pre-defined groupings such as operability block are also be used for reporting purposes in the timber supply model.

6. Timber Harvesting Land Base Assumptions

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). The CFLB consists of provincial Crown land with forest cover that is managed by the FLNR for TSA timber supply. The CFLB excludes:

- Non-forested areas such as rock, ice and water;
- Non-productive forest such as tundra, shrubs and brush;
- Federal lands and reserves;
- Long-term leases;
- Parks and ecological reserves; and,
- Private lands.

The THLB is that portion of the Crown forested land base that is available for timber harvesting. Within the CFLB the THLB excludes:

- Non-commercial tree species such as aspen;
- Areas that are not suitable for timber production; and,
- Areas where timber harvesting is incompatible with management objectives for other resource values.

The Crown forested land base may contribute to meet timber and non-timber management objectives. The THLB and non-THLB portions of the CFLB needed to meet broader forest management objectives, such as wildlife habitat management, are tracked in the timber supply model. Timber harvesting may be constrained when there is insufficient non-THLB area to meet forest objectives.

The current timber harvesting land base may increase in size over time in the following situations:

- Where management activities improve land base productivity or operability (e.g., the stocking of land currently classified as non-commercial brush with commercial tree species);
- Through the acquisition of productive forest land (e.g., timber licence reversions).

Or decrease in size where:

- Where management activities prevent the re-establishment of a productive forest (e.g., future permanent roads).

The following sections describe the assumptions for each factor used to derive the timber harvest land base. A summary of the factors and area reductions is presented in Section 2, “Determination of the Timber Harvesting Land Base”.

6.1 Non-forest, non-productive forest and non-commercial cover

Table 9 shows the criteria used to remove non-forested areas, non-productive forest and non-commercial cover from the TLHB.

Table 9. Description of non-forest, non-productive forest and non-commercial cover areas

Attributes	Description
Non-forest	
VRI BCLCS level 1 equal to 'N'	Non-vegetated
BCLCS level 2 = 'N' AND BCLCS level 4 not equal to 'ST or 'SL'	Non-treed, excluding shrub areas
BCLCS level 2 = 'N' AND BCLCS level 3 = 'W'	Non-treed wetlands
BCLCS level 3 = 'A'	Alpine
Non-productive forest	
Projected height (metres) <= 5 and project age > 35 years; OR Crown closure layer 1 <= 20% AND no logging history	Forested but not productive (low site productivity)
Non-commercial forest	
BCLCS level 2 = 'T' AND BCLCS level 3 = 'W'	Treed wetlands
BCLCS level 4 = 'ST or 'SL' AND no logging history	Shrub and not already logged

Data source and comments:

BC land classification system (BCLCS) attributes are used to identify non-vegetated and various classes of vegetated areas.

- Non-forest areas include water, and non-vegetated land such as rock, ice, and bare land.
- Non-commercial areas are generally covered by brush species and are not capable of growing commercial forests, and as such do not contribute to the CFLB or to meeting forest cover objectives such as wildlife habitat or biodiversity.
- Non-productive forest is comprised of forest of very low site productivity such as tundra. These forests do not contribute to the CFLB or to meeting forest cover objectives.

Logging history is defined through the following VRI attributes for the analysis:

- OPENING_ID (Opening Indicator) > 0
- HARVEST_DA (Harvest Date) is not null
- Disturbance > 0. This data was developed by district staff using RESULTS, VRI data or field survey information (locally developed consolidated cutblock layer)
- LINE_7B_DISTURBANCE_HISTORY – fields with logging (L) history.

6.2 Land not administered by FLNR for TSA timber supply

Land is administered in the province through ownership types. Those not administered by FLNR for timber supply includes private land, municipal land, federal land, Indian Reserves, and woodlot licences. These areas do not contribute to meeting biodiversity, wildlife habitat or visual quality management objectives. Other areas not administered by the FLNR but do contribute to meeting management objectives include UREP/Recreation reserves, parks and ecological reserves.

A spatial data set of land ownership was developed using information from the Crown Land Registry and the Integrated Cadastral Information Society. Table 10 shows the contribution of each ownership type in the Cassiar TSA to the CFLB and whether the CFLB is eligible to contribute to the THLB.

Table 10. Ownership contributions, Cassiar TSA 2013

Ownership code	Crown forested land base	Timber harvesting land base	Area (hectares)
40 Private – Crown Grant	No	No	6 165
50 Federal Reserve	No	No	13 520
52 Indian Reserve	No	No	3 752
60 Crown Ecological Reserve	Yes	No	63 477
61 Crown UREP (Use, Recreation and Enjoyment of the Public) Reserves	Yes	No	179 894
62 Crown Forest Management Unit (TSA)	Yes	Schedule C: Yes Schedule N: No	10 174 760 0
63 Crown Provincial Park Class A	Yes	No	2 481 292
67 Parks	Yes	No	162 980
69 Crown Miscellaneous Reserves	Yes	Schedule C: Yes Schedule N: No	10 665 N 478
99 Crown Misc. lease	No	No	34 836 58
Total			13 131 876

Data source and comments:

Ownership-schedule codes 62C and 69C indicate Crown land in a forest management unit and miscellaneous reserves, respectively. Agricultural land reserve (ALR) area has been included in ownership code 62C.

Crown UREP (ownership code 61) are removed from eligibility to the timber harvesting land base under Section 6.4, “Areas with high recreational values”.

6.3 Environmentally sensitive areas

Some forested lands are environmentally sensitive and/or significantly valuable for other resources. These areas are called environmentally sensitive areas (ESAs) and areas have been identified on 39 mapsheets.

More current and specific information is available for protecting non-timber values and sensitive sites. As such, ESAs have not been used in this analysis.

6.4 Areas with high recreation values

Areas for the Use, Recreation and Enjoyment of the Public (UREP ownership code 61) are administered by Ministry of Forests, Lands and Natural Resource Operations and do not contribute to the timber harvesting land base.

UREP land base was not removed under the ownership factor. It was removed under its own factor so that the forested land base can contribute to forest cover constraints.

Recreation reserves - Recreation Sites and Trails, are managed in an integrated fashion that permits a certain level of harvest. For this analysis it is estimated that approximately of 25 percent of the areas are reserved from harvest. Table 11 shows the data source and reductions to the timber harvesting land for areas of high recreation value.

Table 11. *Recreational values, Cassiar TSA 2013*

Category	Attributes	Reduction (%)
UREP	Ownership code = 61	100
Recreation	MoTCA recreational reserves (REC_FEATURE = "RR" or "SIT")	25 ¹

¹ No reductions have been applied in the analysis for the recreation category in Table 10. Of the 471 hectares identified for recreation only 8.1 percent remains in the timber harvesting land base. It is assumed that the need to constrain harvesting activities will occur in the field on a site-by-site basis.

6.5 Areas considered inoperable

Forest stands considered inoperable are areas excluded from harvesting by land use plans, stands that are not accessible from current infrastructure and stands not viable for harvest due to size, market or existing logging opportunity (e.g., conventional *versus* helicopter). Changing technology and economic conditions can affect future conditions for harvesting opportunities.

Inoperable areas were defined using the following criteria:

- Areas located outside the operable corridor;
- Areas with slopes greater than 35 percent;
- Pulpwood stands in the Atlin, Dease-Liard and Swan-Teslin operable blocks were excluded from the THLB. Pulpwood stands in the Iskut blocks are eligible for inclusion in the THLB. Table 12 shows the attributes that define pulpwood stands.

Table 12. *Definition of pulp-quality stands, Cassiar TSA 2013*

Component	Age class	Average total tree height (metres)	Site index	Volume by species
Mature, balsam-leading stands	> 6	< 24		> 50% subalpine fir and hemlock
Immature, balsam-leading stands	<= 6		< 13	> 50% subalpine fir and hemlock
All hemlock-leading stands				> 50% hemlock and subalpine fir

Data source and comments:

Cassiar TSA is divided into six legally-defined Timber Supply Blocks (TSB). Only four of the TSB (Iskut, Boundary, Dease-Liard, and Atlin) contain significant concentrations of merchantable timber that are within 10-20 kilometres of trafficable roads.

Within these four TSBs the district has historically defined an "Operable Corridor" in consideration of factors of physical accessibility (e.g., terrain limitations) and economic feasibility (e.g., distance to markets and wood quality). For example, isolated patches of merchantable timber were excluded if estimated costs to access and harvest were likely to grossly exceed stand value.

The Operable Corridor has been refined for this round of TSR to coincide with boundaries of “commercial timber harvest” zones established under the Dease-Liard Sustainable Resource Management Plan (DLSRMP) and Atlin Taku Land Use Plan. All areas outside the Operable Corridor are considered inoperable.

The refined Operable Corridor has also been divided into five “Operability Blocks” to be eligible for geographic partitioning of the Cassiar AAC: Atlin, Dease-Liard, Iskut-A (more accessible land base), Iskut-B (more remote areas, and harvest deferral areas), and Swan-Teslin.

- In the Atlin, Dease-Liard, and Swan-Teslin Operability Blocks - consistent with historic harvesting practices - only higher volume stands that are likely to yield >50 percent sawlog grades on harvest and that can be harvested with conventional, ground-based logging methods (slopes less than or equal to 35 percent), are considered for inclusion in the THLB. The remainder will be removed.
- In the Iskut-A and Iskut-B Operability Blocks, higher volume pulp-quality stands as described in Table 10, on slopes less than or equal to 35 percent, are considered for inclusion in the THLB.

6.6 Sites with low timber growing potential

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. As these stands are not considered to be harvestable, unless there is previous harvest history they are removed from the THLB using the criteria listed in Table 13.

Table 13. Description of sites with low timber growing potential, Cassiar TSA 2013

Description	Leading species	Characteristics						Reduction (%)
		BCLCS Level 4	BCLCS Level 5	Site index	Stems/ hectare	Age	Height class	
Low site class	Fir, Hemlock, Pine, Spruce			< 8				100
Stocking problems	All	TC (treed-coniferous), TM (treed-mixed)	SP (sparse)	All				100
	All				< 300	> 100 years		100
Low height	All					>	<= 2	100

Data source and comments:

Sites with low timber growing potential include existing forested stands that are unlikely to achieve minimum harvestable age criteria prior to decadence. These can be categorized as “low” site class sites. The site index limiters shown in Table 12 are essentially consistent with the low to poor site class split by species from the VDYP Batch Users Guide.

Mature treed sites with low levels of stocking are also unlikely to achieve minimum stand volume criteria. These were previously identified using stocking class codes, which are either no longer carried or are not consistently updated in newer VRI.

- BCLCS Level 4 and 5 criteria for treed, coniferous sites with sparse (i.e., less than 25 percent) cover are used as a proxy.
- It was determined by analysis that treed, coniferous stands with less than 300 stems per hectare also do not achieve minimum volume criteria by maturity.

Mature stands with low height class are also identified for removal, consistent with the previous timber supply review (TSR 2). There may be overlap with stands removed for other reasons for low site class.

6.7 Non-commercial species

Table 14 describes stand types that are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. They are wholly excluded from the THLB.

Table 14. Problem forest types criteria, Cassiar TSA 2013

Leading species	Reduction (%)
Black spruce, Whitebark Pine Yellow pine, tamarack and deciduous species	100

Data source and comments:

Because there are no markets for these species, they are not targeted for harvest in Cassiar TSA.

The volume contribution from these species has been removed from all of the volume estimates for natural and managed stands.

6.8 Wildlife habitat reductions

Wildlife habitat may be identified and managed through several processes including the Identified Wildlife Management Strategy (IWMS), identification and approval of ungulate winter range (UWR) and wildlife habitat areas (WHA), and management practices specified in plans that establish legal objectives.

Table 15. Wildlife habitat exclusions, Cassiar TSA, 2013

Description	Layer	Attributes	Reduction (%)
Dease-Liard - Core Caribou Winter Range	RMP_PLAN_LEGAL_POLY_SVW	LEGAL_FE_4 ¹ = "Core Forested Winter Range" or "Alpine Core winter range"	100
Dease-Liard - Selected Critical Caribou Habitats	RMP_PLAN_LEGAL_POLY_SVW	LEGAL_FE_62 ¹ = "Selected"	100
Dease-Liard - Critical Bull Trout Habitat	dlsmp_bt_500m	BT_BUFF = "YES"	100
Atlin - Northern Caribou	ncfhz_cwr_at	NCFZ ² = "caribou"	100

¹ These attributes have been renamed in the timber supply analysis database as IF_VALUE1 and IF_VALUE2 fields.

² A small area is located in the Atlin operable block. After 'dissolving' for minimum one hectare blocks, no area remained in the CFLB.

Data source and comments:

Cassiar TSA has no legally established UWRs or WHAs.

Dease-Liard Supply Block

Mapped areas of high-value wildlife habitat for grizzly bear, moose, mountain goat, mule deer and caribou, have objectives set by government (OSBG) specified in the Dease-Liard SRMP (2004). Areas that will be excluded from THLB are described in Table 15. Areas with forest cover constraints are described in Section 7.4.1, "Objectives with forest cover requirements".

The Dease-Liard SRMP legal objective for bull trout requires maintenance of a 500 metre no harvest zone around known or suspected spawning or natal reaches. The SRMP did not provide a map to spatially support this objective, so a proxy was built for analysis purposes. All stream reaches in SRMP area that had bull trout sightings tracked in FISS (BC Ministry of Environment's Fisheries Information Summary System) were selected and buffered by 500 metres for exclusion from THLB.

Iskut and Boundary Supply Blocks

The Cassiar-Iskut-Stikine LRMP area is within the Iskut and Boundary Supply Blocks. It did not establish legal objectives for wildlife.

A Forest Planning and Practices Regulation Section 7 Wildlife Notice (2004) provides indicators of the amount, distribution and attributes of wildlife habitat required for survival of Species at Risk including marbled murrelet and grizzly bear.

- marbled murrelet - the Notice specifies an amount of "suitable nesting habitat" to a maximum mature THLB impact of 350 hectares. Suitable habitat is defined¹ as "forest in CWH and MH biogeoclimatic zones, within 85 kilometres of saltwater, in age class 8 and 9 stands", with preference for suitable habitats within 30 kilometres of saltwater.
 - Because there is no THLB within 30 kilometres of saltwater, and abundant forest of suitable habitat characteristics does exist within that distance, no THLB constraints have been applied.

¹ As defined in *Accounts and Measures for Managing Identified Wildlife*, in Identified Wildlife Management Strategy (2004 version).

- grizzly bear— for Cassiar TSA, the Notice specifies forest cover constraints for an area of 16 246 hectares of “suitable habitat” of which 1693 hectares are to be within THLB and located within CWH and ICH biogeoclimatic zones (which are only present in the Iskut and Boundary Supply Blocks).

Mapping of candidate Grizzly Wildlife Habitat Areas was conducted to support Section 7 Notice requirements and eventual WHA establishment².

Cassiar Forest Corp’s Forest Stewardship Plan (FSP) provides forest management results/strategies for grizzly bear, moose, and marten.

- Results/strategies for moose and marten do not result in additional land base exclusions or increased forest cover constraint (e.g., retention of non-merchantable stems as visual screening around critical habitats; access control; timing constraints; avoidance of deciduous-leading stands).
- Results/strategies for grizzly include a commitment to address Section 7 Notice requirements for selected candidate WHA areas for the proportion of forest/THLB present within their Forest Development Unit area. Forest cover constraints are described in Section 7.4.1, “Objectives with forest cover requirements.

Atlin Supply Block

A Section 7 Notice (2004) provides indicators for winter survival of ungulate species in the Atlin Timber Supply Block, namely northern caribou. The Notice specifies a gross area amount of 479 375 hectares of “suitable habitat” in the Teslin Plateau ecosection, SWB and BWBS biogeoclimatic zones, of which 519 hectares are to be within the THLB.

A 2009 Ministerial Order established Land Use Objectives for the Atlin Taku Framework Agreement area. Included in this Order were two “No Commercial Timber Harvest Zones” of which one has both THLB and mapped caribou habitat. This area shall be excluded from THLB per Table 14, and assumed to address needs of the Section 7 Notice.

6.9 Cultural heritage resource reductions

Cultural heritage features in the Cassiar TSA include traditional use sites and archaeological features. Known features (e.g., major grease trail networks; significant clusters of culturally modified trees), and areas with cultural heritage resource (CHR) potential, are identified and mapped at an operational scale. Licensees use this information to advise to the intensity of CHR reconnaissance, First Nations information sharing, and the design, location and timing of forest operations to protect features.

Pre-1846 archaeological features are protected under the *Heritage Conservation Act*. These features are assessed by a professional archaeologist. Typically assessments are conducted prior to the application of harvest permits. Values may be protected by the timing of harvest (seasonal) or the design of harvest blocks. Design may include incorporating features into leave strips, wildlife tree patches and riparian reserves.

CHR values are generally accommodated without additional THLB reductions. Table 16 lists exceptions.

² McElhanney Consulting Services Ltd. March 2009. Contract GS-McElhanney-08-01: Grizzly Bear Habitat Assessment and Candidate WHA Submission: South Central Cassiar TSA. 29 pp.

Table 16. Cultural heritage and archaeological features reductions, Cassiar TSA 2013

Description	Data layer	Attributes	Reduction (%)
Archaeological Features	RAAD_2010	BORDEN_RAA = not <null>	100
Dominion/ Yukon Telegraph Trail	dca_trailbuff, dca_tsb	TRL_NM = "Telegraph" AND TSB = "04F"	100
McDame Trail	dca_trailbuff	TRL_NM = "McDame"	100
Davie Trail	dca_trailbuff	TRL_NM = "Davie"	100

Data source and comments:

McDame Trail and Davie Trail are identified as CHR's by the Dease-Liard SRMP (2004). Consistent with the legal objective, a 100-metre reserve zone to either side of each trail has been excluded from the THLB.

Portions of the Dominion/Yukon Telegraph Trail have been protected as Heritage Trail under the *Heritage Conservation Act*. For undesignated trail within the operable blocks (Iskut only) the Cassiar Forest Corp commits to a 50 metre no-harvest reserve to either side of the trail.

6.10 Exclusion of specific, geographically defined areas

Table 17 describes additional areas to be excluded from the timber harvesting land base to account for area exclusions not discussed in previous sections.

Table 17. Exclusion of specific, geographically defined areas, Cassiar TSA 2013

Description	Layer	Attributes	Reduction (%)
Community watersheds	WLS_COMMUNITY_WS_PUB_SVW	cws_tag = 600.001	100
Atlin "No Commercial Harvest Zone"	ncfhz_ors_at	NCFZ = "odonnell"	100
Research installations	RESPROJ_RSRCH_INSTN_GVT_SVW	PROJECT_KEY = not <null>	100
Proposed "Protected Areas", establishment imminent	Dease-Liard SRMP area: RMP_PLAN_NON_LEGAL_POLY_SVW	NON_LEGA_1 (nlf_value1 ¹) = "Ne'ah'-Horseranch/Deadwood Area to be Protected"	100
	Atlin LUP area: RMP_PLAN_NON_LEGAL_POLY_SVW	NON_LEGA_1 (nlf_obj1 ¹) = "Atlin Taku Proposed Protected Areas"	
Cabinet Approved Protected Areas Strategy Study Areas	RMP_PLAN_NON_LEGAL_POLY_SVW	NON_LEG_11 (nlf_value5 ¹) = not <null>	100
Landscape units, other than those associated with "Operable Corridor"	dca_lu_opcorr	LU_NAME = <null>	100

¹ Indicates field name in the analysis database.

Data source and comments:

There is one established community watershed serving the community of Telegraph Creek will be geographically excluded from THLB.

A 2009 Ministerial Order established Land Use Objectives for the Atlin Taku Framework Agreement area. Included in this Order were two "No Commercial Timber Harvest Zones". One carried known caribou habitat and is spoken to in Section 6.8, "Wildlife habitat reductions", the second shows in Table 16.

A Government Actions Regulation (GAR) process was initiated then discontinued for the protection of research installations, growth and yield plots, and permanent sample plots. These areas and their forested buffers have instead been established as map notations which flag electronically during government and industry conflict checks.

Management practice is to avoid research installations and not include in WTP or other reserves, because they are managed for research purposes so are not "representative" of the natural forest over a rotation. Growth and yield plots and permanent sample plots are intended to be "representative" thus are retained in the THLB.

Areas proposed for protection where designation has not occurred but is imminent have been excluded from THLB. In the event that the proposed protected areas have not been legally established prior to the AAC determination, sensitivity analysis results will be used to assess the timber supply impact of excluding them from the THLB.

The land base considered for analysis includes forested areas within the Operable Corridor, where industrial, landscape-altering timber harvest has highest likelihood of occurrence. It additionally includes forested area within the landscape units associated with the Operable Corridor, to which landscape-level biodiversity objectives are applicable. All other landscape units are excluded.

6.11 Riparian reserve and management areas

Table 18 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 18. *Riparian management areas, Cassiar TSA 2013*

Waterbody description	Riparian class	Reserve zone (RZ) width (metres)	Management zone (MZ) width (metres)	MZ reduction (%) ¹	Modelled buffer width (metres) (=RZ width + (MZ reduction% x MZ width))
Iskut River	SPECIAL	100	0	0	100
River >100m	S1-A	0	100	20	20
River >=20 and <=100m width	S1-B	50	20	20	54
River <20m width	S2	30	20	20	34
Stream	S3	20	20	20	24
Stream	S4	0	30	10	3
Stream	S5	0	30	10	3
Stream	S6	0	20	0	0
S4, S5, S6 streams within Dease-Liard SRMP sensitive watersheds	SPECIAL	20	20	10	22
Wetland >5 ha	W1/ W5	10	40	10	14
Wetland >=1 and <=5 ha	W3	0	30	10	3
Lake, special management	SPECIAL	30	0	10	30
Lake >1000 ha	L1-A	0	0	10	0
Lake >5 and <=1000 ha	L1-B	10	0	10	10
Lake >=1 and <= 5 ha	L3	0	30	10	3

¹ Reflects result/strategy targets from current Forest Stewardship Plan for Cassiar Forest Corp.

Data source and comments:

There are no comprehensive inventories for riparian areas within the Cassiar TSA. A GIS project was conducted to approximate riparian reserve zones and riparian management zones for all streams, lakes, and wetlands within the Operable Corridor. Each stream, lake, and wetland class was spatially identified, then buffered in accordance with Table 17 criteria to create a spatial riparian buffer file. The amount of area within the buffers was calculated and applied as an area reduction to the affected stand in the analysis.

Freshwater Atlas (FWA) rivers, wetlands, lakes and stream network files from the BC *Geographic Warehouse* (BCGW) were used as source files for the project. FWA water feature files were used in preference to other available source files because FWA was determined to correlate most closely with extent of Cassiar VRI waterbody-related polygons.

The Iskut River is an S1-A river with special riparian reserve and management criteria specified by the Cassiar Iskut Stikine LRMP. It was spatially identified from the FWA River file using its GNIS_NM.

Other S1-A, S1-B class and certain S2 class rivers were spatially identified from the FWA Rivers file using measured stream width criteria.

Streams classed as S3, S4, S5, S6, and other S2 class streams were identified using a logical interpretation of Stream Feature Code (FCODE), Order, Magnitude and GNIS_NM attributes from the FWA Streams file.

As an example, S3 class streams were identified using the following attributes:

FCODE = GA24850000, GA24850140, GA24850150 (definite and indefinite streams), OR
 FCODE = WA114100000, WA24111110, WA241111170, WA241111190 (stream connectors), AND
 Order ≥ 4 (relatively lower elevation in watershed, stronger likelihood of being fish-bearing), AND
 Magnitude >20 and ≤ 150 (relatively moderate to high stream flow magnitude)

As legally required by the Dease-Liard SRMP (2004), a minimum 20-metre reserve zone and a 20 metre-management zone was additionally modelled for all streams within the “sensitive watersheds” of community use zones.

W1/W5 and W3 class wetlands, and L1-A, L1-B, and L3 class lakes were identified from the FWA Wetlands and FWA Lakes files, respectively, using their area attributes.

The Cassiar Iskut Stikine LRMP indicates an expectation for some level of riparian protection for Kinaska, Eddontenajon, Tatogga, Ealue and Kluachon Lakes. These are L1-A or L1-B class lakes which under FRPA require no management zone, and minimal to no reserve zone. A 30-metre (one-tree length) special reserve zone is modelled to address the LRMP expectation.

The amount of area reduction for the classes of riparian areas have not been reported as the analysis database only provides the amount of area to be removed from the THLB, not the type of area reduction.

6.12 Wildlife tree retention

Table 19 shows wildlife tree retention targets for the Cassiar TSA landscape units, applicable as a percentage of individual cutblock area.

Table 19. Reductions for wildlife tree retention in cutblocks, Cassiar TSA 2013

Landscape unit or applicable area	Reduction (% of cutblock area)
All cutblocks established from 1996 to 2010	7
Dease-Liard landscape unit	1
All other landscape units	7

Data source and comments:

Dease-Liard SRMP (2004) provides a legal target for wildlife tree retention (one percent) within the Dease-Liard Landscape Unit.

For all other landscape units, the *Forest Planning and Practices Regulation* default practice standard (FPPR s. 66) is applied, consistent with the Cassiar Forest Corp FSP result/strategy for stand-level biodiversity. The practice standard specifies a minimum 3.5 percent wildlife tree retention per individual cutblock, and a minimum retention of seven percent of [the total cutblock area harvested in any one calendar year]. To facilitate modelling, wildlife tree retention is simply set to a minimum level of seven percent of individual cutblock area.

6.13 Roads, trails and landings

Table 20 summarizes the reductions made for existing and future RTL's.

Table 20. *Estimates for existing and future roads, trails, and landings, Cassiar TSA 2013*

Roads, trails and landings (RTL)	Harvest history	Spatially identified	Reduction (%)
Existing RT outside cutblocks	No	Yes	100
Existing RTL, inside cutblocks	Yes		6.9
Future RTL			3.9

Data source and comments:

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL).

Existing roads and trails (RT) outside cutblocks were aggregated from all known digital sources, merged into one spatial file, and coded by road type (paved, unimproved, etc.). A polygonal file of realistic road and trail right-of-ways (ROW) was then generated, using the GIS-derived average ROW buffer width by road class shown in Table 21. Note that only those RT in areas with no harvest history are included in this category.

Table 21. Road ROW buffer criteria, Cassiar TSA 2013

Road description	ROW buffer (metres)	FCODES included
Alaska highway	100	N/A (spatially selected)
Other paved	40	DA25050180 DA25100190 DA25100200 DA25100370
2-4 lane gravel	30	DA25000120 DA25000220
1 lane gravel	20	DA25000110 DA25150140
Unimproved	10	DA25150000 DA25150100
Airstrip	30	AQ00450000 AQ00550000 AQ00550001
Trails, bridges, embankments	10	DD08350000 DD09950000 DD31700000 DD93200000 DD93220000 DD93250000
Railway line	20	DE22950000 DE22950001

The reduction selected for existing RTL's inside cutblocks is derived from an analysis of existing roads, trails and landings in 10 cutblocks completed for TSR 2, and is consistent with expectations for traditional landing-based systems.

Future RTL reductions are applied to individual stand areas when harvested for the first time by the timber supply model. The major licensee (Cassiar Forest Corporation) employs roadside logging (few to no landings) *versus* more traditional landing-based systems. The RTL reduction used (3.9 percent) is consistent with this practice.

6.14 Slow-growing stands

Stands that did not achieve minimum harvestable volumes over the 350-year modelling horizon, not harvested by the timber supply model, are removed from the THLB. These stands were not fully captured by Table 13, "Sites with low timber growing potential criteria". The criteria to remove these stands from the THLB are presented in the following table.

Table 22. Criteria for stands with low growing potential, Cassiar TSA 2013

Analysis unit grouping	Minimum volume criteria (m ³)/ha	Age criteria ¹ (years)
Interior analysis units	140	140 and 250
Coastal analysis units	200	140 and 250

¹ Volume curves are produced for each stand for ages 1 through 350. Review of the volume tables showed that the above age criteria were suitable for testing whether or not a stand would meet the minimum volume criteria for the entire yield prediction period (350 years) for the Cassiar TSA.

In the previous analysis, volume estimation for natural stands was based on the average stand attributes of an analysis unit. In the current analysis volume estimation for natural stands is stand based. Therefore, an individual stand rather than the average may not meet minimum volume criteria for harvest.

7. Current Forest Management Assumptions

7.1 Harvesting

7.1.1 Merchantability limits

The merchantability limits in Table 23 specify the maximum stump height, minimum top diameter (inside bark) and minimum diameter at breast height of harvested tree species. They are used in the analysis to calculate merchantable volume.

Table 23. Merchantability limits, Cassiar TSA 2013

Analysis unit	Utilization			
	Minimum stump diameter (cm)	Corresponding minimum DBH (cm)	Maximum stump height (cm)	Minimum top dib (cm)
All pine	15	12.5	30	10
All other	20	17.5	30	10

Data source and comments:

Table 23 is reflective of current merchantability limits set in Cassiar TSA's forest licences. These limits are consistent with Interior Timber Merchantability Specifications of the *Provincial Logging Residue and Waste Measurement Procedures Manual*.

On April 1, 2006 new log grades were implemented in the BC interior to include all scaled logs in the AAC, regardless of whether they were dead or alive when harvested. The model used to estimate existing stand volume (VDYP) does not account for the dead trees that could potentially be used as sawlogs (dead potential). At this time, the 1997 inventory audit is considered the best source of data regarding dead potential timber (9.0 percent)³ in the Cassiar TSA. This information will be presented to the chief forester at the time of the AAC determination.

7.1.2 Volume exclusions for mixed-species stands

Table 24 identifies any species in mixed-species stands that are unmerchantable and are not harvested. The unharvested portion of a stand does not contribute to estimated stand volumes (timber yield curves).

Table 24. Volume exclusions for mixed-species types, Cassiar TSA 2013

Species	Volume exclusion (%)
Deciduous	100%
Whitebark Pine	100%
Black Spruce	100%
Tamarack	100%

³ Summary of dead potential volume estimates for management units within the Northern and Southern Interior Forest Regions, Ministry of Forests and Range, March 2006.

Data source and comments:

Provincial Harvest Billings System (HBS) records indicate that trembling aspen, cottonwood, and birch billed volumes (including waste) totalled to only 3018 cubic metres over the past 10 years in the Cassiar TSA. It was concluded that deciduous volumes in pure- and mixed-species stands can reasonably be excluded from consideration.

Because whitebark pine is most often present in open-grown high-elevation stands, it generally has undesirable piece size and stem characteristics (i.e., branchiness, severe stem taper), so volumes are excluded from consideration. HBS revealed no billings in the past 10 years.

Black spruce and tamarack are short height, low-volume stems associated with wetter ecosystems that are commonly avoided for harvest. HBS revealed no billings in the past 10 years.

7.1.3 Minimum harvestable ages

The minimum harvestable age is the earliest age at which a stand is considered to be harvestable. While harvesting may occur in stands at the minimum age, 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). Table 25 shows the criteria used to determine minimum harvestable ages.

Table 25. Minimum harvestable age criteria, Cassiar TSA 2013

Analysis unit	Minimum criteria	
	Height class	Volume (m ³ /ha)
Mature stand - coastal/transitional	3	220
Mature stand - interior	3	150
Managed stand - all	3	150

The following table lists the area, average site index and minimum harvestable age (MHA) for natural and managed stand analysis units. The figures shown are based area weighted averages for existing and managed stand analysis units. Actual MHA for timber supply modelling for existing analysis are based individual stand attributes.

Table 26. Minimum harvest ages for the natural and managed analysis units

Analysis unit by leading species	Timber harvesting land base ¹ (hectares)	Average site index (m @ 50 years of age)	Existing stands MHA (years)	Managed stands MHA (years)
1 Coastal - Spruce — good sites (G)	29	33.9	45	35
2 Coastal - Spruce — medium sites (M)	2 006	20.9	68	55
3 Coastal - Spruce — poor sites (P)	7 132	12.7	108	99
4 Coastal - Pine — G	1 171	20.8	60	55
5 Coastal - Pine — M	5 255	16.3	82	75
6 Coastal - Pine — P	3 296	12.5	98	140
7 Coastal - Balsam — G	220	18.6	75	60
8 Coastal - Balsam — M	824	14.8	98	82
9 Coastal - Balsam — P	3 502	9.4	135	145
10 Coastal - Hemlock — G	162	19.7	58	56
11 Coastal - Hemlock — M	1 361	16.1	80	60
12 Coastal - Hemlock — P	15 138	10.4	105	120
21 Interior - Spruce — G	113	30.8	45	30
22 Interior - Spruce — M	1 769	18.8	73	60
23 Interior - Spruce — P	55 983	11.0	125	95
24 Interior - Pine — G	4 085	19.7	55	47
25 Interior - Pine — M	33 771	16.0	74	65
26 Interior - Pine — P	66 977	12.5	100	92
27 Interior - Balsam — G	2 039	16.7	75	55
28 Interior - Balsam — M	429	14.4	86	68
29 Interior - Balsam — P	5 252	9.5	135	110
Total area and average site index	210 681	12.90	95 ²	80 ²

¹. Area rounded to the nearest integer.

². Based on a criteria of 140 cubic metres per hectare.

Data source and comments:

Minimum volume and height criteria were derived from a district compilation of historic harvest information, which was used as an indicator of what licensees consider to be economically operable. A height class three cut off was chosen because it reflects the limit of piece sizes commonly accepted by mills along Highway 16.

Volume criteria for natural mature stands in the “coast/transitional” analysis units are higher than for “interior” analysis units and “managed stand” analysis units because a higher volume/hectare is required to offset the higher cost of initial road construction in more challenging coastal terrain.

7.1.4 Harvest scheduling priorities

Harvest priorities or minimum harvest levels are set for certain management zones or analysis units to reflect current licensee practices in response to forest health issues, operational pressures and/or licence requirements. Table 26 describes harvest scheduling priorities, and states the time period over which this priority applies.

The timber harvesting land base within the Cassiar TSA is not contiguous. There are four distinct blocks (Atlin, Dease-Liard, Iskut and Swan-Teslin) and each block is managed to be sustainable unto itself. This is further enhanced as landscape units are self contained within the block and it is at the level or sub-level that integrated resource management is practiced. The exception is the Iskut Block which has been sectioned in A and B zones given that the B zone will not be accessible for at least 15 years. B zone will have its own harvest flow to prevent over harvesting in the A zone. Within these zones harvest flows will be developed for both sawlog and pulpwood forest stands.

The harvest priorities for timber supply forecasting are shown in Table 27.

Table 27. Priorities for scheduling the harvest

Priority	Block	Description	Term (decades)
1	Iskut A - sawlog	Location of current operations	1-25
2	Iskut B - sawlog	Location of future operations when accessible	1-25
3	Iskut A - pulpwood	Location of current operations less economic wood	1-25
4	Iskut B - pulpwood	Location of future operations less economic wood	1-25
1	Atlin, Dease-Liard and , Swan-Teslin	Blocks unique to landscape units which will have individual harvest flows. The Dease-Liard block has a small area that overlaps with the Iskut Block. Harvest in the Iskut Block will have priority over the latter block.	1-25

Data source and comments:

Historic and recent harvest focus in the Cassiar TSA has been on more economically viable “sawlog” stands as defined by Table 12, within the Iskut-A and Atlin operability units. This focus is anticipated to continue.

Iskut-B comprises areas that are more remote or where a formal harvest deferral exists (i.e., the Klappan River area 15-year harvest deferral, which ends in 2015). The remaining area in Iskut-B will not be accessible for at least 10 years due to the need to develop road systems into the block. The base case harvest forecast shows harvests in Iskut-B block due to a modelling assumption of even-flow harvest – this does not imply that operationally harvesting must occur in the Iskut-B block during that time frame. In the timber supply model actual operational sawlog harvest priority is kept high in Iskut-B as these stands will be required to pay off any new infrastructure costs.

It is anticipated that a volume-based tenure opportunity will continue, or be made newly available, within the Iskut Supply Block. Also, that a tenure requirement will be harvest of the full quality profile - including pulp stands – as is currently required by the Cassiar Forest Corp non-replaceable forest licence. Thus pulp stands are set as a secondary harvest priority in the more accessible Iskut-A. A lower harvest priority is set for Iskut-B pulp: areas are more remote thus development and transport costs will be higher for a relatively low-value product.

Greenwood harvest activity within Dease-Liard and Swan-Teslin operability units has been limited to non-existent since the mid-1990's. However, in recent years local operators have commenced small-scale firewood operations within accessible portions of the past decade's major wildfires. This deadwood harvest focus is projected to continue over at least the short term.

7.1.5 Silvicultural systems

Most harvesting within the Cassiar TSA has employed a “clearcut” or “clearcut with reserves” silvicultural system. There is currently minimal partial cutting occurring, and accounting for these approaches is not warranted.

7.2 Non-recoverable/unsalvaged losses (NRL)

Non-recoverable/unsalvaged losses are merchantable volumes on the timber harvesting land base impacted by disease and insect epidemics, fires, wind damage or other agents that are not recovered by harvesting activities. These volumes are not accounted for by growth and yield estimates. To account for these volumes, a yearly estimate is 'harvested' by the timber supply model. This volume does not contribute to the timber supply harvest forecast.

The average past 30-year loss for Cassiar TSA is 41 546 cubic metres per year wholly from fire-impacted stands within the timber harvesting land base. Information for other losses are accounted for in other factors, such as OAF 2 in managed stand yields or no accounted for due to lack of information. The sources of known NRL's for the Cassiar TSA are described in the following sections.

Wildfire

Fire suppression began in the 1950's, and at that time the level of response to wildfire depended on the number of other fires burning elsewhere in the province. In the 1970's, suppression efforts aimed to extinguish all fires. By 1980, the "selective suppression" era began, in which suppression efforts were focused around communities, highways, other infrastructure, and valuable timber. The selective suppression concept has continued from 1980 to the present, thus represents "current management". Wildfires occurring during this period have therefore been selected to determine unsalvaged loss estimates.

The original Cassiar TSA forest cover inventory is 1970's vintage. A Cassiar TSA wildfire reconciliation project occurred in 1991, during which all major wildfires occurring to that point were re-inventoried via aerial survey (40 hectares minimum polygon size, aerial attribute calls).

From 1988-1997, silviculture surveys were completed in accessible portions of major wildfires. District inventory staff updated the forest cover inventory from survey information up until 1997 when the Cassiar District merged with the Bulkley District. It is unclear the degree to which wildfires occurring during the 1990's were captured in the inventory file – but few wildfires occurred during that period anyways.

The VRI has not been updated for 1997-2011 wildfires. Section 4.2, "Vegetation resource inventory update for the analysis" provides the processes and information used to update this fire history.

Table 28 provides the summary of THLB area burnt by wildfires for the 1980 to 2011 period. The average yearly loss is 41 546 cubic metres. It is assumed this average loss will continue into the future so this volume will be added to the harvest request in the timber supply analysis. In the event of a abnormally large fire within the operable corridor, an assessment would be made whether losses as sufficient to initiate a new timber supply review to adjust the AAC accordingly.

Table 28. *Historic natural stand disturbance losses due to fire, Cassiar TSA 2013*

Analysis unit	THLB wildfire area (1980-2011) in hectares	Area weight average age of the THLB area burnt (years)	Volume per hectare at the area weighted average age of THLB area burnt (m ³ /ha)	Total volume (m ³)
Coast	Nil	-	-	-
Interior				
Balsam - good	138.3	64.6	140	19 368
Balsam - poor	365.8	239.9	186	68 219.5
Pine - good	14.8	90	305	4 518
Pine - medium	1 166.9	144.3	266	310 407.2
Pine - poor	1 701.9	194.2	203	345 479.3
Spruce - poor	2 378.5	171.8	227	539 926.7
Total				1 287 918.9
Average loss				41 545.8

Note: Average age was rounded up to the nearest 10-year age class as the volume tables were derived in 10-year age classes.

Although some firewood salvage does occur within accessible portions of wildfires, it is small in scale. For purposes of analysis, all wildfire losses shall be considered unsalvaged losses.

With the recent issuance of larger harvest licences, recovery of NRL's may be possible. District staff will advise the chief forester as to the extent this is possible and the estimates presented here may be adjusted accordingly.

Balsam bark beetle

The last TSR contained an unsalvaged loss estimate for balsam bark beetle. However, results gathered and analysed to date from balsam bark beetle studies conducted in Kispiox, Morice and Lakes TSAs indicate that VDYP yield curves accurately address losses, and therefore no additional volume reductions are required. The regional entomologist is currently conducting a study to verify those results. Until such time as this study is complete, no additional losses shall be modelled.

Other pests affecting mature timber

Other known forest pests include mountain pine beetle, spruce beetle, spruce budworm, large aspen tortrix, and porcupine. Incidences of wind throw, flooding, and animal damage (porcupine, bear, squirrel and rabbit) have been noted.

With the exception of spruce beetle, these damaging agents are concentrated within a few isolated patches of the Cassiar TSA, or are already excluded from the timber harvesting land base; therefore, they are not significant enough to warrant calculation of an unsalvaged loss figure.

Spruce beetle is known to be presently at light to moderate levels in coastal drainages, with attack areas mostly concentrated around the US-Canada border. This pest is primarily affecting spruce-leading stands that have already been excluded from the timber harvesting land base; therefore, no annual loss figure will be calculated.

Pests of young stands (POYS)

Certain POYS (e.g., soft stem rusts, leader weevils and *Tomentosus* root rot) occur sporadically in the Cassiar TSA plantations. Western gall rust is a chronic issue in young fire-origin pine stands in the BWBSmk.

In the absence of localized loss data, losses towards maturity due to POYS, and decreased growth attributable to *Tomentosus*, are assumed to be accounted for through a five percent operational adjustment factor (OAF2) applied to TIPSy yield curves (Section 6.3.1).

7.3 Silviculture**7.3.1 Regeneration activities in managed stands**

Yields for all managed stands, and stands harvested in the future, are projected using managed stand yield tables produced by the Tree Interpolation Program for Stand Yields (TIPSy) model.

Table 29 shows the inputs required to produce managed stand yield tables for the analysis. A managed stand yield table may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables are produced for the different regeneration methods (each method x species combination) and then aggregated into one table.

Table 29. Regeneration assumptions by analysis unit¹

Analysis unit	Regen delay (years)	OAFs (%)		Method		Species		Density stems/ha initial
		1	2	Type	%	Code	%	
1, 2, 21, 22	2	18	5	Plant	100	Sw	60	1200
						PI	40	1200
3, 23	2	18	5	Plant	100	Sw	80	1200
						PI	20	1200
4, 5, 24, 25	2	18	5	Plant	100	PI	50	1200
						Sw	50	1200
6, 26	2	18	5	Plant	60	PI	100	1200
				Natural	40	PI	100	5000
7, 8, 27, 28	2	18	5	Plant	100	Sw	50	1200
						PI	50	1200
9, 29	2	18	5	Plant	100	Sw	50	1200
						PI	50	1200
10, 11	2	18	5	Plant	80	Sw	80	1200
						PI	20	1200
	-10	18	5	Natural	20	Hw	80	4000
						BI	20	2000
12	2	18	5	Plant	80	Sw	100	1200
				Natural	20	Hw	100	4000
13	2	18	5	Plant	70	Ss	70	1200
						Yc	20	1200
						Ba	10	1200
						Hw	50	4000
	-5	18	5	Natural	30	Ss	50	3000
						PI	20	1200
						Sw	50	1200
						PI	50	1200
29	3	18	5	Plant	100	Sw	50	1200
						PI	50	1200

¹ No local data is available to adjust post harvest site indices. See Table 7 for site index estimates.

Data source and comments:

Regeneration delay

The figures are based on an analysis of regeneration delay conducted for all areas harvested prior to 1995. Regeneration delay is planting delay (from initiation of harvest), less planting stock age. A negative regeneration delay indicates advanced regeneration. The figure represents the number of years it would likely take before planted seedlings would grow to the same height as advanced-growth regeneration that exists at time of harvest.

Operational adjustment factor (OAF)

OAFs are used to adjust timber yield estimates to account for operational factors. OAF 1 is a constant percentage reduction to account for small unproductive areas within stands, uneven stem distribution and endemic losses that do not increase with age. OAF 2 accounts for losses that increase with stand age, for example, decay due to disease. The value of OAF 2 increases from zero and passes through the shown value when the stand is 100 years old.

Provincial average OAF 2 values will be applied to the managed stand yield curves, as no local values are available. OAF 1 percent has been adjusted from the provincial average 15 percent to 18 percent to account for edaphic and vegetative gaps unique to northern growing conditions, consistent with results of a 1998 study⁴ and Chief Forester's "Reasons for Decision" from the previous timber supply review.

Method type; species code; density

An analysis was conducted to determine which BEC zone comprised the highest proportion of stands of each analysis unit. The regeneration assumptions for each analysis unit were derived based on this representative BEC zone, and adhere in general to stand characteristics and stand management recommendations summarized in *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region*. No thinning is expected to occur in the Cassiar TSA.

Regeneration assumptions were further modified to reflect forest district staff field experience with characteristics of harvested stands at time of free growing.

Initial density

Refers to the expected density of trees at time of free growing that will contribute to 250 prime stems at maturity (a TIPSYS parameter). In the past, 1600 stems per hectare were planted. An assessment of historical regeneration trends for the 1994 timber supply analysis revealed well-spaced densities averaging 1200 stems per hectare at time of free growing.

The average total stems per hectare (planted and naturally regenerating) at time of free growing ranges from 2000 to 5000, depending on the BEC unit. The above table reflects the likely densities that would occur at year 0 on the TIPSYS yield curves, given the indicated regenerated stand profiles.

7.3.2 Genetic gain from using class A seed

Where permissible under the Chief Forester's Standards for Seed Use and where production is available, licensees are required to use provincial seed orchard Class A seed for reforestation purposes. Class A seed provides "genetic worth" (GW) to seedlings in comparison to seed from natural wild stand collections (Class B), including an expected gain in volume at rotation.

No Class A seedlots are transferable to Cassiar TSA and therefore genetic gain is not factored into future yields.

7.3.3 Immature plantation history

Areas of existing immature forest where the density (stems per hectare) has been controlled are considered to be managed, thereby justifying assignment of these stands to a managed stand yield table (MSYT).

Most of the harvesting activity in the Cassiar TSA has occurred in the last 10 years. District review regenerating areas indicates that stands less than 15 years old have some form of density control. These post-harvest stands have been modelled as managed stand using the TIPSYS model. All future harvested stands are also modelled as managed stands.

Stands of fire origin regenerate naturally with no density control and have been modelled as existing stands using the VDYP model.

⁴Ministry of Forests, Prince Rupert Forest Region. 1998. Gap disturbances in northern old-growth forests of British Columbia.

7.3.4 Not satisfactorily restocked (NSR) areas

In the last timber supply analysis, land was classified using the FIP file format in which stands were mostly classified by 'timber' attributes. Often recently harvested or fire disturbed stands were classified as 'NSR' in the 'type identity projected' field. Under the old inventory system stand age was not assigned until the stands were considered 'free-to-grow'. Pre-analysis strategies were required to assign 'NSR' stands to analysis units, including age estimates.

The current analysis utilizes the Vegetation Resource Inventory file format which is more comprehensive utilizing many more ecological, vegetative and timber attributes. Harvesting activities are accounted for in 'logging history' or 'disturbance' fields. Further, prior stand attributes such as species composition and site index are carried forward into the post-harvest stands until updated from other sources such as RESULTS and free-to-grow surveys. Identifying and classifying NSR areas is no longer an issue. Procedures for identifying and classifying fire disturbed or the small area of stands with missing values is discussed in Section 4.2, "Vegetation resource inventory update for the analysis".

7.4 Integrated resource management

7.4.1 Objectives with forest cover requirements

Forest cover requirements may be examined at a number of different levels, including landscape units, wildlife areas, 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 30 describes the forest cover requirements to be applied in the analysis.

Table 30. Forest cover requirements

Resource objective	Area target	Condition target	Affected land base
Old seral, all landscape units except Dease-Liard	See Table 30		Crown forested land base by landscape unit and BEC variant
Seral stage distribution, Dease-Liard LU	See Table 31		Crown forested land base by landscape unit and BEC variant
Visual quality objectives	Maximum allowable disturbance for individual VSU's (PLAN_PCT)	Height \leq mean visually effective green-up height for individual VSU's (VEG)	Crown forested land base for each visual sensitivity unit (VSU)
Patch size distribution	Maximum 33%	ht < 3 m	THLB by landscape unit and natural disturbance type (NDT), outside of all habitat areas, special management zones, and areas with VQOs
Sensitive watersheds within Dease-Liard SRMP community use zones	Maximum 5%	age < 27 yrs	Crown forested land base for each "sensitive watershed"
Critical Grizzly Bear habitat areas in CWH and ICH (Iskut and Boundary Supply Blocks)	Minimum 30%	age > 250 yrs	Crown forested land base, across aggregate of all critical habitat areas within Cassiar Forest Corp FDU boundary
	Maximum 25%	ht < 3 m	

Data source and comments:

Green-up height for the patch size distribution objective (three metres) was taken from the report, *B.C. Ministry of Forests. 2000. Age to green-up height: using regeneration survey data by region, species and site index. B.C. Min. For. and Forest Renewal BC*. Other height requirements use normal height curves directly, without being converted to ages.

Tables 31 and 32 describe legal seral stage distribution targets that have been assigned by landscape unit and BEC subzone. Table 31 old-seral targets are consistent with the *Order Establishing Provincial Non-Spatial Old Growth Objectives (2004)*. Table 32 seral targets are consistent with *Dease-Liard SRMP (2004)*. Because Cassiar TSA does not have spatial old growth management areas (OGMA), old seral targets are applied in the timber supply model.

All forested stands inside and outside of the operable contribute towards meeting biodiversity objectives. Park area is also allowed to contribute towards meeting the objective as per Section 2.1 of the *Landscape Unit Planning Guide, Ministry of Forests and Ministry of Environment, Lands and Parks, 1999*.

Table 31. Target old seral retention, all landscape units except Dease-Liard

Landscape unit	Target old ¹ seral retention (%)											
	BWBSdk	CWH wm	ESSFmc	ESSFun	ICHvc	ICHwc	MH mm2	MHun	SBS mc2	SB Sun	SWBmk	SWBun
Atlin Lake	>16		>13						>16			>13
Barrington River	>11	>13	>9	>19			>19	>19	>11	>11		>9
Gladys River	>16											>13
Jennings River	>11											>9
Kakiddi Creek	>11		>9						>11		>9	
Klappan River	>11		>9								>9	
Lower Iskut River		>13		>19		>9	>19					
Mess Creek	>11		>9								>9	
Middle Iskut River	>11		>9	>19	>13	>9	>19					
Middle Stikine River	>11										>9	>9
Nahline River	>11											>9
Nakina River	>16		>13				>28	>28	>16			>13
Pitman River	>11										>9	
Sheslay River	>11		>9	>19			>19	>19	>11			>9
Stikine River	>11		>9	>19		>9	>19		>11	>11	>9	>9
Swift River	>11											>9
Tahltan River	>11		>9									>9
Teslin River	>11											>9
Tuya River	>11											>9
Upper Iskut River	>11		>9	>19		>9			>11	>11	>9	

¹ "Old" seral is defined as >140 years for BWBS and SBS variants, and 250 years for all others.

Table 32. Seral stage targets, Dease-Liard landscape unit

BEC variant	Maximum early ¹ (%)	Minimum mature + old ² (%)	Minimum old (%)
BWBSdk	<20	>57	>16
BWBSmk	<33	>37	>16
SWBmk	<12	>67	>13
SWBun	<12	>67	>13

¹“Early” seral is defined as <40 years for all BEC variants.

²“Mature + Old” seral is defined as ≥100 years for BWBS variants, and ≥120 years for SWB variants.

The Cassiar TSA has no legal patch size distribution targets, within the Iskut Supply Block, as a FSP result/strategy and consistent with FPPR s. 64, the forest licensee has committed to establish cutblocks “designed to be consistent with the structural characteristics and temporal and spatial distribution of an opening that would result from a natural disturbance”.

This commitment will be approximated (and extended across the remainder of Cassiar TSA) using a three-harvest pass concept.

Visual quality objectives

Cassiar TSA’s scenic areas were by and large established under the *Forest Practices Code Act (CODE)*, and have been grandparented under *Forest and Range Practices Act (FRPA)* Section 180.

Visual quality objectives (VQO’s) that were made known by the District Manager in the *CODE*-era (primarily associated with the Highway 37 corridor), were grandparented under FRPA Section 181. VQO’s for remaining scenic areas have been established via several legal avenues including *Forest Planning and Practices Regulation* Section 9.2 and *Government Actions Regulation* Section 17(b).

This section describes the approach used to determine the Table 30 forest cover constraints for allowable percent alteration of scenic areas from a planimetric or “plan” view, and minimum visually effective green-up (VEG⁴) heights.

Table 33 shows a maximum permissible percent alteration from a perspective view for each VQO. The alteration percentage is applicable to the vegetated portion of individual visual sensitivity units (VSU’s) within a scenic area. Targets are consistent with the December 2003 *Forest Service Bulletin - Modelling Visuals in TSR III*.

⁴ VEG is the stage at which regeneration is seen by the public as newly established forest. Research has found that tree height is the best biophysical variable for predicting VEG and that it is very dependent on the slope of the land: the steeper the ground, the higher must the trees be to achieve VEG.

Table 33. Assignment of visual quality objectives

VQO	Visual absorption capability (VAC)	Maximum % alteration (perspective view)
Preservation	All	0
Retention	High	1.1
	Medium	3.0
	Low	5.0
Partial retention	High	5.1
	Medium	10.0
	Low	15.0
Modification	High	15.1
	Medium	20.0
	Low	25.1

The percent alteration in perspective view from Table 33 has been converted to a measure in plan view for use in a timber supply model. A Plan to Perspective (P2P) ratio is determined for each VSU by area-weighting the P2P across slope classes within that VSU, using data from Table 34. The percent alteration in perspective view was then multiplied by the area-weighted P2P ratio to calculate the maximum allowable plan view percent alteration for each VSU.

A mean visually effective green-up (VEG) height was also determined for each VSU by area-weighting the VEG across the slope classes within the unit that contribute to THLB, using data from Table 34. This mean VEG is used as a forest cover height constraint for individual VSU's – i.e., the model only permits harvest to occur in VSU's that are at or below their mean VEG height.

Table 34. Slope classes for calculating P2P ratio and VEG height

	Slope classes ¹ (%)			
	0 - 10	10 - 20	20-30	30-40
P2P ratios ²	4.23	3.41	2.75	2.22
VEG height (m)	3.5	4.5	5.5	6.5

¹ 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.

Average slope percent per visual polygon was derived using a slope raster GIS layer obtained from the Hectares BC database.

² The table stops at 40% because forested areas on slopes >35% are excluded from THLB.

In March of 2013 a revised visual landscape inventory became available to the district staff and has been incorporated into the base case. After the application of the P2P ratio's some stands had very high permissible rates of young stands below VEG height. For modelling purposes the maximum permissible rate of young stands was capped at 35 percent. In the timber supply modelling, park area was permitted to contribute towards meeting forest cover constraints if the area was included in the visual polygon.

7.4.2 Disturbance outside of the timber harvesting land base

Harvesting is not the only stand disturbance agent on the land base. Other natural disturbance agents include fire, wind throw, insects and diseases. The impact of these agents is to turn the forest over regardless of whether the forest is inside or outside the timber harvesting land base (THLB). Up until the current mountain pine beetle epidemic the primary stand replacement event within the province has been fire (Delong 2002⁵). Fire is still the primary source of stand replacement in the Cassiar TSA.

The difference between disturbed stands inside *versus* outside the THLB is that those outside have a zero probability of salvage while those inside have some probability of salvage depending on the degree of disturbance, the value of the dead trees and the cost of salvage (proximity to milling centres).

Studies^{5,6,7,8} have been undertaken to estimate rates of natural disturbance within the province. Table 35 shows the rates and source of the rates used in the analysis. The methodology for the conversion of the disturbance return interval to annual probability of natural stand replacement is outlined in Delong 1998.

Table 35. Fire return interval

BEC variant	Natural disturbance type	Disturbance interval (years)	Annual probability of natural stand replacement (%)
BWBSdko	3	175 ⁶	0.57
BWBSmk	3	140 ⁶	0.71
BWBSvk	3	125 ⁷	0.8
CWH (all)	1	250 ⁷	0.4
ESSF (all)	2	200 ⁷	0.5
ICH vc	1	250 ⁷	0.4
ICH wc	2	200 ⁷	0.5
MH (all)	1	350 ⁷	0.29
SBS (all)	3	125 ⁷	0.8
SWB (all)	2	300 ⁶	0.23

In the timber supply analysis, the timber supply model randomly selects stands from the area outside of the THLB and resets the stand age to 0 according to the amount specified in the above table. For example, if there is 100 hectares of non-THLB in the BWBSdk BEC variant, 0.57 hectares have their ages reset to 0.

⁵ Delong, S.C. 2002, Natural Disturbance Units of the Prince George Forest Region: Guidance for Sustainable Forest Management, B.C. Ministry of Forests (<http://www.for.gov.bc.ca/hfd/library/documents/bib90746.pdf>).

Delong, S.C 1998, Natural Disturbance Rate and Patch Size Distribution of Forests in Northern British Columbia: Impactions for Forest Management, Northwest Science, Vol. 72. (http://www.vetmed.wsu.edu/org_nws/NWSci%20journal%20articles/1998%20files/Special%20addition%201/v72%20p35%20DeLong.PDF)¹

⁶ Source: Dease-Liard SRMP (2004), Section 3.1.1.2 Natural Disturbance Patterns.

⁷ Source: Landscape Unit Planning Guide, Ministry of Forests and Ministry of Environment, Lands and Parks, 1999. - .Forest Practices Code Biodiversity Guidebook. September 2005.

⁸ Natural disturbance modelling is applied to all stands in the productive forest; i.e. stands inside and outside of the operable blocks as the entire area is used for biodiversity and visual quality objective constraints.

8. Sensitivity Analyses

Sensitivity analyses assess the timber supply impact of uncertainty in data and management assumptions. Table 36 lists the sensitivity analyses to be performed.

Table 36. *Sensitivity issues*

Issue to be tested	Sensitivity levels
Alternative harvest flows for the base case harvest forecast	The base case attempts to model even-flow or non-declining harvest forecasts. Many initial and mid-term harvest flows may be possible. This sensitivity analysis will present alternative possibilities to the base case.
Operable blocks	Vary harvest priorities – timing of access to operable blocks: e.g., equally accessible over time.
Volume estimates for existing stands	Test existing volumes (VDYP) based on results of 1997 inventory audit. Analyse the amount of volume overestimate based on current knowledge and research.
Site productivity	Test implication of applying the provincial SIBEC inventory with links to the site index estimates from a biophysical model developed by the ministry.
Visual quality objective	Test the impact of including 'RVQC' on the base case.
Change harvest queuing rule	Test the impact of changing the harvest rule from maximum volume first to oldest first.
Natural disturbance modelling	Test the impact of removing natural disturbance modelling.

Critical issue:

The major issue associated with the timber supply analysis is that the forest cover inventory is primarily 1970's vintage that has been 'rolled over' into a 2011 VRI update. A project conducted in 1999 re-inventoried 15 mapsheets to a phase I standard (approximately 15 000 hectares).

A statistical audit of the Cassiar TSA inventory was completed in 1997 and was based on the timber harvesting land base identified in the 1995 timber supply analysis. For the last AAC determination the results for the mature plots were re-calibrated into coastal and interior analysis units which showed the volumes was coastal analysis units to be overestimated by 14 percent and the volumes for the interior analysis units to be overestimated by 49 percent. The impact on the 2001 base case was estimated at 16 percent. In the AAC determination the chief forester acknowledged that a great deal of uncertainty was introduced by the re-stratification of the inventory plots and noted the range of uncertainty on the base case could be between 0 and 16 percent. The AAC determination for accounted an 8.5 percent downward pressure on the base case timber supply.

The audit and last timber supply analysis used VDYP 6 for volume estimation for existing/natural stands. The current analysis used VDYP 7. In a January 2009 draft publication of a province wide volume comparison of VDYP 6 and VDY7 (Appendix 2 Results for northern interior TSAs) shows that VDPY 7 underestimates, on average, VDPY 6 volumes by 24.7 percent for the Cassiar TSA. Given the differing methodologies for estimating volumes, the results are not comparable.

Finally, planned harvest blocks (57) for the last 10 years were overlaid onto a map showing where the current THLB is located. Compared to the analysis area it was found that 13 percent of the harvest block area is non-THLB.

Conclusion:

It is very difficult to quantify the uncertainty of existing volume estimation in the analysis. The base case does not apply the VRI audit adjustment ratios.

Currently the FLNR staff are researching ways to better quantify the uncertainty associated with the inventory audit and estimating existing volume. Additional sensitivity analyses may be performed and presented to the AAC determination decision maker. These may include:

- Comparison of the inventory and past harvest volumes.
- Re-examination of the inventory audit plots; e.g. stratification based on leading species.
- Further investigate the comparison of VDYP 6 and VDYP 7 volume estimation for the Cassiar TSA.

Appendix A Area weighted existing or natural stand yield tables

The variable density yield prediction (VDYP) model, version 7 developed and supported by the BC Ministry of Forests, Lands and Natural Resource Operations, Forest Analysis and Inventory Branch, was used to estimate timber volumes for all existing natural stands. These volumes will be used in the timber supply analysis. For presentation purposes, the average area weighted volume tables for each analysis unit were calculated and are presented in the following table.

Table A-1. Average area weighted timber volumes tables for existing natural stands by analysis unit

Age (years)	Coastal analysis units							
	Balsam good	Balsam medium	Balsam poor	Hemlock good	Hemlock medium	Hemlock poor	Pine good	Spruce poor
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
30	0	0	0	19	0	0	29	0
40	24	3	0	75	23	2	88	2
50	74	24	0	155	60	14	159	12
60	140	58	9	252	108	35	223	35
70	206	101	24	352	166	68	277	68
80	264	148	49	446	224	109	321	108
90	312	193	80	528	281	154	356	150
100	350	234	114	597	331	201	382	192
110	381	269	149	651	374	249	403	232
120	406	301	183	695	409	295	417	269
130	424	326	216	731	440	339	426	301
140	437	346	246	760	465	378	432	329
150	446	361	269	784	483	409	433	350
160	450	370	285	794	494	429	431	361
170	451	375	295	799	499	443	427	367
180	451	378	302	798	498	451	422	369
190	449	380	307	791	496	455	417	368
200	447	381	309	781	493	457	411	366
210	442	379	308	771	488	454	405	362
220	439	378	307	761	483	451	399	359
230	435	377	305	752	478	448	392	356
240	431	375	304	742	474	445	386	353
250	428	374	303	732	469	442	380	350
260	424	373	302	723	464	439	373	346
270	420	372	301	713	460	436	367	344
280	417	371	300	704	455	433	360	340
290	414	370	299	695	451	429	353	337
300	411	369	298	685	447	427	346	334
310	407	368	297	678	443	424	340	332
320	405	367	296	673	439	422	335	330
330	403	366	295	668	436	420	329	328
340	400	365	294	663	432	418	323	327
350	398	364	293	658	429	416	318	325

(continued)

Table A-1. Average area weighted timber volumes tables for existing natural stands by analysis unit (continued)

Age (years)	Coastal analysis units					Average
	Pine medium	Pine poor	Spruce good	Spruce medium	Spruce poor	
0	0	0	0	0	0	0
10	0	0	0	0	0	0
20	0	0	0	0	0	0
30	8	3	34	1	0	2
40	38	23	136	26	2	12
50	85	56	252	84	12	33
60	135	95	345	161	35	63
70	180	135	413	237	68	100
80	218	172	462	304	108	140
90	249	204	497	358	150	181
100	274	231	522	401	192	221
110	294	253	539	435	232	258
120	308	272	547	462	269	293
130	320	287	543	482	301	324
140	329	299	542	496	329	352
150	334	308	540	507	350	372
160	335	313	537	510	361	385
170	335	314	534	510	367	393
180	333	315	529	507	369	396
190	330	314	525	503	368	398
200	326	312	522	498	366	397
210	322	309	518	493	362	394
220	318	306	515	487	359	391
230	313	302	511	482	356	387
240	308	299	508	476	353	384
250	303	295	505	471	350	381
260	298	292	502	465	346	377
270	293	288	499	460	344	374
280	288	283	497	454	340	371
290	282	279	494	449	337	367
300	277	275	491	444	334	364
310	271	271	489	439	332	361
320	267	267	487	435	330	358
330	262	263	486	432	328	356
340	257	258	485	429	327	353
350	252	254	483	426	325	351

(continued)

Table A-1. Average area weighted timber volumes tables for existing natural stands by analysis unit (concluded)

Age (years)	Interior analysis units									Average
	Balsam good	Balsam medium	Balsam poor	Pine good	Pine medium	Pine poor	Spruce good	Spruce medium	Spruce poor	
0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
30	0	0	0	16	2	0	28	0	0	1
40	7	2	0	63	18	5	128	5	0	7
50	38	16	1	122	50	20	264	30	1	22
60	86	43	5	180	89	43	393	73	6	43
70	140	80	13	231	129	69	485	124	19	68
80	192	123	29	272	163	96	565	177	38	94
90	238	165	49	305	192	120	611	227	61	119
100	276	203	72	331	215	142	644	272	88	144
110	308	235	96	349	232	161	667	311	116	166
120	333	261	120	362	246	177	686	343	143	185
130	349	279	143	370	255	189	699	368	167	201
140	357	297	163	374	263	198	709	386	190	215
150	359	308	178	375	266	203	712	396	208	225
160	356	313	187	373	267	206	706	399	219	230
170	351	315	192	368	266	206	694	397	225	231
180	344	315	194	363	264	206	681	393	227	231
190	338	313	195	357	261	204	668	388	227	230
200	333	312	195	351	258	203	654	382	227	228
210	326	308	193	344	254	200	639	374	223	225
220	321	305	190	337	250	197	625	366	220	221
230	315	301	188	331	246	194	612	359	217	218
240	310	298	186	324	242	191	599	352	214	215
250	305	295	184	318	238	189	586	346	211	212
260	299	292	182	312	234	186	574	339	208	209
270	294	289	180	307	230	183	563	333	205	206
280	289	286	178	301	226	181	552	327	202	203
290	284	283	176	296	223	178	541	321	200	200
300	279	281	175	290	219	175	530	316	197	197
310	274	278	173	286	217	173	520	310	194	194
320	271	276	171	284	215	171	516	306	192	192
330	267	274	170	281	213	169	512	303	191	190
340	263	272	168	279	211	168	508	300	189	189
350	260	270	167	276	209	166	504	298	188	187

Appendix B Managed Stand Yield Tables

Batch TIPSy (Table Interpolation Program for Stand Yields) version 4.1, supported by the Ministry of Forests, Lands and Natural Resource Operations, was used to estimate growth and yield for existing and future managed stands. The tables are presented in the following table.

Table B-1. Volume tables for managed stand yields

Age (years)	Coastal analysis units							
	Spruce good	Spruce medium	Spruce poor	Pine good	Pine medium	Pine poor	Balsam good	Balsam medium
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	58	6	0	7	0	0	1	0
30	207	53	1	54	12	1	23	6
40	346	136	9	134	49	10	77	27
50	448	217	35	211	102	33	141	67
60	495	288	76	278	155	63	200	113
70	518	351	120	338	203	94	251	158
80	525	397	164	382	244	122	301	197
90	526	430	202	415	286	146	338	231
100	526	457	237	442	319	166	366	265
110	526	476	273	464	344	184	389	296
120	526	491	307	477	363	199	408	320
130	526	497	333	487	378	211	423	337
140	526	499	354	491	392	222	436	352
150	526	496	371	492	404	231	447	363
160	526	494	384	489	414	240	455	373
170	526	492	395	486	422	248	460	382
180	526	488	405	484	428	254	462	390
190	526	485	413	480	434	261	462	396
200	526	482	421	477	435	266	462	401
210	526	479	428	474	436	268	462	405
220	526	479	432	472	436	270	461	409
230	526	479	436	472	437	272	461	411
240	526	479	439	472	437	273	460	412
250	526	479	442	472	437	274	459	412
260	526	479	442	472	437	275	457	412
270	526	479	440	472	436	276	456	413
280	526	479	439	472	436	277	454	411
290	526	479	437	472	436	278	453	407
300	526	479	437	472	436	279	453	407
310	526	479	437	472	436	279	453	407
320	526	479	437	472	436	279	453	407
330	526	479	437	472	436	279	453	407
340	526	479	437	472	436	279	453	407
350	526	479	437	472	436	279	453	407

(continued)

Table B-1. Volume tables for managed stand yields (continued)

Age (Years)	Coastal Analysis Units				Area weighted average
	Balsam poor	Hemlock good	Hemlock medium	Hemlock poor	
0	0	0	0	0	0
10	0	0	0	0	0
20	0	3	1	0	1
30	0	44	13	0	7
40	1	127	62	3	23
50	8	218	128	21	48
60	21	304	196	57	81
70	40	374	257	96	119
80	66	426	318	141	156
90	91	467	364	179	191
100	116	500	399	216	224
110	140	526	427	254	252
120	162	541	453	292	277
130	181	552	474	320	300
140	199	561	491	344	321
150	217	568	506	363	339
160	236	574	514	379	354
170	251	578	520	392	366
180	264	582	526	404	376
190	275	587	531	415	385
200	284	593	535	424	392
210	292	598	539	433	398
220	299	603	542	440	403
230	304	608	544	446	407
240	309	613	545	452	411
250	313	617	544	456	415
260	316	621	544	460	418
270	319	624	543	460	420
280	322	626	543	460	422
290	325	628	543	460	423
300	325	630	545	462	424
310	325	630	545	462	424
320	325	630	545	462	424
330	325	630	545	462	424
340	325	630	545	462	424
350	325	630	545	462	424

(continued)

Table B-1. Volume tables for managed stand yields (concluded)

Age (years)	Interior analysis units									Area weighted average
	Spruce good	Spruce medium	Spruce poor	Pine good	Pine medium	Pine poor	Balsam good	Balsam medium	Balsam poor	
0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
20	58	1	0	3	0	0	1	0	0	0
30	207	28	0	38	10	1	13	5	0	4
40	346	93	3	111	40	12	50	24	1	19
50	448	165	14	185	89	37	104	62	8	45
60	495	229	40	249	139	67	158	107	21	79
70	518	288	75	307	186	97	205	150	42	115
80	525	339	112	353	226	125	247	189	68	149
90	526	377	149	388	264	148	289	223	93	180
100	526	405	183	414	300	168	322	255	119	208
110	526	427	212	436	327	185	346	287	143	231
120	526	447	241	455	347	199	366	311	165	252
130	526	462	272	468	363	212	381	330	184	271
140	526	474	300	476	376	222	395	345	202	288
150	526	479	321	480	388	232	407	356	221	302
160	526	481	339	482	398	241	417	366	239	314
170	526	483	353	484	407	248	425	375	254	324
180	526	483	366	485	414	254	431	383	267	332
190	526	484	375	482	420	260	436	390	278	339
200	526	484	384	479	425	265	437	394	286	345
210	526	483	392	475	427	268	438	399	295	350
220	526	479	398	471	426	270	438	402	301	352
230	526	474	404	468	426	271	439	406	307	355
240	526	470	409	465	426	272	439	406	311	357
250	526	467	414	462	426	274	439	406	315	359
260	526	464	416	462	425	275	439	407	319	360
270	526	461	419	462	424	276	439	407	322	361
280	526	461	421	462	423	277	439	407	325	362
290	526	461	423	462	422	278	438	407	328	363
300	526	461	423	462	422	278	438	407	328	363
310	526	461	423	462	422	278	438	407	328	363
320	526	461	423	462	422	278	438	407	328	363
330	526	461	423	462	422	278	438	407	328	363
340	526	461	423	462	422	278	438	407	328	363
350	526	461	423	462	422	278	438	407	328	363