Tree Farm Licence 49 – Management Plan #6

INFORMATION PACKAGE

Version 1.0

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Project 30-122

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List of Acronyms

AAC	Allowable Annual Cut
AOS	Aerial Overview Survey
AU	Analysis Unit
BEC	Biogeoclimatic Ecosystem Classification
BG	Bunch Grass
ECA	Equivalent Clearcut Area
ERR	Enhanced Riparian Reserve
ESSF	Engelmann Spruce Sub-alpine Fir
FAIB	Forest Analysis and Inventory Branch
FPPR	Forest Planning and Practices Regulation
FRPA	Forest and Range Practices Act
FSP	Forest Stewardship Plan
FWA	Fresh Water Atlas
GAR	Government Actions Regulation
GIS	Geographic Information System
ICH	Interior Cedar Hemlock
IDF	Interior Douglas-Fir
ITI	Individual Tree Inventory
LU	Landscape Unit
MAI	Mean Annual Increment
MS	Montane Spruce
NDT	Natural Disturbance Type
NRL	Non-Recoverable Losses
NSR	Not Satisfactorily Restocked
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
ONA	Okanagan Nation Alliance
OSLRMP	Okanagan Shuswap Land and Resource Management Plan
P2P	Plan to Perspective
PFLB	Productive Forest Land Base
PP	Ponderosa Pine
SIC	Snow Interception Cover
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation of Stand Yields
TSR	Timber Supply Review
UNB	Upper Nicola Band
VDYP	Variable Density Yield Projection
VEG	Visually Effective Greenup
VQO	Visual Quality Objective
VLI	Visual Landscape Inventory
VRI	Vegetation Resource Inventory
WFN	Westbank First Nation
WHA	Wildlife Habitat Area
WTP	Wildlife Tree Patch
WTR	Wildlife Tree Retention

Document Revision History

Version	Date	Description
1.0	November 2022	Initial Information Package

1 Introduction

This Information Package has been prepared by Forsite Consultants Ltd. on behalf of Tolko Industries Ltd., Southern Interior Woodlands (Tolko). The Information Package describes the information and assumptions used to prepare the timber supply analysis that will become part of Management Plan #6 for Tree Farm Licence 49 (TFL 49).

A review of this type is normally completed at least once every ten years to capture changes in data, practices, policy or legislation influencing forest management in the TFL. The previous analysis for TFL 49 was completed in 2011 with an Annual Allowable Cut (AAC) determination on February 24, 2012.

The timber supply analysis will model timber harvest over a 300 year planning horizon. It will use a new LiDAR based forest inventory, Tolko's current understanding of the land base where harvesting is likely to occur, and projected growth rates as the forest ages. The modelling will also consider non-timber objectives for the TFL, including wildlife, biodiversity, visual quality, and requirements of the Okanagan Shuswap Land and Resource Management Plan (OSLRMP). The Forest and Range Practices Act (FRPA) Base Case scenario will represent current management practices, legal requirements, and any additional requirements in Tolko's environmental certification program that influence timber supply.

Tolko has been working collaboratively with the Okanagan Nation Alliance to develop an understanding and framework for future forest management on the TFL. This timber supply analysis will include an additional Syilx Forest Management scenario that incorporates the elements of this framework.

In addition to the FRPA Base Case and Syilx Forest Management scenarios, sensitivity analyses will be undertaken to understand the implications to timber supply for changes to factors where there is uncertainty, such as growth and yield estimates.

Once completed the timber supply analysis will provide information to assist the Chief Forester of BC in determining the Allowable Annual Cut (AAC) for TFL 49 which is expected to be in place by September 30th, 2023.

1.1 TFL 49 LOCATION

TFL49 is within the Okanagan Shuswap Forest District and is approximately 114,426 hectares in size, of which 109,741 hectares is crown land and 685 hectares is Schedule A private land owned by Tolko and managed as part of the TFL. TFL 49 includes three distinct geographic units. The south block (Block A) is located northwest of the City of Kelowna to the west of Okanagan Lake. The west block (Block B) is located south of Monte Lake, and the north block (Block C) is situated north of the community of Falkland (Figure 1).

The forests are predominately Douglas-fir and ponderosa pine at lower elevations, Douglas-fir and lodgepole pine at mid elevations, and spruce/subalpine fir types at the higher elevations. Biogeoclimatic zones include the Ponderosa Pine, Interior Douglas-fir, Interior Cedar Hemlock, Montane Spruce, and Engelmann Spruce Subalpine Fir zones.

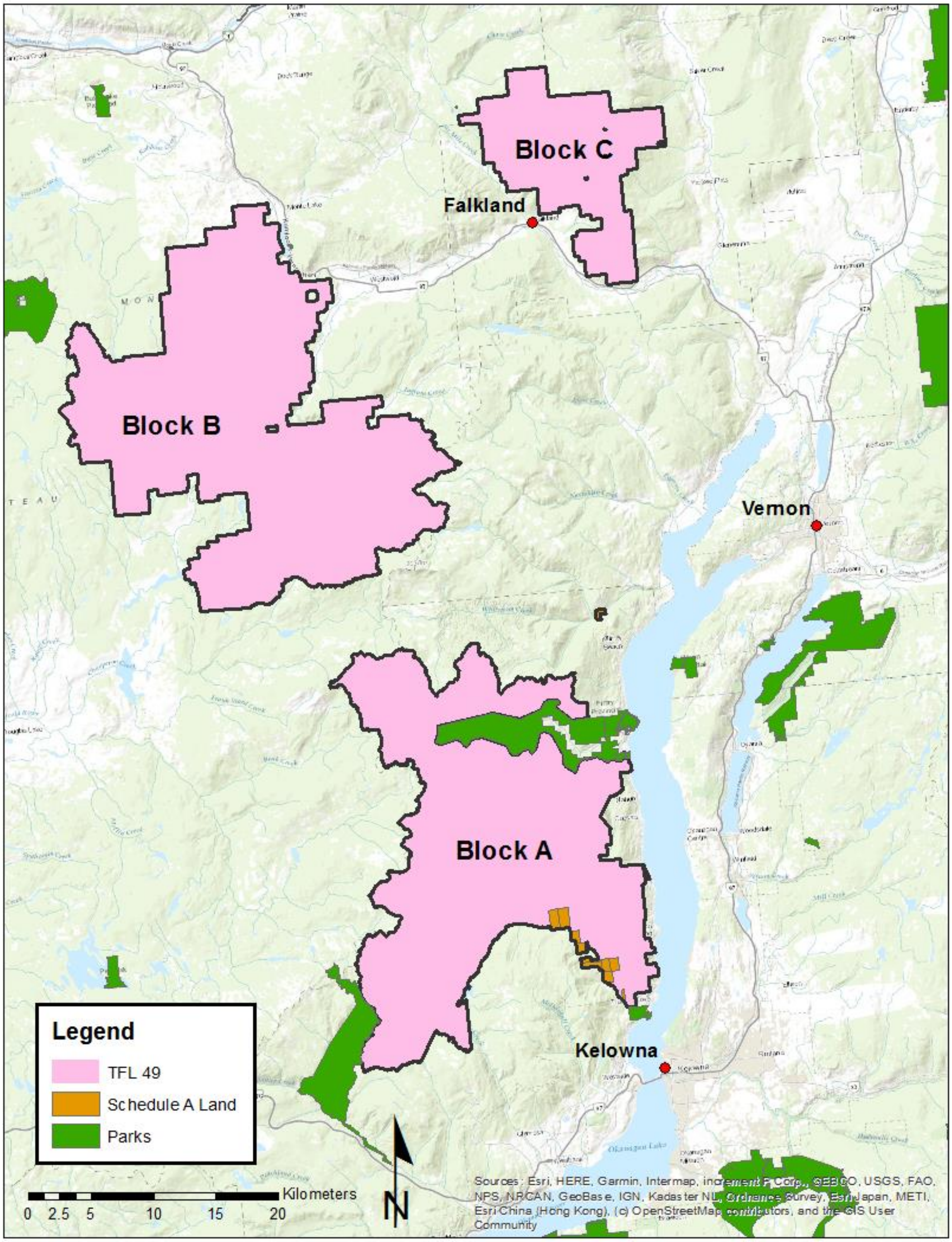

Figure 1 TFL 49 overview map

1.2 FIRST NATIONS TERRITORIES AND AREAS OF INTEREST

The Consultive Area Database indicates that there are three Nations, 27 First Nations, four Tribal Councils, and one Referral Agency with territories and areas of interest that overlap TFL 49, including:

- Nlaka'pamux Nation
    - Nooaitch Indian Band
    - Esh-kn-am Cultural Resource Management
    - Skuppah Indian Band
    - Lower Nicola Indian Band
    - Siska First Nation
    - Scw'exmx Tribal Council
    - Shackan Indian Band
    - Cook's Ferry Indian Band
    - Nicomen Band
    - Oregon Jack Creek Indian Band
    - Coldwater Indian Band
    - Boothroyd Indian Band
    - Nlaka'pamux Nation Tribal Council
    - Spuzzum First Nation
    - Lytton First Nation
- Secwepemc Nation
    - Ashcroft Indian Band
    - Splats'in First Nation
    - Adams Lake Indian Band
    - Skeetchestn Indian Band
    - Skw'lax te Secwepemc
    - Tk'emlups Band
    - Shuswap Band
    - Simpcw First Nation
    - Neskonlith Indian Band
    - Stk'emlupsemc te Secwepemc Nation
- Syilx Nation
    - Penticton Indian Band
    - Okanagan Nation Alliance
    - Lower Similkameen Indian Band
    - Upper Nicola Band
    - Okanagan Indian Band
    - Westbank First Nation

2 Process

This information package has been prepared to meet the requirements outlined in the draft "*Provincial Guide for preparation of Information Packages and Analysis Reports for Area-based Tenures, June 2021*" document. Current forest and non-forest inventories, legal requirements, and non-legal management direction were used to categorize the land base and outline proposed modelling parameters that will be used to complete a FRPA Base Case scenario and additional sensitivity analyses.

2.1 MISSING DATA

There is no missing data for this version of the data package.

3 Response to 2012 AAC Determination Implementation Requests

The Chief Forester did not provide any specific implementation requests in the 2012 AAC determination. However, he did recognize that there was uncertainty in two factors that affect timber supply and encouraged the development of improved information for two other factors. These factors and responses to how they have been addressed in the current analysis are outlined below.

3.1 INTERIOR LOG GRADES

Description of Uncertainty: The new interior log grade system results in logs being charged to the AAC if they meet grade specifications regardless of whether they were alive or dead at the time of harvest. This volume was not included in the base case harvest forecast. I have concluded that the harvest levels projected for the short- and mid-term in the base case have been underestimated by approximately six percent due to this factor.

Response: For this analysis, no additional work has been completed to determine the volume from dead potential trees. VDYP 7 has been used to create volume estimates for existing natural stands based on the current attributes for live trees.

3.2 GENETIC GAIN

Description of Uncertainty: The values applied for genetic gain were not reduced to account for planting stock availability. I have concluded that this resulted in a small overestimate of timber supply around the time of the transition from the mid- to long-term harvest levels.

Response: Silviculture records have been used to estimate genetic gains by silviculture era for existing managed stands in the current analysis. Genetic gains for future managed stands are based on recent silviculture practice in the TFL and consider current seed transfer guidelines and availability (see Section 10.6.4).

3.1 INVENTORY

Description: The vegetation resources inventory (VRI) for TFL 49 was one of the first VRI projects completed in B.C. For this determination I find that the best available information was used for the base case. I encourage the licensee to follow through on its intention to conduct a new Phase I inventory for TFL 49, especially in view of the effects the mountain pine beetle epidemic likely has had on the forest cover of the TFL.

Response: Tolko initiated a new LiDAR based inventory for TFL 49 in October 2019. This inventory was completed in March 2022 and has been used as the basis for the current analysis (see Section 7).

3.2 OPERATIONAL ADJUSTMENT FACTORS

Description: A non-standard OAF 1 of 10 percent was applied, justified on the basis that the TFL 49 VRI was mapped to a finer resolution, with non-productive stands mapped to a minimum of 0.5 hectares or less compared to a typical minimum of two hectares in other inventories. This rationale was previously accepted to be reasonable but it is not an approach that is widely used in other management units with inventories mapped to the same VRI standards. For this determination I consider the OAF 1 to be adequate, however I encourage the licensee to consider developing a monitoring strategy that will, over time, confirm the yields that can be expected from managed stands on TFL 49.

Response: The new LIDAR based inventory retains the finer resolution of non-productive stands that was used in the older VRI, and Tolko believes that an appropriate OAF1 is likely less than the standard 15% normally used in timber supply analyses. The LiDAR individual tree inventory may provide an opportunity to provide a more reliable estimate for OAF1 but this has not been explored yet. Therefore, this analysis will use the standard OAF1 of 15 percent for the Base Case, and a sensitivity analysis will be completed using an OAF1 of 10 percent.

4 Timber Supply Forecast / Options / Sensitivity Analyses

Tolko and the Okanagan Nation Alliance have engaged in a collaborative process during preparation of this Information Package, with the goal to incorporate Syilx forest management principles into the timber supply analysis and management plan. As a result, two different scenarios will be modelled, including a FRPA Base Case scenario, and a Syilx Forest Management scenario.

4.1 FRPA BASE CASE SCENARIO

The FRPA Base Case scenario is meant to be representative of current management practice on TFL 49. Changes from the analysis completed in 2011 for Management Plan 5 include:

- New LiDAR based inventory will be used.
- A significant area was affected by the catastrophic White Rock Lake wildfire in 2021.
- Approximately 31,500 hectares in the Browns Creek area has been removed from the TFL.
- Updated versions of VDYP and TIPSY will be used for yield table development.
- The provincial site productivity layer and LiDAR derived site indices will be used for managed stand site indices.

4.2 SYILX FOREST MANAGEMENT SCENARIO

The Syilx Forest Management scenario developed collaboratively with ONA envisions different forest management direction for the TFL than that modelled in the FRPA Base Case scenario. The key differences include:

- Alternate approach to old growth management using zonation to identify areas where the primary objective is to manage for old growth attributes.
- Increased riparian retention.
- Increased in-block retention.
- Increased protection for all watersheds.
- Recognition that implementing the above objectives will likely meet the requirements for other non-timber values such as visual quality and wildlife.

A full description of this scenario is provided in Section 13.

4.3 SENSITIVITY ANALYSES

Sensitivity analyses provide a measure of the reasonable upper and lower bounds of the harvest forecast, reflecting the uncertainty of assumptions made in the Base Case. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that given variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most influence results. To allow meaningful comparison of sensitivity analyses, they are usually performed using the Base Case and varying only the assumption being tested. An overview of the sensitivity analyses that will be carried out are provided in Table 1, with further details found in Section 14 and Section 15.

Table 1 Sensitivity analyses

Category	Scenario	Sensitivity
Land Base Definition	FRPA	THLB Area +/- 10%
Growth and Yield	FRPA	Natural Stand Yields +/- 10%
		Managed Stand Yields +/- 10%
		Minimum Harvest Ages +/- 10 years
		Reduce OAF1 to 10%
	Syilx	Increase minimum harvest ages for managed stands to be at least 20 years older than when maximum mean annual increment is achieved.
		No use of Class A seed for future managed stands
Integrated Resource Management	FRPA	Increase natural disturbance in the non-THLB
		Old growth deferral areas – prevent harvest throughout the planning horizon
	Syilx	Implement FRPA non-timber value objectives
		Reduce maximum ECA to 30% for all watersheds
Timber Harvesting		Turn off cutblock aggregation (no minimum cutblock size)

4.4 ALTERNATIVE HARVEST FLOWS

Non-timber objectives and the growth capacity of the THLB will determine the harvest flow options that will be considered. In general, the choice of harvest flow for the each scenario will strive to balance current and future harvest rates using the following objectives:

- Avoid any large or abrupt disruptions in timber supply during transitions from short to mid to long-term periods (generally increases and decreases in steps of 10% per 10 year period)
- Achieve a stable long-term harvest level over a 300 year planning horizon.
- Ensure that the growing stock on the THLB does not decline during the last 100 years of the planning horizon.

Options for alternative harvest flows will become more evident after the initial timber supply model is built and the timber supply dynamics for the TFL 49 land base become evident. Examples of potential options include maintaining the current allowable annual cut for as long as possible or minimizing the length of a mid-term harvest reduction if one exists. Tolko will explore and include alternative harvest flow options in the analysis report and present the recommended option as the Base Case.

4.5 OTHER OPTIONS

There are no additional scenarios other than the FRPA Base Case scenario, Syilix Forest Management scenario,and associated sensitivity analyses identified at this time

5 Model

The PATCHWORKS ™ modeling software will be used for forecasting and analysis. This suite of tools is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (www.spatial.ca).

PATCHWORKS is a fully spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It utilizes a practical goal seeking approach to simulate forest growth and schedule activities such as harvesting and silviculture across the land base to find a solution that best balances the targets/goals defined by the user. Realistic spatial harvest allocations can be optimized over long-term planning horizons because PATCHWORKS integrates operational-scale decision making within a strategic analysis environment.

The PATCHWORKS model continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal seeking algorithm works to minimize these penalties, resulting in a solution that reflects the user objectives and priorities.

Targets can be applied to any aspect of the problem formulation. For example, the solution can be influenced by issues such as desired mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, and visual quality objectives. For this analysis, PATCHWORKS will be configured to consider the range of non-timber values that exist on TFL 49 while evaluating possible harvest flows.

6 Data Sources

Table 2 lists the spatial data and sources used for this analysis. In general, data was either downloaded directly from the Land and Resource Data Warehouse maintained by the provincial government, sourced from datasets maintained in Tolko's Forest Management System, or downloaded from other government websites.

Table 2 Spatial data sources

Description	Source File Name	Source	Year
TFL Boundary	TFL49_boundary	Tolko	2019
Schedule A Land	ADMIN_BOUNDARIES_FADM_TFL_SCHED_A*	DataBC	2021
Private Land	FOREST_VEGETATION_F_OWN*	DataBC	2020
Tenured Roads	LRM/Roads/LRM_Tenure/LRM_Deactivation/	Tolko	2022
Non-Tenured Roads	GIS_Roads	Tolko	2022
Digital Road Atlas	BASEMAPPING_DRA_DGTL_ROAD_ATLAS_DPAR_SP	DataBC	2021
OSLRMP Legal Objectives	LAND_USE_PLANNING_RMP_PLAN_LEGAL_POLY_SVW	DataBC	2020
OSLRMP Non-legal poly objectives	LAND_USE_PLANNING_RMP_PLAN_NON_LEGAL_POLY_SVW	DataBC	2020
OSLRMP Non-legal linear features	LAND_USE_PLANNING_RMP_PLAN_NON_LEGAL_LINE_SVW	DataBC	2020
Parks and Protected Areas	TANTALIS_TA_PARK_ECORES_PA_SVW	DataBC	2020
Kelowna Dirt Bike Club	TANTALIS_CROWN_TENURES_POLY_SVW	DataBC	2022
Landscape Units	LAND_USE_PLANNING_RMP_LANDSCAPE_UNIT_SVW	DataBC	2020
Old Growth Management Areas	LAND_USE_PLANNING_RMP_OGMA_NON_LEGAL_CURRENT_SVW	DataBC	2020
Priority Old Growth Deferrals	FOREST_VEGETATION_OGSR_TAP_PRIOIRTY_DEF_AREA_SP	DataBC	2022
Recreation Polygon Features	FOREST_TENURE_FTEN_RECREATION_POLY_SVW	DataBC	2020
Recreation Linear Features	FOREST_TENURE_FTEN_RECREATION_LINES_SVW	DataBC	2020
Terrain Stability	TERRESTRIAL_ECOLOGY_STE_TER_STABILITY_POLYS_SVW	DataBC	2020
Terrain Stability – Block C	TFL_C_terrain_mapping	Tolko	2006
Visual Landscape Inventory	FOREST_VEGETATION_REC_VISUAL_LANDSCAPE_INVENTORY	DataBC	2020
Ungulate Winter Ranges	WILDLIFE_MANAGEMENT_WCP_UNGULATE_WINTER_RANGE_SP	DataBC	2020
Wildlife Habitat Areas	WILDLIFE_MANAGEMENT_WCP_WILDLIFE_HABITAT_AREA_POLY	DataBC	2020
BEC version 12	FOREST_VEGETATION_BEC_BIOGEOCLIMATIC_POLY	DataBC	2021
BEC version 6	Abec_bc_v6	BECweb	2006
Community Watersheds	WATER_MANAGEMENT_WLS_COMMUNITY_WS_PUB_SVW	DataBC	2021
Tolko Watershed Units	WRU_FINAL_SMALLEST_ABOVE	Forsite	2022
LiDAR based streams	Streams_dissolve_final_class	Forsite	2021
Enhanced Riparian Reserves	ERR	Tolko	2022
LiDAR Forest Inventory	TFL49_FC_Final_202203_14	Forsite	2022
Tolko Depletions 2020/2021	TFL_Harvested_Blocks	Tolko	2022
Tolko WTPs 2020/2021	TFL_Harvested_Blocks_Retention	Tolko	2022
Tolko Planned Blocks	Planned_blocks	Tolko	2022
BCTS Planned Salvage Blocks	Whiterock_Blocks_BCTS.shp and TFLBLK_BCTS_ADD.shp	BCTS	2022
Predictive Ecosystem Mapping	Dist_Pkg_PEM_Thompson_Okanagan.gdb	LRDW	2010
Provincial Site Productivity Layer	Sprod 22, Sprod18, Sprod11	FOR	2022
Burn Severity Mapping - 2021	Provincial_burn_severity_2021 (updated Nov 10, 20210)	FOR	2021
Historic Fires	PROT_HISTORICAL_FIRE_POLYS_SP	LRDW	2022
Pest overview surveys – polygons	FOREST_VEGETATION_PEST_INFESTATION_POLY	LRDW	2022
Pest overview surveys – points	FOREST_VEGETATION_PEST_INFESTATION_POINT	LRDW	2022
Retention Plans	Retention Plan	Tolko	2022

* *Edited to match TFL Licence document and rationalize with TFL Boundary*

7 Current Forest Cover Inventory

LiDAR data was collected in 2016/2017 and stereo imagery was flown in 2018 for TFL 49. This data was used by Forsite Consultants Ltd. to complete a new LiDAR based inventory in 2021 on behalf of Tolko and BC Timber Sales. In summary, the following approach was used:

- Field sampling was completed to obtain a representative sample of the mature timber harvesting land base. In total, 210 plots were collected on the THLB over 60 years of age, with 180 of the plots used for model development/training and 30 plots used for final inventory auditing.
- An individual tree inventory (ITI) was completed to identify and attribute stems greater than or equal to 5 metres tall, with the knowledge that trees under 10m tall have reduced accuracy. Output from this phase are GIS polygon and point features for each tree with attributes including species, height, crown area, diameter at breast height, volume (gross and merchantable), basal area, biomass, and estimated tree age.
- An area-based inventory (hexagon tiles) was also completed that aggregated the individual tree inventory data into 400 m^2 hexagon cells. The aggregated ITI metrics were used as predictor variables, along with a range of other area-based metrics to estimate the final attributes on each hex tile using regressions build from the ground plot data.
- A polygonal inventory was then created that consists of homogenous polygons with VRI-like inventory attributes suitable for strategic planning purposes including timber supply analysis. This inventory will be incorporated into the provincial dataset and has a flat database structure similar in format to what would be downloaded or sourced from the provincial data warehouse. This polygon inventory also incorporated RESULTS polygons and attributes provided by Forest Analysis and Inventory Branch in December 2020.

The process used to complete this inventory is fully documented in the November 2021 report "*TFL 49 Lidar Derived Individual Tree, Hexagon, and Polygonal Forest Inventories*."

While the ITI and hexagon inventories provide a great deal of detail that can be used operationally by Tolko, the polygonal inventory is more appropriate for timber supply analyses and will be used for this management plan.

There was a small (48.3 hectares) isolated area of Schedule A land that was excluded from the LiDAR inventory project. Polygons and attributes from the provincial VRI dataset were extracted and used for this area.

7.1 UPDATES FOR HARVESTING AND PLANNED BLOCKS

The date chosen for the start of the harvest forecasts is January 1, 2022. All harvested blocks and blocks planned for harvest prior to December 31st, 2021 were used to update the inventory for depletions not already included in the inventory, with ages assigned based on the year of the depletion.

The ages for all other polygons in the inventory were incremented from the reference year in the inventory as necessary to adjust them to January 1st, 2022.

7.2 UPDATES FOR FIRES

TFL 49 was severely impacted by the catastrophic White Rock Lake fire in 2021, with about 33,270 hectares of the TFL between Monte Lake and Okanagan Lake contained within the fire perimeter. Tolko has worked with First Nations to develop a fire retention plan and identify salvage opportunities for the area affected by the fire. Specific blocks that will be salvaged have been identified and will be harvested and regenerated within the first period of the planning horizon in this analysis. In addition, Tolko expects that an additional 250,000 m^3 of salvage from within the fire area will occur in the first five years of the planning horizon to address fir beetle that occurs in green stands.

As part of the post fire planning process, Tolko has also worked with hydrologists and other experts to identify the proportion of stands burnt by burn severity class (Table 3), and the expected natural regeneration delay by biogeoclimatic zone/burn severity rating for unharvested stands (Table 4).

The following approach was used to incorporate the White Rock Lake Fire into the inventory for use in this analysis:

- All polygons that are not identified for salvage were assigned either a burned or unburned attribute using an automated script to achieve the burn percentages indicated in Table 3.
- To ensure an even distribution across the land base, the burned/unburned assignment was achieved proportionately by burn severity rating and 20-year age class groupings. Where possible, resultant polygons within the same VRI polygon were assigned the same attribute to reduce fragmentation of burned/unburned areas. Assignments were completed prior to determination of the timber harvesting land base.
- Unburned stands will retain their VRI age and other attributes with no further adjustments made.
- Burned non-free growing stands will be treated as a regenerating stand with a two year regeneration delay based on the assumption that these represent stands that are eligible for funding under Section 108 of the *Forest and Range Practices Act.*
- Burned natural and free-growing managed stands will be treated as a natural regenerating stand with regeneration delay assigned by BEC subzone/burn severity rating as outlined in Table 4.
- In addition to the identified salvage blocks, the model will be configured to harvest an additional 250,000 m^3 from unburned stands that are within the low or unburned burn severity classes. Douglas-fir leading stands will have the highest priority for this harvest.

Table 5 summarizes the updates completed for the 2021 White Rock Lake fire, and Figure 2 shows an overview map of the update and planned salvage and retention areas.

Table 3 Burn severity factors

Stand Height	Burn Severity	% Burned
< 3 metres	High	100%
	Medium	90%
	Low	70%
	Unburned	-
>= 3 metres	High	90%
	Medium	80%
	Low	50%
	Unburned	-

Table 4 Natural regeneration delay for fires

BEC Subzone	Burn Severity	Regeneration Delay (yrs)
ESSFdc2	High	10
	Medium	10
	Low	5
	Unburned	-
MSdm2	High	5
	Medium	5
	Low	2
	Unburned	-
IDFdk1/	High	10
IDFdk2/	Medium	10
ICHxm1	Low	5
	Unburned	-
IDFxh1/	High	70
IDFxh2	Medium	70
	Low	10
	Unburned	-

Table 5 Summary of 2021 White Rock Lake fire burned areas after update

Burn Severity	Total PFLB Area (ha)	Non-THLB		THLB			
		Burned (ha)	Unburned (ha)	Burned (ha)	Unburned (ha)	Salvage Area (ha)	Salvage Volume (m^3)
High	7,638	1,395	149	5,106	449	540	64,956
Medium	11,550	1,874	399	7,262	1,444	571	72,443
Low	7,319	834	729	2,554	2,424*	777	92,901
Unburned	5,503	-	736	-	4,130*	636	99,433
Total	**32,010**	**4,104**	**2,012**	**14,922**	**8,448**	**2,524**	**329,733**

***** *An additional 250,000 m^3 of fir beetle salvage will be allowed in these stands in the first five years*

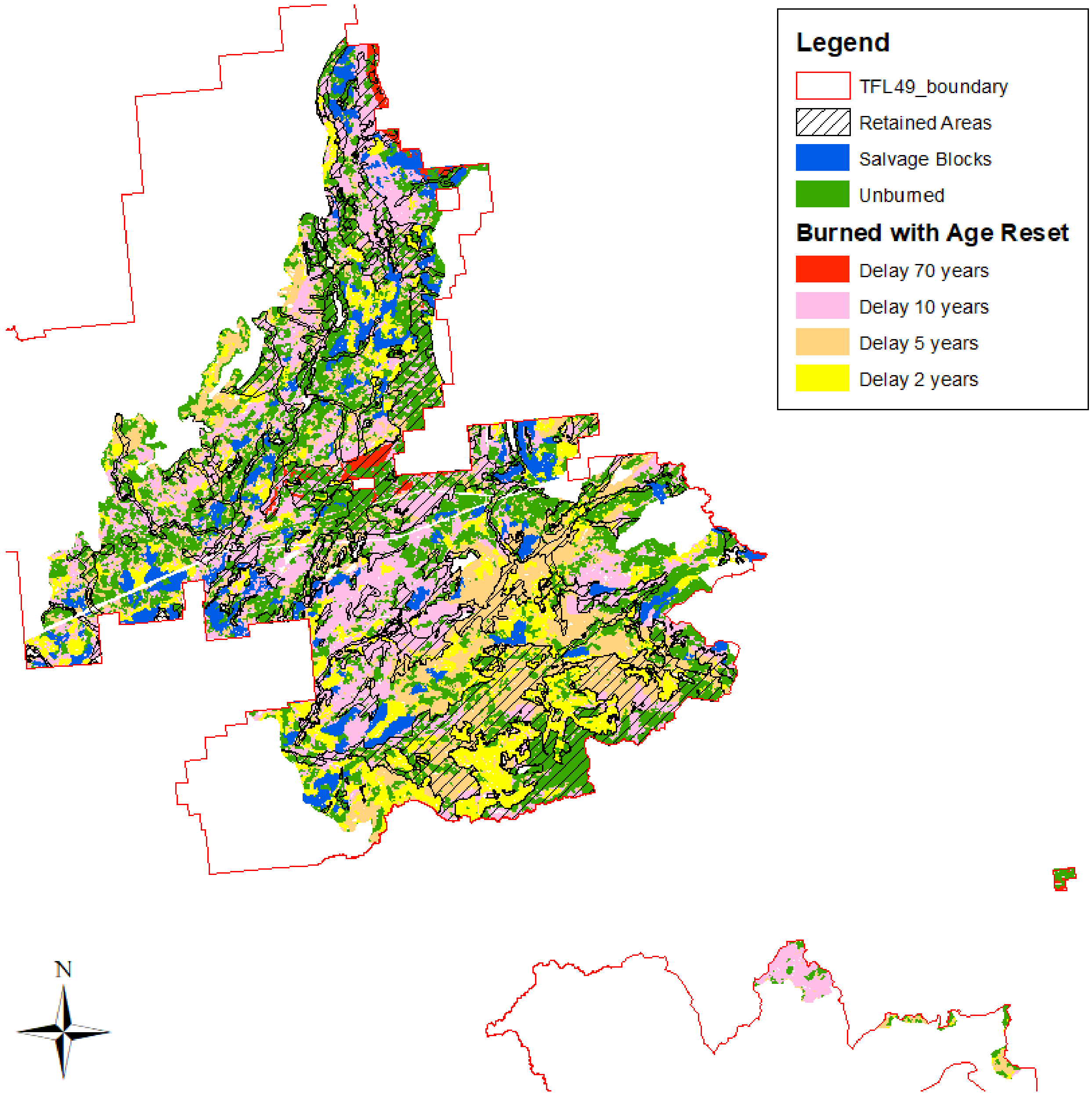

Figure 2 White Rock Lake Fire update and salvage/retention plans

8 Description of the Land Base

This section describes the land base data and assumptions used to define the productive forest land base (PFLB) and timber harvesting land base (THLB) in TFL 49 for the FRPA Base Case scenario. The THLB is designated to support timber harvesting while the PFLB includes all productive forest land in the TFL. PFLB areas that are not part of the THLB may not be available for harvest because of non-timber objectives or because the timber characteristics or site productivity is not aligned with Tolko's commercial requirements. Nevertheless, these PFLB areas along with non-forested areas such as wetlands are an important component of the TFL and its ecosystem health. For example, they contribute to biodiversity and may provide critical wildlife habitat, trees and plants important to First Nations communities, and recreation opportunities for the public.

8.1 TIMBER HARVESTING LAND BASE

Table 6 provides a summary of the area reductions made to the total area of TFL 49 to determine the Timber Harvesting Land Base. Reductions are applied in the order presented in the table using a step wise process to ensure that area is only removed once. In the table, gross area refers to the total area covered by the item, and net area refers to the incremental reduction after considering areas that were removed in previous lines in the table. Detailed descriptions of these reductions are provided in subsequent sections of this Information Package. A map showing the resulting land base classification is provided in Figure 3.

TFL 49 covers a total area of approximately 110,426 hectares. Of this total area, approximately 96.1 % is productive forest and 77.1 % is current THLB.

There has been a significant reduction in the total area of TFL 49 since the last management plan because of the removal of the Birch Creek (Browns Creek) area. For this reason, it is very difficult to make direct comparisons with the land base summary documented in the 2010 Information Package. However, the productive forest in 2010 comprised 93.7% of the total area, and the THLB was 81.8% percent of the total area. This suggests that there may be additional land base reductions being considered for the current analysis. It is believed that the two factors most likely responsible for this are unstable terrain and non-merchantable forest types.

Table 6 TFL 49 land base area summary – FRPA Base Case scenario

Land Base Element	Gross Area (ha)	Productive Area (ha)	Net Area (ha)			Percent of Total Area (%)	Percent of PFLB (%)
			Sched. A	Sched. B	Total		
Total Land Base (incl. fresh water)	**110,426**		**685**	**109,741**	**110,426**	**100.0**	
Less:							
Non-Forest/Non-Productive Forest	2,752		28	2,723	2,752	2.5%	
Existing Roads	1,617		14	1,565	1,579	1.4%	
Productive Forest Land Base			**642**	**105,452**	**106,095**	**96.1%**	**100.0%**
Less:							
Unstable Terrain	4,049	3,893	10	3,884	3,893	3.5%	3.7%
Steep Slopes	728	683	-	38	38	0.0%	0.0%
Non-merchantable	7,745	7,015	46	5,956	6,003	5.4%	5.7%
Wildlife Habitat Areas	7	7	-	7	7	0.0%	0.0%
Riparian Areas	4,824	3,344	38	2,912	2,950	2.7%	2.8%
Enhanced Riparian Reserves	1,350	1,278	-	903	903	0.8%	0.9%
Old Growth Management Areas	4,672	4,563	-	2,710	2,710	2.5%	2.6%
Canyon Rim Trail	56	56	-	34	34	0.0%	0.0%
Kelowna Dirt Bike Club	15	14	-	2	2	0.0%	0.0%
Existing Wildlife Tree Patches	2,389	2,335	6	1,738	1,744	1.6%	1.6%
Future Wildlife Tree Patches (spatial)	129	129	2	115	117	0.1%	0.1%
Future WTR (aspatial)			21	2,545	2,567	2.3%	2.4%
Timber Harvesting Land Base - Current			**520**	**84,607**	**85,126**	**77.1%**	**80.2%**
Less:							
Future Roads (aspatial)					228*	0.2%	0.2%
Future Timber Harvesting Land Base					**84,898**	**76.9%**	**80.0%**

**** To be applied with a yield table reduction of 0.8% for future managed stands without an existing harvest history***

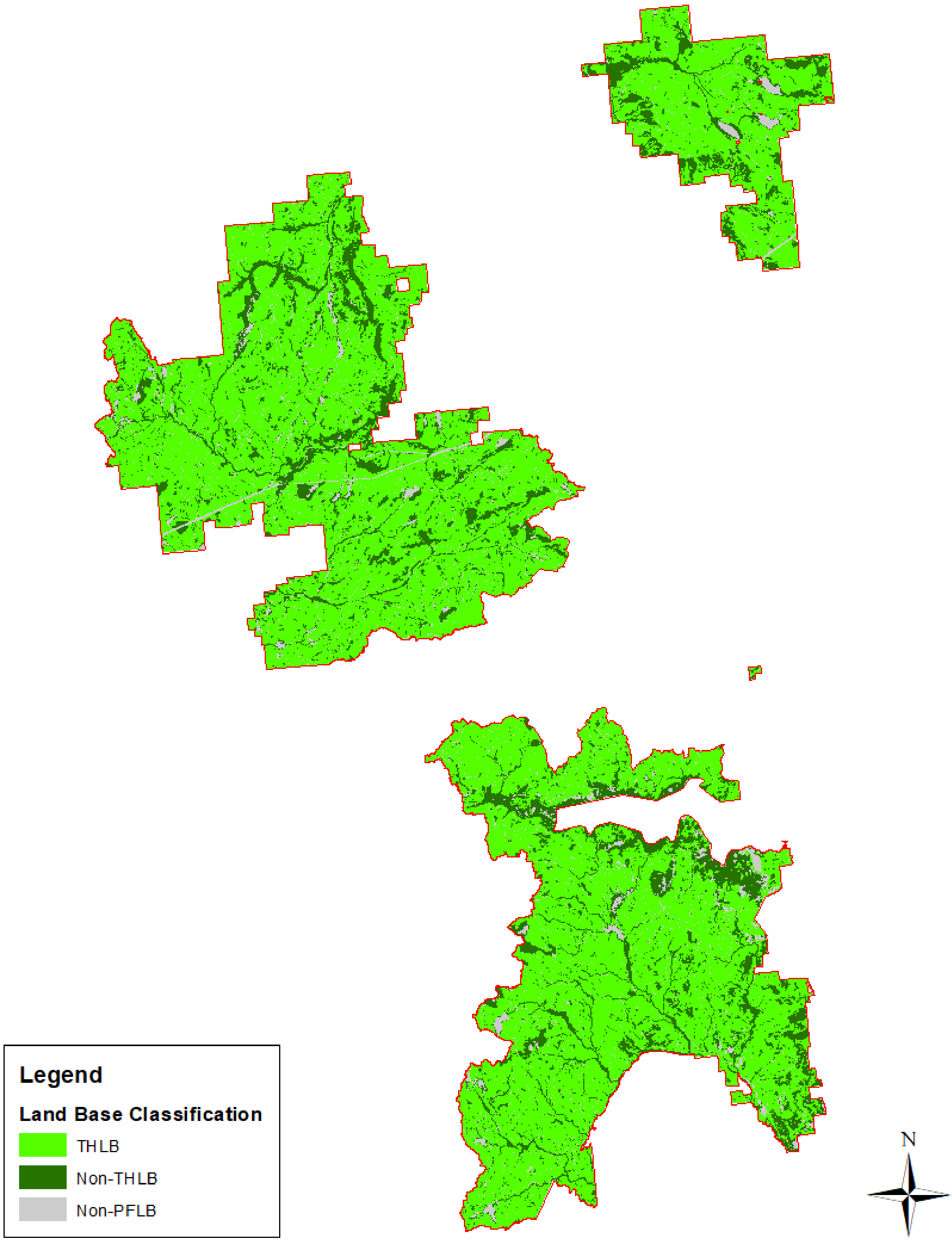

Figure 3 TFL 49 Land base classification – FRPA Base Case scenario

8.1.1 AGE CLASS DISTRIBUTION

The current age class distribution for TFL 49 is summarized in Table 7 and illustrated in Figure 4. About 18% of the total THLB has had its age reset for this analysis through the update completed for the White Rock Lake fire, and roughly 66% of the THLB is younger than 50 years.

Table 7 Age class distribution

Age Class (years)	THLB Area (ha)	Non-THLB Area (ha)	Total PFLB Area (ha)
<0 (Fire Updates)	14,922	4,104	19,026
0- 10	4,806	115	4,921
10- 19	14,266	1,979	16,245
20- 29	7,303	126	7,430
30- 39	7,851	676	8,527
40- 49	7,065	757	7,822
50- 59	2,332	297	2,629
60- 69	1,088	274	1,362
70- 79	1,798	557	2,354
80- 89	1,948	490	2,438
90 – 99	2,821	753	3,574
100-109	2,108	700	2,808
110-119	1,944	808	2,753
120-129	1,752	839	2,590
130-139	2,995	1,452	4,447
140-149	1,732	1,146	2,878
150-159	1,140	792	1,932
160-169	598	471	1,069
170-179	654	617	1,271
180-189	1,220	789	2,009
190-199	721	392	1,114
200-209	765	516	1,281
210-219	535	384	919
220-229	1,110	778	1,889
230-239	268	138	406
240-249	627	235	862
>= 250	757	784	1,540
Total	**85,126**	**20,968**	**106,095**

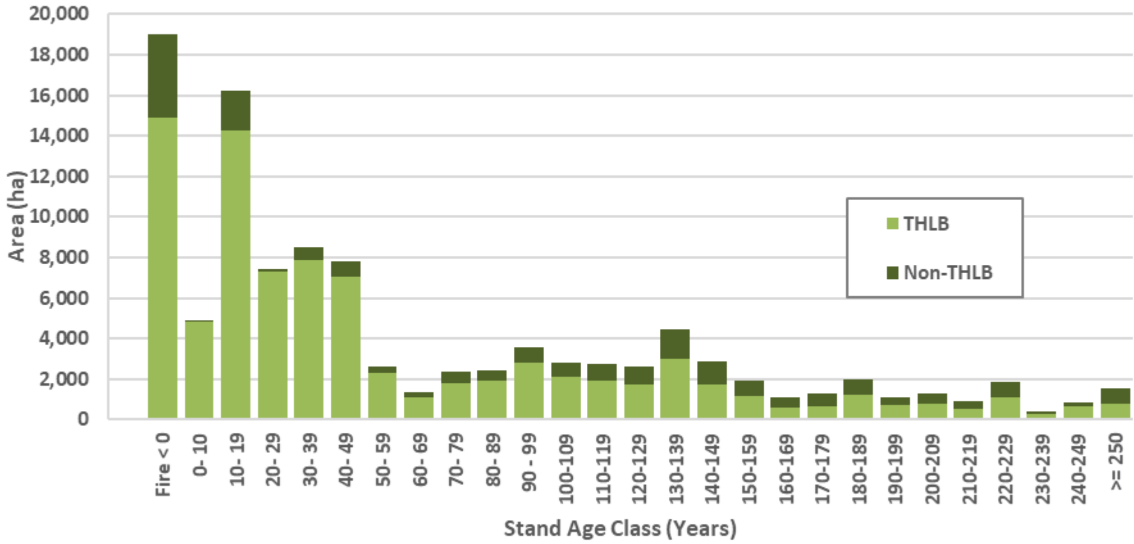

Figure 4 Age class distribution

8.1.2 SPECIES COMPOSITION

The overall species composition for the THLB and non-THLB are shown in Figure 5. The predominant species on the THLB is lodgepole pine (31.9%), with the remainder mostly comprised of Douglas-fir, balsam and spruce. Minor proportions of cedar, ponderosa pine, and deciduous are also present.

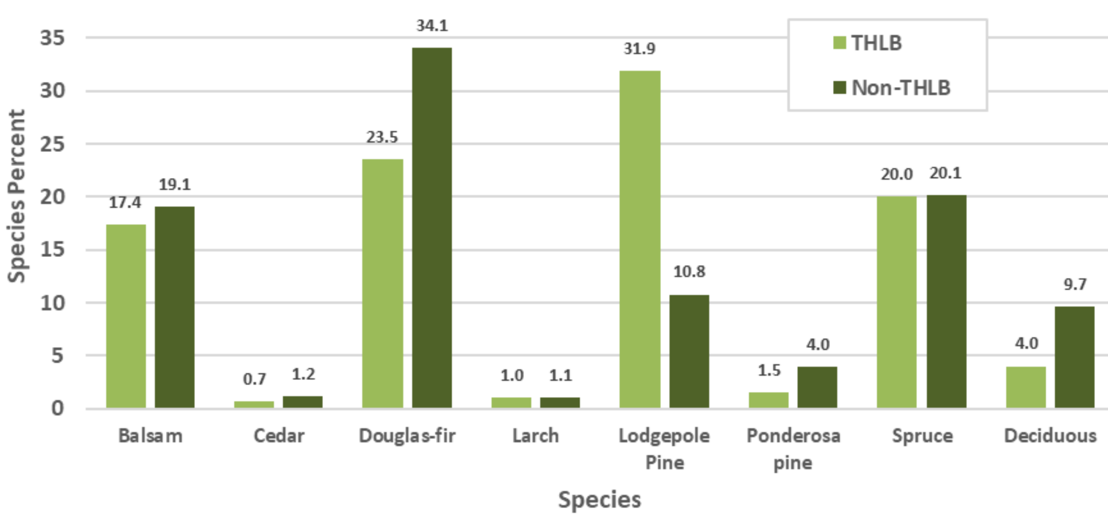

Figure 5 Overall species composition derived from individual stand composition percentages

8.1.3 BIOGEOCLIMATIC CLASSIFICATION

The distribution of the biogeoclimatic classifications (Version 12) for the THLB, Non-THLB, and non-PFLB are shown in Figure 6. The three most predominant BEC subzones within TFL 49 THLB are the MSdm2 (39.7%), IDFdk2

(22.3%), and ESSFdc2 (15.8%). Other subzones include the ESSFdc3 (5.8%), IDFdk1 (5.6%), ICHmk2 (2.4%), IDFxh1 (2.2%), ICHxm1 (1.9%), IDFxh2 (1.6%), MSdm3 (1.2%), MSxk2 (1.1%), ICHmk1 (0.4%), and PPxh1 (0.1%). When rolled up to the Natural Disturbance Type, 66.4% of the THLB is in NDT3 (ecosystems with frequent stand-initiating events), and 33.6% is in NDT4 (stands with frequent stand-maintaining fires).

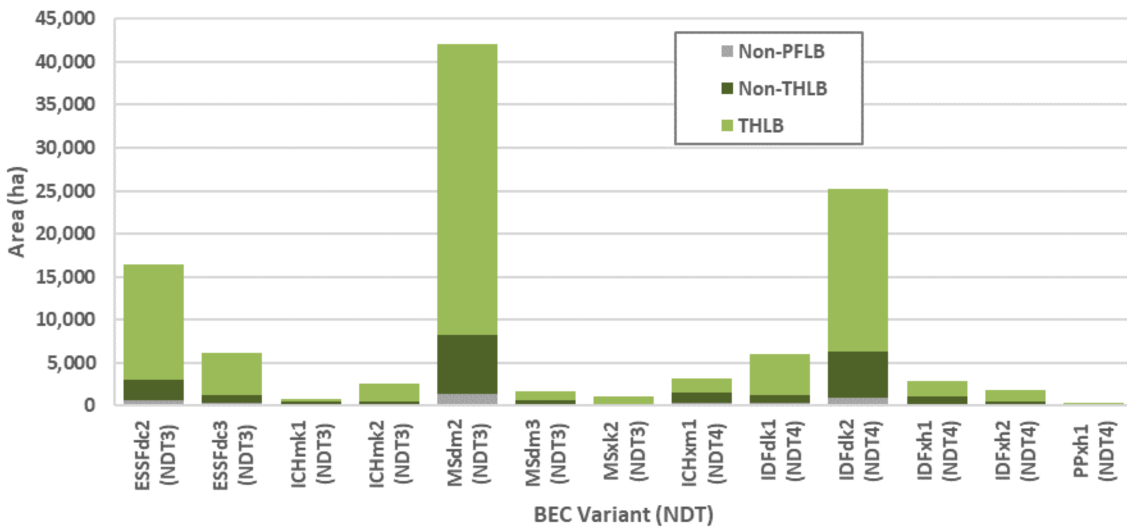

Figure 6 Area distribution of BEC variants

8.2 TOTAL AREA

The gross area within the mapped TFL 49 boundary is 110,426 hectares. Of this, 685 hectares are Schedule A private land owned by Tolko and managed as part of the TFL. All other private land has already been excluded from within the boundary.

8.3 NON-FOREST AND NON-PRODUCTIVE FOREST

The LiDAR based forest inventory for TFL 49 does not include the full set of BC Land Classification System attributes that are normally used to identify non-forested and non-productive forest polygons. However, it was found that most non-forest/non-productive forest polygons could be selected using the "NON_VEG_COVER_TYPE", "HERB_COVER_TYPE" and "FOR_MGMT_LAND_BASE_IND" attributes. Additional lakes and wetlands were also sourced from the Fresh Water Atlas (FWA) where imagery confirmed that they should be considered as non-forest. Finally, there was a very small area along the boundary of the TFL that was not included in the LiDAR inventory.

Table 8 summarizes the areas removed from the land base as non-forest or non-productive forest. Although these polygons (e.g. meadows, lakes, wetlands, etc.) are not considered as forest for purposes of the timber supply analysis, it is recognized that they may provide important indigenous and habitat values.

Table 8 Non-forest and non-productive forest area summary

Description	Criteria	Gross Area (ha)	Removed Area (ha)
Rock	NON_VEG_COVER_TYPE = "RO"	115.0	115.0
Lakes	NON_VEG_COVER_TYPE = "WA" or from FWA	905.9	905.9
Wetlands	HERB_COVER_TYPE = "HG" or from FWA	455.1	415.3
Non-forest	FOR_MGMT_LAND_BASE_IND" = "N"	2,686.1	1,315.1
Not Typed	No VRI attributes	0.5	0.5
Non-forest Total		**4,162.7**	**2,751.9**

8.4 ROADS, TRAILS, AND LANDINGS

8.4.1 EXISTING ROADS, TRAILS AND LANDINGS

Permanent roads, trails and landings are not suitable for growing trees. Tolko maintains spatial data that identifies the location and classification of existing roads within TFL 49. Although wider roads are often delineated as polygons in the forest inventory, many roads are too narrow to be typed as non-forest. Therefore, buffers representing the unproductive width of the roads are created and used to approximate the appropriate reduction to the forested land base. In 2009, Tolko contracted Forsite to sample the roads, trails and landings within TFL 49 and determine the true widths of the non-productive buffer. The widths from this study ("*Estimating the Non Productive Losses Associated with Roads, Trails and Landings in TFL 49*") will be used in the current analysis.

Roads from three different spatial sources were combined to ensure that all non-productive area due to roads was accounted for. First, tenured roads with a status of "*construction completed*" were extracted from Tolko's forest management system. Roads where rehabilitation is proposed or completed were not included as they will be reforested. Additional non-status roads were extracted from Tolko's GIS system and were checked visually against recent satellite imagery to confirm that they had been built and were not rehabilitated. Finally, roads from the provincial digital roads atlas were extracted for BCTS operating areas where there was no data available in Tolko's GIS system.

Almost all logging in TFL 49 is completed using roadside harvesting systems that do not require landings or trails. Therefore, no additional allowance for these features has been included in this Information Package.

Table 9 Existing road summary

Road Type	Length (km)	Buffer Width (m)	Gross Area (ha)	Removed Area (ha)
Highway	-	23.4	-	-
Secondary	17.4	19.2	33.6	32.2
Mainline/FSR	356.8	12.1	432.2	421.8
Operational	1,704.0	6.3	1,077.9	1,053.7
Spurs/Trails	468.9	1.8	73.6	71.4
Total	**2,547.1**		**1,617.3**	**1,579.2**

8.4.2 FUTURE ROADS, TRAILS, AND LANDINGS

The permanent road network on TFL 49 is very well developed, with most of the TFL in close proximity to an existing road. Existing roads have been removed from the THLB, and it is assumed that all stands with a logging history will need no additional reduction for future roads. These stands can be used as the basis for determining the approximate area required to account for future roads, as follows:

The current THLB area with a logging history is 54,653 hectares. There are another 1,075 hectares within permanent road buffers that do not overlap with another land base reduction (i.e. would otherwise be THLB) and are within previously logged stands. Therefore, the proportion of THLB removed for permanent roads in previously logged stands is 1.9% calculated as:

Proportion of THLB in permanent road = 1,075 ha / (54,653 ha + 1,075 ha) = 1.9%

The remaining THLB area without a logging history is 30,473 hectares. However, there are already some existing access roads (i.e. roads between existing cut blocks) within this area. The area within permanent road buffers that does not overlap with another land base reduction (i.e. would otherwise be THLB) and that has not been previously logged is 358 hectares. Therefore, the additional area required for future roads is 228 hectares calculated as:

*Total future roads = 1.9% * (30,473 ha + 358 ha), less 358 ha = 228 ha*

This reduction will be applied as a yield table adjustment of 0.8% for future managed stands where there is no existing harvest history, calculated as:

Reduction factor = 228 ha / 30,473 ha = 0.8%

8.5 UNSTABLE TERRAIN

Section 37 of the Forest Planning and Practices Regulation requires that a primary forest activity not cause a landslide that has a material adverse effect. One of the tools that forest companies use to address this requirement is terrain stability mapping that identifies areas where there is potential for landslides.

Detailed (Level C) terrain stability mapping has been completed for the entire area of TFL 49. Tolko has a geotechnical engineer on staff that has worked extensively with this mapping during cutblock development. Based on his advice, all areas with a mapping classification of V (High likelihood of landslide initiation following timber harvesting) were excluded from the THLB unless there was evidence of previous harvest or they are in a proposed cutblock. For terrain polygons with mapping classification of IV (Moderate likelihood of landslide initiation following timber harvesting), all areas where the slope is greater than 60% were excluded from the THLB unless there was evidence of previous harvest or they are in a proposed cutblock. Table 10 summarizes the areas removed from the THLB for unstable terrain.

Table 10 Terrain stability area summary

Terrain Class	Description	Gross Area (ha)	Productive Area (ha)	Removed Area (ha)
V	High likelihood of landslide initiation following harvesting	1,428.9	1,338.7	1,338.7
IV, slope >60%	Moderate likelihood of landslide initiation following harvesting	2,620.2	2,554.8	2,554.8
Total		**4,049.1**	**3,893.5**	**3,383.5**

8.6 STEEP SLOPES

LiDAR data has been acquired for TFL 49 and was used to generate a slope layer that was used in this analysis. Slopes greater than 80% are generally not harvested by Tolko and have been excluded from the THLB unless there is evidence of previous harvesting or they are in a proposed cutblock. The total area of slopes greater than 80% in TFL 49 is 728.1 hectares, of which 682.6 hectares is productive forest. After previous land base reductions are accounted for, the net reduction to the THLB was 38.4 hectares.

8.7 INOPERABLE

An operability layer for TFL 49 has not been developed. The land base reductions for unstable terrain and steep slopes account for areas that are considered to be inoperable and not suitable for timber harvesting.

8.8 NON-MERCHANTABLE STANDS

Non-merchantable forest types have characteristics that make them unlikely to be economically viable for harvest by Tolko. As discussed in Section 8, they contribute to other values and are an important component of the overall forest in the TFL. The following stands were removed from the THLB unless there is history of previous harvesting or they are in a proposed cutblock:

- Deciduous (aspen, cottonwood and birch) leading stands,
- Douglas-fir leading stands less than 141 years old with an inventory site index < 8.5,
- Cedar leading stands less than 141 years old with an inventory site index < 9.0,
- Balsam leading stands less than 141 years old with an inventory site index < 8.0,
- Spruce leading stands less than 141 years old with an inventory site index < 7.5,
- Lodgepole pine leading stands less than 141 years old with an inventory site index < 7.5,
- Larch leading stands less than 141 years old with an inventory site index < 6.5,
- Ponderosa pine leading stands less than 141 years old with an inventory site index < 7.0,
- Deciduous leading stands less than 141 years old with an inventory site index < 8.0,
- Stands that are not expected to achieve conifer volumes of at least 75 m^3/hectare and heights of at least 15 metres based on the VDYP yield tables.

Table 11 summarizes the non-merchantable areas within TFL 49.

Table 11 Non-merchantable stands area summary

Description	Gross Area (ha)	Productive Area (ha)	Removed Area (ha)
Deciduous Leading	1,976.1	1,826.0	1,707.0
Douglas-fir leading, <= 140 years old, site index < 8.5	265.2	205.5	170.4
Cedar leading, <= 140 years old, site index < 9.0	7.3	7.3	5.9
Balsam leading, <= 140 years old, site index < 8.0	174.0	123.9	117.0
Spruce leading, <= 140 years old, site index < 7.5	130.2	93.5	88.7
Lodgepole pine leading, <= 140 years old, site index < 7.5	74.5	63.6	48.7
Larch leading, <= 140 years old, site index < 6.5	0.8	0.8	0.8
Ponderosa pine leading, <= 140 years old, site index < 7.0	72.5	51.8	21.2
Deciduous leading, <= 140 years old, site index < 8.0	54.6	40.6	-
Low volume (will not achieve 75 m^3/ha and 15 metres of height)	5,860.8	5,261.6	3,843.0
Total	**7,744.8****	**7,014.9****	**6,002.7**

***** Does not add to above values because overlaps between categories are removed***

8.9 WILDLIFE HABITAT AREAS

Sections 9 and 10 of the Government Action Regulation permit the government to establish General Wildlife Measures and Wildlife Habitat Areas (WHA). Section 69 of the Forest Planning and Practices Regulation specifies that primary forest activities on an area must comply with each General Wildlife Measure that applies to the area.

There is one WHA for Western Screech Owl within TFL 49, and it identifies a core no harvest zone and a surrounding conditional harvest zone. The no harvest zone has a gross area of 7.0 hectares and was removed from the THLB. Of this, 7.0 hectares is forested and part of the PFLB. The net area removed from the THLB after accounting for previous netdown categories is 7.0 hectares.

8.10 RIPARIAN MANAGEMENT AREAS

Riparian management areas are designed to minimize the impacts of harvesting in areas immediately adjacent to water bodies, including streams, lakes, and wetlands. The Forest Planning and Practices Regulation (Sections 50, 51, and 52) and Tolko's Forest Stewardship Plan specify the management requirements for riparian areas. There are no additional requirements identified for lakeshore management zones.

A riparian management area consists of a riparian management zone in which harvesting activity is restricted through basal area retention requirements, and, depending on the water body classification, may also include a riparian reserve zone immediately adjacent to the water body. Harvesting is fully excluded within the reserve zone.

An equivalent riparian management area width was calculated for each riparian class by considering the widths of the riparian reserve zone and riparian management zone, along with the percentage basal area retention within the management zone. Buffers were then generated around the riparian features and removed from the THLB.

Table 12 summarizes the buffer widths and area reductions for riparian features. Further details about the source riparian data and classification details are provided in Section 8.10.1 and Section 8.10.2.

Table 12 Riparian management area summary

Feature	Class	Feature Area or Length	RRZ* Width (m)	RMZ* Width (m)	RMZ Basal Area Retention (%)	Buffer Width for Modelling (m)	Gross Area (ha)	Productive Area (ha)	Removed Area (ha)
Lake	L1-A	-	0	0	N/A	0	-	-	-
	L1-B	715.4 ha	10	20**	100	30	956.0	199.9	188.1
	L3	82.7 ha	0	30	20	6	98.1	6.6	5.8
	L4	0.2 ha	0	30	20	6	0.2	0.1	0.1
Wetlands	W1	215.5 ha	10	40	20	18	321.3	79.8	65.7
	W2	1.2 ha	10	20	20	14	2.3	1.0	0.6
	W3	139.9 ha	0	30	20	6	177.7	22.7	18.5
	W4	0.4	0	30	20	6	0.5	0.1	0.1
	W5	51.1 ha	10	40	20	18	88.2	31.6	30.0
Streams	S2	104.3 km	30	20	50	40	822.0	792.7	671.5
	S3	202.8 km	20	20	50	30	1,201.2	1,113.9	977.5
	S4	447.0 km	0	30	30	9	778.5	732.6	688.3
	S5	84.3 km	0	30	50	15	250.2	242.0	201.7
	S6-L	64.6 km	0	20	50	10	127.9	120.4	101.9
	S6	557.1 km	0	20	>0	0	-	-	-
Total							**4,824.2**	**3,343.5**	**2,949.7**

* RRZ = Riparian Reserve Zone, RMZ = Riparian Management Zone

** RMZ width for L1-B exceeds FPPR requirement of 0 metres

8.10.1 LAKES AND WETLANDS

Lakes and wetlands were extracted from the forest inventory and supplemented with others from the Fresh Water Atlas where a review of imagery indicated they should be included. These lakes and wetlands were then classified using the definitions provided in the Forest Planning and Practices Regulation. Table 13 summarizes the criteria used for classification of lakes and wetlands.

Table 13 Classification criteria for lakes and wetlands

Feature	Class	Criteria
Lake	L1-A	>= 1,000 ha
	L1-B	> 5 ha and < 1,000 ha
	L2	>= 1 ha and <= 5 ha and in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
	L3	>= 1 ha and <= 5 ha and not in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
	L4	>= 0.25 ha and <= 1 ha and in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
Wetlands	W1	> 5 ha
	W2	>=1 ha and <= 5 ha and in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
	W3	>=1 ha and <= 5 ha and not in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
	W4	>= 0.25 ha and <= 1 ha and in PP/BG/IDFxh/IDFxm/IDFxw biogeoclimatic zone/subzones
	W5	Two or more wetlands with overlapping riparian management zones and combined area >= 5 ha

8.10.2 STREAMS

Streams are classified using the definitions provided in the Forest Planning and Practices Regulation, based on their width, presence or absence of fish, and whether they are in a community watershed. In addition to the FRPA criteria, Tolko's Forest Stewardship Plan classifies S6 streams into large (S6-L) and small (S6) categories. Table 14 summarizes these criteria.

In March 2021, a LiDAR based stream layer for timber supply review purposes was developed by Forsite using the following general methodology:

- Creation of a stream network using flow accumulation modelling of the LiDAR digital elevation model. This network is very dense and many of the predicted streams do not actually have water present in them. It also does not provide information about the predicted stream width.
- LiDAR data was used to generate average slope for each 100 m segment of the stream network.
- Tolko's operational stream class dataset was used to develop relationships between stream width and LiDAR derived flow accumulation data.
- The stream width/flow accumulation relationship was used to classify the stream data into predicted width categories.
- Tolko's operational stream class data, provincial fish presence/absence data, and stream slope was used to classify each stream according to whether it is expected to contain fish.
- The predicted stream widths, fish presence/absence, and location relative to community watershed boundaries was used to assign the predicted stream class as defined in Table 14.
- Minor edits to stream class were completed where the stream class from operational data did not correspond with the predicted stream class.

Table 14 Classification criteria for streams

Class	Fish Present or in a Community Watershed	Width
S1-A	Yes	> 100m
S1-B	Yes	> 20 m and < 100 m
S2	Yes	>= 5 m and <= 20 m
S3	Yes	>= 1.5 m and < 5 m
S4	Yes	< 1.5 m
S5	No	> 3 m
S6-L	No	>= 1.5 m and <= 3m
S6	No	< 1.5 m

8.11 ENHANCED RIPARIAN RESERVES

The Okanagan Shuswap Land and Resource Management Plan identified an additional budget of 10,000 hectares within the THLB in the Okanagan TSA and associated TFL's to be designated as enhanced riparian reserves (ERRs). Tolko has spatially located the required area within TFL 49 and these areas have been removed from the THLB. The total area of ERRs within TFL 49 is 1,350.4 hectares, of which 1,278.4 hectares is forested and part of the PFLB. The net area removed from the THLB after accounting for previous netdown categories is 903.2 hectares.

8.12 OLD GROWTH MANAGEMENT AREAS

Non-legal, spatial Old Growth Management Areas (OGMAs) have been established as part of the Okanagan-Shuswap Land and Resource Management Plan process to manage for the old growth requirements outlined in the *Order Establishing Provincial Non-Spatial Old Growth Objectives, June 2004.* All OGMAs within the TFL 49 boundary were excluded from the THLB. The gross area of OGMAs within TFL 49 is 4,671.9 hectares, of which 4,562.8 hectares is productive forest. After accounting for other reductions to the land base, the net area removed from the THLB was 2,710.2 hectares.

8.13 RECREATION SITES AND RESERVES

There are several active recreations sites and recreation reserves located within TFL 49. In general, these areas are not removed from the THLB in timber supply reviews as harvesting can occur within them if it can be completed in a manner consistent with the established recreation objectives. However, the areas within each recreation polygon are summarized in Table 15 for information purposes.

Table 15 Recreation sites and reserves

Name	Type	Gross	Productive	Removed	THLB Area
Arthur Lake North	Recreation Site	3.1	3.0	-	1.9
Bear Creek	Recreation Site	24,788.0	23,912.6	-	19,337.2
Bear Creek Aspen Trail Head	Recreation Reserve	38.1	36.6	-	30.7
Bear Creek Upper Pits	Recreation Reserve	6.7	6.1	-	5.7
Bearcat Caves	Recreation Reserve	93.3	91.0	-	53.7
Beautiful Lake	Recreation Site	50.1	28.8	-	16.7
Blackwell Lake	Recreation Site	23.8	23.3	-	10.2
Blue Grouse Mountain Bike Trails	Recreation Reserve	788.4	734.0	-	390.9
Bolean Lake	Recreation Site	2.3	2.1	-	1.3
Dobbin Lake	Recreation Reserve	1.2	0.8	-	0.3
Esperon Lake Cabin	Recreation Reserve	0.2	0.2	-	-
Islaht Lake	Recreation Site	25.7	24.9	-	15.9
Jackpine Lake	Recreation Site	20.5	18.5	-	14.5
Jimmy Lake	Recreation Site	7.9	7.9	-	5.3
Lambly Lake	Recreation Site	49.7	44.6	-	31.2
Nugget Lake	Recreation Site	1.9	1.8	-	1.1
Okanagan Lake (East Sun)	Recreation Site	34.5	34.3	-	25.7
Pond Lake	Recreation Reserve	7.7	5.6	-	2.8
Pratt Lake	Recreation Site	10.6	9.2	-	6.5
Salmon River	Recreation Site	8.1	6.3	-	4.9
Sandberg Lake	Recreation Site	6.2	6.1	-	3.9
Sheila Lake	Recreation Site	20.3	14.1	-	10.0
Spa Hills Snowmobile Cabin	Recreation Site	0.3	0.3	-	0.1
Spa Lake	Recreation Site	12.5	11.9	-	7.8
Spanish Lake	Recreation Site	33.4	24.1	-	12.0
Terrace Mountain Lookout	Recreation Site	3.9	2.1	-	0.1
Weyman Creek	Recreation Reserve	7.6	7.1	-	-
Weyman Falls	Recreation Reserve	6.4	6.4	-	0.6
Woods Lake North	Recreation Site	16.6	15.1	-	11.3
Total		**26,069.1**	**25,078.9**	**-**	**20,002.3**

8.14 SHORTS CREEK CANYON RIM TRAIL

A portion of the Shorts Creek Canyon Rim Trail is located within TFL 49. Tolko's Forest Stewardship Plan indicates that this Class A trail will be managed by retaining 66% of the basal area within 100 metres of the trail. This will be modelled in the timber supply analysis by removing a 66 metre buffer on each side of the trail from the THLB.

The total area of this buffer within TFL 49 is 55.9 hectares, of which 55.8 hectares is forested and part of the PFLB. The net area removed from the THLB after accounting for previous netdown categories is 33.6 hectares.

8.15 KELOWNA DIRT BIKE CLUB

The Kelowna dirt bike club has a Licence of Occupation within TFL 49 which has been removed from the THLB. The total area of this polygon is 14.9 hectares, of which 14.0 hectares is productive forest. After previous land base reductions are accounted for, the net reduction to the THLB is 2.3 hectares.

8.16 WILDLIFE TREE RETENTION

Section 66 of the Forest Planning and Practices regulation requires that on average, 7% of the total cutblock area harvested must be retained as wildlife tree retention (WTR). Tolko's Forest Stewardship Plan is consistent with this requirement.

Wildlife tree patches (WTPs) are defined during layout and are maintained spatially in Tolko's forestry management system and are also reported to RESULTs. All long-term WTPs were removed from the THLB. The gross area of existing WTPs within TFL 49 is 2,388.6 hectares of which 2,334.8 hectares is productive forest. The net reduction to the THLB after accounting for other land base reductions is 1,744.2 hectares.

In addition to these existing WTPs, Tolko's planned cutblock data includes 129.4 hectares of spatially located future WTPs, of which 128.8 hectares are productive forest, and 117.0 hectares would otherwise be THLB. These future WTPs were also removed from the THLB. When these are combined with the existing WTPs, approximately 73.9% of the WTPs would otherwise be THLB, calculated as:

1,861.2 ha THLB in WTPs / 2,518.0 ha gross WTP area

Future WTP retention will be modelled as 7% of gross cutblock area, as specified in Tolko's FSP. Using the historical proportion of WTPs that would otherwise be THLB (73.9%) within existing WTPs, the anticipated incremental THLB reduction to account for wildlife tree retention is (7% * 73.9%), or 5.17%.

RESULTs data shows that the first blocks with wildlife tree retention were harvested in 1992. Therefore, this analysis assumes that existing WTPs are associated with previously harvested stands that are currently 30 years or younger in age. For the remainder of the THLB that is greater than 30 years old and not in a planned cutblock, an aspatial netdown of 5.17% will be applied in the model.

9 Inventory Aggregation

Aggregation of individual forest stands is used to reduce complexity of the inventories for purposes of timber supply modelling.

9.1 ANALYSIS UNITS

Stands are grouped into analysis units (AUs) to reduce the number of yield tables required within the model. The criteria used to assign analysis units varied depending on stand origin (natural, existing managed and future managed), stand age, silviculture history, fire update, and salvage status.

Base AUs were assigned to each polygon using biogeoclimatic subzones, leading species groups, and three managed stand site index classes. The thresholds for these site index classes were chosen by reviewing the managed stand site index distribution for each biogeoclimatic subzone/species group and choosing breakpoints such that the medium class captures most of the land base within a relatively narrow site index range, with the lower and upper classes representing those areas that are either much lower or much higher than the average. Table 16 summarizes the base analysis units. These base AUs were used to define the analysis units for future managed stands, as well as forming part of the analysis unit definition for existing stands.

Analysis units for natural stands were assigned using the age of the stand (< 81 years, >= 81 years) and the maximum volume that the stand is expected to achieve using the VDYP projected yield table for the stand (< 100 m^3/ha, 100-150 m^3/ha, 150-200 m^3/ha, 200-350 m^3/ha, and > 350 m^3/ha). These groupings were then further subdivided using the base analysis units except for the <100 m^3/ha category which had very little area in it.

Analysis units for existing managed stands were assigned to each individual silviculture opening where an opening was identified in the spatial data. For those managed stands where an opening was not identified, the base analysis units were used to assign the analysis unit. The silviculture era of the managed stand was also used to further define the aggregations.

Stands within the White Rock Lake fire that are within proposed salvage blocks were aggregated using the base analysis units. Similarly, stands where the age was reset during the fire update process were grouped according to their base analysis unit. Table 17 summarizes the analysis units that will be used for the modelling.

Table 16 Base analysis units

BEC	Species	Site Index	AU	THLB Area (ha)	BEC	Species	Site Index	AU	THLB Area (ha)
ESSFdc2	Sx/Bl	< 14.5	1	2,157.7	IDFdk2	Fd/Lw/Py	< 16.0	40	1,574.7
		14.5 – 19.0	2	4,965.3			16.0 – 19.0	41	9,148.5
		> 19.0	3	2,255.2			>19.0	42	1,314.3
	Other	< 15.5	4	855.6		Pl	< 17.5	43	314.9
		15.5 – 18.0	5	2,060.2			17.5 – 20.5	44	4,078.3
		> 18.0	6	1,140.6			> 20.5	45	1,049.1
ESSFdc3	Sx/Bl	< 14.5	7	1,415.7		Other	< 16.0	46	161.4
		14.5 – 19.0	8	1,772.5			16.0 – 21.0	47	1,103.2
		> 19.0	9	1,013.2			> 21.0	48	206.2
	Other	<17.5	10	429.1	IDFxh1	Fd/Other	< 15.0	49	440.8
		17.5 – 21.5	11	285.4			15.0 – 17.0	50	633.7
		> 21.5	12	54.1			> 17.0	51	58.2
ICHmk1	Fd/Lw	< 18.0	13	4.3		Py	< 15.0	52	185.8
		18.0 – 19.5	14	104.8			15.0 – 17.0	53	521.6
		> 19.5	15	13.0			> 17.0	54	38.9
	Other	< 18.5	16	25.4	IDFxh2	All	< 15.0	55	298.4
		18.5 – 20.0	17	138.3			15.0 – 17.0	56	773.5
		> 20.0	18	28.4			> 17.0	57	259.1
ICHmk2	Sx/Bl	< 18.0	19	142.9	MSdm2	Pl	< 18.0	58	2,655.2
		18.0 – 21.0	20	606.7			18.0 – 20.5	59	12,596.6
		> 21.0	21	550.0			> 20.5	60	3,728.4
	Fd/Lw	< 18.0	22	44.2		Sx/Bl	< 15.0	61	398.1
		18.0 – 20.5	23	190.0			15.0 – 19.5	62	7,856.9
		> 20.5	24	118.0			> 19.5	63	2,892.0
	Pl	< 20.0	25	71.9		Other	> 18.0	64	197.7
		20.0 – 22.5	26	223.4			18.0 – 19.5	65	2,978.7
		> 22.5	27	121.7			> 19.5	66	456.0
ICHxm1	All	< 18.0	28	464.6	MSdm3	Pl	< 18.0	67	64.9
		18.0 – 22.0	29	552.2			18.0 – 20.5	68	195.3
		> 22.0	30	565.7			> 20.5	69	124.8
IDFdk1	Fd/Lw	< 16.5	31	167.9		Sx/Bl	< 17.5	70	164.9
		16.5 – 19.0	32	2,623.4			17.5 – 21.0	71	57.9
		> 19.0	33	462.2			> 21.0	72	24.8
	Pl	< 18.0	34	60.8		Other	< 18.5	73	14.1
		18.0 – 20.0	35	720.2			18.5 – 21.0	74	178.0
		> 20.0	36	174.5			> 21.0	75	195.7
	Other	< 17.0	37	135.6	MSxk2	Pl/Fd	< 18.0	76	99.0
		17.0 – 21.0	38	359.4			18.0 – 21.0	77	563.0
		> 21.0	39	80.5			> 21.0	78	85.6
						Sx/Bl	< 16.5	79	15.0
							16.5 – 18.5	80	107.4
							> 18.5	81	45.7
					PPxh1	All	< 15.0	82	6.9
							15.0 – 18.0	83	107.6
							> 18.0	84	1.0

Table 17 Modelling analysis units

Analysis Units	Description	Land Base	Regeneration Analysis Unit
1 – 6	Existing Natural Stands, Max. volume < 100 m³/ha	THLB	400001 - 401084
101 – 184	Existing Natural Stands < 81 years old, Max volume 100 to 150 m³/ha	THLB	400001 - 401084
201 – 284	Existing Natural Stands < 81 years old, Max volume 150 to 200 m³/ha	THLB	400001 - 401084
301 – 384	Existing Natural Stands < 81 years old, Max volume 200 to 350 m³/ha	THLB	400001 - 401084
401 – 484	Existing Natural Stands < 81 years old, Max volume > 350 m³/ha	THLB	400001 - 401084
1101 – 1184	Existing Natural Stands >= 81 years old, Max volume 100 to 150 m³/ha	THLB	400001 - 401084
1201 – 1284	Existing Natural Stands >= 81 years old, Max volume 150 to 200 m³/ha	THLB	400001 - 401084
1301 – 1384	Existing Natural Stands >= 81 years old, Max volume 200 to 350 m³/ha	THLB	400001 - 401084
1301 – 1384	Existing Natural Stands >= 81 years old, Max volume >350 m³/ha	THLB	400001 - 401084
11001 – 11084	Existing Natural Stands (non-THLB)	Non-THLB	
100001 - 100084	White Rock Lake Fire Salvage Stands	THLB	400001 - 401084
200001 – 201484	Un-salvaged burnt stands with ages reset due to fire	PFLB	400001 - 401084
300001 – 300084	Existing Managed without opening, 37 to 52 years old (1971-1986)	PFLB	400001 - 401084
300101 – 301999	Existing Managed with opening, 37 to 52 years old (1971-1986)	PFLB	400001 - 401084
302001 – 302084	Existing Managed without opening, 32 to 36 years old (1987-1991)	PFLB	400001 - 401084
302101 – 303999	Existing Managed with opening, 32 to 36 years old (1987-1991)	PFLB	400001 - 401084
304001 – 304084	Existing Managed without opening, 26 to 31 years old (1992-1997)	PFLB	400001 - 401084
304101 – 305999	Existing Managed with opening, 26 to 31 years old (1992-1997)	PFLB	400001 - 401084
306001 – 306084	Existing Managed without opening, 13 to 25 years old (1998-2010)	PFLB	400001 - 401084
306101 – 307999	Existing Managed with opening, 13 to 25 years old (1998-2010)	PFLB	400001 - 401084
308001 – 308084	Existing Managed without opening, 6 to 12 years old (2011-2017)	PFLB	400001 - 401084
308101 – 309999	Existing Managed with opening, 6 to 12 years old (2011-2017)	PFLB	400001 - 401084
310001 – 310084	Existing Managed without opening, 1 to 5 years old (2018-2021)	PFLB	400001 - 401084
310101 – 311999	Existing Managed with opening, 1 to 5 years old (2018-2021)	PFLB	400001 - 401084
400001 – 400084	Future Managed stands without future road reduction	THLB	400001 - 401084
401001 – 401084	Future Managed stands with future road reduction	THLB	400001 - 401084
600001 – 600084	Future stands following disturbance in non-THLB	Non-THLB	600001 - 600084

9.2 NON-TIMBER RESOURCES

The forest estate model used for this analysis (PATCHWORKS ™) does not require that unique, mutually exclusive zones be established to model non-timber resource requirements. Rather, stands are assigned to non-timber values based on their geographic location to allow objectives to be formulated for those values in the modeling framework. In general, a single stand will often belong and contribute to the status of more than one non-timber resource.

Table 18 provides an overview summary of the aggregations that will be used in this analysis to model non-timber resource objectives. Further details concerning the aggregation and model formulation are found in the sections of this report cross referenced in the table.

Table 18 Aggregation for non-timber resources

Non-timber Resource	Aggregation Level	Objective Type	Section Cross Reference
Landscape level biodiversity	Landscape unit, BEC	Min. Retention	Section 12.2.1
Adjacency	NDT,TFL Block	Patch Size	Section 12.2.3
Watershed health	Watershed/snowline	Max. Disturbance (ECA)	Section 12.2.4
Visual quality	Visual landscape inv. polygon	Max. Disturbance	Section 12.2.5
Mule deer winter range	Mule deer planning cell	Min. Retention/ Max. Disturbance	Section 12.2.6
Moose winter range	Moose planning cell	Min. Retention/Max. Disturbance	Section 12.2.7
Bighorn sheep	Sheep planning cell	Min. Retention	Section 12.2.8
Mountain goat	Goat planning cell	Max. Disturbance	Section 12.2.9
Bear Creek trails	Buffered polygon	Max. Disturbance	Section 12.2.10

10 Growth and Yield

Forest estate modelling requires estimates for attributes such as net volume, species composition, and diameter for different stand types over time as the stands age. Growth and yield assumptions describe how these attributes are developed and incorporated in the model for natural and managed stands.

This section describes the information, data sources, assumptions, and methods for generating growth and yield estimates for TFL 49.

10.1 SITE INDEX

Site index is an estimate of site productivity for tree growth and provides a common base for comparing the productivity of different sites. Site index is species-specific and is expressed as the height of the dominant trees at the reference age of 50 years.

The LiDAR based forest inventory contains an estimate of site index for each forested polygon calculated using the height and age attributes present in the inventory. In general, site indices for older stands are underestimated using this methodology, and site indices for younger stands are dependent on the accuracy of both stand heights and stand ages. Site index for stands less than 20 years old is also unreliable when calculated using age and height. Therefore, the potential site index for managed stands in timber supply analyses is generally derived from the provincial site productivity layer maintained by the Ministry of Forests. In the case of TFL 49, the LiDAR based inventory results in accurate estimates of stand height, and ages are also accurate for stands less than or equal to 51 years as they were derived from RESULTs data. As a result, this analysis will use the inventory site index for stands 20 to 50 years old and the provincial site productivity layer for all other stands when estimating the potential site index for input into the TIPSY model used to generate managed stand yields.

Figure 7 provides a comparison of inventory site index with the managed stand site index for stands in the THLB. Overall, the weighted managed stand site index is 18.5 metres versus 17.8 metres for the inventory site index.

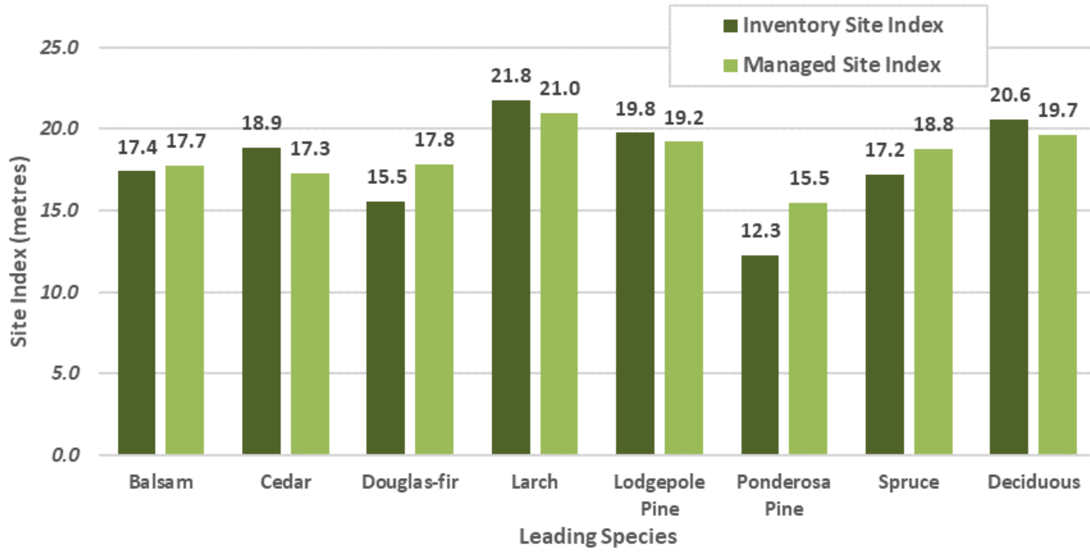

Figure 7 Site index comparison by species

10.2 UTILIZATION LEVELS

Utilization levels define the portion of the tree considered to be merchantable volume. Standards for utilization are specified in the cutting authority for the licence, and volume that meets these standards is charged against the allowable annual cut. The minimum merchantable timber specifications for TFL 49 are shown in Table 19. These will be used for all species and analysis units (natural and managed) when developing the yield tables for this analysis.

Table 19 Utilization levels

Species	Minimum Diameter at Breast Height	Maximum Stump Height	Minimum Top Diameter Inside Bark
Lodgepole pine	12.5 cm	30.0 cm	10.0 cm
Other conifer	17.5 cm	30.0 cm	10.0 cm

10.3 DECAY, WASTE, AND BREAKAGE

For natural stands, default reductions to stand volume for decay, waste and breakage will be applied in the Variable Density Yield Projection (VDYP 7) model. Within the TIPSY model used for managed stands, the default Operational Adjustment Factor 2 (OAF2) will be applied to account for merchantable volume losses due to decay, waste, and breakage (Section 10.6.5).

10.4 VOLUME REDUCTIONS

Deciduous volumes were removed from all yield tables by not including reported deciduous volumes from TIPSY or VDYP in total merchantable volume. In addition, future managed stand yield tables for existing natural stands will be reduced by 0.8% in the model to account for future roads (see Section 8.4.2).

10.5 YIELD TABLES FOR NATURAL STANDS

Although the inventory for TFL 49 has attributes that show harvest dating from 1950, the first evidence of planting occurring is in 1971. For this analysis, all stands without a logging history or stands older than 52 years old (the approximate age of stands established in 1971) will be considered natural for purposes of yield table development. Yield tables for natural stands were created using the Variable Density Yield Table Projection (VDYP 7) model (version 7.19h, VDYPSI version 7.13c, SINDEX Version 1.51).

Details regarding the creation of yield tables for each stand in the LiDAR inventory are provided below. Once these individual yield tables were created, they were used to create yield tables for the analysis units used in the modelling by area-weighting their contribution to the analysis unit.

10.5.1 CREATION OF VDYP INPUT FILES

The LiDAR inventory has a reliable estimate of existing stand volume for each polygon based on the relationship between LiDAR attributes and field sampled volume. To create yield tables that project future growth, the LiDAR inventory attributes of age, height, basal area, stems per hectare, and crown closure for live stems were used to develop an initial VDYP input record for each inventory polygon. It was found that the yield tables created by VDYP overestimated the existing inventory volume by about 11.8% for stands greater than 52 years old. Figure 8 shows a comparison of the LiDAR volumes versus the initial VDYP predicted volumes.

To correct for this difference, the density attributes (basal area, stems per hectare, and crown closure) were proportionately adjusted in the VDYP input records so that a better correlation was obtained between existing live volume and predicted volume. Figure 9 shows the comparison of predicted VDYP volumes with existing LiDAR volume after the adjustment to VDYP inputs was completed. There were a few polygons that could not be fully adjusted because the VDYP inputs would have unreasonable values.

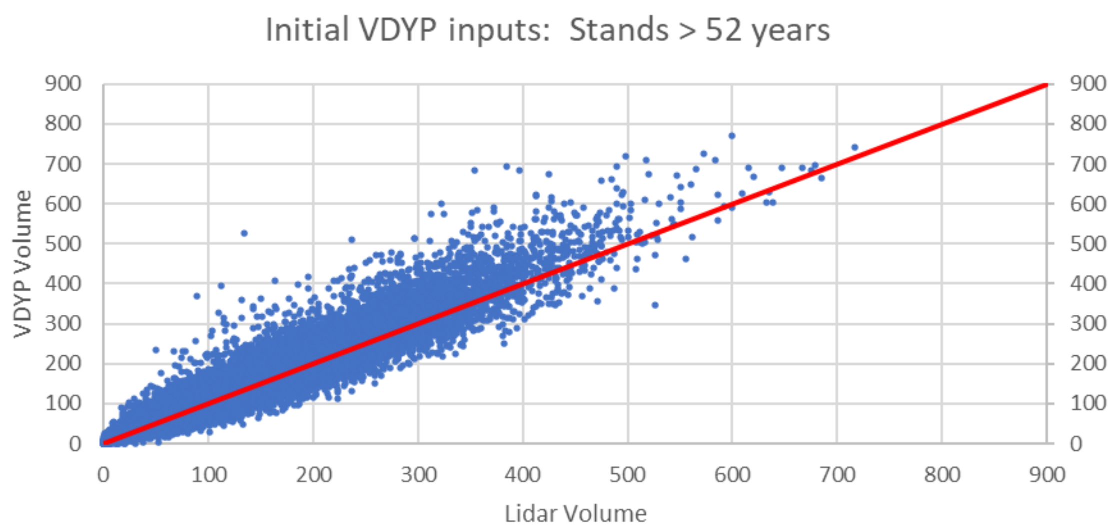

Figure 8 Comparison of LiDAR volume and unadjusted VDYP volumes

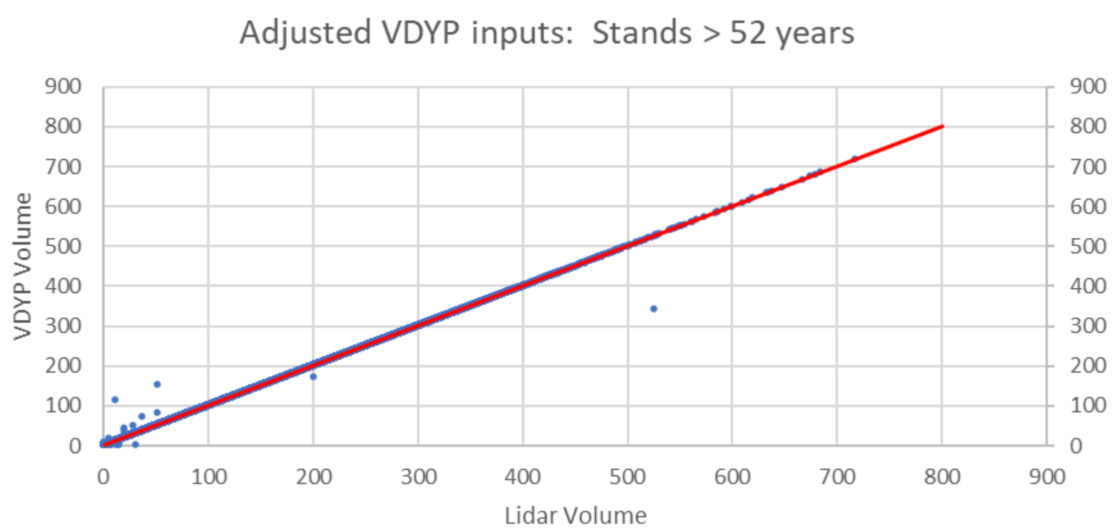

Figure 9 Comparison of LiDAR volume and adjusted VDYP volumes

10.5.2 ADJUSTMENT FOR STANDS WITH DEAD VOLUME

The LiDAR inventory contains attributes for both estimated live and dead volumes present within the stands. While the source of these dead volumes is not always known, there have been infestations of mountain pine beetle, spruce beetle, and Douglas-fir bark beetle in the past.

The VDYP input files were calibrated to match the current live volumes and project these through time. However, the projections do not account for the growing space occupied by the dead trees that will eventually be replaced with an understorey that can contribute to future harvest volumes if the stand is not harvested in the short or medium term. This can result in stands being removed from the THLB because of low productivity when they in fact have the potential to contribute to future timber supply. Therefore, yield tables that account for this future growth were created for stands with more than 10 percent current dead volume, as follows:

- A VDYP curve was created using the density attributes for both the live and dead stand components combined. These inputs were adjusted in a similar manner to that described in Section 10.5.1 above so that the predicted volume was similar to the total live and dead LiDAR inventory volume. This yield curve represents the expected yield for the polygon if the dead component was still alive.
- The difference between the above yield curve and the live yield curve was calculated to create a curve representing the growth of the dead trees.
- The curve representing the growth of the dead trees was shifted along the age axis so that it started at the reference year of the inventory
- The yield table for the live component was added to the curve representing the understory to create the final yield table for the polygon.

Figure 10 illustrates the results of this approach for a stand that is currently 150 years old and 41 percent dead. The predicted understory curve does not contribute to the total stand volume for another 55 years when it reaches 205 years old. This ensures that short-term harvest levels reflect the current growing stock, while recognizing that there will likely be understorey growth in the future to replace the current dead volume component.

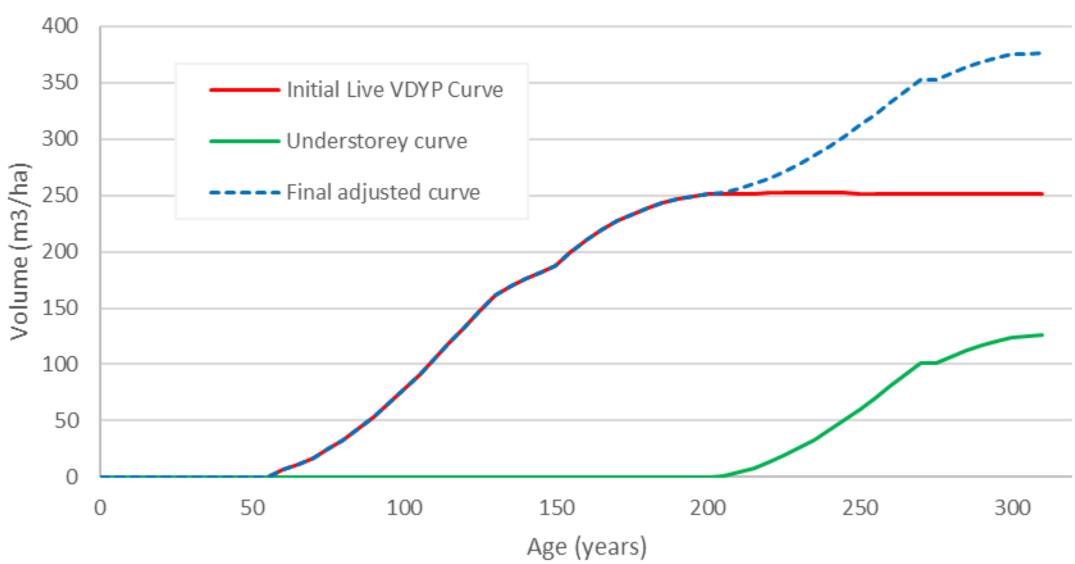

Figure 10 Example yield table adjusted for understorey growth to replace dead component

10.5.3 TERRACE MOUNTAIN AND FALKLAND FIRE LOW VOLUME STANDS

The Terrace Mountain Fire occurred in 2009 and affected a large area of Block A south of Shorts Creek, and a fire in the Falkland area in 2003 affected a portion of Block C. Salvage operations were completed shortly after these fires and the LiDAR inventory reflects the current stand characteristics for unharvested stands that were affected by the fires. For burned stands that were not salvaged, there are examples in the inventory where it is apparent that the projected VDYP yield tables do not account for the future growth potential of the site. These stands have mature ages with low crown closure and reasonable site indices. The adjustment made for dead volume described in Section 10.5.2 does not always work for these stands because the remaining dead volume has been reduced as a result of the fire. For these stands, the following approach was used.

- Average yield tables by biogeoclimatic subzone and 5 metre site index classes were created by area weighting the VDYP yield tables for stands outside the area affected by the fires.
- The difference between the initial live volume yield curve for fire affected stands and the appropriate average yield curve (i.e. same BEC subzone and site index class) was calculated to create a curve representing the difference in growth potential of the stand.
- The curve representing the difference in growth potential was shifted along the age axis so that it started at the reference year of the inventory.
- The yield table for the live component was added to the curve representing the understory to create the final yield table for the polygon.

Figure 11 illustrates the results of this adjustment for a stand that is currently 133 years old with a crown closure of 10 percent. The original live volume yield curve produces a maximum volume of about 38 m^3/ha. When the adjustment to account for future understorey growth is made, the stand achieves a merchantable volume of 75 m^3/ha at age 270 (over 137 years from now). Similar to the adjustment for dead volume described in Section 10.5.2, this ensures that short and mid-term harvest levels reflect current growing stock, while recognizing the future growth potential of the site.

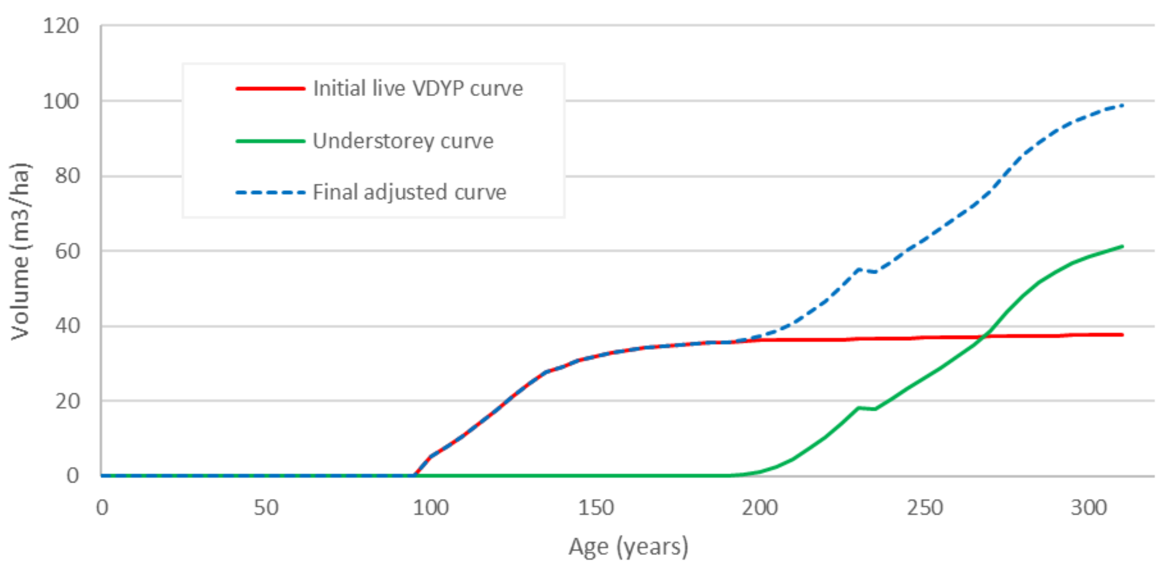

Figure 11 Example yield table for a stand affected by the 2009 Terrace Mountain fire

10.5.4 SALVAGE YIELD TABLES

Yield tables for fire salvage blocks were created by area-weighting the LiDAR inventory live volume for each analysis unit. No further growth was accounted for on the assumption that this volume is dead and is salvaged in the first period of the planning horizon.

10.5.5 EXISTING TIMBER VOLUME COMPARISON

The total volume of the current inventory using LiDAR based polygon specific inventory volumes was compared to the total volume using the natural stand yield table volumes. This step is undertaken to ensure that no errors were made in aggregation and that no significant aggregation bias exists. Managed stand analysis units were not included in this comparison. Table 20 shows the results of this comparison for the timber harvesting land base. Overall, the yield tables are just over 2% higher than the LiDAR based inventory volumes.

Table 20 Existing timber volume check for the THLB

Polygon Description	AU Range	Inventory Volume (m^3)	Yield Table Volume (m^3)	Percent Agreement (yield table/inventory)
Existing Live Natural Stands	1 – 1384	3,802,705	3,891,570	102.3
Salvage Stands	100001 - 100084	329,926	329,930	100.0
Total		**3,802,705**	**3,891,570**	**102.3**

10.6 YIELD TABLES FOR MANAGED STANDS

Managed stands for this analysis are all stands that are 52 years of age and younger where there is a harvest history, and non-free growing stands that were assumed to be burned and regenerated with Section 108 funding during the update process used to account for the 2021 White Rock Lake fire (see Section 7.2). Yield tables were created for these stands using the Table Interpolation for Stand Yields (TIPSY) model, version 4.4, March 25, 2019. Site index for each regenerated species was determined for each managed stand analysis unit using the area weighted average managed stand site index described in Section 10.1. Other TIPSY inputs (species composition, genetic worth, density, and regeneration method) will be discussed in the subsequent sections of this information package.

10.6.1 SILVICULTURE MANAGEMENT ERAS

Existing managed stands were divided into six historic eras that reflect availability of planting records and different levels of genetic worth for the planted stock (see Section 10.6.4). The age of existing stands will be used as a surrogate for these silviculture eras.

An additional era represents non-free growing stands affected by the 2021 White Rock Lake fire that are expected to be reforested under Section 108 of the Forest and Range Practices Act. Finally, an era has been created to represent future managed stands. Table 21 lists the silviculture eras and age ranges that will be used for this analysis.

Table 21 Silviculture eras

Silviculture Era	Age Range	THLB Area (ha)
1971 – 1986	37 to 52 years	9,325
1987 – 1991	32 to 36 years	3,871
1992 - 1997	26 to 31 years	4,604
1998 – 2010	13 to 25 years	13,715
2011 – 2017	6 to 12 years	6,250
2018 – 2021	<= 5 years	2,215
Fire Regeneration - Section 108		3,744
Future Managed		85,126

10.6.1.1 SILVICULTURE ERA 1 (1971 TO 1986)

Planting records indicate that planting first occurred in 1971 within TFL 49. In 1987, forest licensees became legally responsible for reforestation activities. Therefore, the first silviculture era has been defined as stands established between 1971 and 1986.

There are incomplete silviculture records for this era, and not all stands in this era have openings identified in the spatial data. An analysis of RESULTs data where it exists indicates that the proportion of openings that were planted in each biogeoclimatic zone is roughly:

- ESSF: 75%
- ICH: 40%
- IDF: 85%
- MS: 85%

10.6.1.2 SILVICULTURE ERA 2 (1987 TO 1991)

This era represents the period where Tolko was legally responsible for reforestation prior to the first use of Class A seed in the TFL. RESULTs data indicates that the proportion of openings planted by biogeoclimatic zone increased from that prior to 1987, as follows:

- ESSF: 100%
- ICH: 80%
- IDF: 85%
- MS: 92%

10.6.1.3 SILVICULTURE ERA 3 (1992 TO 1997)

This era is characterized by the first use of Class A seed, primarily for planted spruce. RESULTs data indicates that the proportion of stands planted by biogeoclimatic zone is similar to that for the period 1987 to 1991:

- ESSF: 100%
- ICH: 80%

- IDF: 85%
- MS: 92%

10.6.1.4 SILVICULTURE ERA 4 (1998 TO 2010)

Planting increased during this era, with virtually all ESSF, ICH, and IDF stands being planted. The proportion of MS stands that were planted remained the same at 92%. Genetic worth for both lodgepole pine and spruce increased, and Class A seed with improved genetic worth was introduced for western larch.

10.6.1.5 SILVICULTURE ERA 5 (2011 TO 2017)

Planted proportions for this era are the same as those used for the period 1998 to 2010, with all biogeoclimatic zones 100% planted except the MS (92% planted). The genetic worth for both lodgepole pine and spruce both increased significantly during this era.

10.6.1.6 SILVICULTURE ERA 6 (2018 TO 2021)

Tolko's silviculture forester confirmed that virtually all stands were planted during this period, including those in the MS biogeoclimatic zone. Genetic worth for spruce increased when compared with the previous era, and Class A seed was also used for Douglas-fir and a small proportion of the planted ponderosa pine.

10.6.1.7 FUTURE MANAGED STANDS

This era includes all future managed stands. For this era, planting records for the past 10 years on TFL 49 were reviewed to determine species composition and planting density for BEC subzone/previous leading species combinations. These regimes were reviewed by Tolko's silviculture forester and confirmed to be appropriate for expected future silviculture practices with a few minor adjustments. Table 22 summarizes the species and densities that will be used for future managed stands.

For this analysis, the regeneration assumptions for the non-free growing stands burned in the 2021 White Rock Lake fire that are expected to be reforested with Section 108 funding will be the same as for future managed stands.

Table 22 Silviculture regimes for future managed stands

BEC	Leading Species	Base Analysis Units	Regen Method	Density	Species Composition	Regen Delay
ESSFdc2	Sx/Bl	1 – 3	Planted	1325	Sx80 Pl 20	2
	Other	4 - 6	Planted	1325	Sx60 Pl40	2
ESSFdc3	Sx/Bl	7 – 9	Planted	1250	Sx77 Pl23	2
	Other	10 – 12	Planted	1200	Sx50 Pl49 Fd1	2
ICHmk1	Fd/Lw	13 – 15	Planted	1450	Fd49 Pl46 Sx5	2
	Other	16 – 18	Planted	1350	Pl63 Sx21 Fd16	2
ICHmk2	Sx/Bl	19 – 21	Planted	1275	Sx57 Pl38 Fd3 Cw2	2
	Fd/Cw	22 – 24	Planted	1200	Sx44 Pl33 Fd23	2
	Pl	25 – 27	Planted	1200	Pl65 Sx24 Fd10 Lw1	2
ICHxm1	All	28 – 30	Planted	1275	Fd52 Pl25 Lw21 Cw2	2
IDFdk1	Fd/Lw	31 – 33	Planted	1250	Fd56 Pl39 Sx3 Lw1 Py1	2
	Pl	34 – 36	Planted	1050	Pl73 Sx19 Fd8	2
	Other	37 – 39	Planted	1125	Pl45 Fd31 Sx24	2
IDFdk2	Fd/Lw/Py	40 – 42	Planted	1350	Fd62 Pl30 Py5 Sx2 Lw1	2
	Pl	43 - 45	Planted	1150	Pl51 Fd40 Sx8 Py1	2
	Other	46 – 48	Planted	1125	Fd46 Pl46 Sx7 Py1	2
IDFxh1	Fd/Other	49 – 51	Planted	1250	Fd81 Py10 Pl9	2
	Py	52 - 54	Planted	1075	Fd82 Py18	2
IDFxh2	All	55 – 57	Planted	1425	Fd78 Py22	2
MSdm2	Pl	58 – 60	Planted	1250	Pl74 Sx20 Fd6	2
	Sx/Bl	61 – 63	Planted	1250	Pl64 Sx28 Fd5 Lw3	2
	Other	64 – 66	Planted	1150	Pl64 Fd26 Sx8 Py2	2
MSdm3	Pl	67 – 69	Planted	1175	Pl75 Sx25	2
	Sx/Bl	70 – 72	Planted	1400	Pl60 Sx30 Fd10	2
	Other	73 – 75	Planted	1200	Pl55 Fd35 Py8 Sx2	2
MSxk2	Pl/Fd	76 – 78	Planted	1000	Pl84 Sx15 Fd1	2
	Sx/Bl	79 – 81	Planted	1000	Pl75 Sx25	2
PPxh1	All	82 – 84	Planted	1200	Py80 Fd20	2

10.6.2 GENERAL APPROACH FOR TIPSY YIELD TABLES

Where possible, site-specific silviculture information was used to generate the managed stand yield tables. The following subsections describe the approach used for the various levels of available data.

10.6.2.1 PLANTED STANDS WITH IDENTIFIED OPENINGS

Some, but not all, of the existing managed stands have openings identified in the inventory. For these stands where openings are present, two approaches were used to develop the inputs for TIPSY.

For openings with planting records, the species composition, genetic worth, and initial density were summarized from the planting records. A yield table was created with TIPSY using these parameters for each opening.

There were other openings in the data where RESULTs data indicated that the opening had been planted but there were no planting records available. For silviculture eras prior to 2018, these openings used weighted species composition and density derived from the LiDAR inventory attributes. The maximum planting density allowed was 1250 stems per hectare even if the inventory indicated a higher number. Genetic worth was assigned using the average genetic worth values for the specific era. For the most recent silviculture era (2018 to 2021), the TIPSY inputs were the same as for future managed stands.

10.6.2.2 NATURAL STANDS WITH IDENTIFIED OPENINGS

Where RESULTs information indicates that an opening was regenerated naturally, weighted species composition and density were derived from the LiDAR inventory attributes for the stands included in the opening. A minimum density of 800 stems per hectare was used for openings that were below this threshold. TIPSY yield tables were created for each opening using these parameters and the "Natural" regeneration option. Genetic worth was not assigned to these natural yield tables.

10.6.2.3 IDENTIFIED OPENINGS WITH UNKNOWN REGENERATION TYPE

In some cases, the regeneration type for openings could not be identified from the RESULTs data. For these openings, the weighted species composition and density were derived from the LiDAR inventory attributes for the stands included in the opening. A minimum density of 800 stems per hectare was used for openings that were below this threshold. Both a "Planted" and a "Natural" TIPSY yield table was created for each opening using these inputs, with the density for the "Planted" table limited to a maximum of 1250 stems per hectare. Genetic worth was not assigned to either the planted or natural tables. These two yield tables were then weighted according to the historic planted/natural proportions by BEC zone and silviculture era described in Section 10.6.1.

10.6.2.4 STANDS WITHOUT IDENTIFIED OPENINGS

In some cases, particularly for older managed stands, there is no opening identified. Tolko's silviculture forester has indicated that although there is no silviculture information available, it is likely that these stands followed the same general reforestation practices that were used for that era. Therefore, a similar approach was used to that described for identified openings with unknown regeneration type. The analysis units for these stands were created using the base analysis units and silviculture eras (see Section 9.1). Weighted species composition and density by biogeoclimatic zone/silviculture era were derived from the LiDAR inventory attributes. A minimum density of 800 stems per hectare was used for combinations where the density was below this threshold. Both a "Planted" and a "Natural" TIPSY yield table was created for each analysis unit using these inputs, with the density for the "Planted" table limited to a maximum of 1250 stems per hectare. Genetic worth was not assigned to either the planted or natural tables. These two yield tables were then weighted according to the historic planted/natural proportions by BEC zone and silviculture era described in Section 10.6.1.

10.6.3 REGENERATION DELAY

Regeneration delay is the time elapsed between harvesting and the establishment of a new stand of trees, taking into account the age of the planted trees. For this analysis, regeneration delays will be applied in the yield tables when they are created using TIPSY. Tolko typically experiences regeneration delays of two years or less for planted stands, and four years when stands regenerate naturally. These regeneration delays will be used for this analysis.

As discussed in Section 7.2, an additional regeneration delay has been incorporated into the age of stands impacted by the White Rock Lake fire.

10.6.4 GENETIC IMPROVEMENT

Planting records from RESULTs were combined with the genetic worth for each planted seedlot to evaluate the historic use of Class A seed in TFL 49. The first use of Class A spruce seed occurred in 1992. Class A seed was first used for lodgepole pine in 1998, and for western larch in 2002. In contrast, there was no use of Class A seed for Douglas-fir until 2018. A small amount of Class A seed was also used for ponderosa pine in 2018.

Genetic worth values for these species were reviewed to develop four silviculture eras with similar genetic worth characteristics. For example, the use of Class A seed for Douglas-fir in 2018 and an increase in the genetic worth of spruce seed at about the same time suggests that the period from 2018 to 2021 would be a logical silviculture era. Table 23 summarizes the weighted genetic worth by species and silviculture era for TFL 49. The values shown for the period 2018 to 2021 will be used for future managed stands. For existing managed stands where planting records are available, genetic worth will be based on the actual trees planted in the opening and genetic worth will not be used for managed stands without planting records

Table 23 Genetic worth

Period	Lodgepole Pine	Spruce	Douglas-fir	Western Larch	Ponderosa Pine
1992 - 1997					
Total Trees Planted	4,075,704	2,591,235	373,747	125,791	96,871
Improved Trees Planted	53,480	2,145,823	-	-	-
Genetic Worth of Improved	3.00	2.95	-	-	-
Weighted Genetic Worth	**0.04**	**2.44**	**-**	**-**	**-**
1998 - 2010					
Total Trees Planted	15,919,113	5,529,064	2,639,440	212,775	257,570
Improved Trees Planted	5,823,366	5,154,576	-	50,220	-
Genetic Worth of Improved	7.23	8.33	-	11.36	-
Weighted Genetic Worth	**2.65**	**7.77**	**-**	**2.68**	**-**
2011 - 2017					
Total Trees Planted	6,210,683	3,345,098	784,255	57,630	3,870
Improved Trees Planted	4,237,709	3,199,853	-	-	-
Genetic Worth of Improved	14.62	16.78	-	-	-
Weighted Genetic Worth	**9.98**	**16.05**	**-**	**-**	**-**
2018 - 2021					
Total Trees Planted	1,965,900	898,220	2,182,130	57,330	163,740
Improved Trees Planted	1,617,330	898,220	621,720	57,330	8,960
Genetic Worth of Improved	10.85	19.93	24.72	21.46	7.00
Weighted Genetic Worth	**8.93**	**19.93**	**7.04**	**21.46**	**0.38**

10.6.5 OPERATIONAL ADJUSTMENT FACTORS FOR MANAGED STANDS

The TIPSY projection model reports the potential yield of a specific site, species and management regime. Operational adjustment factors (OAFs) were applied to reflect the operational environment accordingly:

- OAF1 of 15% to address a constant reduction for unmapped stocking gaps (e.g., non-productive areas, management effects, and losses due to forest health and random risk factors). Tolko believes this value is conservative and will undertake a sensitivity analysis with a reduced OAF1 consistent with that used in the previous management plan.
- OAF2 of 5% to address dynamic reductions over the life of the stand such as decay, waste and breakage and some forest health concerns.

10.7 NOT SATISFACTORILY RESTOCKED

Not satisfactorily restocked (NSR) is defined as a forested area that does not have enough well-spaced trees of desirable species. Backlog NSR refers to stands disturbed prior to 1987 that are not declared as satisfactorily restocked. Backlog NSR is not considered to be an issue in TFL 49 and was therefore not addressed in this analysis. Current NSR typically refers to stands recently disturbed (i.e., since 1987) that are not yet declared as being stocked.

Current NSR is addressed in the analysis as part of the regular regeneration assumptions described in Section 10.6.

11 Protection

Damage to timber caused by fire, wind, insects, diseases and other pests contribute to loss in harvestable volumes. This volume loss is difficult to quantify, although losses to insect and disease that are normally found in stands (i.e. endemic losses) are accounted for in yield table estimates. Depending on the type of damage and stand accessibility, losses due to catastrophic or epidemic events may be either salvageable or un-salvageable and are not accounted for in the yield tables.

TFL 49 has good road access virtually throughout which allow occurrences of catastrophic stand damage to easily be detected and accessible for salvage harvesting. Salvage operations are normally carried out using amendments to existing cutting authorities, or by developing new cutting permits. Stands within the THLB that are damaged and not recovered are usually small, isolated, or of marginal quality.

11.1 UN-SALVAGED LOSSES

Average un-salvaged losses for the past 10 years, excluding those within the 2021 catastrophic White Rock Lake fire were estimated for TFL 49 using aerial overview survey data obtained from DataBC. Table 24 summarizes these un-salvaged losses, and further details are provided in Appendix 1. Annual harvest volumes determined using the timber supply model will be reduced by this amount (2,940 m^3/year) when harvest flows are reported. Losses due to the White Rock Lake fire are dealt with through the updates to the forest inventory as outlined in Section 7.2.

Table 24 Un-salvaged losses

Loss Category	Annual Volume (m^3/year)
Mountain pine beetle	95
Spruce beetle	0
Douglas-fir bark beetle	699
Balsam bark beetle	910
Windthrow	65
Drought mortality	938
Wildfire	232
Total	**2,940**

12 Integrated Resource Management

This section describes the criteria and considerations used to model non-timber resources.

12.1 FOREST RESOURCE INVENTORIES

The status of the non-timber resource inventories used in this analysis has previously been described in Section 6. If required, additional details will be provided in the individual sections below.

12.2 NON-TIMBER FOREST RESOURCE MANAGEMENT

Forest cover requirements and maximum disturbance objectives are applied within the timber supply model to recognize timber and non-timber resource objectives. These requirements maintain appropriate levels of specific forest types needed to satisfy the objectives for wildlife habitat, biological diversity, etc. and are used by the model to limit harvesting within the THLB.

12.2.1 LANDSCAPE-LEVEL BIODIVERSITY

The *Order Establishing Provincial Non-Spatial Old Growth Objectives, June 2004* specifies the required retention of old seral stage by landscape unit, biodiversity emphasis option, and biogeoclimatic subzone. Although Appendix 2 in this order provides required hectares by THLB/non-THLB for each landscape unit/subzone, the OGMAs described in Section 8.12 were developed to address these requirements. There have also been several updates to the BEC since the order was created, the TFL boundary has changed, and the THLB has been revised which makes it very difficult to match the targets outlined in the Appendix. The order also allows for an initial 2/3 reduction of the targets in low biodiversity emphasis landscape units, with the full targets being met by the end of the third rotation, or 240 years from the date of the order. For these reasons, this analysis will implement the percent old seral targets outlined in the order using the BEC version 12 subzones. The initial 2/3 reduction in the targets will be used, and the model will be configured to meet 2/3 of the full target by the end of the second rotation and the full target by the end of the third rotation with a 20 year adjustment to account for the elapsed times since the date of the order. Table 25 summarizes these requirements.

Table 25 Old seral requirements

LU	Bio-diversity Emphasis	BEC (v12)	NDT	Productive Forest Area (ha)	Old Seral Age (years)	Initial Old Seral Required (%)	Old Required by End of 3rd Rotation (%)
Okanagan West Side	Low	ESSFdc2	3	1,230.4	>140	4.7*	14
		ICHmk1	3	4.7	>140	4.7*	14
		MSdm2	3	1,377.5	>140	4.7*	14
		ICHxm1	4	253.1	>250	4.3*	13
		IDFxh1	4	45.9	>250	4.3*	13
Trepanier	Low	ESSFdc2	3	8,232.0	>140	4.7*	14
		ICHmk1	3	753.4	>140	4.7*	14
		MSdm2	3	23,249.4	>140	4.7*	14
		ICHxm1	4	760.1	>250	4.3*	13
		IDFdk2	4	5,305.9	>250	4.3*	13
		IDFxh1	4	2,521.7	>250	4.3*	13
		PPxh1	4	228.5	>250	4.3*	13
Upper Salmon	Low	ESSFdc2	3	6,454.9	>140	4.7*	14
		ESSFdc3	3	5,816.0	>140	4.7*	14
		ICHmk2	3	2,583.6	>140	4.7*	14
		MSdm2	3	16,002.6	>140	4.7*	14
		MSdm3	3	1,607.4	>140	4.7*	14
		MSxk2	3	1,040.6	>140	4.7*	14
		ICHxm1	4	1,884.3	>250	4.3*	13
		IDFdk1	4	5,610.5	>250	4.3*	13
		IDFdk2	4	19,034.5	>250	4.3*	13
		IDFxh1	4	237.1	>250	4.3*	13
		IDFxh2	4	1,860.8	>250	4.3*	13

**** Initial target drawn down by 2/3***

12.2.2 STAND-LEVEL BIODIVERSITY

Wildlife tree retention targets consistent with Tolko's FSP have been addressed through a THLB reduction as specified in Section 8.16. Therefore, no additional requirements will be implemented in the analysis.

12.2.3 PATCH SIZE DISTRIBUTION

Tolko's planning process for proposed cutblocks attempts to be consistent with the patch size distribution regimes outlined in the Landscape Unit Planning Guidebook, with the desired future condition for the managed landscape outlined in Table 26.

Patch size targets for young seral stands less than 20 years old within 50 metres of each other will be implemented by Natural Disturbance Type in the model within each of the three geographic TFL blocks. The intent is to move the current patch size distribution toward the desired future condition, recognizing that this may take some time to achieve, and in some cases may not be possible. Accordingly, the relative priority set for this objective will be chosen to encourage achievement of that targets over time rather than absolute conformance.

Table 26 Patch size targets

Natural Disturbance Type	Patch Size	Target Distribution
NDT3a (fir absent)	Small: (0 to 40 hectares)	10 to 20 % of land base
	Medium: (40 to 250 hectares)	10 to 20 % of land base
	Large: (250 to 1000 hectares)	60 to 80 % of land base
NDT3b (fir throughout)	Small: (0 to 40 hectares)	20 to 30 % of land base
	Medium: (40 to 80 hectares)	25 to 40 % of land base
	Large: (80 to 250 hectares)	30 to 50 % of land base
NDT4	Small: (0 to 40 hectares)	30 to 40 % of land base
	Medium: (40 to 80 hectares)	30 to 40 % of land base
	Large: (80 to 250 hectares)	20 to 30 % of land base

12.2.4 WATERSHED HEALTH

The level of disturbance in a watershed can impact stream flows, sediment delivery, channel stability, riparian function and aquatic habitat. Assessing equivalent clearcut areas (ECA) is a coarse-level indicator of forest disturbance and recovery in a watershed. ECAs can help identify when a professional hydrologist should be consulted for management recommendations, and individual watersheds often have different ECA disturbance limits before harvesting is affected. ECA is a function of stand height, and will be calculated using the following equation (Winkler and Boon 2017), which is shown graphically in Figure 12:

ECA percent = 100 – (100*(1-exp(-0.24*(height-2)))**2.909)

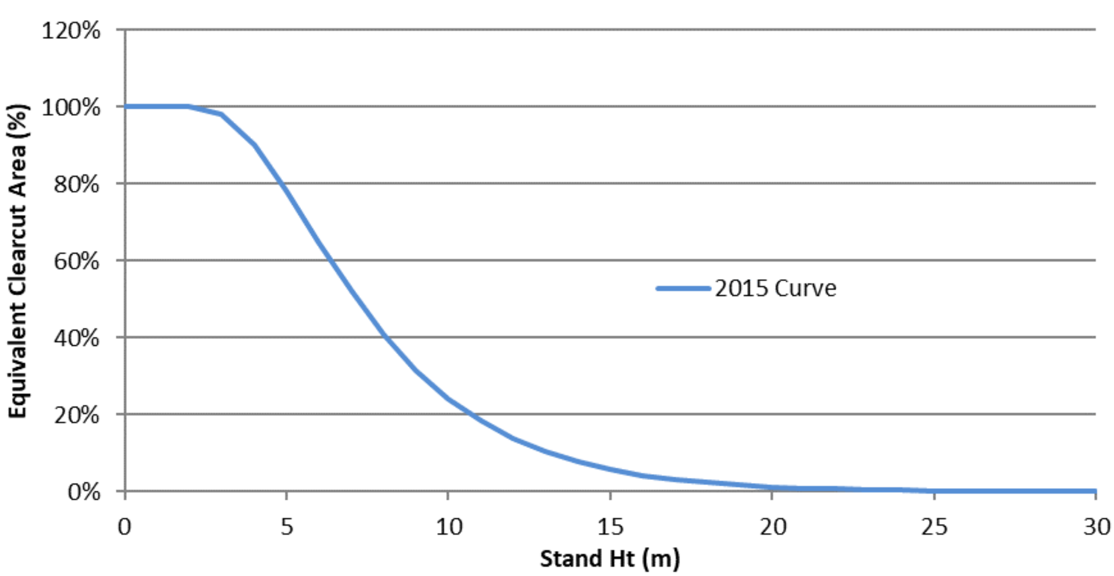

Figure 12 Equivalent clearcut area as function of stand height

The ECA within the area above the snowline at the onset of peak flow is generally the most important when considering ECA thresholds for watershed management. For this analysis, snowlines are based on biogeoclimatic zones (Version 9), with both the MS and ESSF zones considered to be above the snowline.

In accordance with standard practice, ECA calculations will be based on the gross area of the watershed unit above the snowline, with adjustments made for permanent ECA due to anthropogenic disturbances in the non-forested land base.

12.2.4.1 COMMUNITY WATERSHEDS

Portions of three community watersheds overlap with TFL 49, as summarized in Table 27. Tolko's current practice is to manage to a moderate peak flow hazard for the area above the snowline in these watersheds, which will be modelled by limiting ECA to a maximum of 40% above the snowline.

Table 27 Community watershed summary

Watershed Name	Maximum ECA above snowline	Gross Area above snowline (ha)*	PFLB Area above snowline (ha)*	THLB Area above snowline (ha)*
Lambly	40%	14,020.1	13,503.3	11,339.63
Powers	40%	7,634.6	7,348.5	6,348.0
Silver	40%	220.0	217.8	173.3
Total		**21,874.7**	**21,069.6**	**17,860.6**

**** Only includes the portion within TFL 49***

12.2.4.2 FISHERIES SENSITIVE WATERSHEDS

A portion of the Short's Creek fisheries sensitive watershed overlaps with TFL 49. The gross area above the snowline is 13,345.3 hectares, of which 12,842.4 hectares is PFLB, and 10,128.2 hectares is THLB. Similar to community watersheds, the area above the snowline will be limited to a maximum ECA of 40%.

12.2.4.3 OTHER WATERSHEDS

Tolko has identified watershed reporting units for most of their operating area in the southern interior, including TFL 49. The FRPA Base Case will implement a maximum ECA of 50% above the snowline for these watersheds. Table 28 summarizes the areas within these other watersheds.

Table 28 Other watershed summary

Watershed Reporting Unit	Maximum ECA above snowline	Gross Area above snowline (ha)*	PFLB Area above snowline (ha)*	THLB Area above snowline (ha)*
Bolean-Arthur	50%	6,743.9	6,455.6	5,400.3
Goodwin Creek	50%	1,528.4	1,478.7	1,293.3
Monte Creek	50%	3,485.1	3,396.5	2,706.7
Munro Creek	50%	610.1	576.1	527.2
Rush Creek	50%	5.6	5.6	5.5
Salmon River Below Nash	50%	8,040.9	7,811.5	6,520.4
Cain Creek	50%	2,689.5	2,636.2	2,209.8
Ingram Creek	50%	280.2	246.7	205.1
Spa Creek	50%	594.7	506.5	383.4
Twig Creek	50%	1,139.0	1,108.8	973.4
Warren Creek	50%	493.6	478.8	400.3
Weyman Creek	50%	7,141.8	6,817.1	5,776.0
Total		**32,752.8**	**31,518.1**	**26,401.4**

**** Only includes portion within TFL 49***

12.2.5 VISUAL QUALITY

Tolko's forest stewardship plan requires that harvesting and road construction be consistent with established Visual Quality Objectives (VQOs). Visual Landscape Inventory (VLI) data that includes VQO attributes for each VLI polygon was obtained from Data BC.

VQO requirements will be modelled by limiting the area within each visual VLI polygon that can be below a visually effective green-up (VEG) height, as described in the 2003 Bulletin "*Modelling Visuals in TSR III*". This bulletin provides ranges of permissible % alteration in perspective view for each VQO category. For this analysis, the upper range of the permissible alteration will be used.

There are 93 VLI polygons that overlap with TFL 49. The area by five percent classes within each VLI polygon was determined using LiDAR data. These areas were then used to calculate an area weighted P2P ratio and VEG height for each VLI polygon using the specified values by slope class provided in Table 29. The P2P ratios were then multiplied by the allowable disturbance in perspective view to determine the maximum proportion of the polygon that can be below the VEG height.

Although each VLI polygon will be modelled independently with its own unique P2P adjusted disturbance limits and VEG height, the large number of polygons prevents listing them all in this information package. Therefore, Table 30 provides an overview summary of the areas and weighted valued by VQO class.

Table 29 Slope classes for calculating P2P ratio and VEG height

	0-5%	5-10%	10-15%	15-20%	20-25%	25-30%	30-35%	35-40%	40-45%	45-50%	50-55%	55-60%	60-65%	65-70%	70+%
P2P	4.68	4.23	3.77	3.41	3.04	2.75	2.45	2.22	1.98	1.79	1.60	1.45	1.29	1.17	1.04
VEG	3.00	3.50	4.0	4.50	5.00	5.50	6.00	6.50	6.50	7.00	7.50	8.00	8.50	8.50	8.50

Table 30 Average maximum allowable proportions below VEG height by VQO

VQO	Number of Polygons	Productive Forest Area (ha)	THLB Area (ha)	Maximum Perspective Disturbance (%)	P2P Ratio	Maximum Planimetric Disturbance (%)	VEG Height (m)
Retention	24	3,532.8	2,267.9	1.5	2.9	4.4	5.4
Partial Retention	39	7,229.2	4,940.7	7.0	2.5	17.6	6.0
Modification	30	4,150.6	3,389.7	18.0	3.1	56.4	5.0
	93	**14,912.6**	**10,598.3**				

12.2.6 MULE DEER WINTER RANGE

GAR order #u-8-001 signed October 1st, 2006 outlines the requirements for management of mule deer winter range in TFL 49. Although many of the requirements in the order are operational in nature, there are a number that affect timber supply at the strategic level and will be applied in this analysis.

12.2.6.1 SNOW INTERCEPTION COVER

The General Wildlife Measures in the order specify the amount of snow interception cover (SIC) in hectares that must be retained within each mule deer winter range planning cell. There are 72 mule deer planning cells within TFL 49, of which 20 planning cells also contain area outside the TFL. For these planning cells, the required SIC was determined by pro-rating the requirement for the entire planning cell by the relative proportions of forested area inside and outside the TFL boundary. Private land was excluded from this calculation as the GAR order does not apply to private land areas. The model will be configured to retain the required number of hectares of SIC in each planning cell. The overall SIC requirement is 3,904 hectares or 22.8% of the PFLB within mule deer winter range.

Snowpack zones are defined in the GAR order by biogeoclimatic subzone using BEC version 6. Table 31 summarizes the areas within mule deer winter range and the required attributes for a stand to be considered as suitable snow interception cover. Although the LiDAR based inventory provides an accurate representation of the current crown closure for individual stands, the VDYP model used to project natural stands does not allow for projection of crown closure changes into the future. As a result, crown closure will not be considered in the definition of SIC in this analysis. This approach may be more restrictive than the requirements of the GAR order because the model may retain stands with lower crown closure to meet the SIC targets. In other words, the area to be reserved from harvest will be achieved even if there aren't enough stands with sufficient crown closure. In practice, these stands could be harvested if they are unlikely to develop SIC attributes over time.

The GAR order also indicates that up to 50% of the required snow interception cover in the moderate snowpack zone (other than in the IDF mw BEC subzone) can be in the non-THLB. There is no restriction on the amount of snow interception cover that can be in the non-THLB for shallow or deep snowpack zones, or in the moderate IDFmw zone. For areas in the moderate snowpack zone where this non-THLB restriction applies, an additional target will be set up that requires that at least half of the total SIC be located within the THLB.

Table 31 Areas by snowpack zone and definition of snow interception cover attributes

Snowpack Zone	PFLB Area (ha)	THLB Area (ha)	Biogeoclimatic Units (Version 6)	Dominant Tree Species	Minimum Stand Age (years)	Canopy Closure**	Slope
Shallow	6,700.1	4,510.8	BG (all)	Douglas-fir	>= 140	N/A	N/A
			PP (all)	Douglas-fir	>= 140	N/A	N/A
			IDFxh	Douglas-fir	>= 140	N/A	N/A
Moderate*	10,408.0	6,785.7	IDFdk	Douglas-fir	>= 175	>=36%	<= 80%
			IDFdm	Douglas-fir	>= 175	>=36%	<= 80%
			IDFmw	Douglas-fir	>= 140	>= 36%	<= 80%
			MS (all)	Douglas-fir	>= 175	>= 36%	<= 80%
			ICHdw	Douglas-fir	>= 175	>= 36%	<= 80%
Deep	44.0	29.8	ICH, except ICHdw	Douglas-fir	>= 100	>= 46%	N/A
Total	**17,152.1**	**11,326.3**					

**** THLB land base. For non-THLB in the moderate snowpack, minimum age is 120 years for stands >= 50% Douglas-fir and with a crown closure of at least 36%, or at least 50% for IDFmw.***

***** Crown closure will not be modelled due to limitations in the VDYP yield model***

12.2.6.2 DISTURBANCE LIMITS

The GAR order specifies that for the moderate snowpack zone, no more than 30% of the planning cell can be in stands younger than 20 years old. This requirement will be implemented in the model for areas where it applies.

12.2.7 MOOSE WINTER RANGE

GAR Order #u-8-006 signed July 24th, 2006 outlines the requirements for management of moose winter range within TFL 49. Table 32 summarizes the areas where the GAR Order applies. Three of the General Wildlife Measures in the order affect strategic timber supply and will be modelled in this analysis.

Table 32 Moose winter range areas

Moose Winter Range Unit	PFLB Area (ha)	THLB Area (ha)
11	15,282.0	12,718.1
14	11,868.1	9,879.6
Total	**27,150.1**	**22,597.7**

12.2.7.1 RETENTION OBJECTIVES

The GAR Order includes a retention objective for each moose winter range unit that will be modelled for this timber supply analysis. According to the GAR, at least 33% of the productive forest area must be at least 16 metres in height with a canopy closure of at least 56%. Tolko received an exemption to this requirement in June 2015 that allows stands with lower heights or crown closure to be retained if they meet the intent of the general wildlife measure. The exemption indicates that these areas are spatially located and were provided by Tolko as part of the exemption request. Much of the area to which the exemption applies was affected by the White Rock Lake fire, and other areas will eventually grow to the point where the exemption will need to be rescinded. For these reasons, the requirements of the original GAR order will be modelled.

As discussed in Section 12.2.6.1, the LiDAR based inventory provides an accurate representation of the current crown closure for individual stands. However, the VDYP model used to project natural stands does not allow for projection of crown closure changes into the future. As a result, crown closure will not be considered in the definition of suitable retention in this analysis.

The GAR Order indicates that at least 50% of the required cover should be in patches of at least 20 hectares, if practicable. A patch objective with will be implemented in the model to encourage achievement of this objective. The weight set for this objective will be set so that this is not an absolute requirement, but rather, meets the intent of the "if practicable" qualification.

12.2.7.2 DISTURBANCE OBJECTIVES

The GAR order indicates that to the extent practical, a minimum of 15% of the net forested land base of each winter range is to be less than 25 years old for ICH and IDF biogeoclimatic zones, and less than 35 years for MS and ESSF zones. This objective will be implemented in the model for the PFLB area within each moose winter range unit so that it is not an absolute requirement, but rather, meets the intent of the "if practical" qualification.

12.2.8 BIGHORN SHEEP

The Okanagan Shuswap LRMP Land Use Order signed February 6, 2007 establishes the objective to retain sufficient forest cover during primary forest activities, including sanitation and salvage activities, to provide for the thermal, snow interception and security requirements of bighorn sheep. Table 33 summarizes the areas where these requirements apply.

Tolko's current FSP indicates that at least 33% of the forested area within a bighorn sheep planning cell be at least 16 metres in height with a crown closure of at least 26%. The model will be configured to implement this requirement for the productive forest area within each bighorn sheep planning cell within the TFL. As discussed in Section 12.2.6.1, the LiDAR based inventory provides an accurate representation of the current crown closure for individual stands. However, the VDYP model used to project natural stands does not allow for projection of crown closure changes into the future. As a result, crown closure will not be considered in the definition of suitable retention in this analysis.

Table 33 Bighorn sheep areas

Bighorn Sheep Planning Cell	PFLB Area (ha)	THLB Area (ha)
1018	1,022.3	731.6
1020	894.4	339.3
1021	60.8	43.7
1022	3.5	3.3
1023	53.2	51.8
1024	46.2	29.7
1027	129.9	90.6
1028	30.7	19.0
Total	**2,241.0**	**1,309.0**

12.2.9 MOUNTAIN GOAT

GAR Order #u-8-005 signed July 24th, 2006 outlines the requirements for management of mountain goat winter range within TFL 49. There is one winter range planning unit that overlaps TFL 49. Although most of this unit is outside the TFL, there are 235.7 hectares of productive forest within the TFL boundary, of which 29.1 hectares is THLB.

The order indicates that no more than 33% of the forested area within the unit be less than 33 years of age, which will be implemented in the model for the productive forest land base. It also requires that harvesting reflect a minimum 3 pass system with a 100 year rotation in lodgepole pine leading forests, and a 150 year rotation in forests with other leading species. Because only a small proportion of the THLB is pine leading, the model will be configured so that a maximum of 33% of the THLB can be less than 50 years old.

12.2.10 BEAR CREEK TRAILS

There is an extensive trail network (REC 166988) within TFL 49 that is used for dirt bike riding. Tolko has committed to modified harvesting practices within 100 metres on each side of the trails. These harvest practices are site specific and vary with terrain, access, and timber type. For this analysis, the modified harvesting requirements will be approximated by allowing no more than 10% of the forested area to be less than 5 metres tall. There are 3,692.7 hectares of productive forest within these trail buffers, of which 2,900.2 hectares is THLB.

12.2.11 OTHER RESOURCE FEATURES

There are approximately 27 permanent sample plot or research installations within the TFL. Protection for these features is normally accomplished within reserve areas (i.e. wildlife tree retention) during operational planning. Accordingly, no further modelling assumptions will be applied for other resource features in this analysis.

12.2.12 CUTBLOCK ADJACENCY

Cutblock adjacency, or green-up, is a measure of tree height and site occupancy on a harvested site. The achievement of green-up height is required before adjacent areas may be harvested. There are situations when adjacency requirements are not applied, such as for salvage harvest and when applying patch size distributions consistent with the Biodiversity Guidebook.

The intent of adjacency and/or patch size objectives is to ensure harvesting is distributed appropriately over the land base and no one area is harvested too extensively in a short period of time. Tolko's Forest Stewardship Plan indicates that a green-up height of 2 metres will be used for adjacency purposes. However, because patch size distribution requirements will be applied in the model it is unnecessary to apply additional parameters to reflect adjacency requirements.

12.2.13 CULTURAL HERITAGE RESOURCES

A cultural heritage resource is defined in the Forest Act as an object, site, or location of a traditional societal practice that is of historical, cultural, or archaeological significance to the province, a community, or an aboriginal people. Cultural heritage resources are post-1846 and include structural features, heritage landscape features and traditional use sites. Older cultural heritage resources are considered an archaeological resource and are protected under the Heritage Conservation Act.

First Nations have indicated that TFL 49 contains culturally important plants, animals, lands, waters, and other areas. Tolko has been working with First Nations to identify these areas on a site-specific basis during the field review of proposed cutblocks. Often, these areas are incorporated into the retention associated with the cutblock.

More recently, Tolko has engaged with the Okanagan Nation Alliance (ONA) to develop an understanding and framework for forest management on the TFL. This timber supply analysis will include a Syilx Forest Management scenario that incorporates this framework, as described in Section 13. In addition to increased riparian and in-block retention, it includes a defined zone in the TFL that will be managed primarily for old growth attributes. This zone has also been designed to include larger culturally important areas where harvesting is not supported by the ONA member communities.

Tolko also recognizes that ONA does not speak for all First Nations, and that other First Nations have interests on the land base. However, it is believed that many of the interests will be similar in nature to those expressed by ONA.

12.3 TIMBER HARVESTING

12.3.1 MINIMUM HARVESTABLE AGE / MERCHANTABILITY CRITERIA

Minimum harvest criteria are used to determine the youngest age that stands become available for harvesting. For this analysis, minimum harvest ages will be determined for each analysis unit using the criteria outlined in Table 34. Within the timber supply model, a stand can be considered for harvesting once it meets the defined minimum harvest age. Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives (e.g. maintaining overall harvest levels for a short period of time or avoiding large fluctuations in harvest levels). However, other stands may not be harvested until older than these minimum ages due to management objectives for other resource values.

Table 35 summarizes the minimum harvest ages by stand type/silviculture era and biogeoclimatic zone.

Table 34 Minimum harvest age criteria

Stand Type	Minimum Volume (m³/ha)	Minimum Height (m)	Minimum MAI (% of maximum)	Minimum Age (yrs)
Existing Natural	75	15	N/A	60
Natural Regeneration after 2021 fire	75	15	90%	60
Existing Managed	75	15	90%	50
Future Managed	75	15	90%	50

Table 35 Minimum harvest ages by stand type/silviculture era and BEC zone

Stand Type/Silviculture Era	BEC Zone	Minimum Harvest Age (years)		Average Volume at MHA (m³/ha)	Average MAI at MHA (m³/ha/yr)
		Range	Average		
Natural regeneration after 2021 fire	ESSF	70 – 269	116	135.6	1.33
	ICH	87 – 151	121	119.3	1.11
	IDF	60 – 172	94	151.6	1.80
	MS	60 – 216	102	137.7	1.53
Existing Managed: 1971 - 1986	ESSF	50 – 119	74	252.4	3.51
	ICH	57 – 90	59	283.0	4.82
	IDF	51 – 100	67	226.2	3.44
	MS	50 – 109	65	251.8	3.98
Existing Managed: 1987 - 1991	ESSF	50 – 120	63	265.3	4.42
	ICH	50 – 81	57	272.9	4.83
	IDF	50 – 184	64	224.6	3.60
	MS	50 – 148	59	271.7	4.83
Existing Managed: 1992 - 1997	ESSF	50 – 175	68	267.6	4.32
	ICH	50 – 107	75	222.0	3.61
	IDF	50 – 107	67	228.7	3.83
	MS	50 – 126	60	275.1	4.70
Existing Managed: 1998 - 2010	ESSF	55 – 123	79	231.3	2.99
	ICH	51 – 76	66	233.2	3.53
	IDF	50 – 144	69	220.9	3.23
	MS	53 – 104	67	247.4	3.73
Existing Managed: 2011 - 2017	ESSF	57 – 128	80	235.1	2.98
	ICH	50 – 102	68	236.6	3.55
	IDF	59 – 113	73	199.6	2.79
	MS	50 – 94	65	246.2	3.84
Existing Managed: 2018 - 2021	ESSF	65 – 102	78	241.6	3.13
	ICH	60 – 64	61	219.3	3.57
	IDF	54 – 122	86	177.1	2.16
	MS	56 – 93	67	242.5	3.65
Future Managed	ESSF	50 – 97	75	249.8	3.51
	ICH	50 – 76	62	248.5	4.11
	IDF	51 – 126	75	187.1	2.61
	MS	50 – 93	63	257.1	4.20
	PP	112 – 135	120	234.6	1.96

12.3.2 HARVEST SYSTEMS AND ECONOMIC OPERABILITY

Economic operability of stands depends on both harvest system and average merchantable volume per hectare. In general, the harvest systems used on steeper terrain require a higher average merchantable volume per hectare to be economic. Lower volume stands can be harvested, but they are generally combined with higher volume stands so that the entire cut block will be economic. To ensure that the harvest profile is economic, the model will be configured so that the maximum proportion of lower volume stands is limited depending on the slope class, as summarized in Table 36.

Table 36 Economic operability criteria

Slope Class	Maximum proportion of harvest by volume class				
	< 100 m^3/ha	100 to 150 m^3/ha	150 to 200 m^3/ha	200 to 350 m^3/ha	> 350 m^3/ha
0 to 20%	No limit	No limit	No limit	No limit	No limit
20 to 40%	No limit	No limit	No limit	No limit	No limit
40 to 60%	10%	20%	No limit	No limit	No limit
60 to 80%	10%	10%	20%	No limit	No limit
> 80%	5%	10%	20%	No limit	No limit

12.3.3 CUT BLOCK AGGREGATION

Cut block aggregation will be used so that the analysis reflects operational reality by avoiding harvesting of small isolated units, or "slivers". Two forms of aggregation will be implemented.

1. The individual polygons ("fragments") created by overlaying the various data input layers into the "resultant" layer will be aggregated into larger units called "blocks" prior to modelling. Within the model, blocks are the units that get harvested. Individual fragments that are adjacent, have the same analysis unit and are within 5 years of age are potential candidates to be combined into blocks. The target size for these blocks will be 5 hectares, which may not be achieved in all cases due to the differing attributes of the initial fragments.
2. During the model runs, the patching capabilities of the model will be used to control the spatial distribution of the harvested blocks. The model will be configured to prevent creating harvest patches less than 1 hectare in size.

12.3.4 SILVICULTURE SYSTEMS

Partial cutting is rarely used in TFL 49 at this time. Virtually all harvesting is completed using a clearcut with reserves silviculture system, which is the only silviculture system that will be modelled for this analysis.

12.3.5 INITIAL HARVEST RATE

The current AAC for TFL 49 is 204,000 m^3 per year. However, it is expected that this harvest level will not be possible given the extent of the 2021 White Rock Lake fire. As a result, the initial harvest rate will be determined based on the modelling results.

12.3.6 HARVEST RULES

The model used for this analysis does not explicitly use rules such as "oldest first" to rank stands for harvest. Rather, targets are set for harvest levels and individual non-timber resource requirements (e.g. maximum disturbance in a visual polygon, etc.). Each target in the model is assigned a relative weight that is used by the model to balance the achievement of the targets. Non-timber resource targets are typically assigned a very high weight so that the model will ensure they are achieved. Harvest volume is assigned a lower weight so that harvest is only attractive to the model when all other targets have been addressed.

The model will prioritize harvest of individual blocks to best achieve the overall harvest target subject to the non-timber resource targets being met. Stands will be harvested at the age that balances the requirements of all targets, including harvest.

12.3.7 HARVEST FLOW OBJECTIVES

Forest cover objectives and the growth capacity of the THLB will determine the harvest level options that will be considered. In general, the choice of harvest flow will reflect the following objectives:

- Avoid any large or abrupt disruptions in timber supply during transitions from short to mid to long-term periods (generally increases and decreases in steps of 10% per 10 year period).
- Achieve a stable long-term harvest level over a 300 year planning horizon.
- Ensure that the growing stock on the THLB does not decline during the last 100 years of the planning horizon.

12.4 NATURAL DISTURBANCE ASSUMPTIONS

Natural disturbance assumptions define the extent and frequency of natural disturbances such as fire or epidemic insect infestations across the land base. Within the THLB, natural disturbances are typically addressed through harvesting, with any un-salvaged areas contributing to the allowance for un-salvaged losses as outlined in Section 11.1.

For areas outside the THLB, stands will continuously age throughout the planning horizon unless disturbances are explicitly modelled. This can lead to the non-THLB fulfilling an unrealistic portion of the forest cover requirements for non-timber resources values such as landscape-level biodiversity, visual quality, etc. The assumptions used to model this disturbance are explained below.

For this analysis, a constant area will be disturbed annually within each landscape unit, biogeoclimatic zone and natural disturbance type (NDT) using BEC version 12. The area of disturbance varies based on the biogeoclimatic variants present, their associated natural disturbance intervals and old seral definitions, as outlined in Appendix 8 of the "*Old Growth Technical Advisory Panel Old Growth Deferral Background and Technical Appendices* (2021)". In summary, the process used to calculate the annual disturbed area is:

- Calculate the % Area that is greater than old using the equation

  % area old = exp(-[old age / disturbance interval])

- Calculate the effective rotation age using the equation

  Effective rotation age = disturbance interval / (1-% area old)

- Calculate the annual area disturbed using the equation

Area disturbed = non-THLB area / effective rotation age

Table 37 summarizes the calculations used to determine the annual disturbance limits applied in the forested non-THLB. Within the model, these areas will be allocated to the individual landscape unit/BEC combination according to the relative proportion of the landscape unit within the BEC. Across the Non-THLB, approximately 62 ha (0.34%) is disturbed each year.

Table 37 Annual natural disturbance areas in the forested non-THLB

BGC Zone	NDT	Disturbance Interval (yrs)	"OLD" Defn (yrs)	% Area > OLD*	Effective Rotation Age (yrs)*	Contributing Non-THLB Area (ha)	Annual Area Disturbed (ha)**
ESSFdc2	3	150	141	39%	246	2,070	8
ESSFdc3	3	150	141	39%	246	675	3
ICHmk1	3	150	141	39%	246	440	2
ICHmk2	3	150	141	39%	246	433	2
MSdm2	3	150	141	39%	246	5,941	24
MSdm3	3	150	141	39%	246	554	2
MSxk2	3	150	141	39%	246	113	0
ICHxm1	4	250	251	37%	395	1,251	3
IDFdk1	4	250	251	37%	395	691	2
IDFdk2	4	250	251	37%	395	4,813	12
IDFxh1	4	250	251	37%	395	842	2
IDFxh2	4	250	251	37%	395	473	1
PPxh1	4	250	251	37%	395	107	0
Total					**312**	**18,403**	**62**

***** *% area old – exp([-[old age / disturbance interval]), Effective rotation age = old age / (1-% area old)*

*** Annual area disturbed = (non-THLB area / effective rotation age)*

12.5 CLIMATE CHANGE

Within BC, climate change is expected to include a general increase in temperature, change in precipitation patterns, and an increase in the magnitude, frequency, and intensity of extreme weather events. While the trends are generally consistent, the specific magnitude of these changes, and their spatial and temporal distribution, are uncertain. Many adaptation strategies are being assessed, considered, and implemented across the province. Within TFL 49, examples of adaptation strategies that Tolko are adopting to establish resilient forests include:

- Planting a mix of species on most sites,
- Prompt reforestation following harvest,
- Increased use of ponderosa pine in regeneration of drier sites,
- Increased retention around riparian features, and
- Increased in-block retention in the dry IDF subzones.

Climate change may result in either increases or decreases in productivity of forests in the future. While these changes are largely unknown at this time, sensitivity analyses related to productivity of stands have been incorporated into this analysis and can be used to understand the implications for timber supply if stand productivity changes from current understanding.

As indicated in Section 12.4, the FRPA Base Case includes natural disturbance in the non-THLB using parameters derived from Appendix 8 of the Old Growth Technical Advisory Panel Old Growth Deferral Background and Technical Appendices (2021). However, a sensitivity analysis has been included that will explore the degree to which timber supply is influenced by an increase in natural disturbances in the non-THLB.

Potential changes in the rate of natural disturbance in the timber harvesting land base will either be captured as part of the indicated harvest flow through Tolko's ongoing salvage operations, or through the allowance for un-salvaged losses as discussed in Section 11.1. The un-salvaged losses used for this analysis are derived from recent (i.e. past 10 years) historic levels, excluding catastrophic wildfire which are addressed through the inventory update procedure. These estimates represent our best understanding of the current ongoing losses on the land base. Any future changes in these losses will be captured as part of the next timber supply review which will be completed ten years from now.

13 Syilx Forest Management Scenario

The Syilx Forest Management scenario has been developed collaboratively with ONA and envisions different forest management direction for the TFL than that modelled in the FRPA Base Case scenario. This section documents the key differences from the FRPA Base Case scenario.

13.1 MANAGEMENT ZONATION

Using knowledge gained through on-going operational and strategic discussions with representatives from ONA member communities, Tolko staff have identified two broad zones within TFL 49 that will be used in this analysis (see Figure 13).

13.1.1 ZONE 1

The primary objective within this zone is to manage for old growth attributes. Although some harvesting is envisioned, it will be limited and will be undertaken in a manner that conserves or enhances old growth attributes. In addition to the overall goal of old growth management, other items considered when spatially defining this zone included overall connectivity and protection for:

- Spiritual and other culturally important sites,
- Lakes, wetlands, and streams,
- Sensitive terrain, and
- Recreation features such as the Bear Creek trail network.

13.1.2 ZONE 2

Zone 2 includes those areas of the TFL that are not within Zone 1. This is the area where most forest harvesting is expected to occur. However, there will be enhanced protection for riparian features and increased in-block retention when compared to current FRPA requirements. In addition, there are areas within this zone that are not part of the timber harvesting land base and will be maintained in a natural state, including changes resulting from natural disturbance.

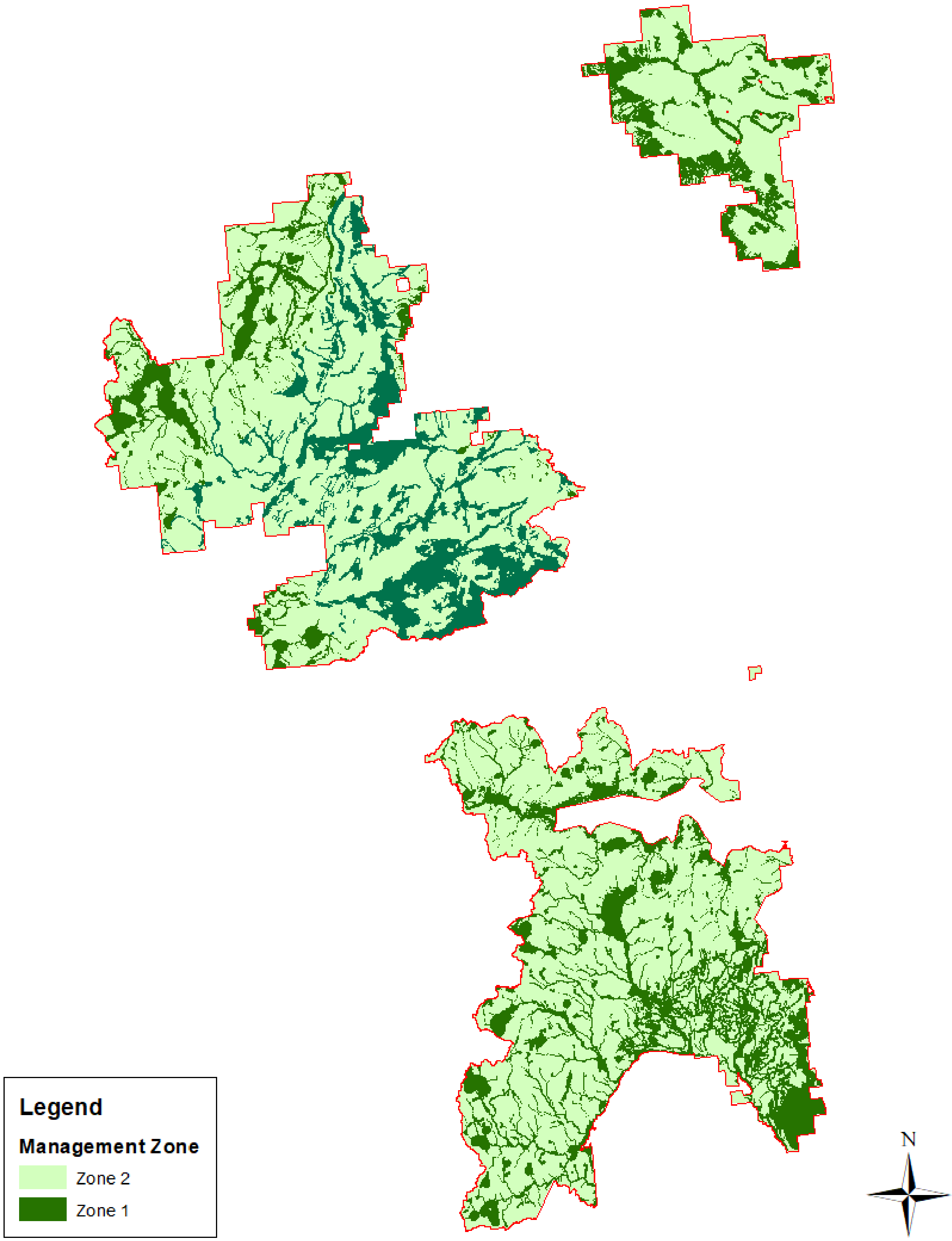

Figure 13 Management zones

13.2 RIPARIAN MANAGEMENT

Water is extremely important to First Nations and ONA member communities have indicated that there must be increased protection for all riparian features. The width of riparian buffers must be flexible to protect the specific attributes of each feature and will be adjusted as necessary during harvest development. Based on field reviews completed to date, Tolko has identified average riparian buffer widths that will be used for this scenario. Table 38 provides a summary of the average riparian buffer widths that will be modelled in the Syilx Forest Management scenario and the productive forest area contained in them in comparison with the FRPA Base Case scenario. Note that the available data used for this analysis does not reliably identify unclassified streams. Therefore, the riparian protection for unclassified streams will be included in the estimates used for in-block retention (Section 13.3).

Table 38 Syilx riparian retention

Feature	Class	Buffer Width for Modelling (m)		Productive Forest Area (ha)	
		FRPA Scenario	Syilx Scenario	FRPA Scenario	Syilx Scenario
Lake	L1-A	-	200	-	43.2
	L1-B	30	200	199.9	1,692.4
	L3	6	200	6.6	797.4
	L4	6	50	0.1	1.0
	Unclassified	-	10	-	55.5
Wetlands	W1	18	200	79.8	1,013.6
	W2	14	200	1.0	24.1
	W3	6	200	22.7	1,497.0
	W4	6	50	0.1	1.3
	W5	18	200	31.6	239.9
	Unclassified	-	10	-	22.4
Streams	S2	40	40	792.7	792.7
	S3	30	30	1,113.9	1,113.9
	S4	9	9	732.6	732.6
	S5	15	15	242.0	242.0
	S6-L	10	10	120.4	120.4
	S6	-	10	-	1,055.9
	Unclassified	-	5*	-	-
Total				**3,343.5**	**9,445.4**

**** Unclassified streams will be modelled aspatially as part of in-block retention***

13.3 IN-BLOCK RETENTION

ONA member communities have indicated that there must be increased in-block retention to provide wildlife habitat and protection for unclassified riparian features. Using knowledge gained through recent field reviews, Tolko estimates that the average retention, including that required for unclassified streams (see Section 13.2), will vary by biogeoclimatic subzone as follows:

- IDF dry subzones: 40%
- IDF wet subzones: 20%
- MS and ICH subzones: 15%
- ESSF subzones: 15%

Although the retention in the IDF dry subzones will likely be achieved through selection harvesting, this analysis will reduce the timber harvesting land base by 40% and model the harvest as clearcut because there is very little of this area outside Zone 1 and reliable yield tables for the future growth of partial cut stands are not readily available.

13.4 TIMBER HARVESTING LAND BASE

The timber harvesting land base for the Syilx Forest Management scenario is reduced compared to the FRPA Base Case scenario because of the increased riparian retention (Section 13.2) and increased in-block retention (Section 13.3). However, this is partially offset by the inclusion of Old Growth Management Areas in the THLB (Section 13.5.1 below).

Table 39 summarizes the land base reductions for the Syilx Forest Management scenario. Overall, the current THLB is 16.7% smaller than the FRPA Base Case. However, 14,675 hectares (20.7%) of the current THLB is located within Zone 1 where the rate of harvest will be significantly reduced because the emphasis will be on old-growth management.

Table 39 Syilx Forest Management scenario land base summary

Land Base Element	Gross Area (ha)	Productive Area (ha)	Net Area (ha)	Percent of Total Area (%)	Percent of PFLB (%)
Total Land Base (incl. fresh water)	**110,426**		**110,426**	**100.0**	
Less:					
Non-Forest/Non-Productive Forest	2,752		2,752	2.5%	
Existing Roads	1,617		1,579	1.4%	
Productive Forest Land Base			**106,095**	**96.1%**	**100.0%**
Less:					
Unstable Terrain	4,049	3,893	3,893	3.5%	3.7%
Steep Slopes	728	683	38	0.0%	0.0%
Non-merchantable	7,745	7,015	6,003	5.4%	5.7%
Wildlife Habitat Areas	7	7	7	0.0%	0.0%
Riparian Areas	11,537	9,445	7,869	7.1%	7.4%
Enhanced Riparian Reserves	1,350	1,278	716	0.6%	0.7%
Old Growth Management Areas	-	-	-	0.0%	0.0%
Canyon Rim Trail	56	56	36	0.0%	0.0%
Kelowna Dirt Bike Club	15	14	2	0.0%	0.0%
Existing Wildlife Tree Patches	2,389	2,335	1,665	1.5%	1.6%
Future Wildlife Tree Patches (spatial)	129	129	117	0.1%	0.1%
Future WTR (aspatial)			2,421	2.2%	2.3%
Additional in-block retention (aspatial)			12,466	11.3%	11.7%
Timber Harvesting Land Base - Current			**70,869**	**64.2%**	**66.8%**
Less:					
Future Roads (aspatial)			262	0.2%	0.2%
Future Timber Harvesting Land Base			**70,607**	**63.9%**	**66.6%**

13.5 NON-TIMBER OBJECTIVES MODELLING

The Syilx Forest Management scenario includes changes to the non-timber objectives in the model framework, as described in the following sections.

13.5.1 OLD GROWTH MANAGEMENT

Old growth management for the Syilx Forest Management scenario is focused within the Zone 1 land base described in 13.1. As a result, the non-legal OGMAs have been included in the THLB. To ensure old growth objectives are met, three modelling objectives for old growth management in Zone 1 will be implemented in the model. Although these objectives will only be implemented for the Zone 1 land base, old seral will still be present within the Zone 2 land base in the non-THLB.

Old Seral Targets: The FRPA Base Case scenario implemented old seral targets by landscape unit/biogeoclimatic subzone with an initial 2/3 drawdown as described in Section 12.2.1. For the Syilx Forest Management scenario, the following alternate approach will be taken:

- Full old seral targets without the initial drawdown will be implemented throughout the planning horizon.
- The old seral requirements will be relocated to the Zone 1 land base and implemented at the TFL Block/biogeoclimatic subzone level.

Mature Plus Old Seral Targets: The FRPA Base Case scenario did not implement mature plus old seral targets. To ensure that sufficient area is retained to allow for recruitment where old seral targets are not initially met, the Syilx Forest Management scenario will implement mature plus old seral targets by TFL Block/biogeoclimatic subzone with the Zone 1 land base.

Rate of Cut: The rate of harvest in the Zone 1 THLB will be limited to the equivalent area that would be expected to occur naturally (0.25% per year for NDT4, and 0.406% per year for NDT3).

Table 40 summarizes the old seral, mature plus old seral, and rate of cut modelling objectives within the Zone 1 land base for the Syilx Forest Management scenario.

Table 40 Syilx Forest Management scenario seral requirements in Zone 1

TFL Block	BEC (v12)	NDT	Productive Forest Area (ha)	THLB Area (ha)	Adjusted Old Seral Required (%)	Adjusted Mature plus Old Seral Required (%)	Rate of Cut (ha/year)
Block A	ESSFdc2	3	1,590.2	875.4	82.3	82.3	3.6
	ICHmk1	3	150.1	37.7	70.7	70.7	0.2
	MSdm2	3	5,888.9	2,499.6	58.5	58.5	10.1
	ICHxm1	4	434.2	32.9	30.3	39.7	0.1
	IDFdk2	4	2,771.0	1,500.2	24.9	32.6	3.8
	IDFxh1	4	1,443,4	505.6	23.1	30.2	1.3
	PPxh1	4	156.9	42.3	18.9	24.8	0.1
Block B	ESSFdc2	3	2,111.1	1,211.6	43.6	43.6	4.9
	MSdm2	3	4,890.3	2,699.1	45.8	45.8	11.0
	MSxk2	3	188.9	122.3	77.1	77.1	0.5
	IDFdk1	4	1,196.7	474.6	61.0	79.7	1.2
	IDFdk2	4	5,157.3	2,523.3	45.6	59.7	6.3
	IDFxh2	4	1,093.7	380.6	22.1	28.9	1.0
Block C	ESSFdc3	3	860.5	336.9	94.6	94.6	1.4
	ICHmk2	3	648.1	324.7	55.8	55.8	1.3
	MSdm3	3	840.6	313.5	26.8	26.8	1.3
	ICHxm1	4	905.9	412.7	27.0	35.4	1.0
	IDFdk2	4	674.3	297.1	18.0	23.6	0.7
	IDFxh1	4	220.6	84.0	14.0	18.3	0.2

13.5.2 WATERSHED MANAGEMENT

The FRPA Base Case scenario implemented maximum ECA targets of 40% above the snowline for community watersheds and the Shorts Creek fisheries sensitive watershed, and 50% above the snowline for the other watershed units. The Syilx Forest Management scenario will implement maximum ECA targets of 40% above the snowline for all watershed units.

13.5.3 OTHER NON-TIMBER VALUES

ONA representatives have indicated that non-timber values such as visual landscape management and wildlife should be addressed through the management approach envisioned for the Syilx Forest Management scenario. Therefore, this scenario will not implement the FRPA Base Case objectives for VQOs, mule deer, moose, bighorn sheep, mountain goats, or the Bear Creek trails.

14 Sensitivity Analyses - FRPA Base Case

This section briefly describes the sensitivity analyses that will be performed against the FRPA Base Case scenario. These analyses explore the stability of the FRPA Base Case relative to the uncertainty surrounding specific analysis assumptions. They also reflect the impact of alternative management or potential changes in forest practices.

14.1 LAND BASE DEFINITION

14.1.1 TIMBER HARVESTING LAND BASE

This sensitivity analysis will test the effect of moving land between the non-THLB and the THLB. This will be accomplished by increasing/decreasing the area of each THLB polygon by 10% when it is entered into the model. The area of each productive non-THLB polygon will have a corresponding proportional adjustment applied so that the total land base area remains the same, and that the area for each non-timber resource value remains the same.

14.2 GROWTH AND YIELD ASSUMPTIONS

14.2.1 NATURAL STAND YIELDS +/-10%

This sensitivity analysis will test the uncertainty in the yields predicted by the VDYP 7 model used to generate natural stand yield tables. The volumes for each natural stand analysis unit will be increased/decreased by 10%. Other yield parameters used by the model (e.g. height, minimum harvest age) will remain unchanged.

14.2.2 MANAGED STAND YIELDS +/- 10%

This sensitivity analysis will test the effect of changes to the yield tables for managed stands. The volumes for each managed stand yield table will be increased/decreased by 10%. Other yield parameters used by the model will remain unchanged.

14.2.3 MINIMUM HARVEST AGES +/- 10 YEARS

This sensitivity analysis will test the effect of increasing/decreasing minimum harvest ages by 10 years for each analysis unit.

14.2.4 DECREASE OAF1 TO TEN PERCENT

Previous management plans used an OAF1 of 10% based on a finer resolution of non-productive polygon mapping in the inventory. The new LiDAR based inventory retains this finer resolution, and Tolko believes that an appropriate OAF1 is likely less than the standard 15% that will be used for the FRPA Base Case. LiDAR individual tree inventory may provide an opportunity to provide a more reliable estimate for OAF1, but this has not been explored yet. This sensitivity analysis will test the effect of decreasing the value for OAF1 to 10%.

INTEGRATED RESOURCE MANAGEMENT ASSUMPTIONS

14.2.5 INCREASE NATURAL DISTURBANCE IN THE NON-THLB

This sensitivity analysis will test the effect of increasing the amount of disturbance in the non-THLB so that the annual area disturbed is increased by 10 percent. Other modelling criteria will remain unchanged.

14.2.6 OLD GROWTH DEFERRAL AREAS

The provincial government has identified old growth deferral areas. It is not yet known how many of these deferrals will become permanent reserves in the future. This sensitivity analysis will investigate the implications for timber supply if all the deferrals become permanent.

14.3 TIMBER HARVESTING ASSUMPTIONS

14.3.1 TURN OFF CUTBLOCK AGGREGATION

This sensitivity analysis will test the effect of relaxing the requirements for cutblock aggregation at the time of harvest so that there is no minimum cutblock size. The aggregation undertaken during data preparation prior to modelling will remain unchanged.

15 Sensitivity Analyses – Syilx Forest Management

The following sensitivity analyses will be run against the Syilx Forest Management scenario.

15.1 GROWTH AND YIELD ASSUMPTIONS

15.1.1 INCREASED MINIMUM HARVEST AGE FOR MANAGED STANDS

ONA representatives have indicated that increasing the minimum harvest age for managed stands may increase the occurrence of favourable stand attributes on the land base. This sensitivity will explore the implications of increasing the minimum harvest age so that it is at least 20 years older than the age at which maximum mean annual increment is achieved.

15.1.2 REDUCED USE OF CLASS A SEED

Concern has been expressed by ONA communities that using Class A seed may reduce the resilience of future stands. This sensitivity analysis will change the yield tables for future managed stands to exclude any gains realized from using seeds with improved genetic worth.

15.2 INTEGRATED RESOURCE MANAGEMENT ASSUMPTIONS

15.2.1 REDUCE MAXIMUM ECA

This sensitivity analysis will set the maximum ECA objective above the snowline for all watersheds to 30 percent.

15.2.2 FRPA NON-TIMBER VALUES

This sensitivity will implement the FRPA Base Case objectives for visual quality, mule deer, moose, sheep, mountain goat, and Bear Creek trails.

16 References

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Appendix 1 Un-salvaged Losses

The estimate of un-salvaged losses was prepared using pest aerial overview survey (AOS) polygon data downloaded from the DataBC website. The general approach used to estimate these losses was as follows:

- Data from the most recent 10 year period (2011 to 2020) were included in the analysis.
- Pests that were found within TFL 49 and were considered in the analysis included wildfire, mountain pine beetle, western balsam bark beetle, Douglas-fir beetle, spruce beetle, drought mortality, and windthrow.
- Fires in the AOS were compared with the provincial historic fire layer to confirm that all fires were accounted for. The catastrophic White Rock Lake fire from 2021 was not considered, consistent with direction in the "*Provincial Guide for the preparation of Information Packages and Analysis Reports for Area-based Tenures, June 2021*." This fire was dealt with through the updates to the forest inventory used in the analysis.
- The timber harvesting land base that was not recently harvested and not within planned salvage, approved, or developed cutblocks was combined with the pest polygons.
- Areas within the White Rock Lake Fire that had their ages reset during the burn update procedure were not considered in the calculations.
- The pest severity ratings were used to estimate the proportion of volume loss within a polygon in each year (Very Severe = 75% loss, Severe = 30% loss, Moderate = 15% loss, Low = 5% loss, Endemic = 0.5% loss).
- Both live and dead volumes from the VRI were included. Losses were applied to individual tree species volumes for mountain pine beetle, western balsam bark beetle, Douglas-fir beetle, and spruce beetle. For all other pests, losses were applied to the total conifer volume. Where pests overlapped in a polygon, conifer volumes were only counted once. For example, fire losses were reduced by the amount assigned to mountain pine beetle if it also occurred.
- Where polygons for a pest occurred in more than one year, the cumulative loss was determined by reducing the volume for the first year, then applying the reduction factor for the next year to the remaining volume. This process was repeated for all remaining years.
- The total volume loss over the 10 year period was summed for each pest, and then divided by 10 as an estimate of the annual loss.

The average annual loss attributed to each forest health factor is summarized in Table 41 below:

Table 41 Un-salvaged loss summary

Loss Category	Annual Volume (m^3/year)
Mountain pine beetle	95
Spruce beetle	0
Douglas-fir bark beetle	699
Balsam bark beetle	910
Windthrow	65
Drought mortality	938
Wildfire	232
Total	**2,940**