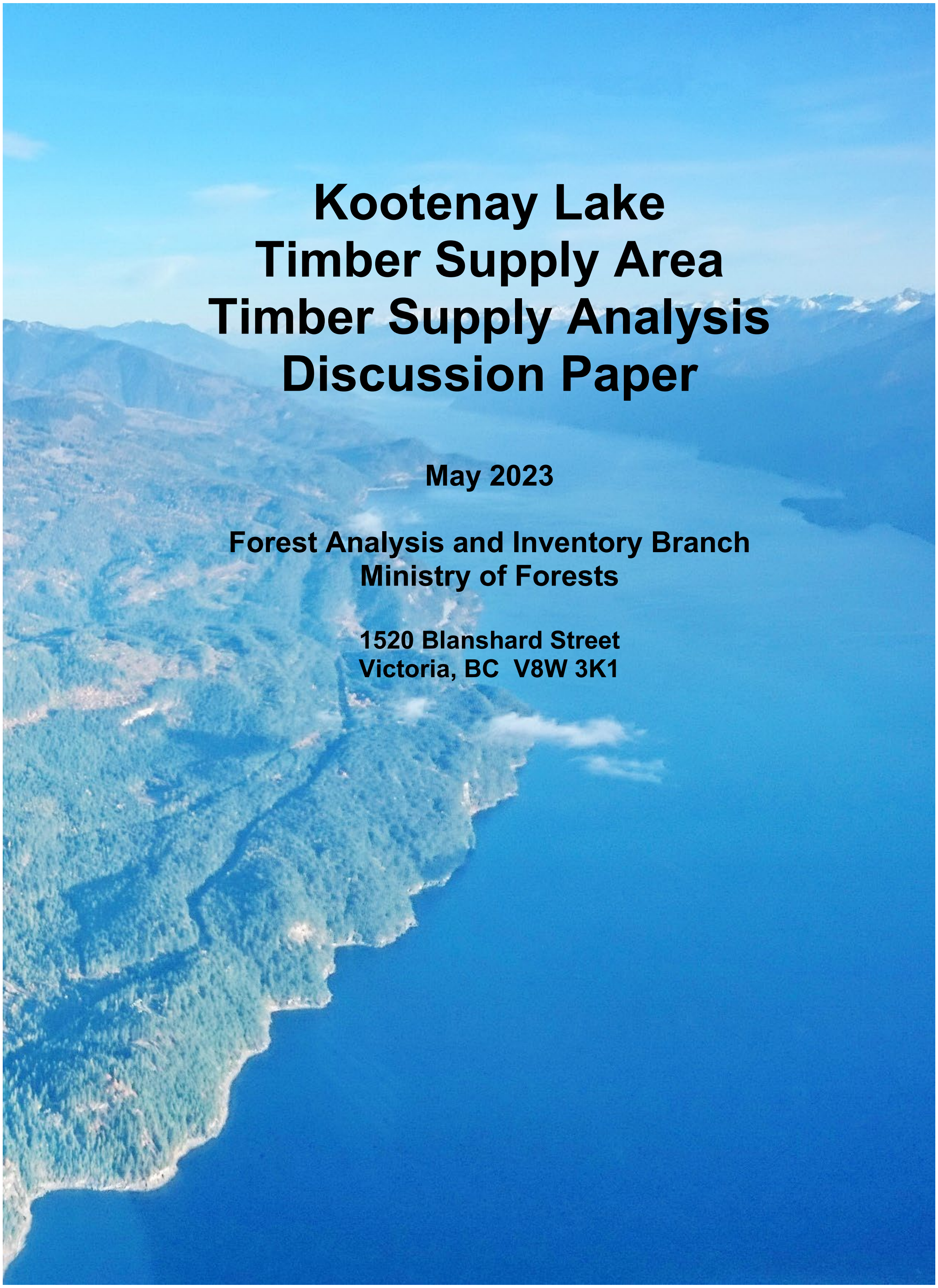

Kootenay Lake Timber Supply Area Timber Supply Analysis Discussion Paper

May 2023

Forest Analysis and Inventory Branch
Ministry of Forests

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BRITISH COLUMBIA | Ministry of Forests

Cover photograph: Kootenay Lake, Kootenay Lake TSA
contributed by Kristine Sacenieks, Kootenay Boundary Natural Resource Region

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Introduction

The British Columbia Ministry of Forests (the Ministry) regularly reviews the timber supply[a] for all timber supply areas[b] (TSA) and tree farm licences[c] (TFL) in the province. This review, the fourth for the Kootenay Lake TSA, examines the impacts of current legal requirements and demonstrated forest management practices on the timber supply, economy, environment and social conditions of the local area and province. Based on this review the chief forester will determine a new allowable annual cut[d] (AAC) for the Kootenay Lake TSA.

According to Section 8 of the *Forest Act* the chief forester must regularly review and determine an AAC for each TSA and TFL in the Province of British Columbia (BC).

The objectives of the timber supply review (TSR) are to:

- examine relevant forest management practices, environmental and social factors, and input from First Nations, forest licensees, stakeholders and the public;
- set a new AAC; and,
- identify information to be improved for future timber supply reviews.

This discussion paper provides a summary of the timber supply analysis and harvest projections supporting the TSR for the Kootenay Lake TSA. Details about the data and assumptions used in the analysis were provided in the *Kootenay Lake Timber Supply Area Timber Supply Review Data Package* (November 2020)[1] (*Data Package*). Updates to the information used and technical details regarding the analysis are available on request from the Forest Analysis and Inventory Branch. Even though the results of the timber supply analysis are being presented here, this analysis should be viewed as a "work in progress" until the chief forester's AAC determination. Prior to the chief forester's AAC determination for the TSA, further analysis may need to be completed and existing analysis reassessed as a result of input received on this *Discussion Paper*.

Timber supply reviews undertaken in support of AAC determinations are based on the current resource management objectives established by government in legislation and by legal orders. Resource management objectives are provided by the *Forest and Range Practices Act* (FRPA), the Kootenay Boundary Higher Level Plan Order (KBHLPO), and subsequent order variances for specific objectives.

[a]**Timber supply**
Timber supply is the amount of timber available for harvesting over a specified period of time.

[b]**Timber supply areas (TSAs)**
Timber supply areas are integrated resource management units established in accordance with Section 7 of the Forest Act.

[c]**Tree farm licences (TFLs)**
Tree farm licences are tenures that grant exclusive rights to harvest timber and manage forests in a specific area; may include private land.

[d]**Allowable annual cut (AAC)**
Allowable annual cut is the maximum volume of timber available for harvesting each year from a specified area of land, usually expressed as cubic metres of wood.

[1] The Kootenay Lake Timber Supply Area Timber Supply Review Data Package (November 2020) can be found on the BC Ministry of Forests Timber Supply Review and Allowable Annual Cut – Timber Supply Areas website: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut/allowable-annual-cut-timber-supply-areas

The information compiled to support this TSR can be made available to support land use planning as required. However, land-use planning and land-use decisions are outside the scope of the chief forester's AAC determination. In the event that resource management objectives and practices change, these changes will be reflected in future timber supply reviews.

Public comments are encouraged and will be accepted until the end of the 60-day review period, on July 4, 2023.

Timber supply review in the Kootenay Lake TSA

The current AAC for the Kootenay Lake TSA, effective August 12, 2010, is 640 000 cubic metres per year. On May 5, 2016, the AAC was automatically reduced to 634 861 cubic metres in accordance with Section 11 of the AAC Administration Regulation to account for an area amendment to a Community Forest Agreement (CFA).

In November 2020, a *Data Package* documenting the data and forest management assumptions to be used in this timber supply analysis was released for public review and to assist with First Nations consultation. This *Discussion Paper* is released in order to provide an overview of the TSR analysis and to highlight the key findings for the Kootenay Lake TSA. Before setting a new AAC, the chief forester will review all relevant information, including the results of the timber supply analysis and input from government agencies, First Nations, the public, and licensees. Following this review, the chief forester's determination will be outlined in a rationale statement that will be publicly available.

The actual AAC that is determined by the chief forester during this TSR may differ from the harvest projections, including the base case, presented in this *Discussion Paper* as the chief forester must consider a wide range of information, some of which is not quantifiable. Ultimately, the chief forester's AAC determination is an independent, professional judgment based on the legal requirements set out in Section 8(8) of the *Forest Act.*

Once the chief forester has determined a new AAC and the TSR process is over, the Minister of Forests will apportion the AAC to the various licence types and programs as per Section 10 of the *Forest Act*. Based on the minister's apportionment, the regional executive director will establish a disposition plan that identifies how the available timber volume is assigned to the existing forest licences and, where possible, to new opportunities.

Description of the Kootenay Lake TSA

The Kootenay Lake TSA is located in south-eastern BC. The Kootenay Lake TSA is in the Selkirk and Purcell Mountain ranges and encompasses three major drainage systems, Kootenay Lake, Duncan River, and Lardeau River. To the north is Glacier National Park and to the south is the Canada-United States international border.

The Kootenay Lake TSA (Figure 1) is administered by the Selkirk Natural Resource district office in Nelson. It is one of seven TSAs lying within the Kootenay Boundary Natural Resource Region. Three community forests and several parks lie within the outer perimeter of the TSA. The total area of the Kootenay Lake TSA including the community forests and parks is approximately 1 240 878 hectares.

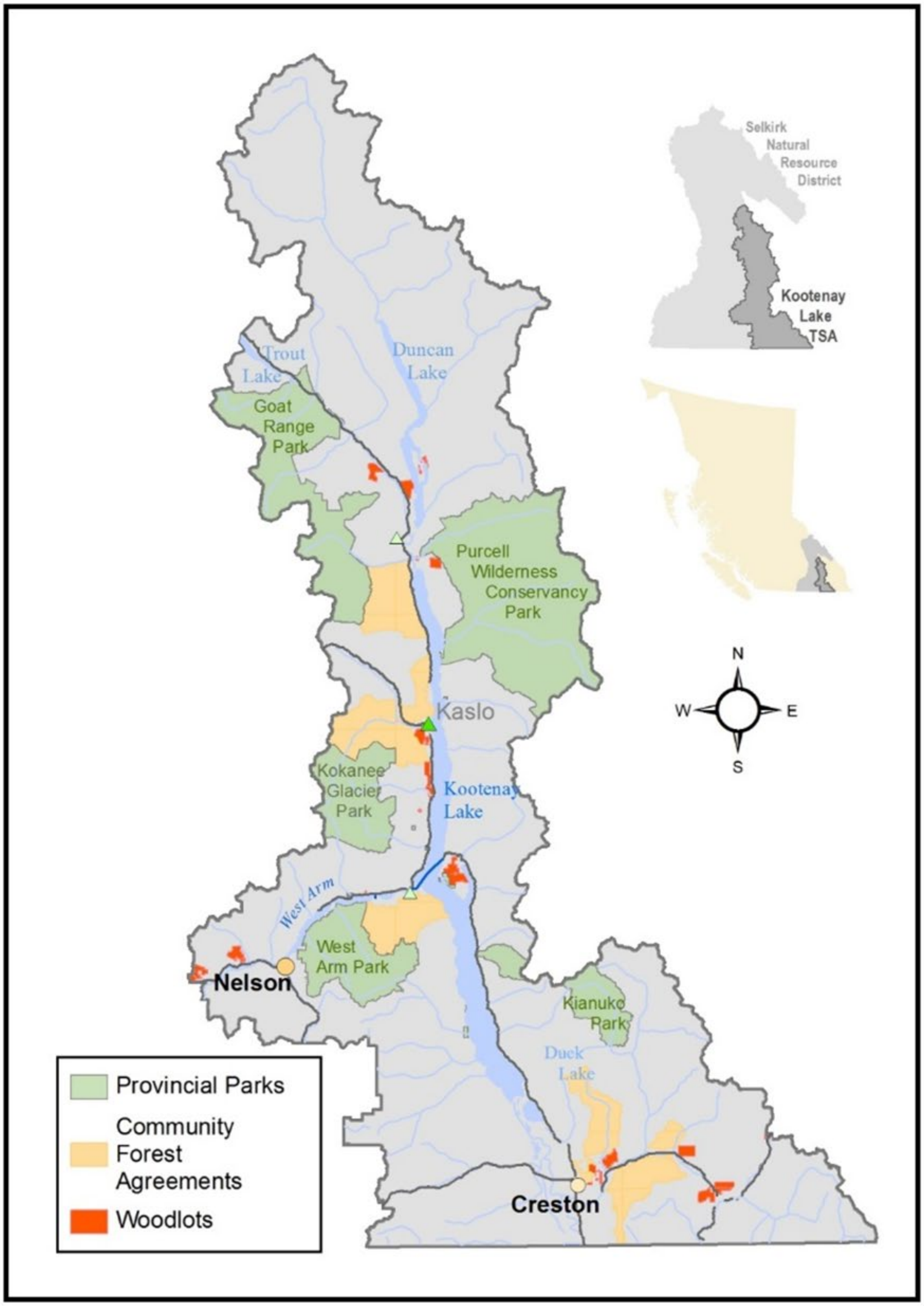

Figure 1. Kootenay Lake TSA.

Environmental values

The Kootenay Lake TSA includes both moist and wet climatic regions and is commonly referred to as part of the Interior Wet Belt. The forests within the TSA are diverse. Tree species at lower elevations, within the Interior Cedar Hemlock (ICH) zone, include western redcedar, western hemlock, grand fir, Engelmann spruce, subalpine fir, western larch, Douglas-fir, western white pine, western yew, ponderosa pine and lodgepole pine. At higher elevations, within the Engelmann Spruce Subalpine Fir (ESSF) zone, Engelmann spruce and subalpine fir are the dominant climax tree species, while alpine larch and whitebark pine also occur.

The diverse forest of the Kootenay Lake TSA supports a wide variety of wildlife species. Large mammals include black bear, grizzly bear, moose, mule deer, white-tailed deer, elk, mountain goat, bighorn sheep, caribou, cougar, lynx, wolverine, badger, and bobcat. Bird species include year-long residents and migratory birds such as woodpeckers, songbirds, waterfowl, raptors and shorebirds. The Kootenays is part of a great migratory corridor, with Creston flats at the south end of Kootenay Lake being particularly rich in birdlife. The rivers and lakes of the TSA are home to numerous fish species including kokanee, Gerrard rainbow trout, westslope cutthroat, bull trout, whitefish, eastern brook trout, burbot and white sturgeon.

Protection and management of environmental values are addressed under provincial and federal legislation. The FRPA is the primary provincial legislation regulating forestry practices. Under FRPA, the Forest Planning and Practices Regulation identifies objectives set by government for environmental values including fish, wildlife, biodiversity, soils and water that are to be addressed within forest stewardship plans. Orders may be established under the Government Actions Regulation (GAR) or the Land Use Objectives Regulation for specific land uses such as ungulate winter ranges, wildlife habitat areas, critical habitat for fish, and old growth management areas (OGMA).

Approximately 48 percent of the forested land base within the Kootenay Lake TSA is reserved as parks to provide for conservation and wildlife habitat.

Natural resources

Numerous natural resources occur within the Kootenay Lake TSA. These include timber, fish and wildlife habitat, recreation and tourism resources, and abundant water resources. Approximately 30 percent of the TSA falls within watersheds providing water for consumptive uses.

Wildlife and their habitat are partially protected by OGMAs, the retention of deciduous stands, and those measures protecting riparian features. There are 220 128 hectares of provincial parks, protected areas and reserves within the TSA. A range of recreational activities such as hiking, canoeing, camping, fishing, hunting, snowmobiling, and downhill and cross-country skiing occur in the TSA.

First Nations

The AAC determination is a strategic-level decision for which the Crown maintains a duty to consult and accommodate, as necessary, those First Nations for whom it has knowledge of claimed or proven Aboriginal Interests that may be impacted by a proposed decision. The chief forester must consider the information provided by First Nations through engagement and the consultation process.

Three Nations have member First Nations/Bands whose territories overlap, in whole or in part, with the Kootenay Lake TSA: the Ktunaxa Nation Council, the Secwepemc Nation, and the Okanagan Nation (Sylix). Sinixt territory also overlaps with the TSA.

Ktunaxa Nation Council

Ktunaxa have four First Nations communities represented by Ktunaxa Nation Council (Yaqan Nuʔkiy – Lower Kootenay; ʔakisq̓nuk – Columbia Lake; Yaq̓it ʔa·knuqⱡiʾit – Tobacco Plains; ʔaq̓am – St. Mary's).

Yaqan Nuʔkiy is located in the TSA near Creston. The Ktunaxa Nation territory encompasses the entire TSA. Ktunaxa have multiple agreements with the Province of BC including a Strategic Engagement Agreement, ECDA Forestry Appendix, and Forest Tenure Opportunity Agreements (FTOAs). The Ktunaxa Nation holds one non-replaceable forest licence within the Kootenay Lake TSA. Ktunaxa Nation Council has been in treaty negotiations since 1993; these negotiations are currently in suspension as of the fall of 2021, initiated by Ktunaxa Nation Council.

An analysis will be conducted that incorporates Ktunaxa forestry stewardship principles (articulated in the *Ktunaxa Forestry Standards Document*; Ktunaxa Nation Council 2023), and key cultural conservation values. Ktunaxa Nation Council representatives shared these principles and values during discussions with FOR staff and the analysis was completed to meet them, given the limitations of the data and model. The *Ktunaxa Forestry Standards Document* continues to be refined and updated as part of an adaptive management approach. The values articulated in that document must be understood to be general, and work remains to identify and map them based on site-specific validation. The results of this analysis, which includes Ktunaxa data, will be provided to the chief forester in the AAC determination meeting.

Secwepemc Nation

Five of the Secwepemc Nation member bands have territories which overlap the Kootenay Lake TSA. Three of the five are signatories to the Secwepemc Letter of Agreement: Adams Lake Indian Band, Little Shuswap Lake Band (Skwl'ax te Secwepemcul'ecw), and Splatsin First Nation. The Secwepemc Letter of Commitment overlaps a significant portion of the TSA. Neskonlith Indian Band is not a signatory to that agreement and the Shuswap Indian Band withdrew in April of 2022. These member bands are not involved in the BC treaty process. Adams Lake Indian Band and Neskonlith Indian Band currently have FTOAs with the Ministry. None hold a timber tenure in the TSA. None of the Secwepemc member band reserves or main communities are situated within the Kootenay Lake TSA.

Okanagan Nation (Syilx)

The territory of the Okanagan Nation member bands, or Syilx, encompasses approximately the western half of the TSA. There are five member bands in Okanagan Nation whose territories are within a portion of the TSA. These include the: Okanagan Indian Band, Lower Similkameen Indian Band, Penticton Indian Band, Upper Nicola Band and Osoyoos Indian Band. The majority of these Okanagan Nation member bands have an affiliation with the Okanagan Nation Alliance (ONA). None of the bands in the ONA are actively involved in the BC treaty process; rather, Ministry staff work with non-treaty First Nations through engagement and economic agreements, working groups, and other non-treaty processes. Lower Similkameen Indian Band and Upper Nicola have FTOAs with the Ministry. All the Okanagan Nation member band reserves and main communities are situated outside of the TSA.

Lakes Tribe of the Colville Confederated Tribes (Sinixt)

The Lakes Tribe of the Colville Confederated Tribes (the Lakes Tribe), in Washington State, is being engaged because the Kootenay Lake TSA overlaps a small portion of the Sinixt Territory. On April 23, 2021, the Supreme Court of Canada (SCC) released its decision on the Desautel case. The SCC found that the Lakes Tribe of Colville Confederated Tribe (CCT) is a modern day successor of the Sinixt and are an "Aboriginal peoples of Canada" who have an Aboriginal right to hunt in Canada under s. 35 (1) of the *Constitution Act*, 1982. As a result, the Province has a duty to consult the Lakes Tribe when contemplating conduct that may adversely affect their Aboriginal rights.

Regional economy

The three largest communities in Kootenay Lake TSA are Nelson, Creston and Kaslo, with numerous smaller communities across the TSA. The 2021 census estimates the population of the Kootenay Lake TSA at approximately 36,000. The economy of the area is diversified and includes tourism, retail trade, forestry, agriculture, education, health care and construction, with technology identified as an emerging sector.

Operating within the Kootenay Lake TSA are six forest licensees, three community forests, fourteen woodlots and British Columbia Timber Sales (BCTS). There are two sawmills located in Creston which are owned by major tenure holders, Canfor (previously Wynndel Box & Lumber sawmill), and J. H. Huscroft. Three other major tenure holders, Atco Wood Products Ltd., Kalesnikoff Lumber Company, and Porcupine Wood Products Ltd., own processing facilities in the adjacent Arrow TSA.

Nearly all these facilities are independently owned, and all have been in operation for decades; Atco (72 years, 1947), Kalesnikoff (79 years, 1940), J.H. Huscroft (92 years, 1927), Wynndel Box, now Canfor (106 years, 1913), and Porcupine Wood Products (40 years,1983). Collectively, the diverse products these mills produce have been pivotal in maintaining a viable timber industry in the area. Since the last TSR was conducted, one mill facility in Meadow Creek has ceased operation.

There are also several small mill operations which process custom lumber located in Harrop-Proctor, Meadow Creek and Kaslo. Additionally, other businesses within the TSA make value added products such as timber frame homes, posts and rails, and products for musical instruments.

Supplemental volume required by these milling facilities is partially supplied by BCTS, TFLs, CFAs, Woodlots, Small Scale Salvage, non-replaceable Forest Licence agreements, and outside TSA purchases or trades.

Land use planning

The Kootenay Lake TSA lies within the area covered by the Kootenay Boundary Higher Level Plan Order (KBHLPO). Forest development in the TSA is required to be consistent with the legally established goals and objectives of this higher-level plan. This timber supply analysis assumes that forest management and timber harvesting will be consistent with the KBHLPO.

Land base and forest management changes since 2010

The last AAC determination for the Kootenay Lake TSA was made effective August 12, 2010. On May 5, 2016, an area amendment to a CFA within the TSA resulted in an adjustment to the AAC. Since the last AAC determination, several changes have occurred to the land base, forest management data and practices, including:

- a new Vegetation Resources Inventory;
- a new Provincial Site Productivity Layer (PSPL) map based on Predictive Ecosystem Mapping;
- a standardized approach to yield projections;
- provincial terrain data; and,
- riparian data informed by a provincial fish model.

Vegetation resources inventory

The current analysis uses a Vegetation Resources Inventory (VRI) that was completed (Phase I) between 2008 and 2011. The aerial photographs used for this inventory were acquired between 2005 and 2006. Once a VRI is completed, an annual updating process is run that projects the ages, heights, density and other attributes of the tree stands and updates those stands that were harvested or disturbed by fire.

The previous TSR was completed using an inventory rolled over from the legacy forest cover Forest Inventory Planning (FIP) files based on aerial photography from 1968 to 1972, with tree growth projected to January 2007. Significant changes in the data structure exist between the two inventories, with a FIP roll over translating as closely as possible attributes in FIP to the new VRI attributes. However, with different definitions used to populate the attributes there are noticeable differences in results. For example, the alpine designation in FIP covered almost 300 000 hectares, and in VRI, the same definition covers less than 150 000 hectares. In the FIP inventory, large polygons were identified as alpine, and in the new VRI, these alpine polygons were further sub-divided to identify areas with very sparse forests.

Differences in these two inventories result in differences in the land classification tables. In the last TSR, there were 569 620 hectares classified as forested land within the TSA analysis area and 198 080 hectares of land available for timber harvesting. In this analysis, there are 675 024 hectares classified as forested land base within the TSA analysis area, of which 168 501 hectares of land is available for timber harvesting.

Site index

In the previous analysis, the PSPL was not yet in production and the site index values from the VRI were used to produce yield tables for both unmanaged stands (natural stands) using the Variable Density Yield Projection (VDYP) model, and managed stands, using the Table Interpolation Program for Stand Yields (TIPSY) model. The VRI site index is estimated based on a photo interpretation of existing stands, and VDYP is calibrated to use those values. For this analysis, the VRI site index was appropriately used again for unmanaged stands.

In contrast with the previous analysis, in this analysis the managed stand yield tables, both current and projected future stands, were generated using the PSPL site index. The PSPL site index is based on the Biogeoclimatic Ecosystem Classification (BEC) of the site which is estimated from ground measurements collected from stands growing in the same BEC site series. The TIPSY model provides more accurate yield projections when site index values from the PSPL are used. The tables generated by TIPSY for the current analysis were validated against tree growth observed in sample plots established under the Young Stand Monitoring Program (YSM). The following comparison of site index from a report summarizing YSM plots within the Kootenay Lake TSA (October 2020) shows there is no significant difference between the site index measured in the YSM ground samples and the PSPL site index used to generate the TIPSY tables in this analysis.

Table 1. Site index vs. PSPL (KL TSA YSM report, Oct. 2020)

Spc	#Pairs	YSM BH Age (yr)			SI (m)		ROM	Sig
	n	Avg	Min	Max	YSM	PSPL		(95%)
BL	2	45	26	65	**17.5**	**20.3**	0.86	N
CW	3	38	17	61	**19.6**	**19.8**	0.99	N
FD	3	31	15	57	**24.2**	**22.3**	1.08	N
HW	2	51	42	60	**23.4**	**21.2**	1.11	N
SE	2	25	23	27	**22.4**	**18.2**	1.24	N

In the YSM report, the growth of the measured stands is projected using the Tree And Stand Simulator (TASS). The average of all YSM TASS projections and their upper and lower 95 percent confidence interval around the mean (red lines) are compared against the average of all spatially matched managed stand yield tables (MSYT) produced for this TSR (blue line). The average TSR MSYT projection overlaps within the 95 percent confidence interval of the average YSM TASS projection. This supports the assumption that the young stands in Kootenay Lake TSA will meet the timber supply expectations that are based on the TSR projections.

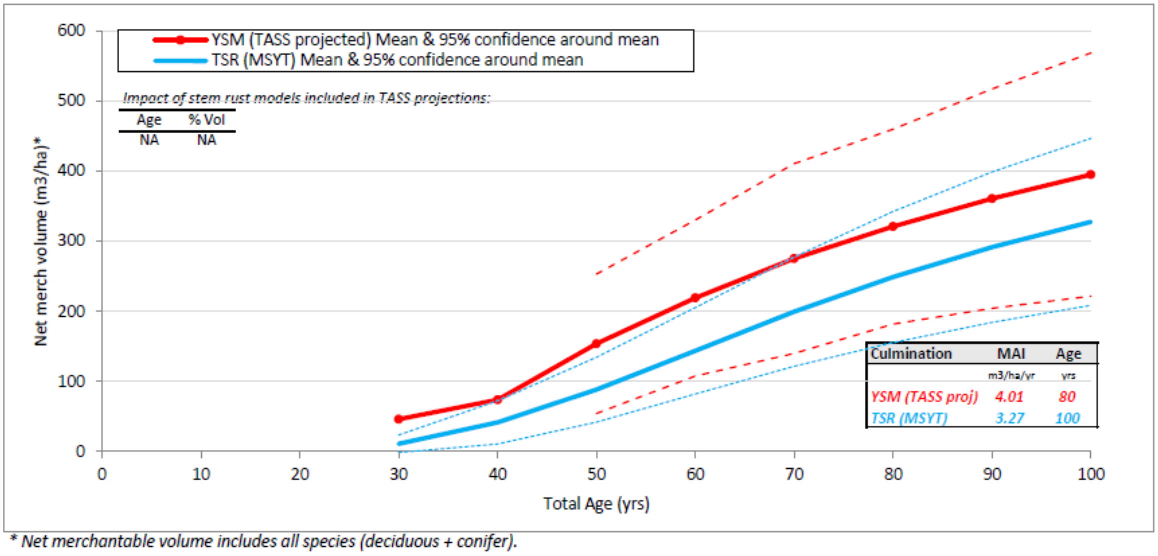

Figure 2. TASS vs spatially matched MSYT curves (KL TSA YSM report, Oct. 2020).

Yield projections

The yield projections used in this analysis were completed by Forest Analysis and Inventory Branch staff following a standardized approach. In the base case, all existing stands that have a history of harvesting with accompanying silviculture obligations, or stands harvested in the future, were modelled using TIPSY generated yield tables where appropriate input information was available.

Species composition information for existing managed stands came from planting survey data, recorded in Reporting Silviculture Updates and Land Status Tracking System (RESULTS), taking into consideration fill plants and replants. This information was augmented with stand density from measured total stems in RESULTS free growing survey data. Species composition was adjusted by combining the two sets of survey data, thus allowing for changes in species composition from the time of planting until the time of free growing. As discussed previously, the site index was provided from the PSPL.

In the previous analysis, this standardized yield projection approach was not available for managed stands, and yield tables were produced for analysis units aggregated based on inventory composition (e.g., species, site index class, and biogeoclimatic zone), using TIPSY inputs estimated from observational trends in regeneration silviculture.

History of the allowable annual cut

The allowable annual cut (AAC) for the Kootenay Lake TSA was first established on June 1, 1981, at 900 000 cubic metres. On June 1, 1995, that AAC was reduced to 700 000 cubic metres. On January 1, 2002, the AAC determination (TSR 1) reduced the AAC to 681 300, and on August 12, 2010, the AAC determination (TSR 2) reduced the AAC to 640 000 cubic metres. After an area amendment to a of a CFA on May 5, 2016, the AAC was reduced to 634 861 in accordance with the Allowable Annual Cut Administration Regulation. Table 2 summarizes the history of the AAC in Kootenay Lake TSA.

Table 2. History of the AAC – Kootenay Lake TSA

TSR #	AAC effective date	Total AAC (m^3/year)	THLB (ha)
Established	January 1, 1981	900,000	296,879
1	June 1, 1995	700,000	296,879
2	January 1, 2002	681,300	257,850
3	August 12, 2010	640,000	198,080
CFA adjustment	May 5, 2016	634,861	197,681

Forest management

Timber harvesting land base

As part of the process used to define the modelled timber harvesting land base[e] (THLB) in the timber supply analysis, a series of deductions were made from the TSA land base. Table 3 shows categories of land that were considered not to contribute to the THLB. The table presents the area of the categories within the gross TSA boundary and the area for each factor that was uniquely (i.e., no overlaps with other factors) considered excluded from timber harvesting.

The total area within the TSA boundary covers 1 240 878 hectares, of which approximately 54 percent, or 675 024 hectares, is analysis forest land base[f] (AFLB). About 25 percent of the AFLB, or 14 percent of the total TSA area, is included in the current THLB of 168 501 hectares.

[e]**Timber harvesting land base (THLB)**
The THLB is an estimate of the land where timber harvesting is considered both acceptable and economically feasible, given the objectives for all relevant forest values, existing timber quality, market values and applicable technology. The THLB is derived from the data, forest management practices and assumptions described in the data package. It is a theoretical, strategic-level estimate used for timber supply analysis and could include areas that may never be harvested or may exclude areas that will be harvested.

[f]**Analysis forest land base (AFLB)**
The forested area of the TSA that the provincial government manages for a variety of natural resource values. This excludes non-forested areas (e.g., water, rock and ice), non-productive forest (e.g., alpine areas, areas with very low productivity), and non-commercial forest. Parks and other non-THLB forested areas contribute to the accounting for biodiversity targets and are therefore included in the AFLB. For the purpose of an AAC determination under Section 8 of the Forest Act*, the AFLB also excludes area-based tenures such as woodlots, community forests, tree farm and First Nations woodland licences. The AFLB was referred to as the Crown Forest Land Base (CFLB) in the Data Package (November 2020).*

Table 3. Land base classification – Kootenay Lake TSA

Land classification	Gross area	AFLB area	Percentage of gross area	Percentage of AFLB area
TSA boundary	**1 240 878**			
Non-provincial Crown lands	141 667		11	
Not managed within TSA AAC	74 756		6	
Non-forest and non-productive forest	399 067		32	
Existing roads	18 293		2	
Analysis forest management land base	**675 024**	**675 024**	**54**	
Provincial Parks, Reserves, and PAS2 Areas	220 128	123,703	18	18
Caribou no harvest	212 547	134,155	17	20
Old growth management areas	264 791	151,286	21	22
Wildlife management areas	21 749	14,530	2	2
Conservation lands	921	374	<1	<1
Wildlife habitat areas	265	150	<1	<1
Wildlife Habitat - Partial	372	361	<1	<1
High recreation value area	70	46	<1	<1
Riparian	36 407	19,049	3	3
Legally harvestable land base	**352 108**	**352,108**	**28**	**52**
Research installation	153	124	<1	<1
Terrain stability areas	95 661	67,101	8	10
Inoperable	706 550	345,699	57	51
Deciduous leading	19 688	11,282	2	2
Low productivity site	166 685	103,867	13	15
Under-utilized site	606 332	295,015	49	44
THLB isolated small area removal	594	493	<1	<1
Wildlife Tree Retention	9 831	9,528	<1	1
Timber harvesting land base		**168 501**	**14**	**25**

Figure 3 shows the age class distribution of the AFLB by THLB and non-THLB in Kootenay Lake TSA.

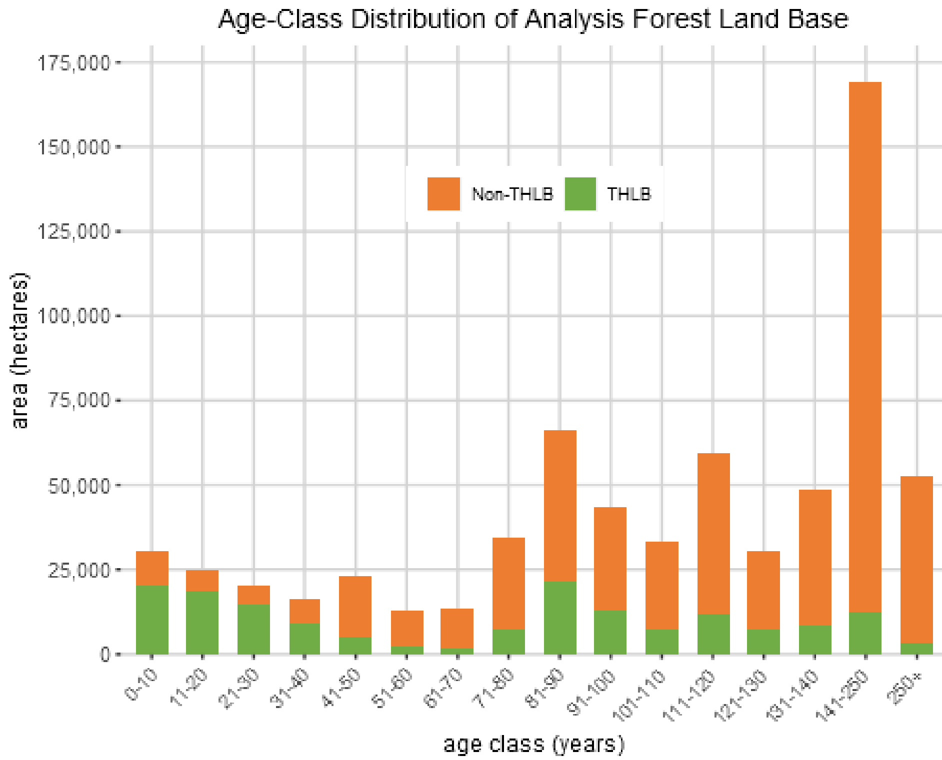

Figure 3. Age class distribution for the AFLB in Kootenay Lake TSA.

Figure 4 summarizes the area and current volume of stands by major leading species on the THLB. Stands without assigned leading species, or with minor leading species, account for less than four percent of the THLB.

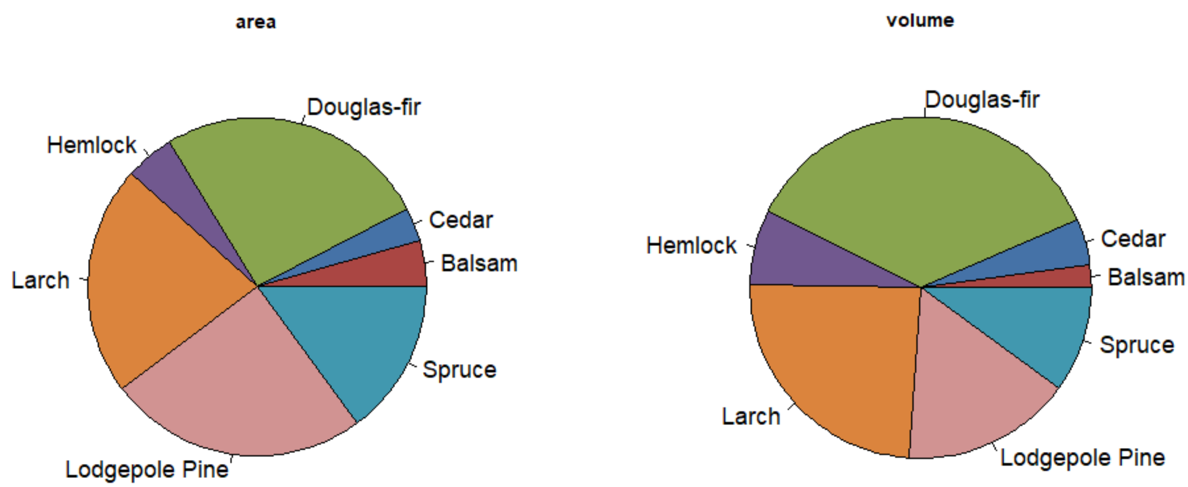

Figure 4. Leading species by area and volume within the Kootenay Lake TSA THLB.

Data package update summary

The *Data Package* was updated after being released for public review and comment. Based on the feedback received and updates to the provincial datasets, changes were made to the data and assumptions outlined in the data package. Notable changes include a modification to modelling biodiversity old-seral retention targets and newly established wildlife habitat areas.

The *Data Package* stated the area reserved in OGMAs would be considered sufficient to achieve old-seral retention targets for biodiversity. In the base case, where the KBHLPO old-seral targets are not met within the OGMAs, the timber supply model reserved additional area to meet the targets.

The THLB used in this analysis was updated to exclude additional WHAs, approved in the Fall of 2021 after the release of the *Data Package*. New WHAs were established for Rocky Mountain Tailed Frog, Western Screech Owl, and data sensitive species.

Timber supply projection

For most AAC determinations, a timber supply analysis is carried out using three categories of information: land base inventory, timber growth and yield, and management practices. Using this information and a computer model, a series of timber supply projections were produced to reflect different starting harvest levels, rates of decrease or increase in harvest levels, and potential trade-offs between short-term and long-term harvest levels.

From a range of possible projections, one was chosen which attempts to avoid both excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This was known as the 'base case' projection and formed the basis for comparison when assessing the effects on timber supply of uncertainty of the information modelled in this analysis. The base case was designed to reflect current management practices and legal requirements.

Because it represents only one in a number of possible projections, and because it incorporates information and modelling assumptions about which there may be some uncertainty, the base case is not an AAC recommendation. Rather, it is one possible timber supply projection, whose validity - as with all the other projections provided - depends on the validity of the data and assumptions incorporated into the computer model used to generate it.

The base case, alternative harvest projections and sensitivity analyses are prepared using a computer model that projects the future availability of timber for harvesting for the next 250 years based on the growth of the forest and the level of harvesting, while staying within the legal land use objectives established by the provincial government.

Due to the existence of uncertainty in the timber supply analysis, additional projections are prepared to test the effect of changing some of the assumptions or data used in the base case. These additional projections are either 'alternative harvest projections' or 'sensitivity analyses'. Alternative harvest projections test the feasible alternatives to the base case by changing the harvest flow, while the sensitivity analyses test the parameters used, such as the harvest priority queue, data uncertainties, and uncertainties that affect timber supply to varying degrees. The resulting level and duration of the harvest flow across the 250 years, referred to as the modelled time horizon, is compared to the base case and the difference is the timber supply impact of the alternative projection or the sensitivity analysis. The harvest flow levels are summarized and compared in the short term (0 to 45 years) and the long term (45 to 250 years).

The computer model used for the Kootenay Lake TSA was the Spatial Timber Supply Model (STSM1) which is run within the Spatially Explicit Landscape Event Simulator (SELES) application. Analysis was conducted using rasterized spatial data at a one-hectare grid resolution.

Harvest flow objectives

All scenario analyses, i.e., base case, alternative harvest projections, and sensitivity analyses, were established with the harvest flow objectives of balancing available timber supply, sustainability of the harvest, and forest management objectives. The following four harvest flow objectives were applied for all scenarios:

1. Start the harvest flow with the AAC from the last determination (640 000 cubic metres).
2. Never drop below the even-flow for the scenario.
3. Limit the change of harvest level between five-year steps to no more than 10 percent.
4. Maintain a stable long-term growing stock (defined below).

An even-flow harvest level, defined as the level of harvest that can be met each year of the time horizon, was identified for each scenario. A stable long-term growing stock was defined as a harvest level that maintains within the THLB a mean growing stock between the years 150 and 200 that is within one percent (to the ones place, or whole number), of the mean growing stock between the years 200 and 250. These objectives were used in the development of the base case, alternative harvest projections and sensitivity analyses unless otherwise stated.

The base case

In the base case an initial harvest level of 640 000 cubic metres per year can be maintained for 45 years before stepping down to the long-term harvest level of 586 000 cubic metres per year. In Figure 5 the base case harvest flow developed for the previous TSR in 2009 is labelled TSR 3. Year 0, seen at the start of the time horizon, is 2020.

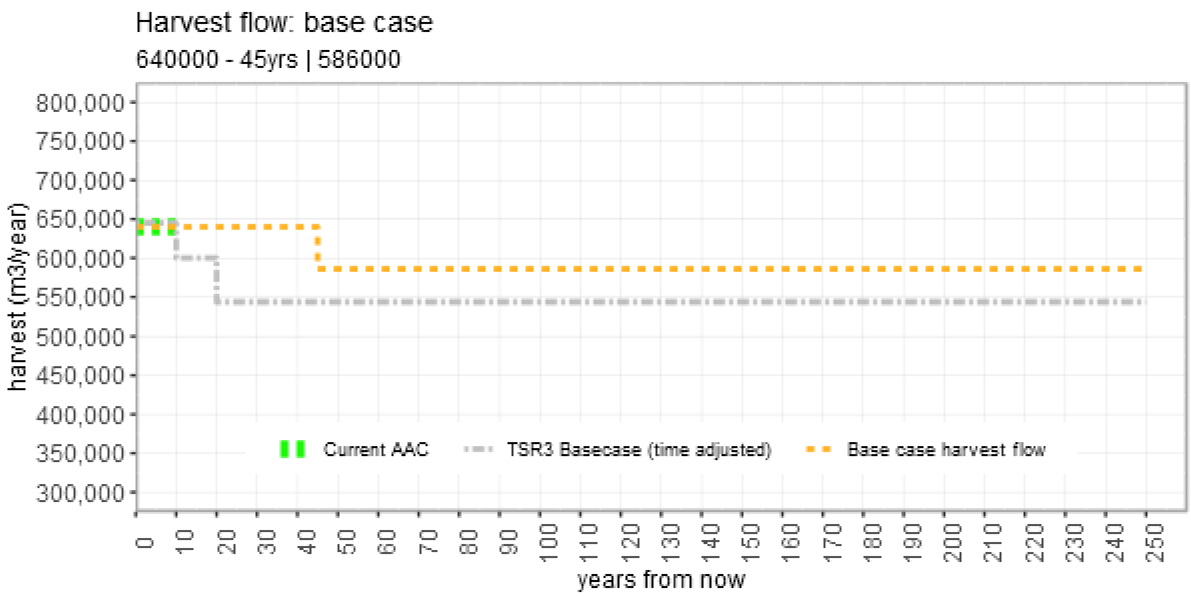

Figure 5. Base case harvest flow.

For comparison, the previous TSR base case proposed an initial harvest level of 645 000 cubic metres per year for two decades before declining to 600 000 cubic metres per year for one decade and then further declining to 544 000 cubic metres per year for the long-term stable harvest level. Note that the updated inventory and the use of the PSPL site index contribute to the higher harvest levels in the current base case even though the current THLB is smaller than the THLB used in 2009.

Figure 6 shows the total growing stock within the THLB and the growing stock available for harvest at each step of the 250-year time horizon. The percentage difference are shown in parentheses in the growing stock graphs.

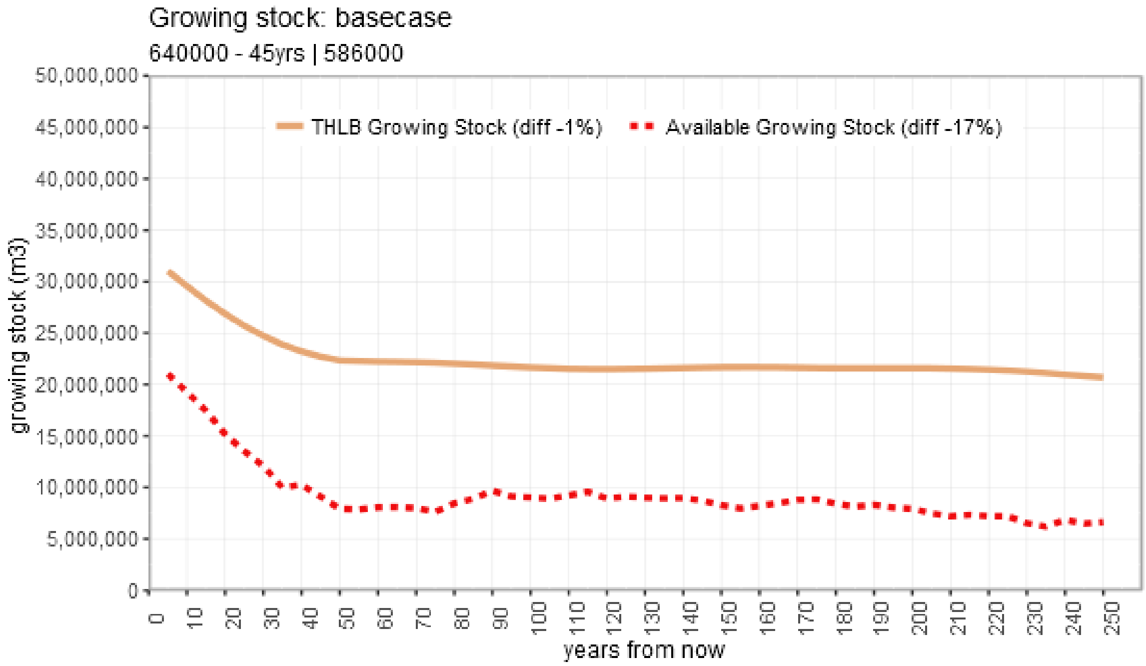

Figure 6. Growing stock for base case.

Figure 7 presents the volume harvested from stand types over time as harvested by the model in the base case. 'Managed volume' is harvested from those stands currently on a TIPSY yield table, assumed to be managed, and 'Old volume' and 'Thrifty volume' is harvested from the VDYP yield tables. Old volume is defined as volume harvested from stands older than 140 years and thrifty volume is defined as volume harvested from stands younger than 140 years and without a silviculture record.

The harvest flow begins with volume predominantly from old stands. Within the first two decades, harvest volume is predominantly from thrifty stands. Managed volume begins contributing at decade five and quickly becomes the predominant contributor to harvest. The old and thrifty volumes continue to contribute up to decade twelve, with some periodic smaller contributions to the overall harvest in later decades.

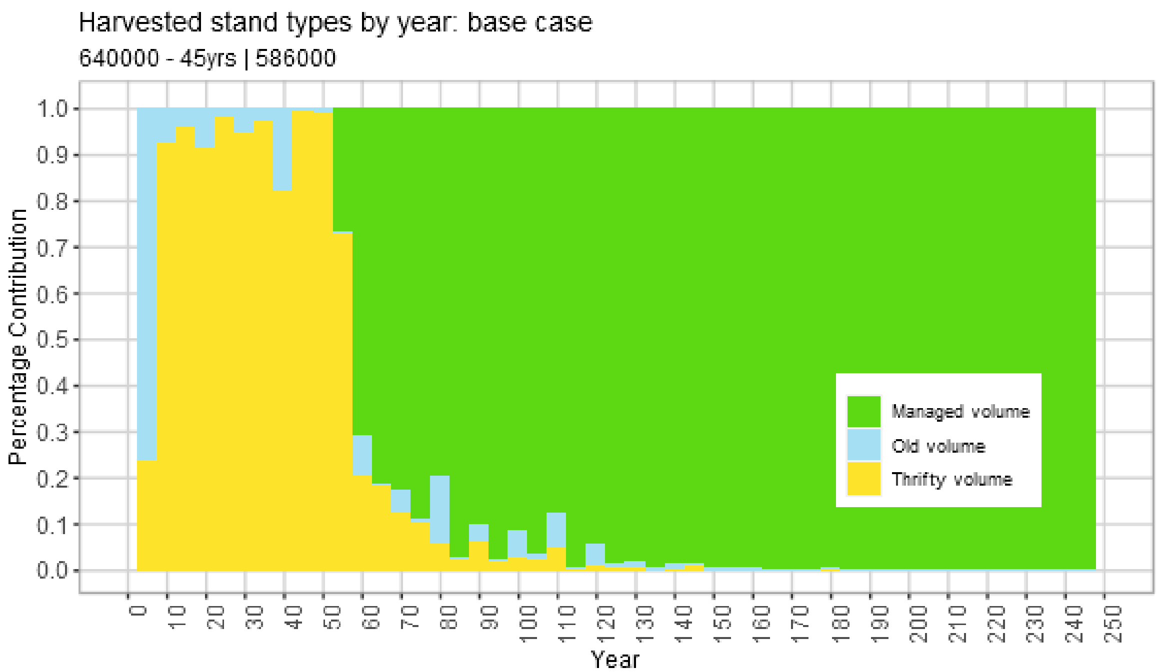

Figure 7. Stand types harvested by model in base case.

Figure 8 presents the changes in mean annual harvest volume per hectare for each year of the projection. The average harvest volume per hectare for the 250-time horizon was 327 cubic metres per hectare. For the first 45 years, the average harvest volume per hectare was 361 cubic metres per hectare. From 45 to 250 years the average harvest volume per hectare was 319 cubic metres per hectare. The volume per hectare declines over time as the older, higher volume stands are harvested first, followed by the managed stands, which the model harvests at a younger age.

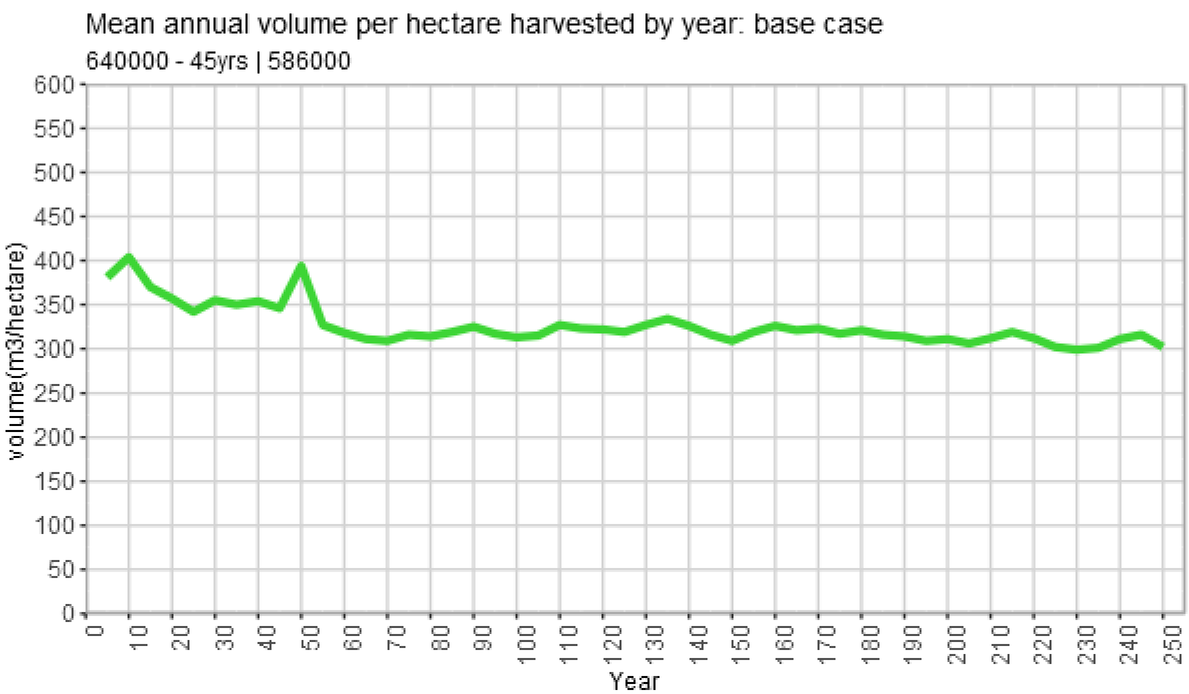

Figure 8. Mean volume per hectare per year harvested by the model in the base case.

Figure 9 presents the changes in the mean annual harvest age over time. The mean average age of harvested stands over the entire 250-year time horizon was 95 years. For the first 45 years, the mean average age of harvested stands was 134 and from 45 to 250 years the average age was 86 years.

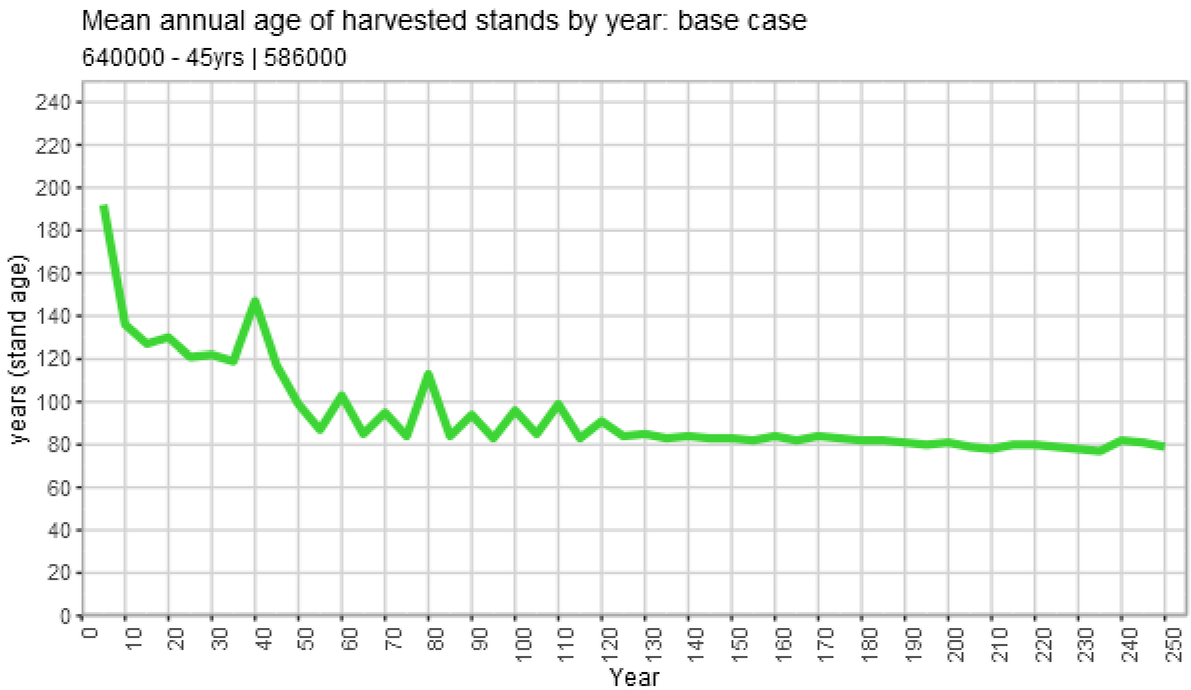

Figure 9. Mean age of stands harvested by the model in the base case.

Alternative harvest projections

The harvest flow selected for the base case is one of many alternative harvest flows possible. Presented below are three alternatives that demonstrate how changing the initial harvest level can affect the projected harvest levels across the entire time horizon. Three alternative harvest projections explore the implications of an even-harvest flow, an initial flow lower than the current AAC, and an initial flow higher than the current AAC.

Even harvest flow

The first alternative projection utilizes an even-harvest flow which sustains the same harvest level every year across the 250-year time horizon while maintaining all base case management objectives and modelling assumptions.

An even-flow of 586 000 cubic metres per year can be sustained for 250 years. This harvest flow, shown in Figure 10, represents an 8.8 percent decrease in the short term and no change in the long term compared to the base case.

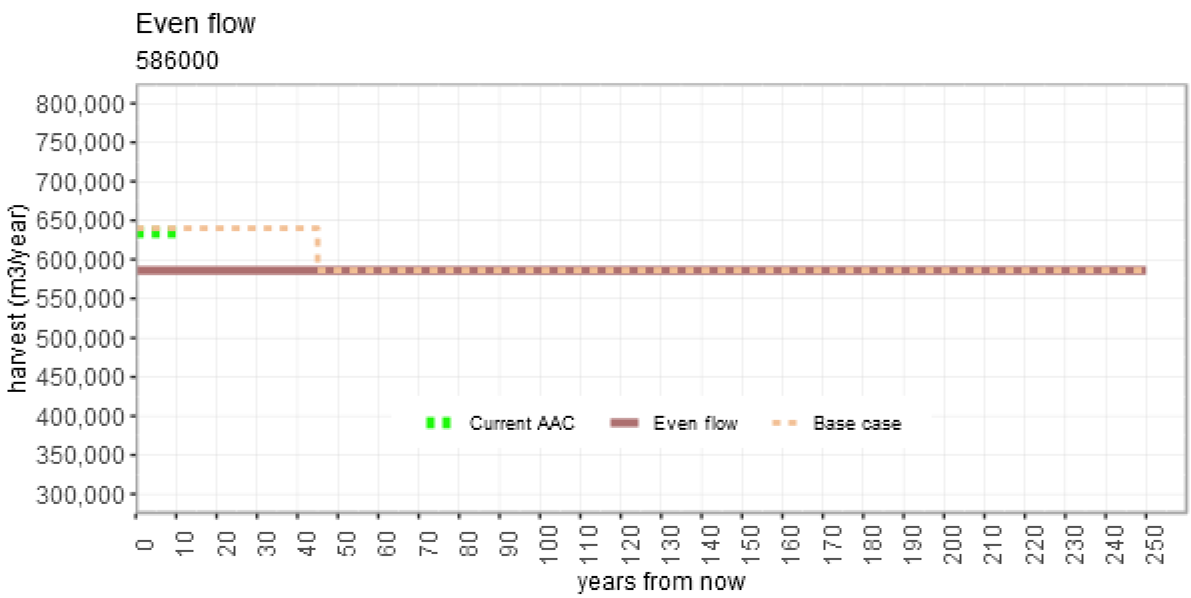

Figure 10. Even-harvest flow.

Lower initial harvest flow

In this alternative projection, the harvest flow starts with a lower initial harvest level of 600 000 cubic metres per year and is maintained for as long as possible.

The lower initial level can be maintained for 100 years before stepping down to the long-term harvest level of 588 000 cubic metres per year. This harvest flow, shown in Figure 11, represents a 6.5 percent decrease in the short term and a 0.9 percent increase in the long term compared to the base case.

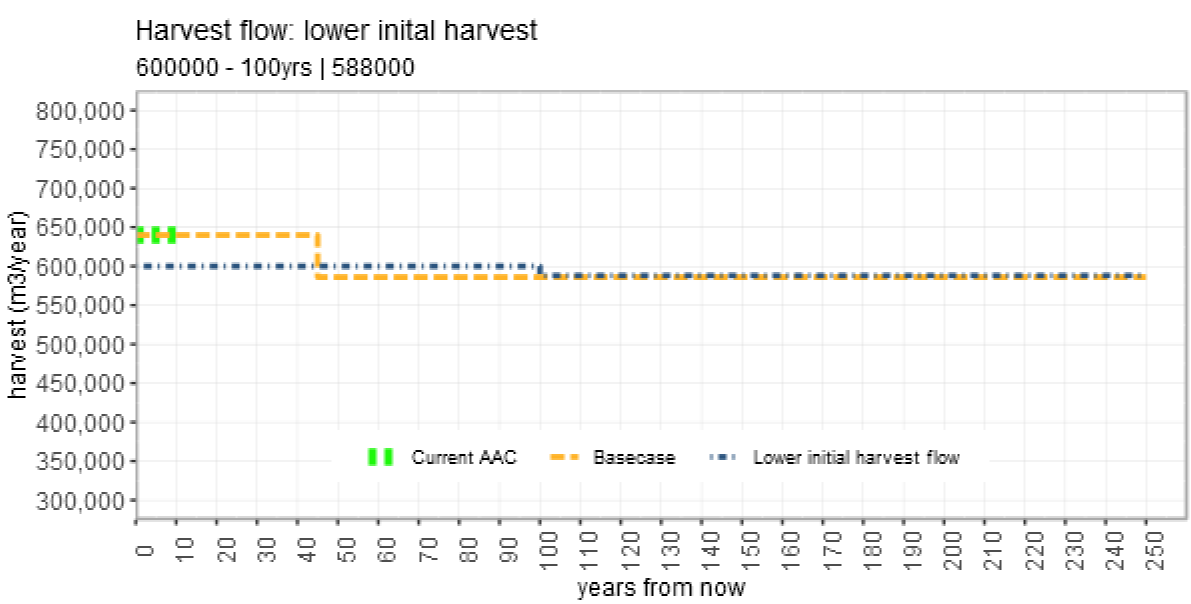

Figure 11. Decreased initial harvest flow.

Higher initial harvest flow

In this alternative projection, the harvest flow starts with an initial harvest level of 700 000 cubic metres per year and is maintained for as long as possible before decreasing in 10 percent steps to the long-term harvest level.

The increased initial level can be maintained for 20 years before stepping down to 631 000 cubic metres per year for 10 years, and then stepping down to the long-term harvest level of 586 000 cubic metres per year. Even though the initial harvest level is higher than the current AAC, this alternative harvest flow, shown in Figure 12, represents a decrease of 2.6 percent in the first 45 years (short term), and no change in the long term, compared to the base case.

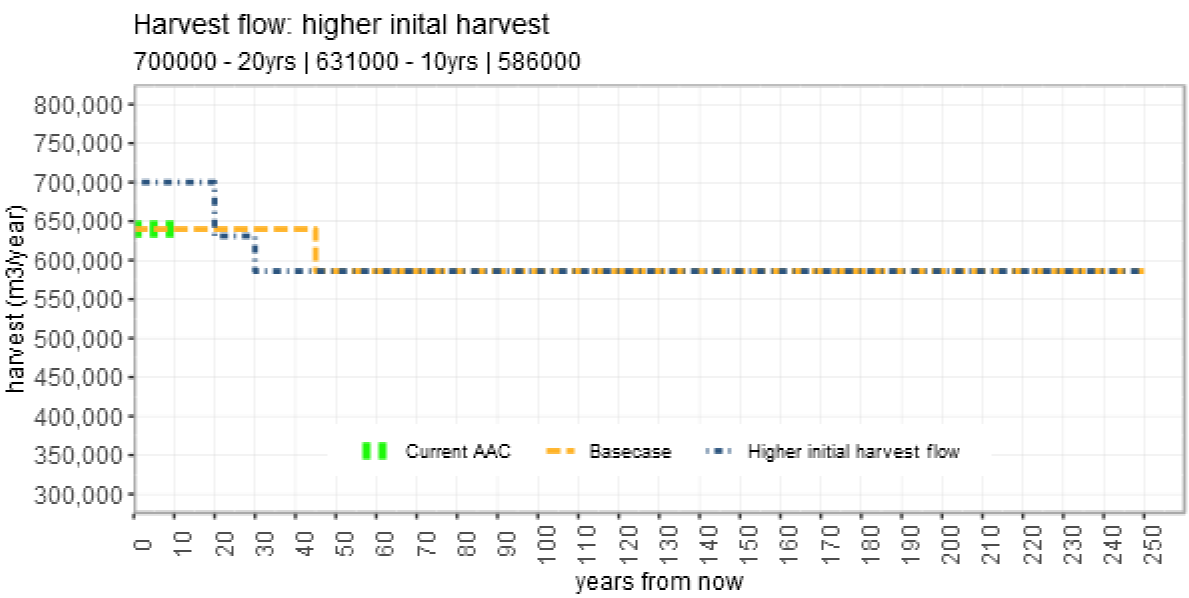

Figure 12. Increased initial harvest flow.

Sensitivity analyses

The base case used a specific set of data and assumptions to reflect forest composition and growth, legally established land use objectives and current forest management practices. While the base case was designed to reflect current management in the Kootenay Lake TSA, there is uncertainty about some management information and the modelling framework, i.e., factors that apply to the timber supply analysis. Therefore, sensitivity analyses are used to understand how manipulating one factor at a time affects the timber supply.

Table 4 shows the sensitivity analyses completed on the Kootenay Lake TSA and the average annual harvest volume impact of each in comparison to the base case, across the short term, the first 45 years, and across the long term, from 45 years to the end of the time horizon at 250 years.

The *harvest flow objectives* outlined above were used to establish the sensitivity analyses, unless otherwise stated. The first 45 years was used as a point of comparison as that is when the first harvest flow step down occurs in the base case, although in some sensitivity analyses a step down occurred earlier or later. An even-flow specific to each sensitivity analysis was identified, and the harvest flow for that analysis was not dropped below that even-flow harvest level. An increase in the short-term timber supply is not always reflected in the percentage impact in the short term. If there is higher timber supply, either the initial harvest can be increased, or the duration of that harvest can be lengthened. In general, the second option was implemented. When the duration exceeded the 45 years defined as the short term, the percentage impact in the short term is zero, shifting the percentage impact to the long term. The percent impact is the percentage difference between the average annual harvested volume in either the short term (first 45 years) or long term (45 – 250 years) between the sensitivity analysis and the base case.

Table 4. Sensitivity analyses – Kootenay Lake TSA

Issue evaluated	Sensitivity levels	Percent impact (average annual harvested volume over short term)	Percent impact (average annual harvested volume over long term)
Timber harvesting land base	THLB + 10% by hectare	0.0	+ 8.1
	THLB - 10% by hectare	-11.8	-11.2
Harvest priority schedule	Stands with higher volume per hectare prioritized for harvest	0.0	-5.9
Minimum harvestable criteria	Minimum age +10 years	-1.7	+0.8
	Minimum age -10 years	0.0	-0.3
	Minimum volume 5th percentile	-1.3	-1.9
	Minimum volume 0.1 percentile	-3.6	+0.5
Natural stand yields	+ 10%	0.0	+3.5
	- 10%	-9.5	-1.2
Managed stand yields	+ 10%	+0.8	+9.6
	- 10%	0.0	-10.5
Low site cutoffs	Minimum volume and SI 5th percentile	-2.5	-5.4
	Site index < 8m	0.0	-0.1
Terrain stability mapping (unstable and potentially unstable)	Increase reduction 10%	-8.8	-1.2
	Decrease reduction 10%	-0.8	+1.4
	Exclude	-12.1	-7.2
Biodiversity old and mature targets	Aspatial targets	0.0	+5.7
	BEC V12	-2.0	-0.5
	Full seral targets (no draw-down)	-6.0	-0.3
Hydrological recovery minimums in community watersheds	Hydrological recovery 75%	0.0	+0.2
	Hydrological recovery 80%	-1.9	+0.2
Climate change	Dry sites	-0.8	-24.7
Domestic watersheds	Hydrological recovery 70%	-6.7	+0.2
Wildfire Urban Interface	See below		
Armillaria Root Disease	See below		
Caribou	See below under Additional Information		

Timber harvesting land base

Two sensitivity analyses explored the effect on timber supply of changing the size of the THLB. The first increased the size of the THLB by adding 10 percent to the proportion of THLB within each one-hectare grid cell, to a maximum of one hundred percent. The second sensitivity analysis decreased the size of the THLB by subtracting 10 percent of the proportion of THLB within each one-hectare cell, to a minimum of zero percent. Overall, the THLB was increased by 6.7 percent, and decreased by 10.5 percent, respectively.

When the THLB was increased, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 170 years before stepping down to the long-term harvest level of 628 000 cubic metres per year. This harvest flow represents no change in the short term and an increase of 8.1 percent in the long term compared to the base case.

When the THLB was decreased, a stable harvest flow starting at 640 000 cubic metres could be maintained for 15 years before stepping down to 580 000 cubic metres for five years, and then stepping down to the long-term harvest level of 524 000 cubic metres per year. This harvest flow represents a decrease of 11.8 percent in the short term and a decrease of 11.2 percent in the long term, compared to the base case.

Harvest scheduling priority: higher volume per hectare

The model selects which stand to harvest next based on a schedule priority. In the base case, the priority is oldest first, with the oldest stands prioritized for harvest.

In this sensitivity analysis, a harvest order priority based on highest timber volume was used. Stands with the highest volume are prioritized for harvest over those with a lower volume.

When a highest volume harvest priority was used, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 55 years before stepping down to 580 000 cubic metres per year for five years, and then stepping down to the long-term harvest level of 547 000 cubic metres per year. This harvest flow, shown in Figure 13, represents no change in the short term and a decrease of 5.9 percent in the long term compared to the base case.

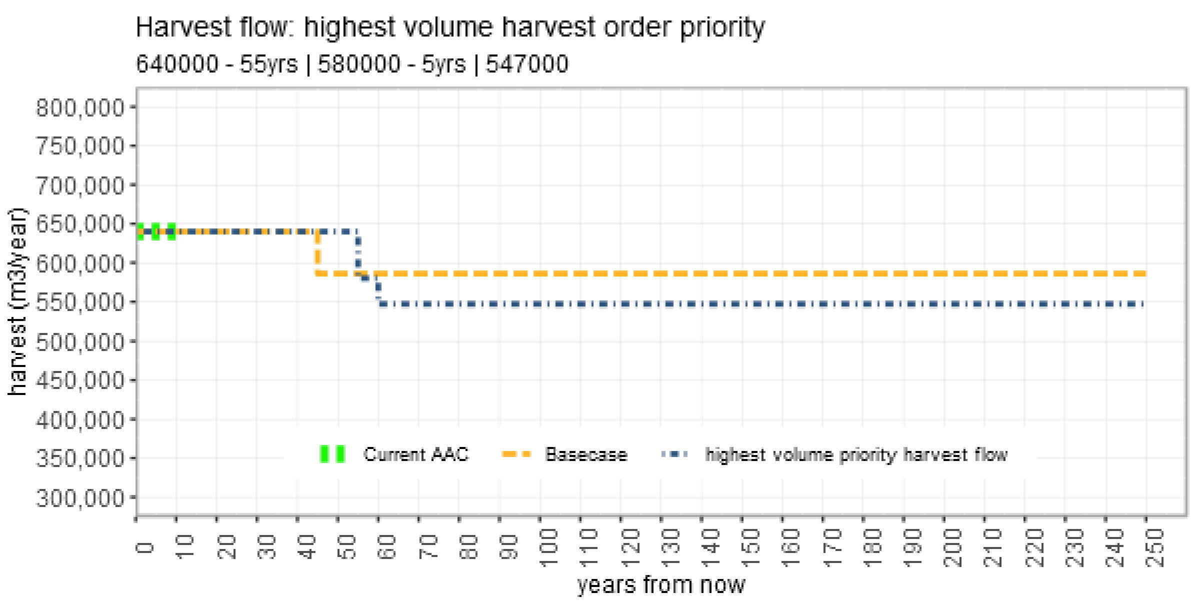

Figure 13. Harvest flow for highest volume harvest order priority.

When the model uses a highest volume harvest order priority, some older stands with a lower volume per hectare drop below younger stands with a higher volume in the harvest priority queue, resulting in more unharvested THLB at the end of the time horizon. For highest volume priority, there were 4444 hectares of unlogged THLB, compared to 2954 hectares in the base case. Figure 14 compares the age class distribution at the end of the 250-year time horizon for the model output from the base case, using oldest first harvest order priority, and the highest volume harvest order priority scenario.

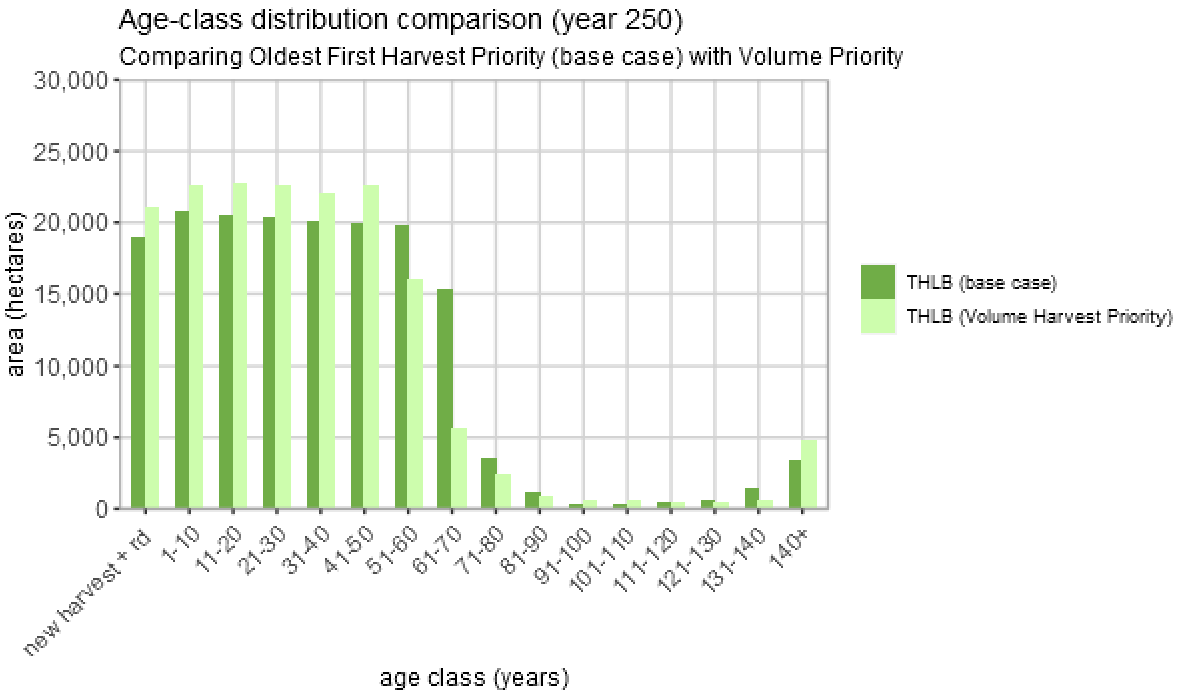

Figure 14. Stand age class comparison between base case and highest volume harvest priority.

Minimum harvestable criteria

The model uses minimum harvestable criteria to determine if a stand meets the minimum threshold to be harvested. In the base case, a minimum age and volume threshold were used, described below.

Minimum harvestable age

In the base case, the minimum harvestable age (MHA) was assigned based on the mean annual increment (MAI), or the average yearly volume of growth. Over the life of a stand, the MAI changes, first increasing, then reaching a peak, and then declining. The peak of the curve is known as the culmination of mean annual increment (CMAI). In the base case, the MHA of a stand was defined as the age at which the MAI of the stand was 95 percent of the CMAI. A stand was not considered for harvest unless it met the MHA threshold. Figure 15 shows the distribution of the MHA threshold for all stands in the THLB. In the base case, most stands are considered harvestable when they are between 60 – 70 years.

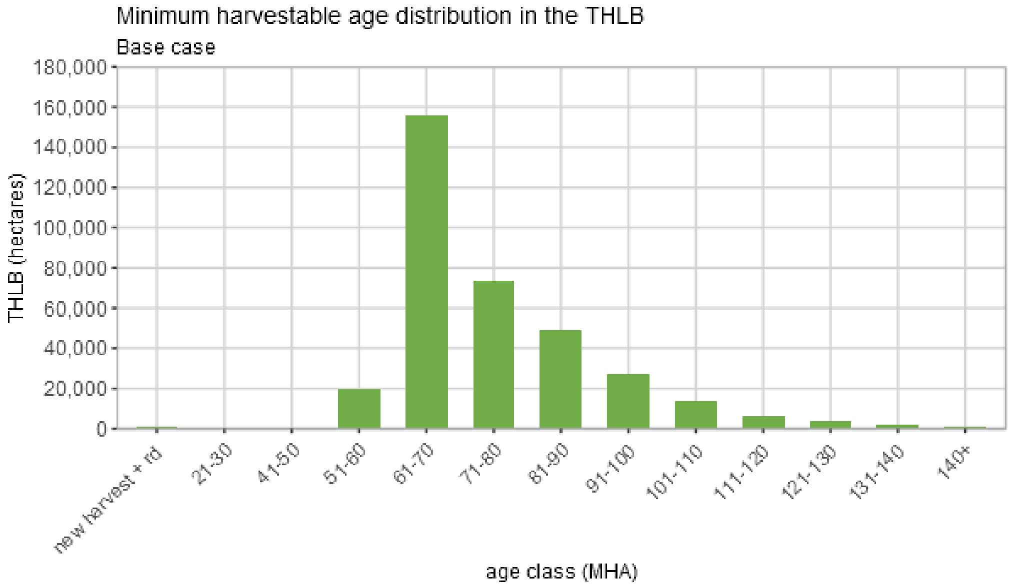

Figure 15. Minimum harvestable age distribution in THLB.

Two sensitivity analyses explored the effect on timber supply of altering the MHA. The first increased the MHA by 10 years, the second decreased the MHA by 10 years.

When the MHA was increased by 10 years a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to the long-term harvest level of 591 000 cubic metres per year. This harvest flow represents a 1.7 percent decrease in the short term and a 0.8 percent increase in the long term compared to the base case.

When the MHA was decreased by 10 years a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 45 years before stepping down to the long-term harvest level of 584 000 cubic metres per year. This harvest flow represents no change in the short term and a 0.3 percent decrease in the long term compared to the base case.

Increasing the MHA delays the point at which harvesting transitions to predominately managed stands which results in a corresponding decrease in the short-term timber supply. Decreasing the MHA allows stands to be harvested before they achieve their full growth potential resulting in a small reduction in harvest volume in both the short- and long-term.

Minimum harvestable volume

The second harvestable criteria used in the base case was minimum harvestable volume (MHV). In the base case, a stand was not considered for harvest unless it met a minimum volume threshold. This threshold was established by reviewing historic cruise data from the Electronic Commerce Appraisal System (ECAS) database and harvesting and silviculture data from the RESULTS database. The distribution of historic harvest volume per hectare within the Kootenay Lake TSA was used to establish minimum harvestable volumes. In the base case, the MHV threshold was set at the first percentile of this distribution, 146 cubic metres per hectare.

Two sensitivity analyses explored the effect on timber supply of changing the MHV. The first increased the MHV threshold to 196 cubic metres per hectare, the fifth percentile in the distribution of volume per hectare in historic harvest. The second decreased the MHV to 111 cubic metres per hectare, the 0.1 percentile in the distribution.

When the MHV threshold was increased to 196 cubic metres per hectare a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to 628 000 cubic metres per year for five years, and then stepping down to the long-term harvest level of 575 000 cubic metres per year. This harvest flow represents a decrease of 1.3 percent in the short term, and a 1.9 percent decrease in the long term, compared to the base case.

When the MHV threshold was decreased to 111 cubic metres per hectare a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 25 years before stepping down to the long-term harvest level of 589 000 cubic metres per year. This harvest flow represents a decrease of 3.6 percent in the short term and an increase of 0.5 percent in the long term, compared to the base case.

Increasing and decreasing the MHV threshold both reduced the timber supply. Increasing the MHV limits the initial growing stock available for harvest and excludes some stands from the THLB that will never achieve the threshold, which reduced the even-flow and the duration of the short term. Decreasing the MHV increased the even-flow but doing so reduced the duration of the short term to ensure harvest flow never dropped below the even-flow. Although decreasing the MHV increased the available volume, as seen in the increased even-flow, this volume is distributed across the 250-year time horizon. Ensuring the harvest flow does not drop below this elevated even-flow required that the short term was shortened to 25 years, contrasting with the base case duration of 45 years, reducing short-term harvest flow and resulting in the short-term impact.

Natural stand yield

Two sensitivity analyses explored the effect on timber supply of changing the yield projections in the natural stand yield tables. Natural stand yield projections are generated by the VDYP program specifically developed to project mature forest inventory. The first natural stand yield sensitivity analysis increased the natural stand yield table volumes by 10 percent. The second decreased the yield table volumes by 10 percent. The managed stands yield tables remained unchanged.

When the natural stand yield was increased by 10 percent, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 130 years before stepping down to the long-term harvest level of 583 000 cubic metres per year. This harvest flow represents no change in the short term and a 3.5 percent increase in the long term, compared to the base case.

When the natural stand yield was decreased by 10 percent, a stable harvest flow starting at 640 000 cubic metres per year could not be maintained. A stable harvest flow starting at 607 000 cubic metres per year could be maintained for five years before stepping down to the long-term harvest level of 579 000 cubic metres per year. This harvest flow represents a 9.5 percent decrease in the short term and a 1.2 percent decrease in the long term, compared to the base case.

Increasing the natural stand yields increases the volume available in the first rotation, before harvesting transitions to managed stands. This can either increase the initial harvest level or increase the number of years the model is able to maintain the initial harvest level. The harvest flow above represents this second option, therefore the increase in timber supply compared to the base case is seen in the long-term harvest level, not the short term. Decreasing the natural stand yields decreases the volume available in the first rotation. The base case timber supply is sensitive to this decrease as seen by the reduced initial harvest level with a reduced duration at that lower level.

Managed stand yield

Two sensitivity analyses explored the effect on timber supply of changing the managed stand yield tables. Managed stand yield projections are generated by TIPSY, which uses information based on stand initiation characteristics from RESULTS. The first managed stand yield sensitivity analysis increased all managed stand yield table volumes by 10 percent. The second decreased all managed stand yield table volumes by 10 percent. The natural stand yield tables remained unchanged.

When the managed stand yield was increased by 10 percent, a stable harvest flow starting at 645 000 cubic metres per year could be maintained for the 250-year time horizon, without stepping down. This harvest flow represents a 0.8 percent increase in the short term and a 9.6 percent increase in the long term, compared to the base case.

When the managed stand yield was decreased by 10 percent, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 45 years before stepping down to 581 000 cubic metres a year for 10 years, and then stepping down to the long-term harvest level of 525 000 cubic metres per year. This harvest flow represents no change in the short term and a 10.5 percent decrease in the long term, compared to the base case.

Increasing the managed stand yields increases the volume available for harvest after the transition to harvesting managed stands (see Figure 7), which results in an increase in timber supply in the long term. Decreasing managed stand yields proportionally decreases the timber supply in the long term.

Low site productivity

In the base case, low productivity sites were excluded from the THLB. The threshold for low site productivity in the base case used both a minimum site index and minimum volume criteria. Stands were identified as low site productivity stands if they had a site index less than 6.7 metres or they did not meet a minimum volume of 146 cubic metres per hectare. Both threshold values were identified by reviewing the distribution of those values in the ECAS / RESULTS historical harvest data (discussed above under minimum harvestable volume). In the base case, the threshold for low site productivity was set at the first percentile for both site index and volume per hectare.

Two sensitivity analyses were completed for low site productivity. In the first scenario, instead of using the first percentile, the fifth percentile from the distribution of the historical harvest data was used, for both site index and volume per hectare minimum thresholds. In the second sensitivity analysis, the definition of minimum harvestable volume used in the previous TSR was applied: all stands with a site index less than eight metres were excluded from the THLB and the minimum volume criteria was not used.

When all stands below the fifth percentile of the historical harvest distribution for site index and volume per hectare, classified as low productivity sites, were removed from the THLB, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to 582 000 cubic metres a year for five years, and then stepping down to the long-term harvest of 555 000 cubic metres per year. This harvest flow represents a 2.5 percent decrease in the short term and a 5.4 percent decrease in the long term, compared to the base case.

When all stands with a site index less than eight, classified as low productivity sites, were removed from the THLB, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 50 years before stepping down to the long-term harvest level of 584 000 cubic metres per year. This harvest flow represents no change in the short term and a 0.1 percent decrease in the long term, compared to the base case.

Increasing the percentile threshold from the historical harvest data distribution to identify low site productivity stands results in more area excluded from the THLB and a resulting lower timber supply.

There is very little difference in timber supply between defining low site productivity as a combination of low site index and low volume per hectare, with the thresholds coming from the harvest data distribution, as was done in the current analysis, or by defining low site productivity solely with site index, using site index of less than eight metres, as was done in the last two TSRs using an historic estimate.

Terrain stability mapping

Within the Kootenay Lake TSA, seven percent of the THLB is within an area identified as unstable or potentially unstable in the terrain stability mapping (TSM).

In the base case, unstable terrain classes U and V in TSM data are modelled as 90 percent exclusions from the THLB and potentially unstable classes P and IV are modelled as 30 percent exclusions from the THLB. Areas outside TSM project boundaries that are classified as Environmentally Sensitive Areas (ESA) level 1 were completely excluded from the THLB.

The historical harvest data for the years between 2010 and 2019 indicate that 0.1 percent of the harvest occurred within areas classified as unstable or potentially unstable in the TSM. Within the first 10 years of the base case, 14 percent of the area harvested was within areas classified as unstable or potentially unstable and the volume harvested from these areas was 35 296 cubic metres per year, six percent of the projected harvest.

The base case projects a disproportionate amount of harvesting, relative to the proportion of the THLB area, within terrain classified as unstable or potentially unstable for the first 10 years. This suggests that the base case short-term harvest level will be sensitive to changes in the terrain stability assumptions.

Two sensitivity analyses explored the effect of changing terrain stability assumptions on timber supply by changing the proportion of area excluded within the terrain stability classifications of unstable and potentially unstable. One sensitivity analysis explored the effect of completely removing the unstable and potentially unstable areas from the THLB.

<u>TSM unstable and potentially unstable percentage removal</u>

When the exclusion percentage applied was increased by 10 percent within areas classified as unstable or potentially unstable terrain in the TSM, the resulting THLB was 1.2 percent smaller than the base case THLB. A stable harvest flow starting at 640 000 cubic metres per year could be maintained for five years before stepping down to the long-term harvest level of 579 000 cubic metres per year. This harvest flow represents an 8.8 percent decrease in the short term and a 1.2 percent decrease in the long term, compared to the base case.

When the exclusion percentage applied was decreased by 10 percent within areas classified as unstable or potentially unstable terrain, the resulting THLB was 1.2 percent larger than the base case THLB. A stable harvest flow starting at 640 000 cubic metres per year could be maintained for 40 years before stepping down to the long-term harvest level of 594 000 cubic metres per year. This harvest flow represents a 0.8 percent decrease in the short term and a 1.4 percent increase in the long term, compared to the base case.

When a greater percentage of the unstable and potentially unstable area was removed from the THLB, the short-term impact was an 8.8 percent reduction, a much bigger impact than can be explained by the THLB area reduction of 1.2 percent. The base case projected harvest showed a disproportionate reliance on this area, and the impact of removing those areas suggests that harvesting within this area was necessary to support timber supply through a period of low growing stock availability. With the availability of this area reduced, it was necessary to decrease the harvest flow across a longer time horizon, resulting in a disproportionately large timber supply impact.

<u>TSM exclusion</u>

When a sensitivity was conducted that completely excluded the unstable and potentially unstable areas from the THLB, the resulting THLB was 7.4 percent smaller than the base case THLB. A stable harvest flow starting at 640 000 cubic metres per year could not be maintained while limiting the change of harvest level between five-year steps to no more than 10 percent. A stable harvest flow starting at 635 000 cubic metres per year could be maintained for five years before stepping down to 599 000 cubic metres per year for 10 years and then stepping down to the long-term harvest level of 545 000 cubic metres per year. This harvest flow represents a 12.1 percent decrease in the short term and a 7.2 percent decrease in the long term, compared to the base case.

As slope and unstable terrain are overlapping factors, it is useful to show the slope distribution of historic harvest compared to the projected harvest from the base case and this scenario. The graph below shows the slope distribution from the historic harvest between 2010 and 2019, the projected harvest in the base case, and the projected harvest in this sensitivity analysis for TSM unstable and potentially unstable area exclusion, against the slope distribution of the THLB.

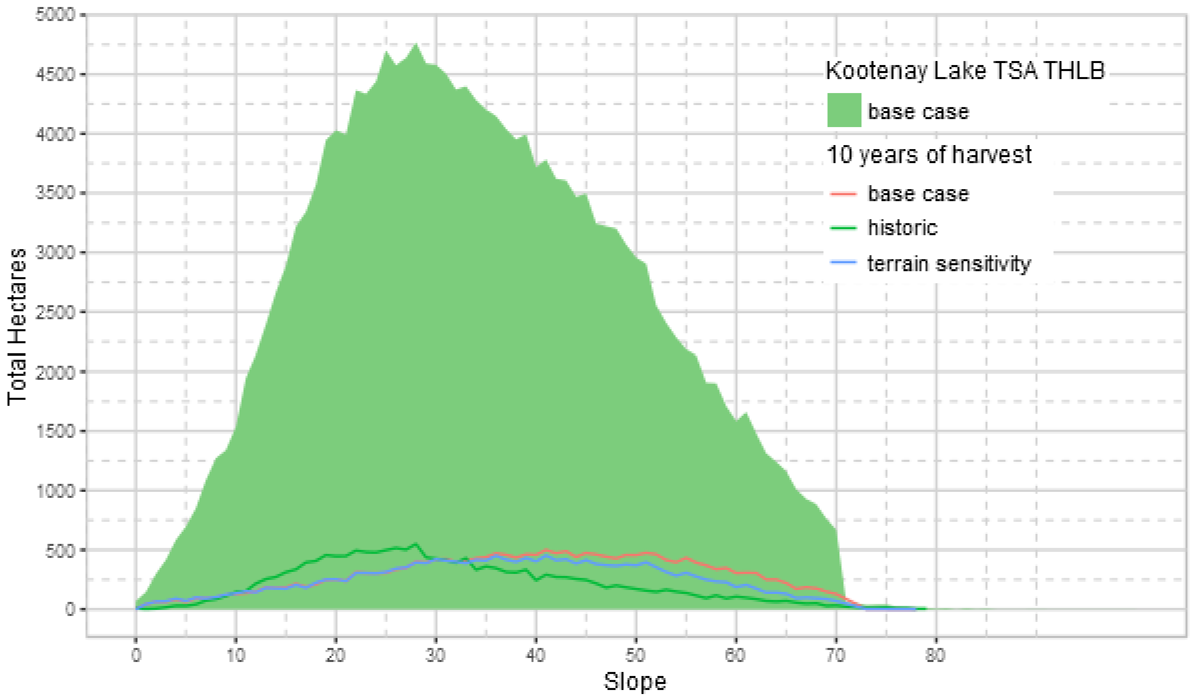

Figure 16. Slope distribution of THLB, harvest, and projected harvest.

Removing the unstable and potentially unstable terrain results in a slope distribution of the area harvested in the first 10 years of the model that is slightly closer to that of the historic harvest. However, the difference between the base case and the sensitivity analysis is not as pronounced as the difference between the outputs of both scenarios and historic harvest. In the 10 years of historic harvest, 26 percent of the harvested area had a slope over 40 percent, compared with 50 percent of the first 10 years of harvest in the base case and 44 percent in the sensitivity analysis removing all unstable and potentially unstable areas. Thirty-five percent of the THLB defined in the base case has a slope over 40 percent. This sensitivity analysis shows the same pattern as the sensitivity analysis above, where the exclusion percentage applied was increased by 10 percent. The base case projected harvest showed a disproportionate reliance on this area, and the impact of removing those areas suggests that harvesting within this area was necessary to support timber supply through a period of low growing stock availability.

Old Growth

Old growth is of high ecological value at the tree, stand and landscape scale. In 2019, the Government of BC appointed an independent, two-person panel as part of an Old Growth Strategic Review to engage the public in a conversation about old growth. On September 11, 2020, the Province released the panel's report, *A New Future for Old Forests*, and announced it was embarking on a new, holistic approach to protecting old growth forests. The Old Growth Strategic Review includes an important recommendation related to the implementation of temporary deferrals to protect areas of old growth at immediate risk of irreversible biodiversity loss (recommendation #6). On June 24, 2021, the Province announced it had brought together an independent Old Growth Technical Advisory Panel (TAP) to ensure the best science and data available were used to identify at-risk old growth ecosystems and prioritize areas for temporary deferral. The panel provided recommendations on priority areas for implementation of deferrals, consistent with recommendation #6 from the Old Growth Strategic Review. On February 15, 2023, the Province announced it is launching new measures to protect more old growth by fast tracking innovation and co-developing new local plans with First Nations to better care for BC's forests.

As engagement and the old growth strategic action plan are developed, sensitivity analyses, designed to reflect the current state of the ongoing work, will be completed and presented for the chief forester's consideration at the AAC determination meeting.

The KBHLPO has legal requirements for old and mature forests that must be retained on the landscape. These targets are expressed as the amount of area (percent of AFLB) that must retain old- and mature-seral stage characteristics within the AFLB for each BEC variant for specific landscape units.

In the base case, KBHLPO targets were evaluated using BEC version 3, and the non-legal OGMAs were excluded from the THLB. The model evaluated if the KBHLPO targets were met using stand age, and where those targets were not met, additional area was reserved from harvest to meet those targets.

Three sensitivity analyses explored the effect on the timber supply of using different datasets and assumptions when modelling the KBHLPO old growth and mature seral targets in the base case.

Old growth management non-spatial

In the Kootenay Lake TSA, draft OGMAs were established to meet the old- and mature-targets but were not legalized. Forest licensees have incorporated commitments to manage the non-legal draft OGMAs in their respective Forest Stewardship Plans (FSPs). The FSPs also specify allowances to harvest within the draft OGMAs and the associated process to replace harvested areas when incursions are necessary.

In this sensitivity analysis the non-legal draft OGMAs were not excluded from the THLB. A management objective was set in the timber supply model that maintained the KBHLPO targets by dynamically reserving older and mature stands from harvest.

When the timber supply model was used to account for the KBHLPO mature- and old-seral targets, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 80 years before stepping down to the long-term harvest level of 616 000 cubic metres per year. This harvest flow represents no change in the short term and a 5.7 percent increase in the long term, compared to the base case.

In the base case, the non-legal draft OGMAs were excluded from the THLB and the management objective maintaining the KBHLPO targets was also implemented to ensure the targets were met where the OGMAs did not reserve sufficient old- and mature-stands to meet those targets. Therefore, this sensitivity analysis differs from the base case only in that it does not exclude the OGMAs from the THLB. The resulting increased timber supply can be attributed to providing the model with additional flexibility to dynamically reserve or harvest old- and mature-stands within the draft OGMAs or outside them as needed, as well as the additional area available to harvest within the OGMAs that do not contribute to meeting the KBHLPO old- and mature-targets. Together, this allows for increased timber supply in the long term.

Mature and old higher level plan seral targets using BEC V12

In the base case, KBHLPO targets were evaluated using BEC version 3, the version in place when the KBHLPO targets were established, and the version currently used to manage mature and old growth targets as specified in the legal order.

A sensitivity analysis was completed to evaluate the effect on timber supply of using BEC version 12, the most current version of BEC available, to evaluate KBHLPO mature- and old-seral targets, while leaving all other parameters the same, including using the non-legal OGMAs.

When BEC version 12 was used a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to the long-term harvest level of 583 000 cubic metres per year. This harvest flow represents a two percent decrease in the short term and a 0.5 percent decrease in the long term, compared to the base case.

BEC version 12 results in more area in the THLB being reserved to meet old and mature KBHLPO targets, and this occurs in the short term to ensure the needed age class distribution is achieved further out in the time horizon.

<u>Old growth management full old-seral targets</u>

In the KBHLPO, as a measure to address impacts to timber supply, old-seral target percentages in low Biodiversity Emphasis Option (BEO) areas are reduced to one-third of the full target percentage (referred to as "drawdown by two-thirds"). In Kootenay Lake TSA, there are 84 462 hectares of THLB in low BEO areas. The low BEO target comes with the requirement that, in accordance with the *Landscape Unit Planning Guide* (1999), the full targets are to be met by the end of the third rotation. Within that guide, a rotation is defined as equaling 80 years, and therefore the end of the third rotation is 240 years from the release of the guide.

A sensitivity analysis was completed to evaluate the effect on timber supply of implementing the full old-seral targets in all areas, including low BEO areas. No other parameters were changed. and this sensitivity analysis, like the base case, excluded the draft OGMAs from the THLB.

When full old-seral targets were implemented, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 15 years before stepping down to the long-term harvest level of 584 000 cubic metres per year. This harvest flow represents a 6.0 percent decrease in the short term and a 0.3 percent decrease in the long term, compared to the base case.

Immediately implementing the full old-seral targets limits timber supply in the short term. The allowance to use reduced targets in low BEO areas comes with a condition that a timber supply analysis, carried out in association with the TSR process, must demonstrate that conserving more than one-third of the target will cause timber supply impacts. The results of this sensitivity analysis demonstrate that the reduced targets were appropriately applied in the base case.

Hydrological recovery in community watersheds

In the *Data Package*, the management objective for community watersheds described the modelling of snow accumulation and melt hydrological recovery as follows: a maximum of 30 percent of the watershed will be less than six metres in height at any one time during the projection period. This objective was based on hydrological recovery estimates from the *1995 Interior Watershed Assessment Procedure*. Since the release of the *Data Package*, the approach to modelling snow recovery processes in this timber supply analysis has been updated, more closely following those found in more recent sources of information (see snow recovery estimates reported in *Extension Note 116)*.[2]

In the base case, the hydrological recovery of a stand is modelled to progress incrementally over time from completely disturbed to fully recovered. The recovery progress tracks along a curve that indicates that a stand has achieved 70 percent recovery when it reaches a height of 17.4 metres. The management objective described above restricts harvesting within community watersheds that fall below a minimum threshold of 70 percent hydrologically functional. This objective is assessed by summing the hydrological recovery progress of all stands within each community watershed.

[2]Winkler R. and S. Boon. 2015. Revised snow recovery estimates for pine-dominated forests in interior British Columbia. Prov. B.C., Victoria, B.C. Exten. Note 116. https://www.for.gov.bc.ca/hfd/pubs/Docs/En/EN116.pdf

Two sensitivity analyses explored the effect on timber supply of changing the minimum hydrological recovery threshold of 70 percent applied to each community watershed used in the model. The first scenario used a threshold percentage of 75, the second used a threshold percentage of 80.

When a hydrological recovery percentage of 75 was used, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 50 years before stepping down to the long-term harvest level of 586 000 cubic metres per year. This harvest flow represents no change in the short term, and a 0.2 percent increase in the long term, compared to the base case.

When a hydrological recovery percentage of 80 was used, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to the long-term harvest level of 587 000 cubic metres per year. This harvest flow represents a 1.9 percent decrease in the short term and a 0.2 percent increase in the long term, compared to the base case.

The impact on timber supply for both a hydrological recovery of 75 percent and 80 percent can be better understood in terms of the duration of the short-term higher harvest flow rather than the impact on the long-term timber supply. Increasing the hydrological recovery percentage reduces the duration the higher harvest flow in the short term can be maintained. The higher short-term duration for a 75 percent hydrological recovery, compared to the 70 percent used in the base case, is likely due to a small shift in harvesting pattern in the simulation model, rather than a higher timber supply.

Climate change

Climate change represents a key area of uncertainty. There is substantial scientific agreement that climate is changing and that the changes will affect forest ecosystems. Forest management practices will need to be adapted to the changes and can contribute to climate change mitigation by promoting carbon uptake and storage. Nevertheless, the potential rate, amount, and specific characteristics of climate change in different parts of the province are uncertain. This uncertainty means that it is not possible to confidently predict the specific, quantitative impacts on timber supply.

Climate change is predicted to impact forest ecosystems due to increases in temperatures, change in precipitation patterns, and an increase in the frequency and severity of natural disturbances including wildfires, floods, landslides, and occurrences of insects and disease. Change to precipitation, temperature and natural disturbance will lead to impacts to hydrology, shifting ecosystems and climate envelopes, biodiversity, tree species distribution and productivity. This will result in ecosystems undergoing both predictable and unpredictable ecological shifts.

Even with better information on climate change, in many cases there will be a range of reasonable management responses. For example, it is not clear if either increases or decreases to current harvest levels would be appropriate in addressing potential future increases in natural disturbance due to climate change, which appear to be likely in some areas. Hypothetically, focused harvests in at risk forests could forestall losses of timber and allow for planting of stands better adapted to future conditions. Conversely, lower harvest levels could provide buffers against uncertainty. The appropriate mix of timber supply management approaches is ultimately a social decision.

In general, the requirement for regular AAC reviews will allow for the incorporation of new information on climate change, on its effects on forests and timber supply, and on social decisions about appropriate responses as it emerges.

In an attempt to quantify, to some degree, the impact of climate change on timber supply, a sensitivity analysis was proposed in the data package that increased the non-recoverable losses (NRLs) of timber volumes destroyed or damaged on the THLB by natural causes such as fire, wind, and disease and that are not recovered through salvage operations.

Since the release of the *Data Package*, and in response to feedback, an alternative sensitivity analysis was designed. To explore the potential impacts of climate change on timber supply, natural stands in the driest BEC units, and the south and southwest facing second driest BEC units, were removed from the THLB once harvested. The driest BEC unit in the Kootenay Lake TSA is the ICHxw, and the second driest BEC unit is the ICHdw1.

In this scenario, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 35 years before stepping down to 617 000 cubic metres per year for 10 years, then next stepping down to 556 000 cubic metres per year for five years, then next stepping down to 501 000 cubic metres per year for 10 years, before finally stepping down to the long-term harvest level of 452 000 cubic metres per year. This harvest flow represents a 0.8 percent decrease in the short term and a 24.7 percent decrease in the long term, compared to the base case.

The total area of dry sites within Kootenay Lake TSA is 26 166 hectares, of which 11 323 hectares are THLB. Of those, 8114 hectares are natural stands within the THLB. This scenario assumes that over the time horizon, 72 percent of the dry sites will stop contributing to the harvest supply, while the remainder will continue to contribute.

Domestic watersheds

Domestic watersheds were modelled in a sensitivity analysis based on maintaining a 70 percent hydrological recovery threshold for each domestic watershed, the same approach taken for community watersheds.

When a hydrological recovery percentage of 70 was used for domestic watersheds, a stable harvest flow starting at 640 000 cubic metres per year could be maintained for 10 years before stepping down to the long-term harvest level of 587 000 cubic metres per year. This harvest flow represents a 6.7 percent decrease in the short term and a 0.2 percent increase in the long term, compared to the base case.

There are 48 609 hectares of THLB within domestic watersheds in Kootenay Lake TSA, which is 29.8 percent of the THLB. In the 10 years of harvest between 2010 and 2019, a smaller percentage of harvest, 25.5 percent, was within domestic watersheds. Of the projected harvest in the base case, for the first 10 years, 37.7 percent was in domestic watersheds. The timber supply impact from maintaining a hydrological recovery of 70 percent reflects not only the constraint on harvesting within domestic watersheds, but also that the base case relies on that harvest disproportionately to its representation in the THLB.

Wildfire urban interface

Wildfire urban interface (WUI) are areas where combustible forest fuel is found within a buffer adjacent to homes, farm structures or other outbuildings. In Kootenay Lake TSA, these areas have been mapped and work has begun developing operational fuel treatments, primarily oriented to reduce fuel loads in these areas. However, there are insufficient data to establish a clear impact to the timber supply resulting from these treatments and a high degree of uncertainty given that impacts to timber supply will differ depending on the treatment type and frequency. Prescriptions could result in a permanent or temporary reduction in stand densities and volumes. Many of these treatments are expensive to implement and require secured funding before they take place. Therefore, it is difficult to predict how many projects will be implemented in the short- or long-term. Stocking standards have been approved for reforesting areas within the WUI and mainly consists of planting seedlings at lower densities and with more fire-resistant tree species. These standards have not been used to date and are not part of the base case. When used, the silviculture data will be available in the next timber supply review and incorporated into that analysis.

There are 26 895 hectares of THLB within the WUIs in Kootenay Lake TSA, 16 percent of the total THLB. Of that 25 031 hectares, or 93 percent, are within risk class 1, the highest risk class.

Armillaria root disease

The timber supply review will include sensitivity analyses investigating armillaria root disease that have not been completed at the time of publication. The analyses will provide projections of timber supply that could be sustained under three varying levels of Armillaria infection severity. The results of these analyses will be presented to the chief forester at the AAC determination meeting.

Additional information

In addition to the analyses presented above, the chief forester will be presented with information at the AAC determination meeting that will focus on non-timber forest values within the TSA.

Resource values assessment - wildlife habitat supply

The potential implications of the chief forester's decision on First Nations rights and interests (e.g., hunting, trapping) will be explored through additional analyses on two species, grizzly bear and goshawk.

An analysis will be conducted that incorporates Ktunaxa forestry stewardship principles (articulated in the *Ktunaxa Forestry Standards Document*; Ktunaxa Nation Council 2023), and key cultural conservation values. Ktunaxa Nation Council representatives shared these principles and values during discussions with FOR staff and the analysis was completed to meet them, given the limitations of the data and model. The *Ktunaxa Forestry Standards Document* continues to be refined and updated as part of an adaptive management approach. The values articulated in that document must be understood to be general, and work remains to identify and map them based on site-specific validation. The results of this analysis, which includes Ktunaxa data, will be provided to the chief forester in the AAC determination meeting.

Caribou

Herds of caribou have roamed across the lands now known as BC for thousands of years contributing to the province's rich biodiversity and ecosystems. They depend on large, undisturbed areas for food resources, reproductive success, and protection from predators and the weather. The Provincial Caribou Recovery Program[3] develops, implements, and monitors management actions and provincial strategies to ensure the BC government is meeting or exceeding provincial and federal population and habitat objectives. A summary of the current state of caribou in Kootenay Lake TSA is attached to this document as Appendix A.

The provincial Caribou Recovery Program intends to release guidance for forest operations occurring in Caribou Core and Matrix habitat. If this guidance is released before the determination meeting for the Kootenay Lake TSA, an analysis will be conducted based on that guidance, and the results will be presented to the chief forester at the AAC determination meeting.

Carbon modelling

Forest carbon is of emerging importance in forest management in BC. The implementation of projects under the Forest Carbon Initiative should directly consider the impacts of management practices on forest carbon. The timber supply review process includes a carbon modelling analysis and the results of that analysis will be reported out to the chief forester at the AAC determination meeting. More information on the carbon modelling can be found in the *Data Package*.

[3] Provincial Caribou Recovery Program - Province of British Columbia (gov.bc.ca) https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/caribou/recovery-program

Conclusion

The base case projects an initial harvest level of 640 000 cubic metres per year that can be maintained for 45 years. The harvest flow then steps down to 586 000 cubic metres per year for the long term. Three alternative harvest projections explored the implications of an even-flow harvest level, an increased initial harvest level, and a lowered initial harvest level.

The THLB is 16 percent smaller than the THLB in the previous TSR. However, this smaller land base is projected to support a higher timber supply. This increased timber supply reflects the updated managed stand yield tables used in this analysis, and those tables reflect updated site index values. The current analysis used the PSPL site index values, and further analysis found that to be conservative when compared with results from the young stand monitoring program.

Of the 23 sensitivities completed 11 showed a short-term timber supply impact of less than one percent. Another six showed a short-term timber supply impact of less than four percent. Decreasing the size of the THLB and decreasing the yield projections in the natural stand yield tables both had an expected proportional impact to timber supply. Implementing full targets in low biodiversity emphasis areas reduced the timber supply in the short term, required to ensure an adequate age class distribution later in the time horizon.

The remaining three sensitivity analyses, one for domestic watersheds, and two for terrain stability mapping, are better understood by looking at the proportion of these areas in the base case, THLB, and historic harvest. In all three sensitivity analyses there is a disproportionate amount of projected harvest in the base case compared to the proportion of those same areas in the THLB and historic harvest. This disproportionate contribution increased the timber supply impact of these three sensitivity analyses.

Although the above timber supply analysis is a significant source of information provided to the chief forester for consideration, the chief forester's AAC is not a calculation solely based on this strategic-level analysis. The AAC determination of the chief forester is an independent judgment based on professional experience and consideration of the broad range of social, economic, and environmental factors required under Section 8 of the *Forest Act* in addition to the timber supply analysis.

Your input is needed

Public input is a vital part of establishing the allowable annual cut. Feedback is welcomed on any aspect of this *Discussion Paper*, the *Data Package* or any other issue related to the timber supply review and the allowable annual cut determination for the Kootenay Lake TSA.

Ministry staff would be pleased to answer questions to help you prepare your response. Please send your comments to the Stewardship Officer at the address below.

Your comments will be accepted until July 4, 2023.

You may identify yourself on the response if you wish. If you do, you are reminded that responses will be subject to the *Freedom of Information and Protection of Privacy Act* and may be made public. If the responses are made public, personal identifiers will be removed before the responses are released.

For more information or to send your comments, contact:

Selkirk Natural Resource District
Ministry of Forests
1907 Ridgewood Road,
Nelson, BC V1L 6K1
Telephone: (250) 825-1100

If you have any comments or questions, contact:

Ian Wiles, Stewardship Officer
Selkirk Natural Resource District
Ministry of Forests
Electronic mail: Ian.Wiles@gov.bc.ca

For information on the Timber Supply Review visit the Timber Supply Review & Allowable Annual Cut web site at https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

Further information regarding the technical details of the timber supply analysis is available on request by contacting Forests.ForestAnalysisBranchOffice@gov.bc.ca

Caribou

The provincial Caribou Recovery Program intends to release guidance for forest operations occurring in Caribou Core and Matrix habitat. While that work is ongoing, a summary of the state of caribou in Kootenay Lake TSA is provided below.

Woodland caribou are a species of great ecological importance and have significant cultural and ecological value for people that call BC home. Once abundant, many caribou herds have declined steeply over the past several decades. The overall population in BC has gone from approximately 40 000 animals to 15 500 currently. Caribou recovery is a key priority of the Government of BC, and a wide range of recovery actions have been implemented in caribou ranges.

Caribou are adapted to live in mature coniferous forests, mountainous terrain, peatlands, and areas with deep persistent snowpack. However, habitat disturbance has severely altered the condition of the landscape in caribou ranges.

When forests are harvested the regrowth is initially dominated by leafy shrubs, herbs, and grasses. This surplus of food leads to more moose, elk, and deer, all of which are the primary prey for wolves. In addition, industrial roads and other linear features facilitate the efficient movement of predators such as wolves into caribou habitat. These result in greater abundance and distribution of wolves within and near caribou habitat, and reduced separation between wolves and caribou. Ultimately this leads to more caribou being predated on by wolves.

Scientific evidence indicates that habitat change resulting from the extraction of natural resources is the main factor leading to unsustainable predation rates on caribou, and the leading proximate cause of woodland caribou declines.

Caribou are a significant wildlife species for Indigenous peoples throughout BC. Caribou have been an important source of food and culture to Indigenous peoples since time immemorial, Indigenous peoples have utilized caribou for food, clothing, and jewelry, and historically Indigenous peoples would follow caribou on their yearly rounds. Currently, Indigenous peoples are unable to meaningfully practice their Constitutional Aboriginal Right to hunt caribou in most parts of BC.

Table 5 summarizes the amount of overlap between caribou herds and Kootenay Lake TSA boundary.

Table 5. Amount of overlap between caribou herd and Kootenay Lake TSA boundary

Caribou herd	Hectares	Percent of TSA	Percent of herd boundary
Central Selkirks	321,255	25.9	38.8
Purcell Central	128,267	10.3	20.9
Purcell South	226,657	18.3	54.2
South Selkirks	217,663	17.5	69.2

Table 6 summarizes the amount of overlap between caribou habitat types and Kootenay Lake TSA boundary.

Table 6. Amount of overlap between caribou habitat types and Kootenay Lake TSA boundary

Caribou herd	Habitat code	Hectares	Percent of TSA	Percent of herd habitat type
Central Selkirks	Core	164,400	13.2	41.8
	Matrix	155,637	12.5	36.1
Purcell Central	Core	49,440	4.0	21.4
	Matrix	78,827	6.4	20.5
Purcell South	Core	102,436	8.3	50.4
	Matrix	123,013	9.9	57.7
South Selkirks	Core	132,718	10.7	82.7
	Matrix	84,628	6.8	55.1

Table 7 summarizes the amount of overlap between caribou GAR orders and Kootenay Lake TSA boundary.

Table 7. Amount of overlap between caribou GAR orders and Kootenay Lake TSA boundary

Caribou herd	Harvest code	Hectares	Percent of TSA	Percent of herd boundary
Central Selkirks	CONDITIONAL HARVEST ZONE	20,090	1.6	2.4
	NO HARVEST ZONE	82,595	6.7	10.0
Purcell Central	NO HARVEST ZONE	2,570	0.2	0.4
Purcell South	CONDITIONAL HARVEST ZONE	513	0.0	0.1
	NO HARVEST ZONE	67,265	5.4	16.1
South Selkirks	CONDITIONAL HARVEST ZONE	282	0.0	0.1
	NO HARVEST ZONE	42,572	3.4	13.5

Caribou GAR orders were implemented in this analysis, as described in the *Data Package* with the THLB implications of the no harvest zones shown in Table 9 above, and conditional harvesting areas modelled in the base case. The chief forester will be presented with the latest information from the BC Caribou Recovery program at the AAC determination meeting, and results from additional caribou sensitivity analyses.