# Tree Farm Licence 49

## MANAGEMENT PLAN #6

**Timber Supply Analysis Report, Version 1.1**

**2024-01-25**


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# Acknowledgements

Forsite would like to acknowledge and thank the following people who made significant contributions that were instrumental in the completion of this project:

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- Kyle Runzer, RPF (Tolko)
- Jerome Girard, RPF (Tolko)
- Dennis MacDonald, RFT (UNB)
- Colleen Marchand (OKIB)
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# Executive Summary

This report documents the timber supply analysis for Management Plan #6 for Tree Farm Licence 49 (TFL 49) held by Tolko Industries Ltd. TFL 49 is within the Okanagan Shuswap Forest District and is approximately 114,426 hectares in size and 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.

Reviews of the projected timber supply for Tree Farm Licences are typically completed once every ten years to capture changes in data, practices, policy, or legislation influencing forest management. The previous analysis for TFL 49 was completed in 2011 with an Annual Allowable Cut (AAC) determination of 330,000 $m^3$/year made on February 24th, 2012. Of this AAC, 204,000 $m^3$/year was attributable to the portion of the TFL outside of the Browns Creek (Birch Creek) litigation area. The Browns Creek litigation area was subsequently removed from TFL 49 on November 30th, 2012.

An Information Package that provides detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis underwent 60 days of public review beginning on December 1st, 2022. An updated Information Package that considered comments received during the public review was accepted by the Ministry of Forests (FOR) on April 12th, 2023 and is included as Appendix 1 in this Analysis Report.

The main changes affecting the timber supply analysis since 2011 include:

- Use of a new LiDAR based inventory.
- Removal of approximately 31,500 hectares in the Browns Creek area.
- A significant area (~33,270 hectares) is contained within the perimeter of the 2021 catastrophic White Rock Lake fire.
- Changes to merchantability criteria.
- Newer versions of Ministry of Forests growth and yield models used for both natural and managed stands.
- Revised silviculture regimes for managed stands.

The timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social and economic factors. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities.

This report focuses on a forest management scenario known as the “Base Case” scenario that reflects current management practices in TFL 49. It also includes a “Syilx Forest Management” scenario that was developed collaboratively with the Okanagan Nation Alliance to model a different forest management vision for the TFL.

The Base Case harvests 176,960 m$^3$/year for 45 years and then transitions over a 50-year period to the long-term harvest level of 293,980 m$^3$/year. The Syilx Forest Management Scenario harvests 141,370 m$^3$/year for 45 years and then transitions over a 50-year period to the long-term harvest level of 231,390 m$^3$/year (see Figure 1).

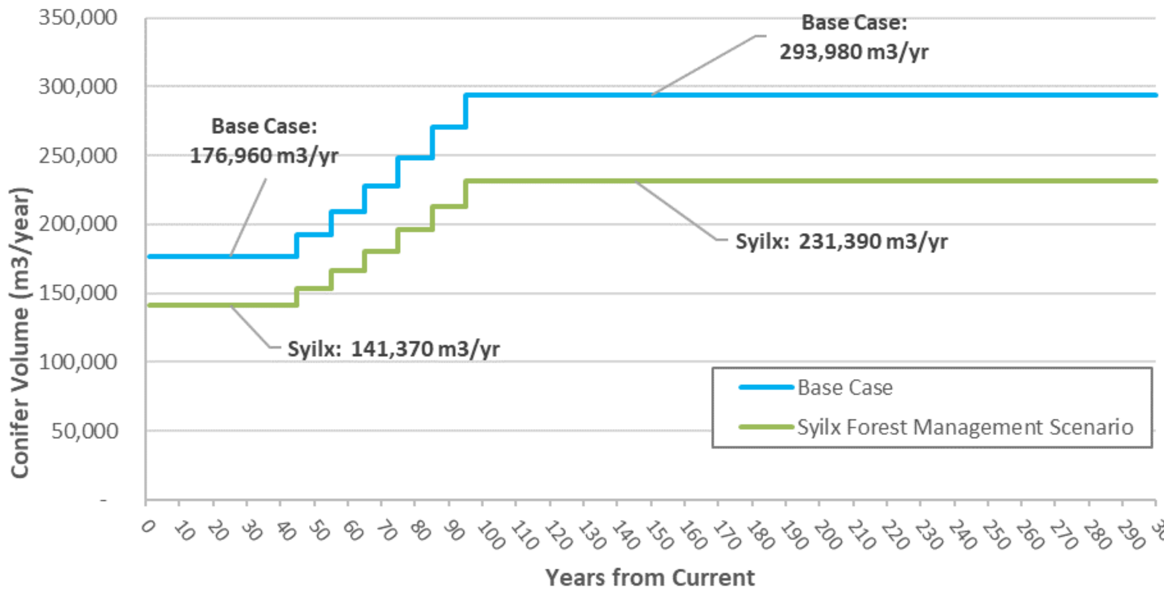


*Figure 1 Base Case and Syilx Forest Management scenario harvest flows*

Several sensitivity analyses relative to the Base Case scenario are also presented that assess how results might be affected by uncertainties in data or assumptions. Four sensitivity analyses relative to the Syilx Forest Management scenario are also included to understand the implications of implementing additional management objectives. Together, these analyses form a solid foundation for discussions with government, First Nations, and stakeholders in the determination of an appropriate timber harvesting level.

For the Base Case, harvest flow changes because of changes to THLB area are in line with those expected. Although increases to natural stand yields allowed for higher initial harvest levels, decreases to natural stand yields had limited impact on harvest flows. In contrast, the harvest flow is very sensitive to changes in managed stand yields in both the short/mid-term and long-term. The short/mid-term harvest flow is also very sensitive to an increase in minimum harvest age. These results highlight the importance that existing managed stands have on short/mid-term harvest in TFL 49.

Application of full old seral targets immediately would result in a 5.5% decrease in short/mid-term harvest, and permanently establishing the *Old Growth Technical Advisory Panel* priority deferral areas would reduce short/mid-term harvest by 6.1% and long-term harvest by 2.5%.

For the Syilx Forest Management scenario, increasing minimum harvest age for managed stands to be 20 years older than the age at which the maximum mean annual increment is achieved is particularly limiting, with a 49.5% reduction in short/mid-term harvest and a 4.9% reduction in long-term harvest. Implementing Forest and Range Practices Act (FRPA) based objectives for visual quality, mule deer, moose, sheep mountain goat, and the Bear Creek trails would result in a 3.0% reduction in short/mid-term harvest and a 2.1% reduction in long-term harvest. Limiting maximum equivalent clearcut area (ECA) above the snowline to 30% in all watersheds would result in a 2.3% reduction to short/mid-term harvest.

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# List of Acronyms

| | |
|---|---|
| AAC | Annual Allowable Cut |
| AU | Analysis Unit |
| BEC | Biogeoclimatic Ecosystem Classification |
| BCTS | British Columbia Timber Sales |
| 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 |
| FOR | Ministry of Forests |
| GAR | Government Actions Regulation |
| GIS | Geographic Information System |
| ICH | Interior Cedar Hemlock |
| IDF | Interior Douglas-Fir |
| ITI | Individual Tree Inventory |
| LRSY | Long Range Sustained Yield |
| LU | Landscape Unit |
| MAI | Mean Annual Increment |
| MS | Montane Spruce |
| MDWR | Mule Deer Winter Range |
| MHA | Minimum Harvest Age |
| NDT | Natural Disturbance Type |
| NRL | Non-Recoverable Losses |
| OGMA | Old Growth Management Area |
| OKIB | Okanagan Indian Band |
| ONA | Okanagan Nation Alliance |
| OSLRMP | Okanagan Shuswap Land and Resource Management Plan |
| P2P | Plan to Perspective |
| PFLB | Product Forest Land base |
| PP | Ponderosa Pine |
| PSPL | Provincial Site Productivity Layer |
| SIC | Snow Interception Cover |
| TAP | Technical Advisory Panel |
| 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 Green-up |
| VLI | Visual Landscape Inventory |
| VQO | Visual Quality Objective |
| WFN | Westbank First Nation |
| WHA | Wildlife Habitat Area |
| WTP | Wildlife Tree Patch |
| WTR | Wildlife Tree Retention |

# Document Revision History

| Version | Date | Description |
|---|---|---|
| 1.0 | September 2023 | Initial Analysis Report |
| 1.1 | January 2024 | Minor edits completed in response to FAIB content review.<br>• Revised Table 2 (Summary of non-timber values and modelling assumptions for the Base Case) to clarify that equivalent clear cut area above the snowline is calculated based on the gross area of the watershed above the snowline. |

# 1.0 Introduction

This Timber Supply Analysis Report for Tree Farm Licence 49 (TFL 49) has been prepared in support of Management Plan #6 by Forsite Consultants Ltd. on behalf of Tolko Industries Ltd., Southern Interior Woodlands (Tolko). Reviews of the projected timber supply for Tree Farm Licences are typically completed once every ten years to capture changes in data, practices, policy, or legislation influencing forest management. The previous analysis for TFL 49 was completed in 2011 with an Annual Allowable Cut (AAC) determination of 330,000 $m^3$/year made on February 24th, 2012. Of this AAC, 204,000 $m^3$/year was attributable to the portion of the TFL outside of the Browns Creek (Birch Creek) litigation area. The Browns Creek litigation area was subsequently removed from TFL 49 on November 30th, 2012.

This timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social, and economic factors. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against social and ecological values such as wildlife, biodiversity, and recreational opportunities.

An Information Package that outlines the basic information and assumptions used to prepare the timber supply analysis underwent 60 days of public review beginning on December 1st, 2022. An updated Information Package that considered comments received during the public review was accepted by the Ministry of Forests (FOR) on April 12th, 2023 and is included as Appendix 1 in this Analysis Report.

The Analysis Report summarizes the results of the timber supply analysis for the Base Case scenario which is intended to model current management practices on the TFL. It also includes an additional Syilx Forest Management scenario developed collaboratively with the Okanagan Nation Alliance that models a different forest management vision for the TFL. In addition, several sensitivity analyses are included that are intended to provide insight into how results may be affected by uncertainties in data or assumptions.

This analysis report provides a focus for public discussion and will provide British Columbia's Chief Forester with much of the information need to make an informed AAC determination. This report does not define a new AAC and is intended only to provide insight into the likely future timber supply of TFL 49. The final harvest level will be determined by the Chief Forester and published along with a rationale in an AAC determination document.

# 2.0 Description of Tree Farm Licence 49

## 2.1 LOCATION

TFL49 is within the Okanagan Shuswap Forest District and is approximately 114,426 hectares in size, of which 109,742 hectares are crown land and 684 hectares are 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 2).

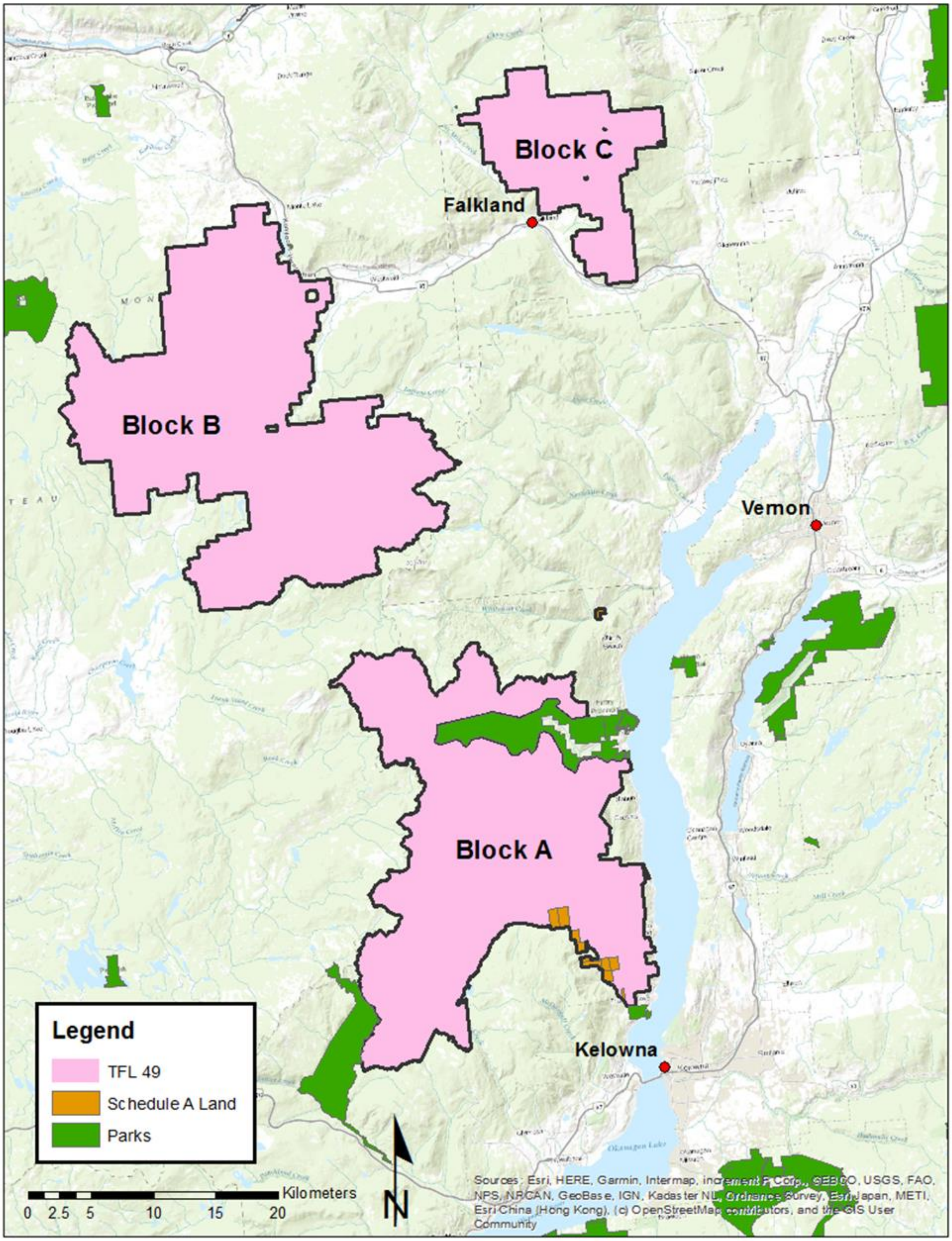



*Figure 2 Location of Tree Farm Licence 49*

## 2.2 CURRENT ATTRIBUTES

### 2.2.1 Species

The forests in TFL 49 are predominately Douglas-fir and ponderosa pine at lower elevations, Douglas-fir and lodgepole pine at mid elevations, and spruce/subalpine fir (balsam) types at the higher elevations. The species composition based on individual species within the forest stands for the Timber Harvesting Land Base (THLB) and non-THLB is shown in Figure 3. The predominant species on the THLB is lodgepole pine (32.1%).

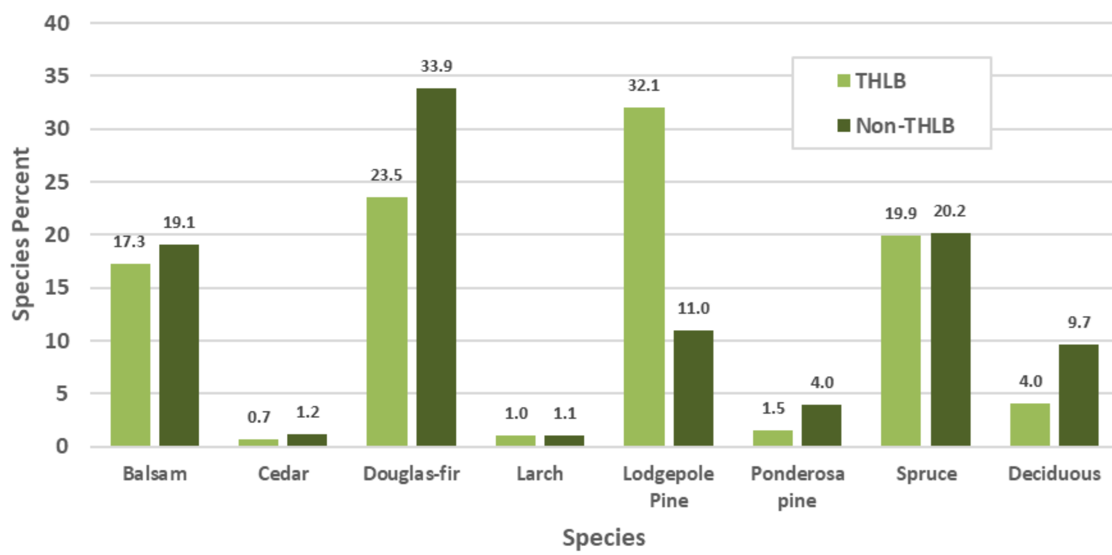



*Figure 3 Overall species composition derived from individual stand composition percentages*

### 2.2.2 Age Class

The age class distribution for TFL 49 is illustrated in Figure 4. Approximately 67% of the THLB is less than 50 years old, and there is a significant proportion of both the THLB and non-THLB less than 10 years old, reflecting the impact from the White Rock Lake catastrophic wildfire in 2021.

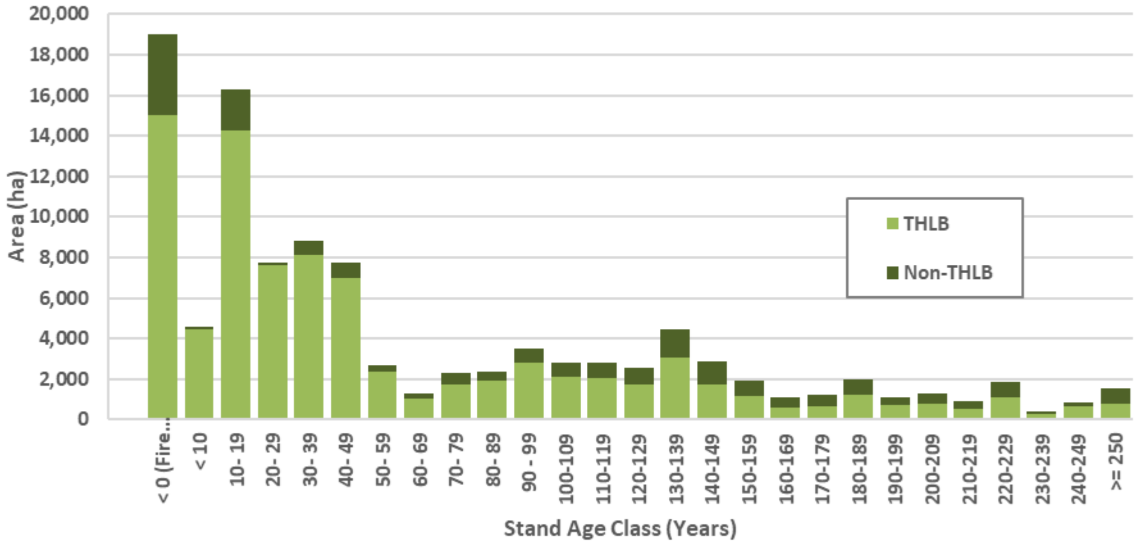



*Figure 4 Age class distribution*

### 2.2.3 Biogeoclimatic Classification

The five predominant BEC subzones within TFL 49 THLB are the MSdm2, IDFdk2, ESSFdc2, ESSFdc3, and IDFdk1. There are seven other subzones also present in smaller amounts (Figure 5). About 66.3% of the THLB is in ecosystems with frequent stand-initiating events, or Natural Disturbance Type (NDT) 3 and 33.7% is in NDT 4 (stands with frequent stand-maintaining fires).

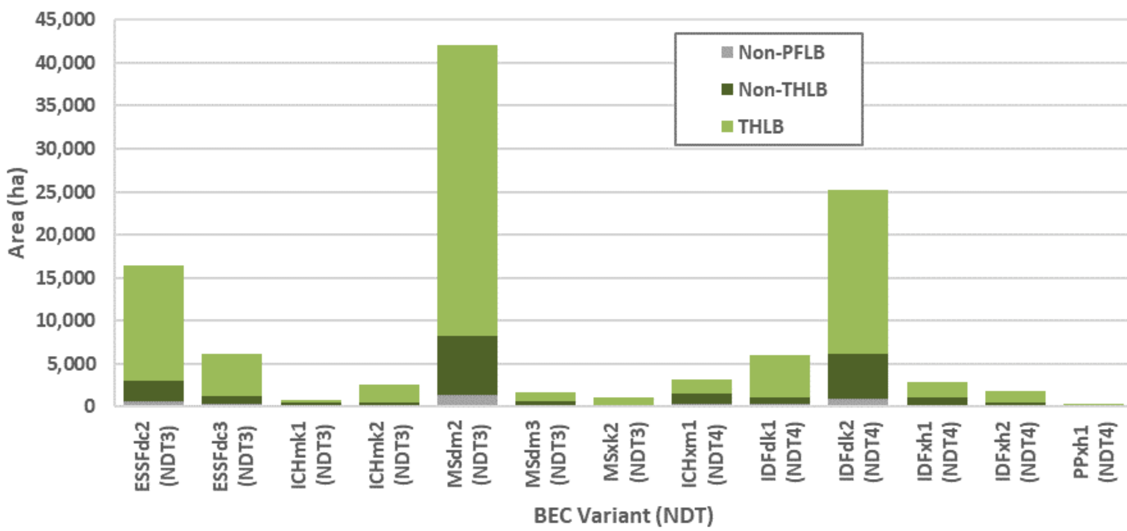



*Figure 5 BEC zone/subzone distribution*

# 3.0 Timber Supply Analysis Assumptions

## 3.1 LAND BASE DEFINITION

The Productive Forest Land Base (PFLB) is the subset of the TFL that is forested and able to contribute toward non-timber values such as biodiversity. It excludes non-crown land other than Schedule A private land, non-forest, and non-productive areas.

The Timber Harvesting Land Base (THLB) is the subset of the TFL where timber harvesting is anticipated to occur now or in the future. The THLB excludes areas that are inoperable or uneconomic for timber harvesting or are otherwise reserved for non-timber values. The THLB is contained entirely within the PFLB.

Table 1 summarizes the PFLB and THLB used to develop the Base Case scenario for TFL 49.

*Table 1 Land base area summary for the 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** | | **684** | **109,742** | **110,426** | **100.0%** | |
| Less: | | | | | | | |
| Non-Forest/Non-Productive Forest | 2,859 | | 28 | 2,830 | 2,859 | 2.6% | |
| Existing Roads | 1,617 | | 14 | 1,560 | 1,574 | 1.4% | |
| **Productive Forest Land Base** | | | **642** | **105,351** | **105,993** | **96.0%** | **100.0%** |
| Less: | | | | | | | |
| Unstable Terrain | 4,048 | 3,876 | 10 | 3,867 | 3,876 | 3.5% | 3.7% |
| Steep Slopes | 728 | 678 | - | 38 | 38 | 0.0% | 0.0% |
| Non-merchantable | 7,210 | 6,444 | 46 | 5,504 | 5,549 | 5.0% | 5.2% |
| Wildlife Habitat Areas | 7 | 7 | - | 7 | 7 | 0.0% | 0.0% |
| Riparian Areas | 4,824 | 3,338 | 38 | 2,923 | 2,961 | 2.7% | 2.8% |
| Enhanced Riparian Reserves | 1,350 | 1,278 | - | 913 | 913 | 0.8% | 0.9% |
| Old Growth Management Areas | 4,661 | 4,541 | - | 2,745 | 2,745 | 2.5% | 2.6% |
| Canyon Rim Trail | 56 | 56 | - | 34 | 34 | 0.0% | 0.0% |
| Kelowna Dirt Bike Club | 15 | 14 | - | 3 | 3 | 0.0% | 0.0% |
| Existing Wildlife Tree Patches | 2,315 | 2,259 | 6 | 1,692 | 1,698 | 1.5% | 1.6% |
| Future WTR (spatial) | 129 | 128 | 2 | 115 | 117 | 0.1% | 0.1% |
| Future WTR (aspatial) | | | 21 | 2,577 | 2,598 | 2.4% | 2.5% |
| **Timber Harvesting Land Base - Current** | | | **520** | **84,934** | **85,454** | **77.4%** | **80.6%** |
| Less: | | | | | | | |
| Future Roads (aspatial) | | | | | 239* | 0.2% | 0.2% |
| **Future Timber Harvesting Land Base** | | | | | **85,215** | **77.2%** | **80.4%** |

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

## 3.2 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. Additional summary information about this inventory is included in the Information Package (see Appendix 1), and 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.*"

TFL 49 was severely impacted by the White Rock Lake catastrophic fire in 2021, with about 33,270 hectares of the TFL between Monte Lake and Okanagan Lake contained within the mapped 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.

Salvage plans and preliminary burn severity information produced by the province were used to reset volumes and ages for selected polygons with the goal of achieving the following proportions by burn severity class and stand height:

- High Severity: Stands < 3 metres tall are 100% burned; Stands >= 3 metres tall are 90% burned
- Medium Severity: Stands < 3 metres tall are 90% burned; Stands >= 3 metres tall are 80% burned
- Low Severity: Stands < 3 metres tall are 70% burned; Stands >= 3 metres tall are 50% burned
- Unburned: 0% burned

Burned non-free growing stands were modelled as a regenerating stand with a two-year regeneration delay based on the assumption that they would be eligible for funding under Section 108 of *the Forest and Range Practices Act (FRPA)*. Regeneration delays for the remaining burned stands were assigned based on BEC subzone/burn severity rating and ranged between 2 years and 70 years as documented in the Information Package.

The date chosen for the start of the harvest forecasts is January 1st, 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.

## 3.3 MANAGEMENT PRACTICES

Management practice assumptions can be grouped into three broad categories, including integrated resource management (IRM), silviculture, and harvesting.

### 3.3.1 Integrated Resource Management

Forest cover retention requirements and/or disturbance limits are applied within the timber supply model to accommodate timber and non-timber resource objectives. These requirements are used by the model to limit and spatially locate harvesting within the THLB. 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 targets 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 2 summarizes the modelling assumptions for non-timber values used in the Base Case scenario.

*Table 2 Summary of non-timber values and modelling assumptions for the Base Case*

| Non-Timber Value | PFLB Area (ha) | THLB Area (ha) | Forest Resource Requirements |
|---|---|---|---|
| **Landscape Level Biodiversity** | 105,993 | 85,454 | Old Seral: Modelled by requiring that each LU/BEC (version 12) variant achieve the equivalent old seral target percentages indicated in the *Provincial Non-spatial Old Growth Order.* All units have low biodiversity emphasis where the initial targets are reduced to 1/3 of the full target, with the expectation that full targets will be achieved by the end of the third rotation (i.e. 240 years from the date of the order). Therefore, the model was configured so that 1/3 of the full target must be achieved initially, 2/3 of the full target must be achieved by year 141, and the full target achieved by year 221 of the planning horizon. |
| **Community Watersheds** | 21,056 | 17,900 | Modelled as a disturbance limit where the Equivalent Clearcut Area (ECA) above the snowline must be no more than 40% for each of the Lambly, Powers, and Silver community watersheds. ECA percentage is calculated based on the gross area of the watershed unit above the snowline using the Winkler and Boone 2017 hydrologic recovery curves. |
| **Fisheries Sensitive Watersheds** | 12,833 | 10,135 | Modelled as a disturbance limit where the Equivalent Clearcut Area (ECA) above the snowline must be no more than 40% for the Shorts Creek Fisheries Sensitive Watershed. ECA percentage is calculated based on the gross area of the watershed unit above the snowline using the Winkler and Boone 2017 hydrologic recovery curves. |
| **Other Watersheds** | 31,513 | 26,501 | Modelled as a disturbance limit where the Equivalent Clearcut Area (ECA) above the snowline must be no more than 50% for each of 12 watershed reporting units. ECA percentage is calculated based on the gross area of the watershed unit above the snowline using the Winkler and Boone 2017 hydrologic recovery curves. |
| **Visual Quality** | 14,900 | 10,707 | Modelled as a disturbance limit for each VLI polygon. Maximum disturbance for each polygon is defined by Visual Quality Objective (VQO), adjusted for slope using P2P ratios. Visually Effective Greenup (VEG) height for each VQO polygon is calculated using slope classes within the polygon. |
| **Mule Deer Winter Range** | 17,109 | 11,428 | Snow Interception Cover (SIC): Modelled as a minimum retention target for Douglas-fir leading stands within each MDWR unit. SIC minimum age and the applicable retention target are defined by BEC version 6 subzone. In addition, 50% of the SIC within the moderate snowpack zone (other than IDFmw) must be located in the THLB, and SIC can not be located on slopes >80% within the moderate snowpack zone.<br>Disturbance: Modelled as a maximum disturbance target for the moderate snowpack zone where no more than 30% of the PFLB in the planning cell can be less than 20 years old. |
| **Moose Winter Range** | 27,123 | 22,675 | Retention: Modelled as a minimum retention target where at least 33% of the PFLB within each Moose Winter Range Unit must be at least 16 metres tall. In addition, at least 50% of the required cover should be in patches of at least 20 hectares, if practicable. The weight for this patch requirement was set relatively low so that it is not an absolute requirement, but rather, meets the intent of the "*if practicable*" qualification.<br>Disturbance: Modelled as a minimum retention target where at least 15% of the PFLB within each moose winter range unit be < 25 years old for ICH and IDF BEC zones, and < 35 years old for MS and ESSF BEC zones. Because the GAR Order indicates that this requirement applies to the "*extent practical*", |

| | | | |
|---|---|---|---|
| | | | the relative weight for this objective was set so that it is not an absolute requirement. |
| **Bighorn Sheep** | 2,240 | 1,330 | Retention: Modelled as a minimum retention target where at least 33% of the PFLB within each bighorn sheep planning cell must be at least 16 metres tall. |
| **Mountain Goat** | 228 | 29 | Disturbance: Modelled as a maximum disturbance target where no more than 33% of the PFLB can be < 33 years old.<br>Rotation Age: As a surrogate for a 150-year rotation age, this objective was modelled as a maximum disturbance target where no more than 33% of the THLB can be < 50 years old. |
| **Bear Creek Trails** | 3,676 | 2,907 | Modified Harvest: As a surrogate for a range of site-specific modified harvesting practices within 100 metres of the trails, this objective was modelled as a maximum disturbance target where no more than 10% of the PFLB can be less than 5 metres tall. |
| **Greenup/Adjacency** | 105,993 | 85,454 | Modelled using patch size targets for young seral (<20 years old) stands within 50 metres of each other. Targets are consistent with those outlined in the Landscape Unit Planning Guidebook and implemented by Natural Disturbance Type (NDT) within each of the three geographic TFL blocks.<br>Weights were set so that the model would attempt to meet the targets but would not unduly constrict timber supply if they were not achievable. |

### 3.3.2 Silviculture

Historical and current silviculture practices within TFL 49 were used to develop the silviculture assumptions for six silviculture eras from 1971 to the present. These assumptions include:

- Regeneration assumptions (establishment method, species distribution, and establishment density)
- Regeneration delay (time between harvesting and when the site is stocked with crop trees), and
- Use of select seed.

All harvesting was modelled as clear-cut with reserves. Refer to the Information Package (Appendix 1) for additional details concerning the silviculture assumptions.

### 3.3.3 Harvesting

Assumptions about timber harvesting practices have been implemented in the model, including the following:

- Minimum harvest ages by analysis unit to ensure a viable log is produced and long-term volume production is maximized.
- Land base definition criteria (removal of unstable slopes, non-merchantable stands, etc.).
- Prioritization of proposed cutblocks from current development plans for harvest in the first 10 years of the planning horizon.
- Limits on the proportion of lower volume stands that can contribute to the harvest on steeper slope classes:

- Slope 40 to 60%: Maximum 10% of harvest volume from stands with < 100 $m^3$/hectare and maximum 20% of harvest volume from stands between 100 and 150 $m^3$/hectare.
- Slope 60 to 80%: Maximum 10% of harvest volume from stands with < 100 $m^3$/hectare, maximum 10% of harvest volume from stands between 100 and 150 $m^3$/hectare, and maximum 20% of harvest volume from stands between 150 and 200 $m^3$/hectare.
- Slope > 80%: Maximum 5% of harvest volume from stands < 100 $m^3$/hectare, maximum 10% of harvest volume from stands between 100 and 150 $m^3$/hectare, and maximum 20% of harvest volume from stands between 150 and 200 $m^3$/hectare.

- Cutblock size requirements
  - Harvest units less than one hectare were not allowed. Areas smaller than this were either retained until they could be aggregated with adjacent units or were not harvested during the planning horizon.

## 3.4 FOREST DYNAMICS

Forest dynamics represent the changing state of the forest through time. Changes occur as the forest ages, or when natural or human caused disturbances occur. The ways in which the model addresses these factors are described below.

### 3.4.1 Growth and Yield Projections

Timber growth and yield refers to the prediction of the growth and development of forest stands over time, and of particular interest, the volume and size of trees that will occur at the time of harvest. For modeling purposes, stands of similar characteristics, growth rates, and management are grouped together into Analysis Units (AUs). Analysis Units used in this analysis are described in the Information Package (see Appendix 1). The attributes of each analysis unit are input into growth and yield models to predict gross and net volume per hectare at various stand ages. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters near the base and the top of a tree.

Two growth and yield models were used to estimate the yield tables used in the analysis. The Variable Density Yield Prediction Model version 7 (VDYP7) was used to create a yield table for each individual natural stand in the inventory. These individual yield tables that represent the stands in an analysis unit were then area-weighted to create a composite table for the analysis unit.

The Table Interpolation for Stand Yields (TIPSY) model, version 4.5 was used to create yield tables for stands that are 52 years of age and younger where there is a harvest history, and for stands that will be regenerated in the future. The required inputs for TIPSY were developed using establishment assumptions for each silviculture era, and managed stand site indices from the provincial site productivity layer or from the LiDAR inventory. Refer to the Information Package (Appendix 1) for additional details.

Based on these yield tables, the current timber inventory or growing stock on the THLB is approximately 5.66 million $m^3$, of which approximately 5.00 million $m^3$ is greater than or equal to the minimum harvest age.

### 3.4.2 Natural Disturbance

Timber losses due to natural causes such as fire, blowdown, or epidemic insect attacks in the THLB that are not salvaged were incorporated into the timber supply analysis as a volume reduction of 3,139 $m^3$/year applied to the projected timber supply forecast. All harvest flows provided in this analysis report have been adjusted to account for this un-salvaged loss.

For areas outside the THLB, a constant area was disturbed annually within each landscape unit and biogeoclimatic zone to ensure that the non-THLB does not continually age and fulfill an unrealistic portion of the forest cover requirements for non-timber resource values. The area of disturbance varies based on the biogeoclimatic variants present and 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)*". Additional details regarding the calculations and process used to model natural disturbance can be found in the Information Package.

## 3.5 TIMBER SUPPLY MODEL

The PATCHWORKS ™ modeling software was 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 was configured to consider the range of non-timber values that exist on TFL49 while evaluating possible harvest flows.

## 3.6 MAJOR CHANGES FROM THE PREVIOUS TIMBER SUPPLY ANALYSIS

There have been some changes to input datasets and assumptions since the previous timber supply analysis completed in 2011. A summary of the significant changes is provided below:

- Use of a new LiDAR based inventory.
- Removal of approximately 31,500 hectares from the TFL in the Browns Creek area.

- A significant area (~33,270 hectares) is contained within the perimeter of the 2021 catastrophic White Rock Lake fire.
- Changes to merchantability criteria.
- Newer versions of Ministry of Forests growth and yield models used for both natural and managed stands.
- Revised silviculture regimes for managed stands.

# 4.0 Base Case Analysis

The Base Case scenario presented in this report uses the best information currently available and reflects current management practices in the TFL. The current AAC for TFL 49 is 204,000 $m^3$/year effective February 24$^{th}$, 2012. Unsalvaged losses in the THLB are estimated to be 3,139 $m^3$/year, and have been subtracted from the graphs, tables and harvest forecasts in this report unless otherwise noted.

## 4.1 LONG RANGE SUSTAINED YIELD

The Long Range Sustained Yield (LRSY) is calculated as the sum of the future THLB area of each regenerated analysis unit, multiplied by the maximum mean annual increment (MAI) of the analysis unit. LRSY represents the theoretical maximum even-flow sustained yield that can be achieved on the land base and is used as a benchmark to evaluate the model runs.

To achieve LRSY, each stand must be harvested at the age where the MAI is greatest. In practice, this does not occur for every stand because some stands may not be available for harvest at the specified age due to non-timber resource requirements. Also, minimum harvest ages for this analysis have been reduced from the optimum age to allow harvest once the stand has achieved 90% of the maximum MAI. In some cases, the model may harvest stands at this reduced age when necessary due to the requirements of non-timber objectives on other portions of the land base.

The LRSY calculated for the Base Case scenario is 333,084 $m^3$/year. After accounting for unsalvaged losses (i.e. reducing by 3,139 $m^3$/year), the LRSY for comparison with harvest flows from the model is 329,945 $m^3$/year.

## 4.2 BASE CASE SCENARIO HARVEST FLOW

In many timber supply analyses, numerous alternative harvest forecasts are possible for a given set of modelling assumptions. However, there are limited opportunities on TFL 49 for alternative harvest flows because the past fires and mountain pine beetle infestations have significantly reduced the mature growing stock.

The *Base Case* scenario, illustrated in Figure 6, initially has a harvest level of 176,960 $m^3$/year which is maintained for the first 45 years of the planning horizon. The harvest level then increases over a 50-year period to the long-term harvest level of 293,980 $m^3$/year.

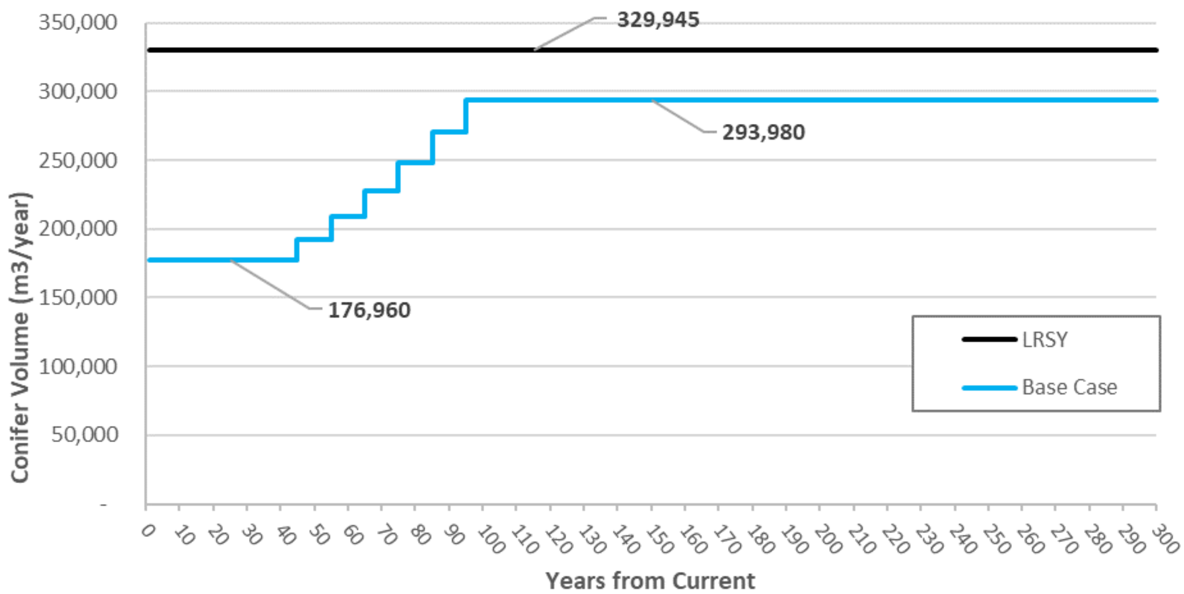



*Figure 6 Base Case harvest forecast*

## 4.3 BASE CASE ATTRIBUTES

Various forest management assumptions have been modelled in the Base Case analysis, many of which affect the condition of the forest over time. This section describes the attributes of stands harvested in the model and the overall state of the forest throughout the planning horizon to understand and evaluate the Base Case harvest forecast. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

### 4.3.1 Growing Stock

Total growing stock represents the net volume of all trees on the timber harvesting land base that are larger than the minimum size specified by the utilization standards (i.e. 12.5 cm dbh for lodgepole pine, 17.5 cm dbh for other species). A flat total growing stock in the long-term indicates that the rate of harvest is sustainable and equal to the rate of forest growth. Merchantable growing stock represents that portion of the total growing stock that is greater than or equal to the minimum harvest age.

The total and merchantable growing stock on the THLB throughout the 300-year planning horizon are shown in Figure 7. The total growing stock is initially about 5.66 million $m^3$. This increases over the first 85 years to about 11.82 million $m^3$. In the long-term, the total growing stock averages about 10.24 million $m^3$. Merchantable growing stock is initially about 5.00 million $m^3$ and generally follows a similar trajectory as the total growing stock over time.

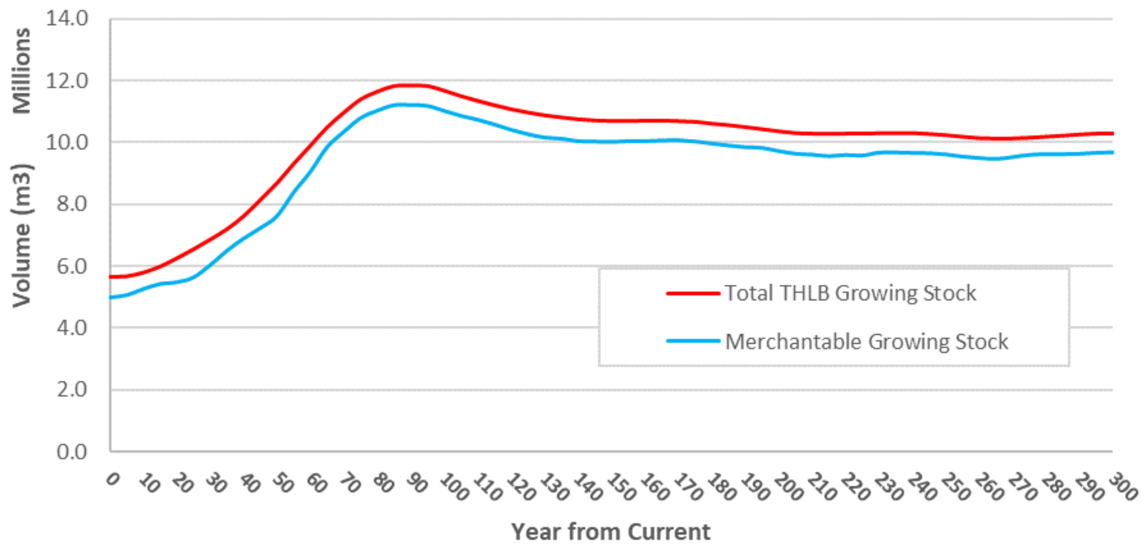



*Figure 7 Total and merchantable growing stock on the THLB for the Base Case*

### 4.3.2 Age Class

The age class of the THLB at years 0, 100, 200 and 300 for the Base Case is illustrated in Figure 8. The forest initially has a large area in the younger age classes, with roughly 35% of the stands less than 21 years old and 66% of the stands less than 61 years old. This changes over time to a more normal distribution, with most of the stands less than 81 years old. It is also noted that stands older than 250 years are present on the THLB throughout the planning horizon, indicating that there are THLB stands that do not get harvested. These unharvested stands may be retained because they are:

- Required to satisfy non-timber objectives,
- Isolated stands that cannot be combined with adjacent stands to meet minimum harvest unit sizes,
- Unable to achieve minimum harvestable volumes.

ONA representatives have indicated that they would also like to understand the projected age class of the TFL for the entire forested land base (PFLB). Figure 9 summarizes the age class distribution for the productive forested land base over time. Initially, 14.7% of the land base is between 141 and 250 years old, and 2.3% is at least 251 years old. By the end of the planning horizon, 8.9% is between 141 and 250 years old, and 12.2% is at least 251 years old.


*Figure 8 Age class of the THLB for the Base Case scenario*

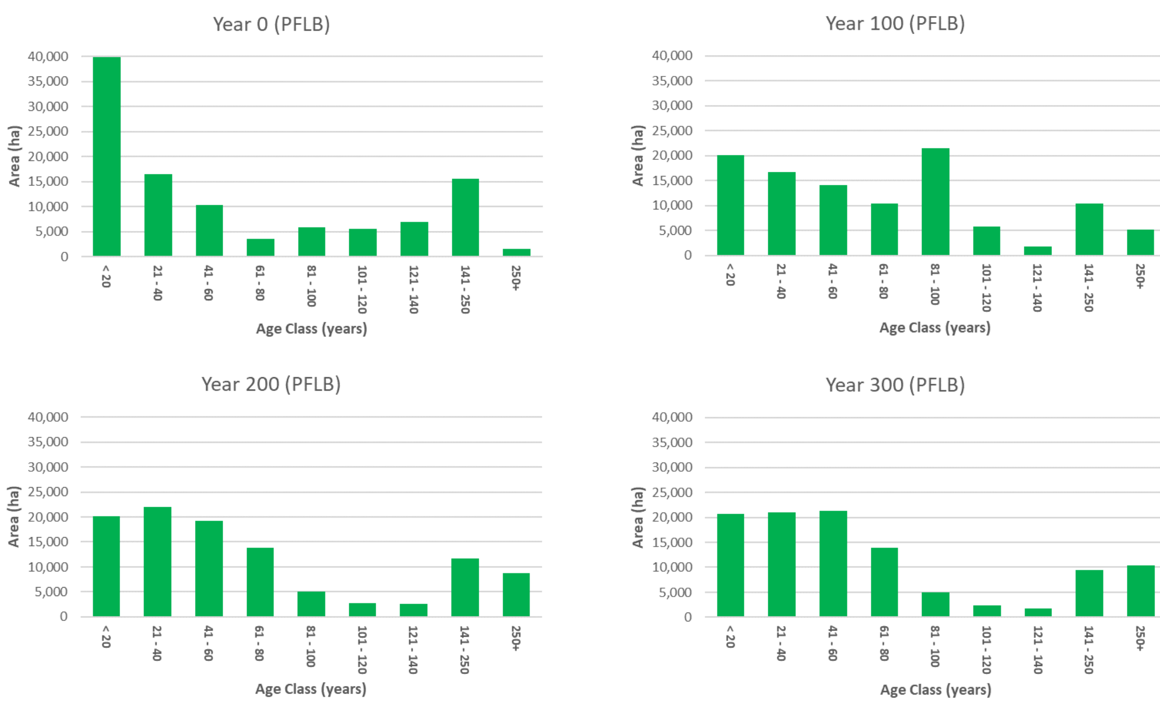



*Figure 9 Age class of the PFLB for the Base Case scenario*

### 4.3.3 Harvest Attributes

Figure 10 shows the contribution of salvage, natural, existing managed, and future managed stands to the Base Case harvest forecast over time. Existing managed stands (i.e. stands currently less than 53 years old) become an important part of the harvested volume starting in about 10 to 15 years.

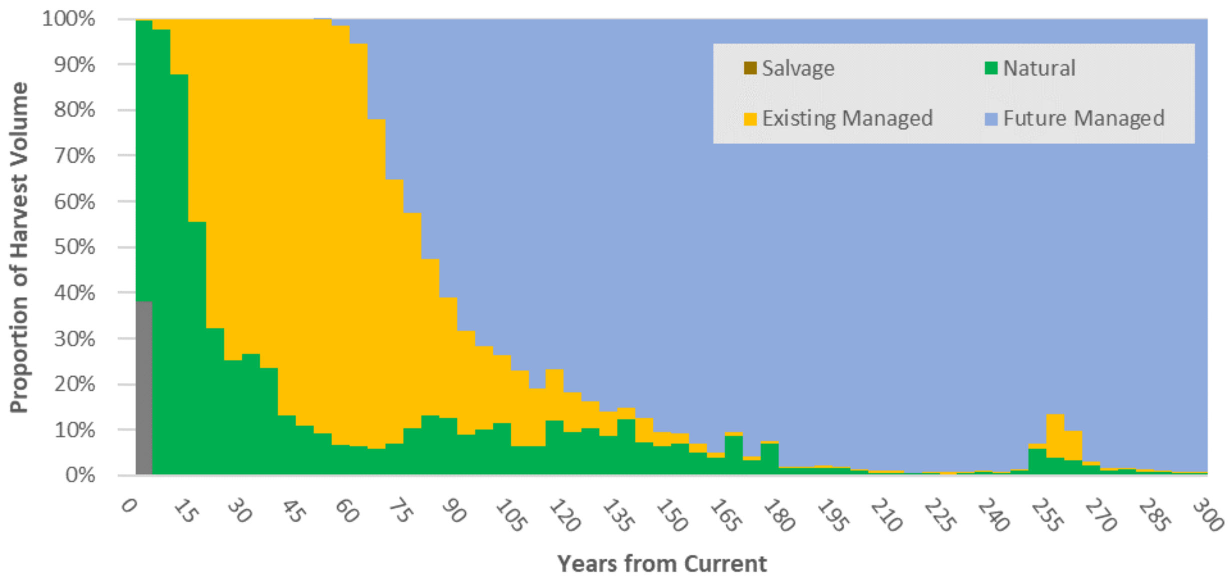



*Figure 10 Contribution of salvage, natural and managed stands to the harvest flow for the Base Case*

The Base Case harvest has various species contributing to the overall harvest, as illustrated in Figure 11. There is proportionately more Douglas-fir harvested in the first period because of the White Rock Lake fire salvage. Spruce and balsam then become the main species harvested for the next 20 years, with the proportion of lodgepole pine increasing for about 50 years as existing managed stands become available for harvest. Cedar, larch, and ponderosa pine are a very minor component of the harvest profile throughout the planning horizon.

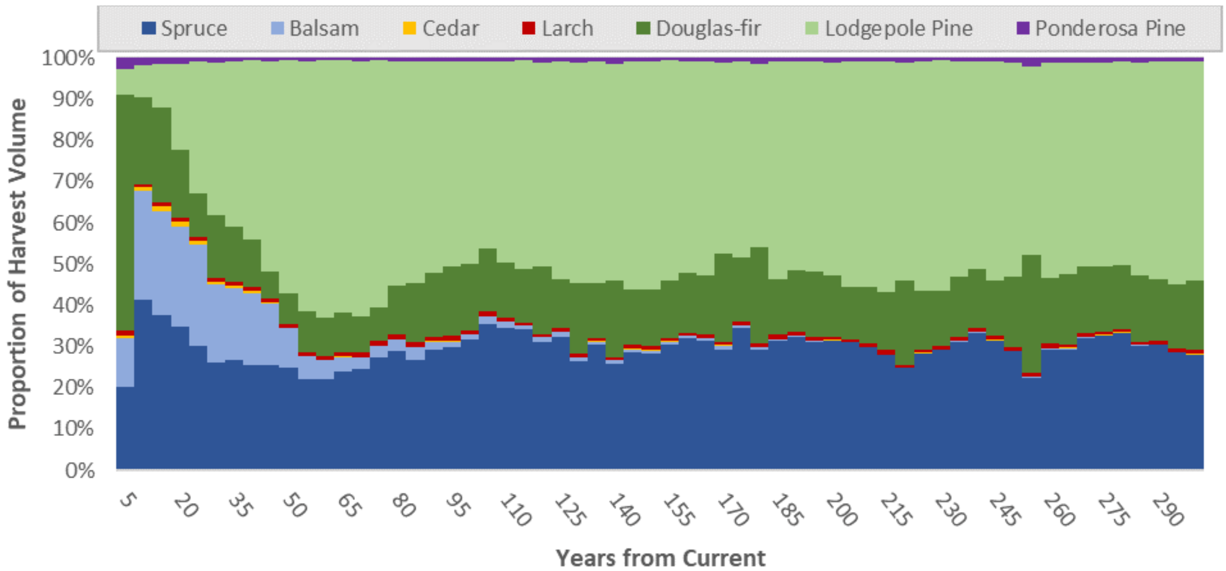



*Figure 11 Harvested species for the Base Case*

Harvest age also provides an indicator of the type and age of stands harvested over time. Figure 12 illustrates the average harvest age for the Base Case, while Figure 13 shows the age class distribution of harvested stands. The average harvest age is lower in the first five years because many of the salvage stands are younger. However, harvest age increases to 162 years in the next five years and then declines over time as harvesting shifts from older natural stands to managed stands. The average harvest age in the long-term is about 87 years.

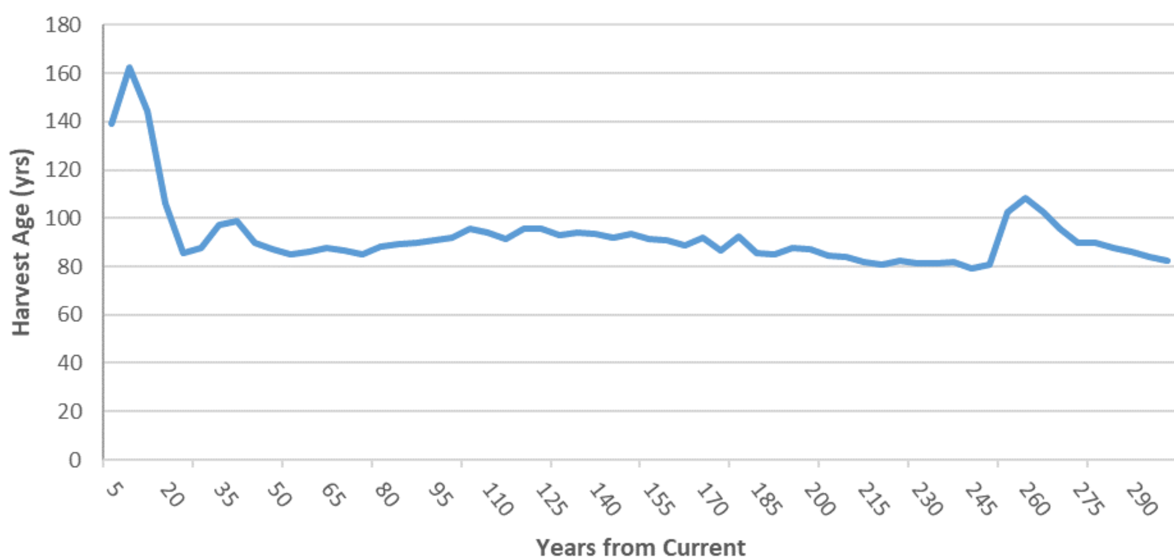



*Figure 12 Average harvest age for the Base Case*

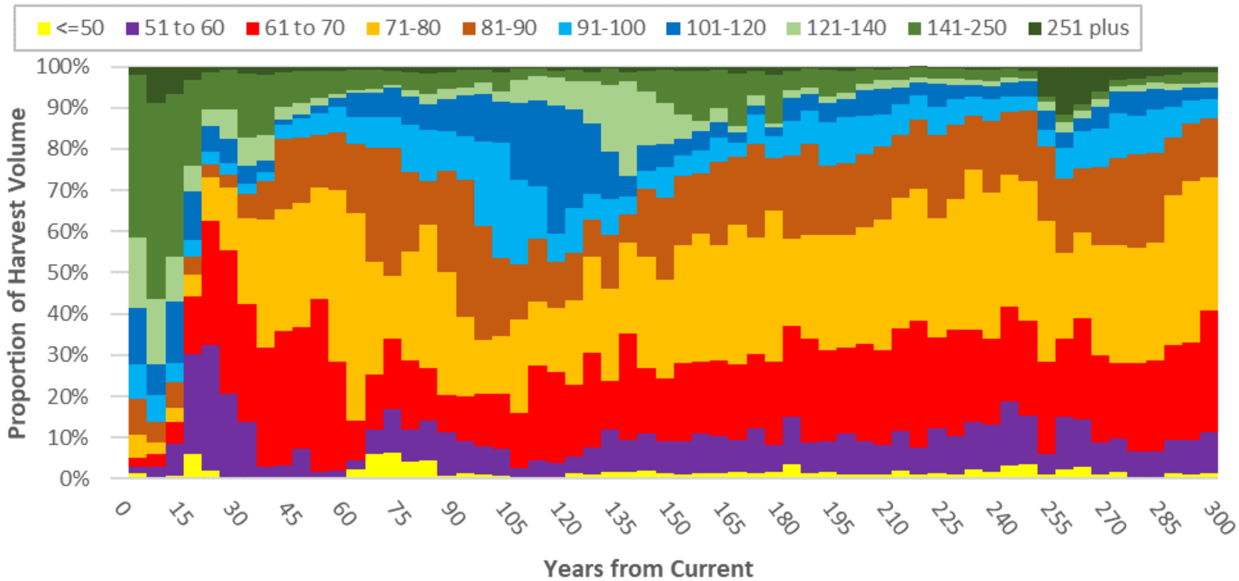



*Figure 13 Age class distribution of harvested stands for the Base Case*

Average harvest volume per hectare is illustrated in Figure 14. Average harvest volume is lower in the first five years because of stands selected for salvage within the White Rock Lake fire area. Following the salvage period, average harvest volume increases through time. In the long-term, the average harvest volume is slightly over 300 $m^3$/hectare.

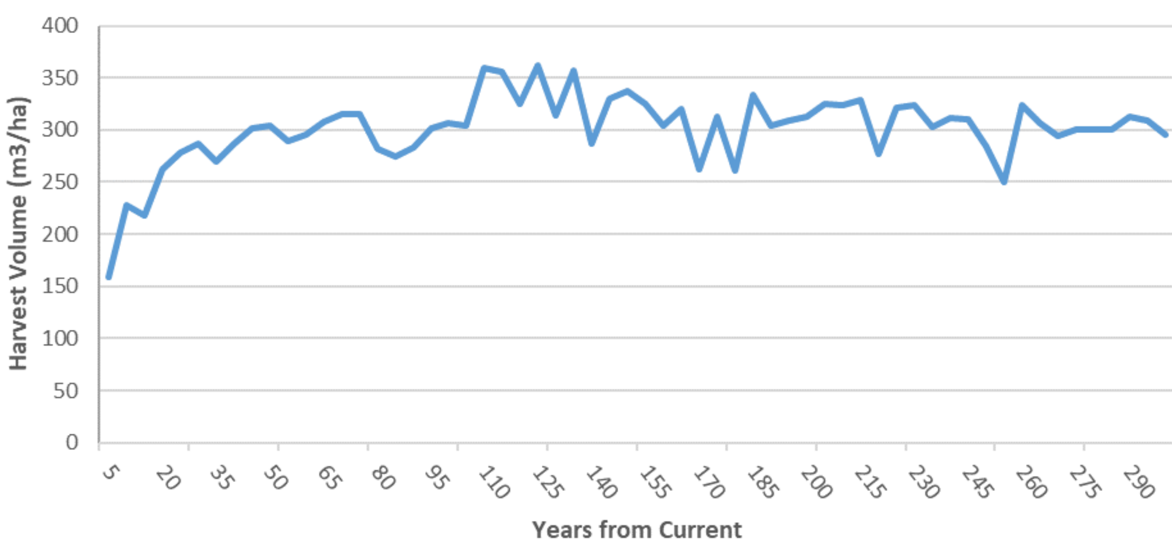



*Figure 14 Average harvest volume per hectare for the Base Case*

Figure 15 summarizes the proportion of harvest volume by volume per hectare class for the Base Case. Following the initial salvage period where lower volume stands are being harvested, the proportion of volume from lower volume stands is very small. From year 6 to year 45, only 1.8% of the harvest is in stands with less than 100 $m^3$/hectare, and only 4.1% of the harvest is in stands between 100 and 150 $m^3$/hectare. These proportions become even less later in the planning horizon.

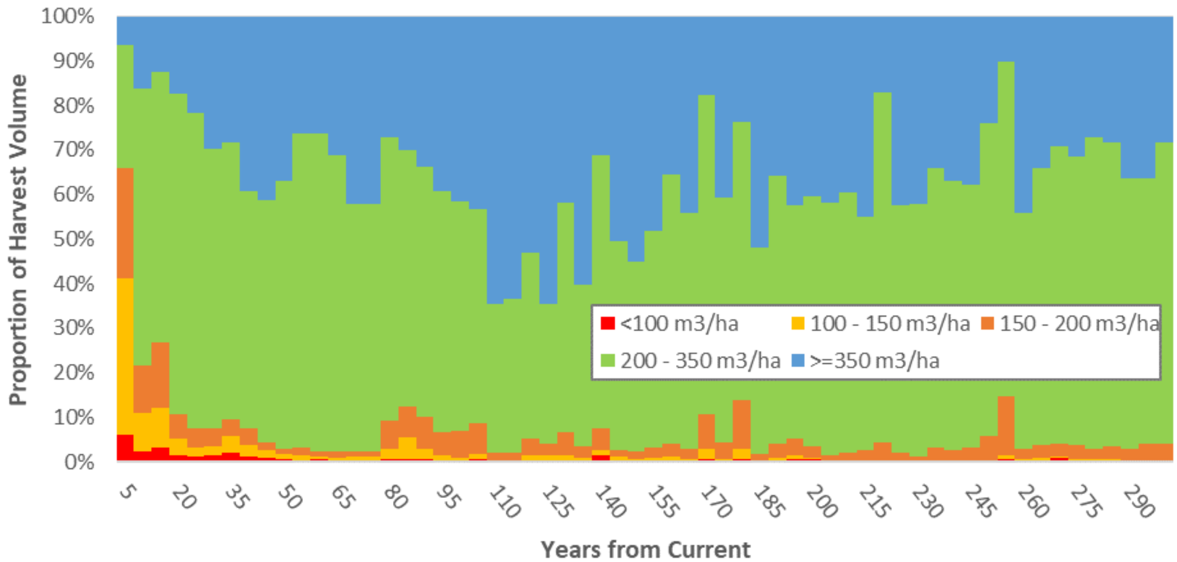



*Figure 15 Harvest volume by volume per hectare class for the Base Case*

The annual area harvested for the Base Case is illustrated in Figure 16. In the long-term, the average area harvested each year is about 975 hectares.

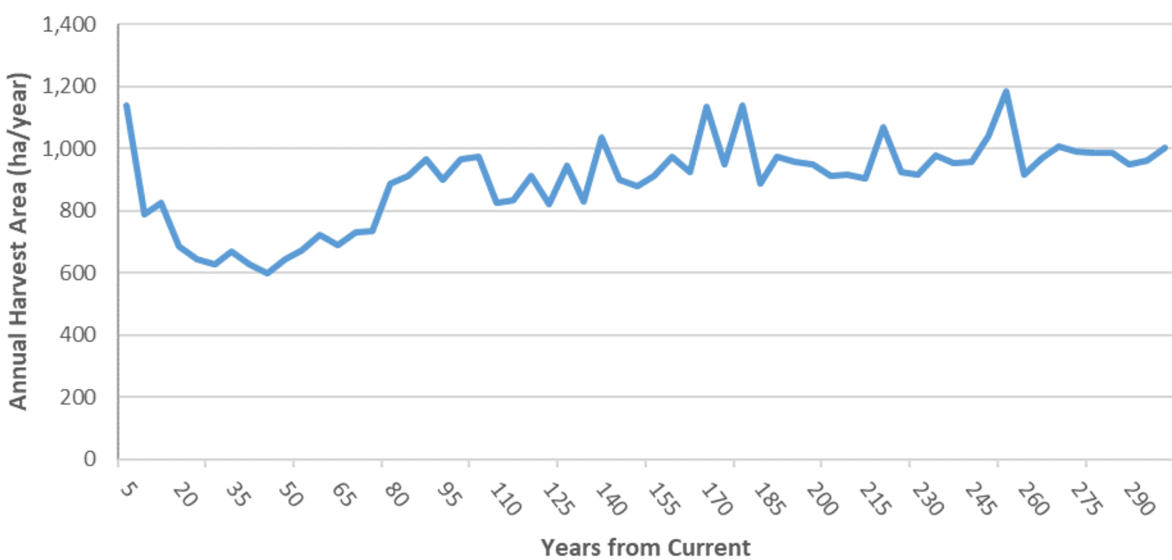



*Figure 16 Annual harvest area for the Base Case*

Figure 17 summarizes the proportion of harvest volume by slope class for the Base Case. On average, only about 0.3% of the harvest is on slopes > 60% throughout the planning horizon, and 4.5% of the harvest is on slopes between 40 and 60%.

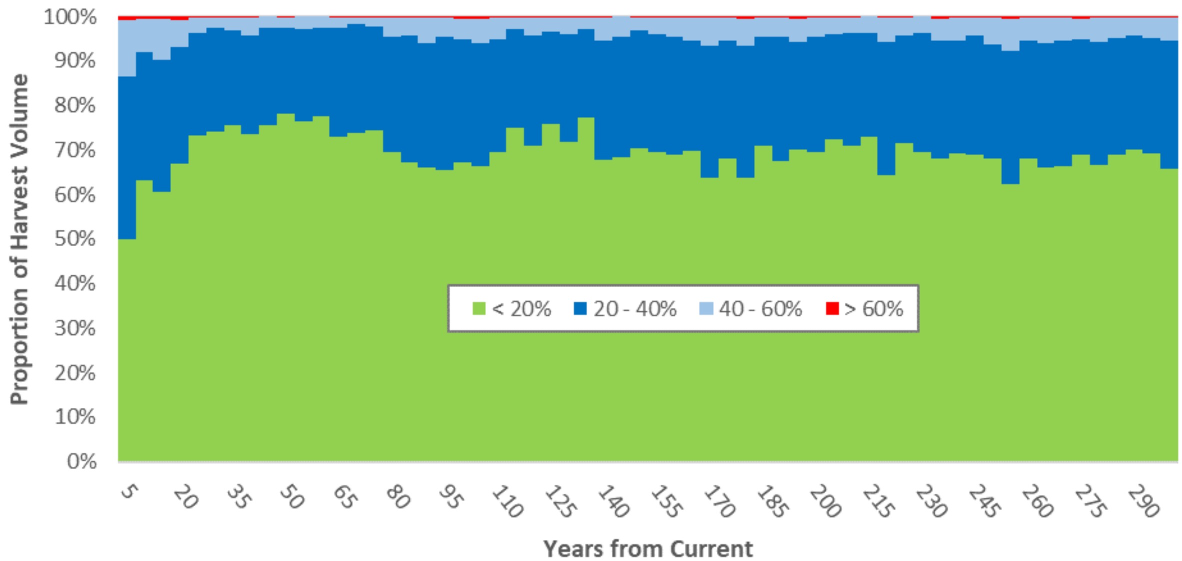



*Figure 17 Harvest volume by slope class for the Base Case*

## 4.4 NON-TIMBER OBJECTIVES ANALYSIS

Several objectives related to non-timber values were modelled in the Base Case to ensure these values are represented on the land base. The objectives include old seral stage targets, visual quality, mule deer winter range, moose winter range, bighorn sheep winter range, mountain goat winter range, watershed health, Bear Creek recreation trails, and early seral patch size objectives.

### 4.4.1 Old Seral

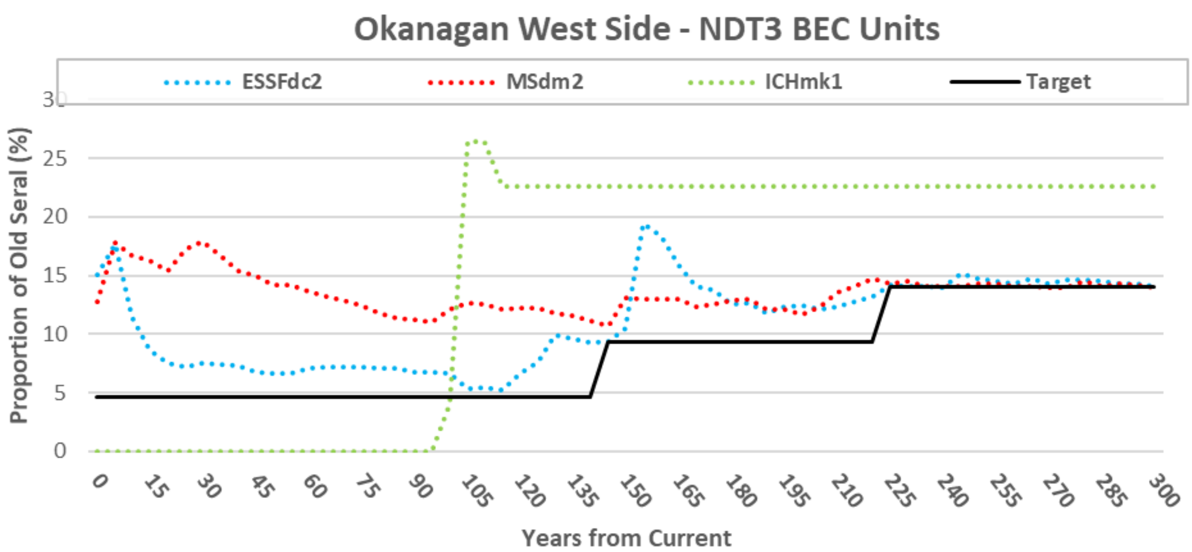
The *Order Establishing Provincial Non-Spatial Old Growth Objectives, June 2004* specifies the required retention of old seral stage by landscape unit, biodiversity emphasis option, and biogeoclimatic subzone. Although Appendix 2 in this order provides required hectares by THLB/non-THLB for each landscape unit/subzone, the old growth management areas (OGMAs) within the TFL 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 area targets outlined in the Appendix. For these reasons, this analysis implemented the percent old seral targets outlined in the order using the BEC version 12 subzones.

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. As the landscape units in TFL 49 have low biodiversity emphasis, the model was configured to meet 1/3 of the full target initially, 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 time since the date of the order.

A significant proportion of the THLB (~35%) is within landscape unit/BEC variants that are initially below the targets for old seral. One reason for this deficit is the White Rock Lake catastrophic fire that occurred in 2021. The Upper Salmon landscape unit was significantly impacted by this fire, with roughly 51% of the productive forest land base within the fire perimeter. The Okanagan West Side landscape unit was also affected by this fire to a lesser extent, with roughly 20% of the productive forest land base within the fire perimeter. Another contributing factor to the old seral deficit, particularly for NDT4 biogeoclimatic subzones, is that sufficient stands have not yet achieved the age required to be old seral.

Although the old seral deficit potentially constrains timber supply, harvest is still possible provided the model can identify sufficient stands for recruitment and that the harvest does not delay achievement of the old seral targets beyond the time that it would occur in the absence of harvesting. It is also noted that the old growth management areas are used as surrogates for the old seral targets and are removed from the THLB during the netdown process. These OGMAs remain as “no harvest” even after the old seral target is achieved or exceeded.

Figure 18 to Figure 20 show the proportion of old seral throughout the planning horizon relative to the targets for each landscape unit and biogeoclimatic subzone. Despite the initial deficits, all old seral objectives are met in the mid to long-term.



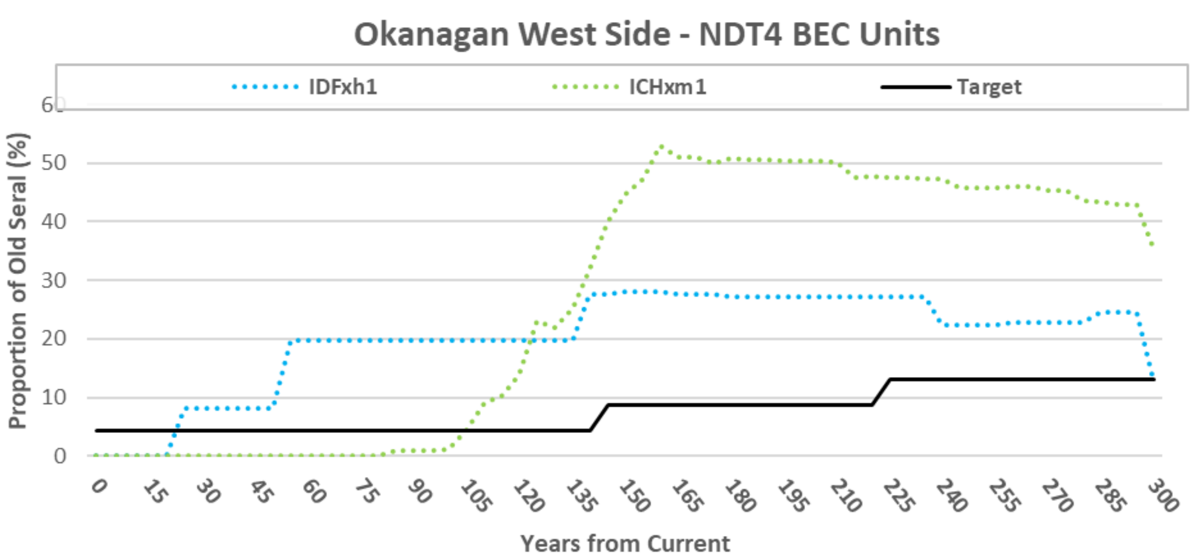
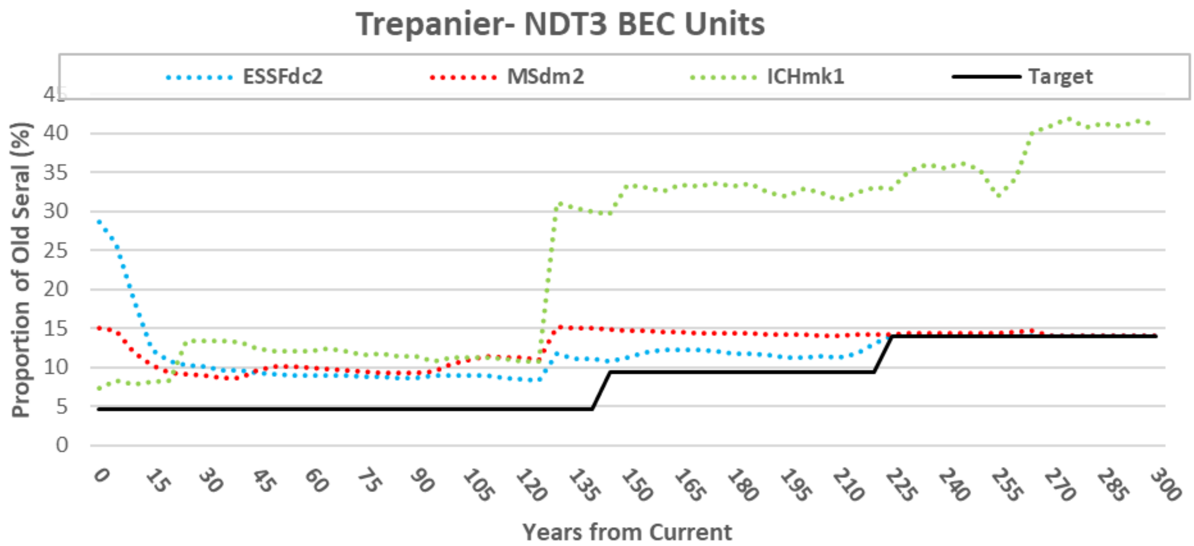




*Figure 18 Old seral status for Upper Okanagan West Side landscape unit*



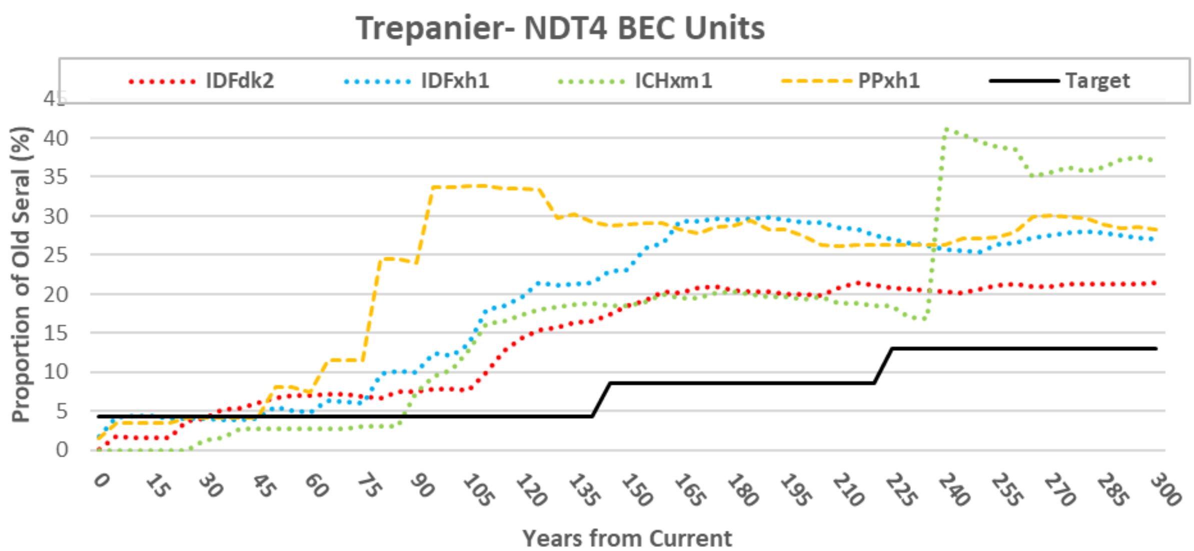
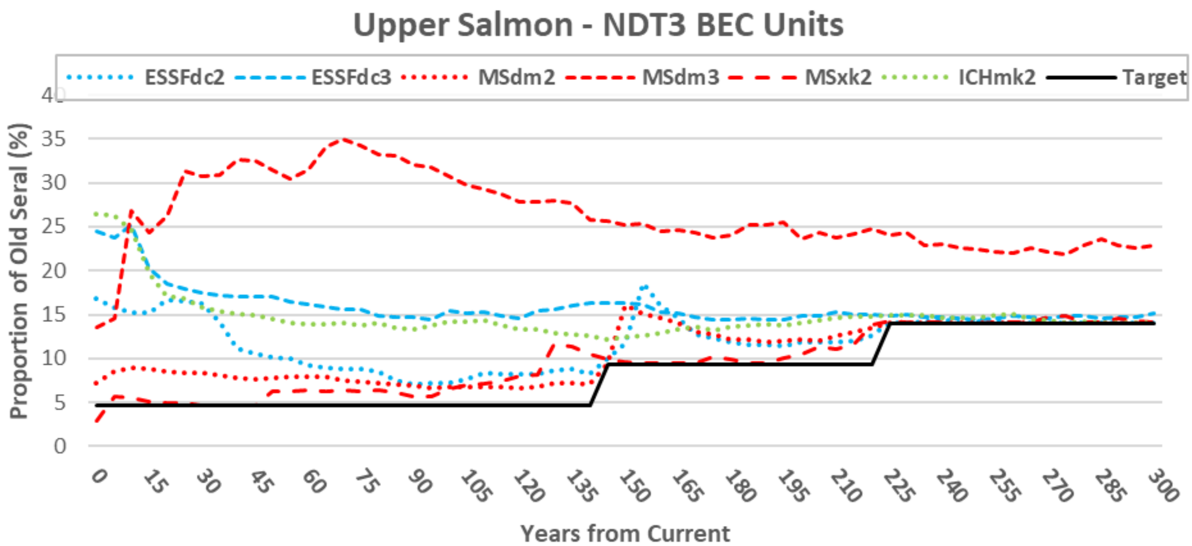




*Figure 19 Old seral status for Trepanier landscape unit*



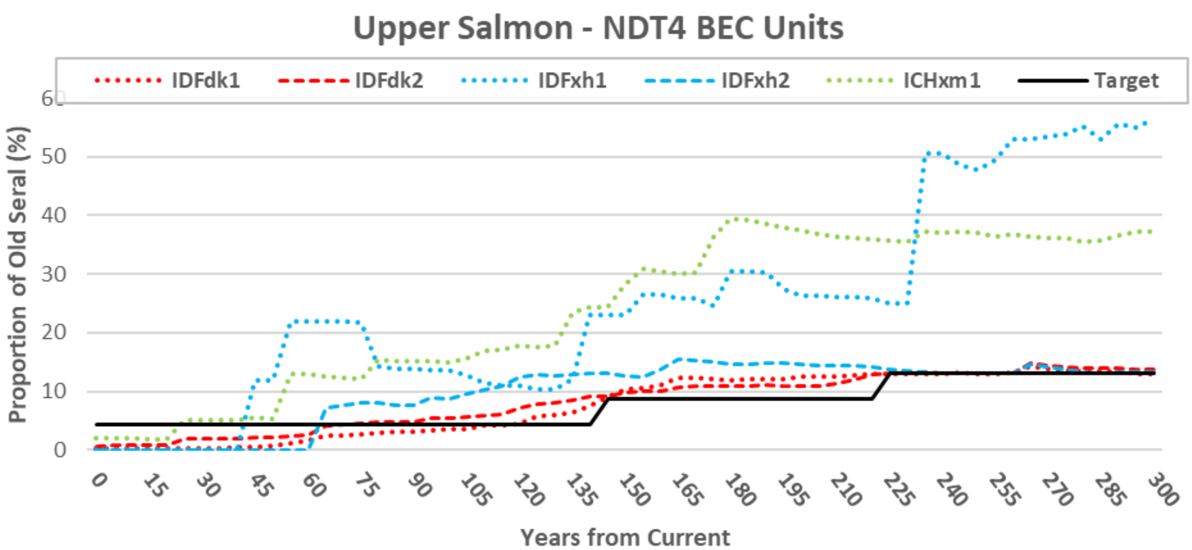




*Figure 20 Old seral status for Upper Salmon landscape unit*

### 4.4.2 Visual Quality

Visual quality objective requirements were modelled as a maximum disturbance objective limiting the proportion of stands less than a visually effective green-up height within each visual landscape inventory polygon (see Section 3.3.1 and/or the Information Package found in Appendix 1). As a result of the 2021 catastrophic fires and other previous disturbances, there is a significant area of THLB where the current disturbance exceeds the maximum disturbance thresholds, as follows:

- Modification: 390 hectares of THLB
- Partial Retention: 2,432 hectares of THLB
- Retention: 1,335 hectares of THLB

The model will not allow any further harvest (other than identified salvage) in these areas until there is sufficient height growth that the thresholds have been met. To assess the degree to which VQO objectives limit timber supply throughout the remainder of the planning horizon, the area of THLB within VQO polygons has been categorized by how close the thresholds are to being exceeded, as shown in Figure 21. For example, if the maximum allowable disturbance is 14 percent and the actual disturbance is 13.1 percent, then the VLI polygon would be categorized as being within one percent of the threshold. In general, it is expected that polygons where the disturbance threshold is exceeded or within 1% of the threshold would potentially be limiting timber supply. For the first 15 years, roughly 4.5% of the total TFL THLB is within VQOs where disturbance exceeds or is within 1% of the maximum threshold. For the next 20 years, VQO's become more limiting with roughly 6.6% of the total TFL THLB within VQOs where disturbance exceeds or is within 1% of the maximum threshold. For the remainder of the planning horizon, the proportion of the total TFL THLB where VQOs could potentially be limiting timber supply is variable, ranging between 2.4% and 6.3%. Note that the small area where the limits are exceeded on an ongoing basis is because of the natural disturbance that is occurring in the non-THLB.

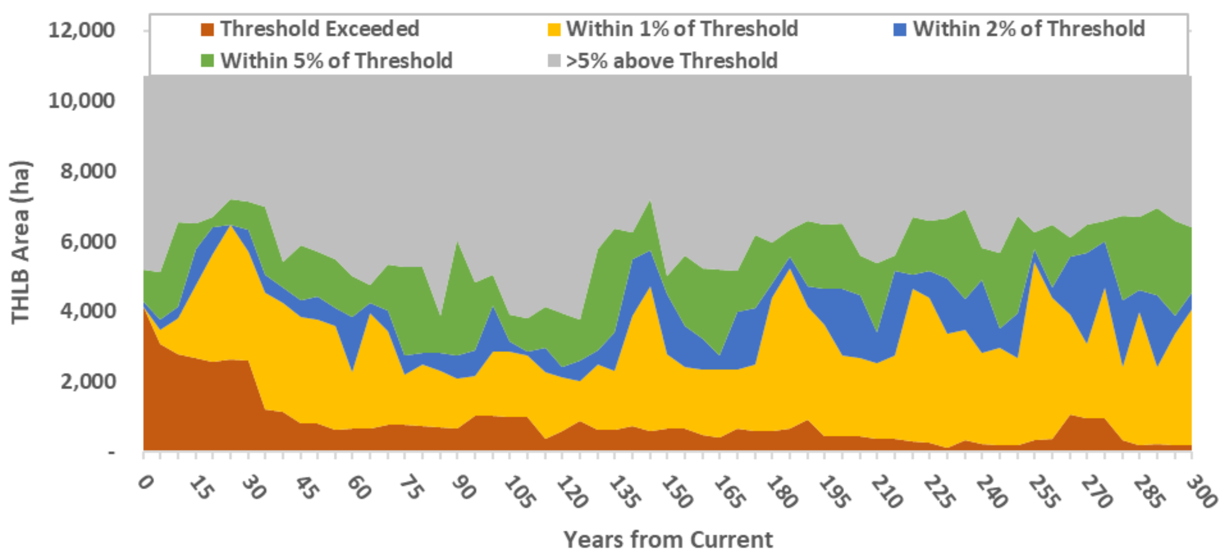



*Figure 21 VQO status*

### 4.4.3 Mule Deer Winter Range

Three objectives related to mule deer winter range (MDWR) were modelled, as follows:

- Snow Interception Cover (SIC): Each mule deer winter range planning cell must retain a minimum area within the productive forested land base as snow interception cover. To be considered as SIC, stands must have Douglas-fir as the dominant species and meet minimum age thresholds depending on the biogeoclimatic zone/subzone (Version 6).
- SIC on THLB in Moderate Snowpack Zone: For the moderate snowpack zone, at least 50% of the required SIC must be located in the THLB.
- Disturbance: Within the moderate snowpack zone, no more than 30% of the planning cell can be in stands younger than 20 years old.

Figure 22 summarizes the status of the total SIC objectives by reporting the THLB area within categories relative to the minimum threshold. There is a significant area of THLB (6,959 hectares, or 8.1% of the total TFL THLB) where the initial SIC requirements are not met. Of this, 4,983 hectares is within the perimeter of the 2021 White Rock Lake fire. It takes almost 175 years for all the planning cells that initially have a SIC deficit to recover.

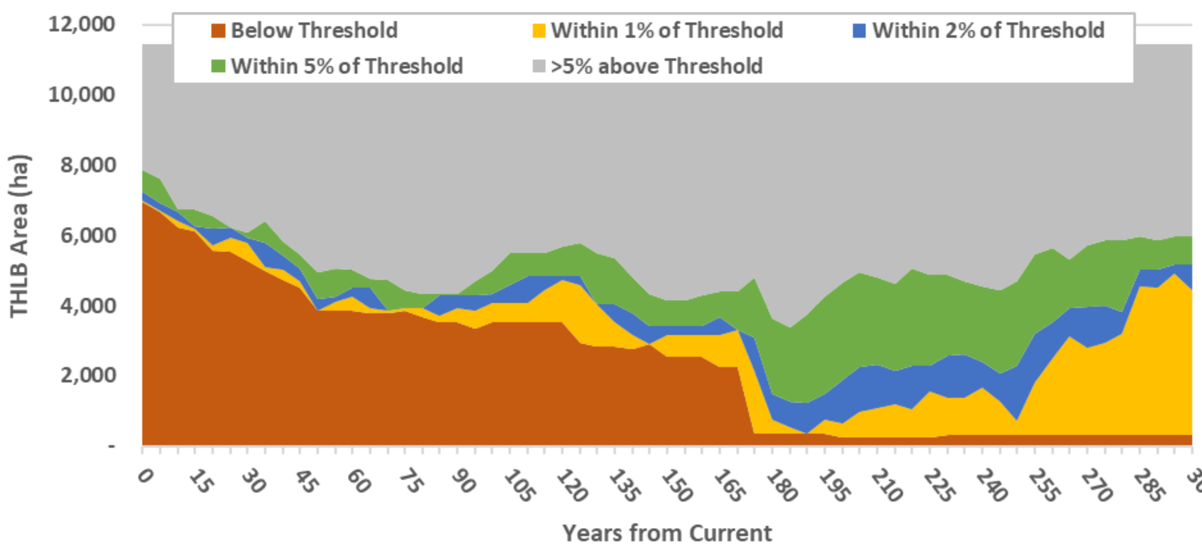



*Figure 22 MDWR Total SIC status*

Figure 23 summarizes the status of the SIC requirements on the THLB for the moderate snowpack zone. In general, the status of this objective follows a similar trend to the total SIC requirements described above.

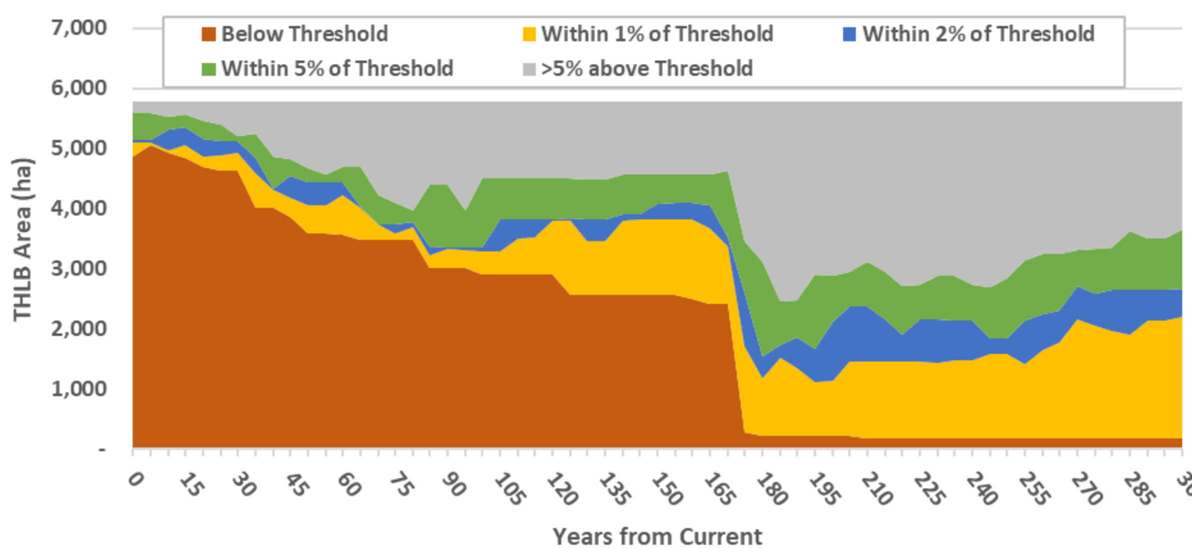



*Figure 23 MDWR SIC status on the THLB for the moderate snowpack zone*

Figure 24 summarizes the status of the maximum disturbance objective throughout the planning horizon. There are initially 3,530 hectares (4.1 % of the total TFL THLB) that exceed the desired threshold. Recovery takes about 30 years after which the requirements are easily met.

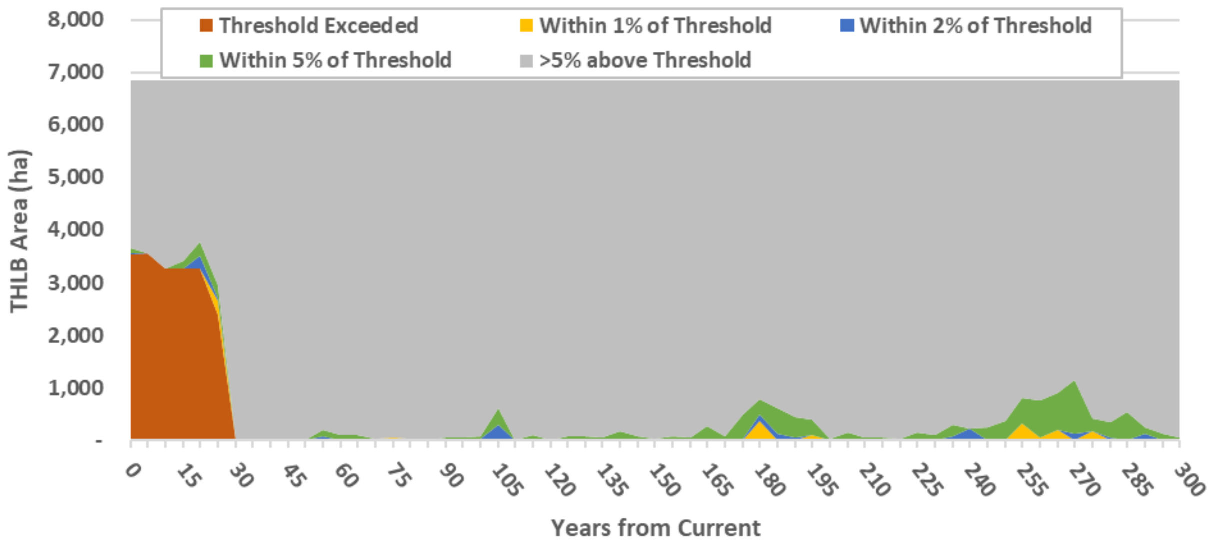



*Figure 24 MDWR disturbance objective status*

## 4.4.4 Moose Winter Range

Three objectives related to moose winter range were modelled, as follows:

- Mature Forest Cover: Each moose winter range unit must retain at least 33% of the productive forested land base as mature forest cover. To be considered mature forest cover, stands must be at least 16 metres tall.
- Mature Forest Cover Patch Size: Where practicable, at least 50% of the mature forest cover should be in patches of at least 20 hectares. This was implemented in the model as a "soft" objective to meet the intent of the "if practicable" qualification.
- Early Seral: Where practicable, at least 15% of the productive forested land base within each moose winter range unit should be less than 25 years old for the ICH and IDF biogeoclimatic zones, and 35 years old for the MS and ESSF zones. This was implemented in the model as a "soft" objective to meet the intent of the "if practicable" qualification.

One of the two moose winter range units was affected by the White Rock Lake fire in 2021, with roughly 67% of the produce forest land base within the fire perimeter. As can be seen in Figure 25, this results in an initial deficit of mature forest cover within the first 35 years of the planning horizon. Moose cover requirements are not limiting to timber supply once recovery has occurred.

Figure 26 illustrates the proportion of mature forest cover patches greater than 20 hectares for each of the two moose winter range units. The requirement to have at least 50% of the mature forest cover in patches greater than 20 hectares is easily achieved for both units.

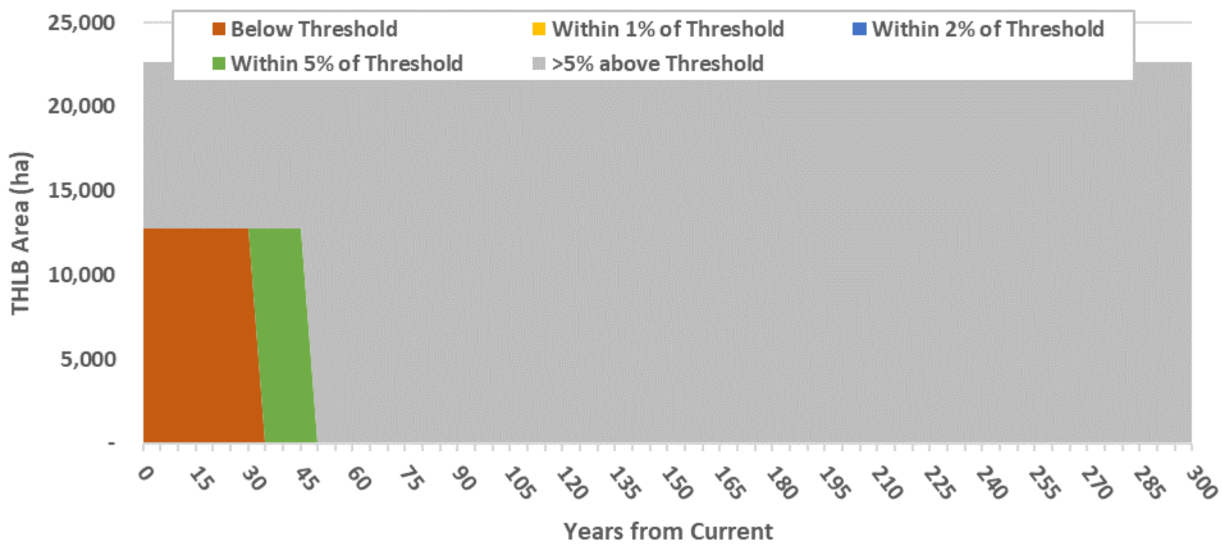



*Figure 25 Moose winter range mature forest cover status*

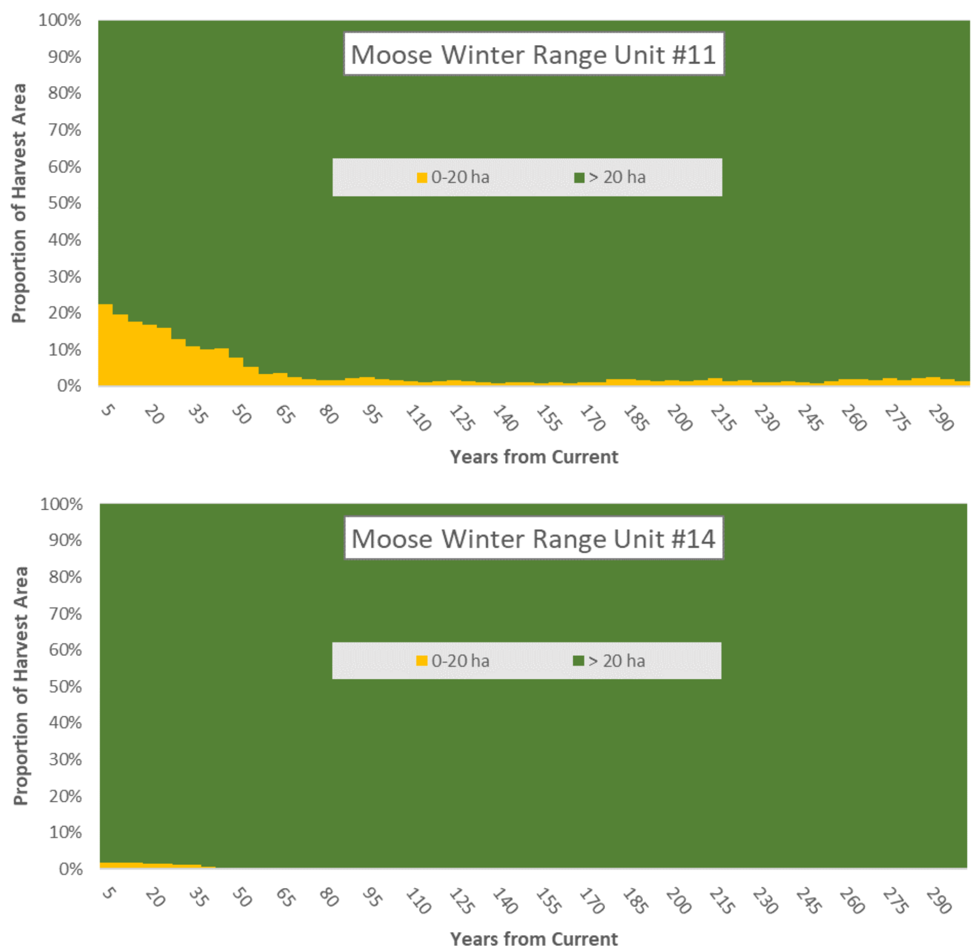



*Figure 26 Moose mature forest cover patch status*

Figure 27 illustrates the status of the early seral objective for moose winter range. One of the units does not achieve the minimum target during a 10-year period starting in year 30 of the planning horizon. This is likely because the White Rock Lake fire did not leave enough mature timber available to allow harvest to create early seral. Because the weight of this objective is set relatively low due to the "if practicable" qualification in the GAR order, it is unlikely that there is a significant limit to timber supply.

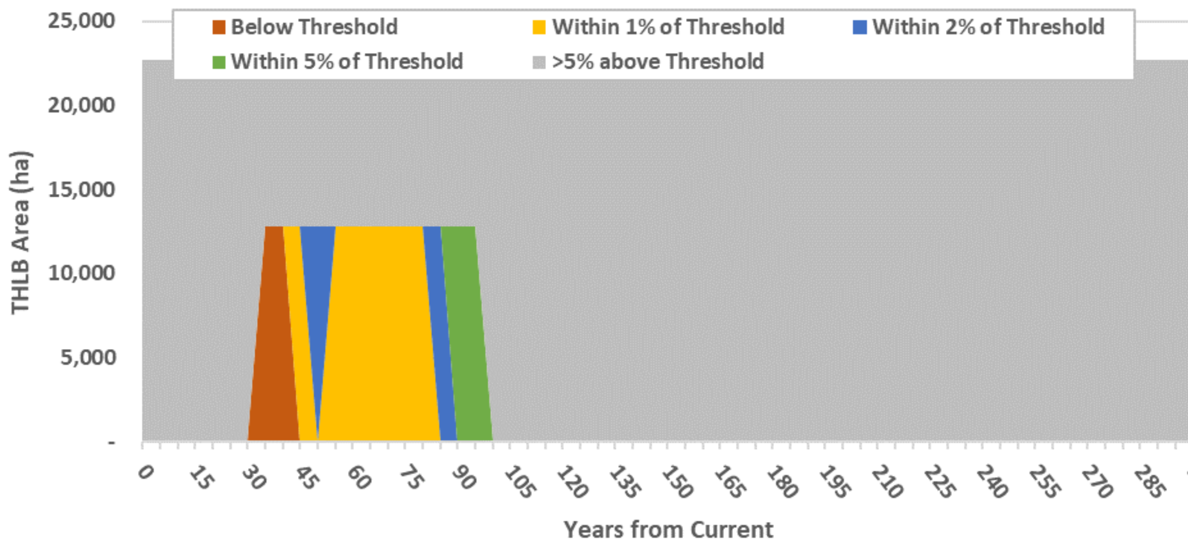



*Figure 27 Moose winter range early seral status*

### 4.4.5 Bighorn Sheep

One objective for each of the eight bighorn sheep planning cells was modelled. At least 33% of the productive forest land base within a planning cell must be at least 16 metres tall to provide thermal cover, snow interception, and security. Figure 28 summarizes the status of this retention objective. There are 445 hectares of THLB within bighorn sheep planning cells that are initially below the required threshold because of the 2009 Terrace Mountain fire. Although it takes forty years before the minimum threshold is reached, the relatively small area of THLB indicates that this objective is not likely to affect timber supply significantly.

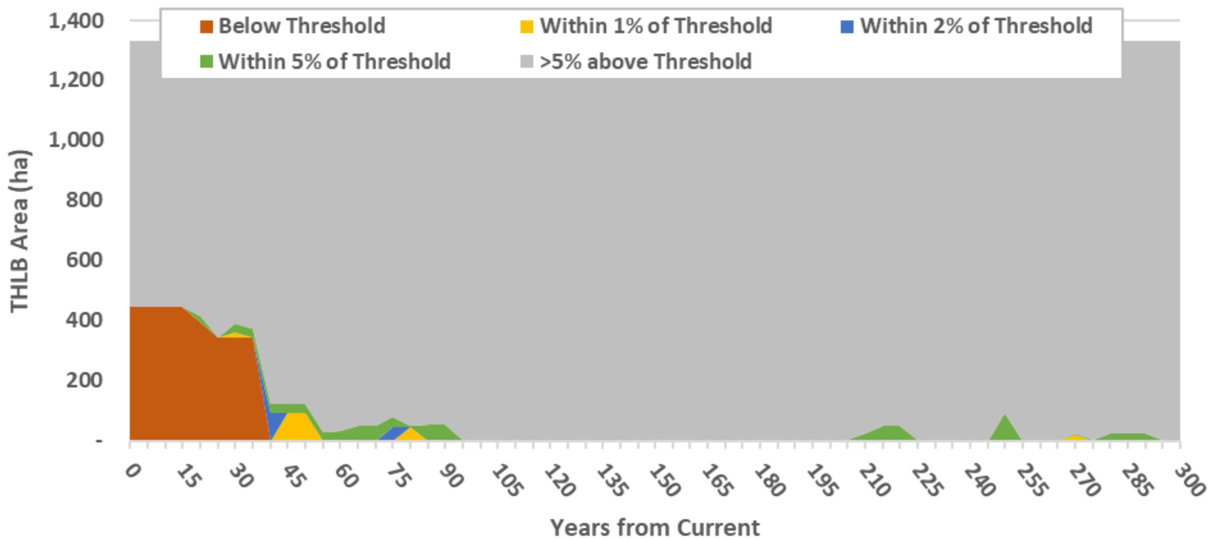



*Figure 28 Bighorn sheep snow interception cover status*

### 4.4.6 Mountain Goat

Two objectives were modelled to address the requirements for mountain goat, as follows:

- Maximum Disturbance: No more than 33% of the productive forest land base can be less than 33 years old.
- Rotation Length: No more than 33% of the timber harvesting land base can be less than 50 years old. This objective was used as a surrogate for the requirement of a three-pass harvest system with 150-year rotation length.

The maximum disturbance objective was easily achieved throughout the planning horizon (see Figure 29). Although the surrogate rotation length objective did approach the maximum threshold (Figure 30), the very small area of THLB indicates that this requirement is not limiting timber supply.

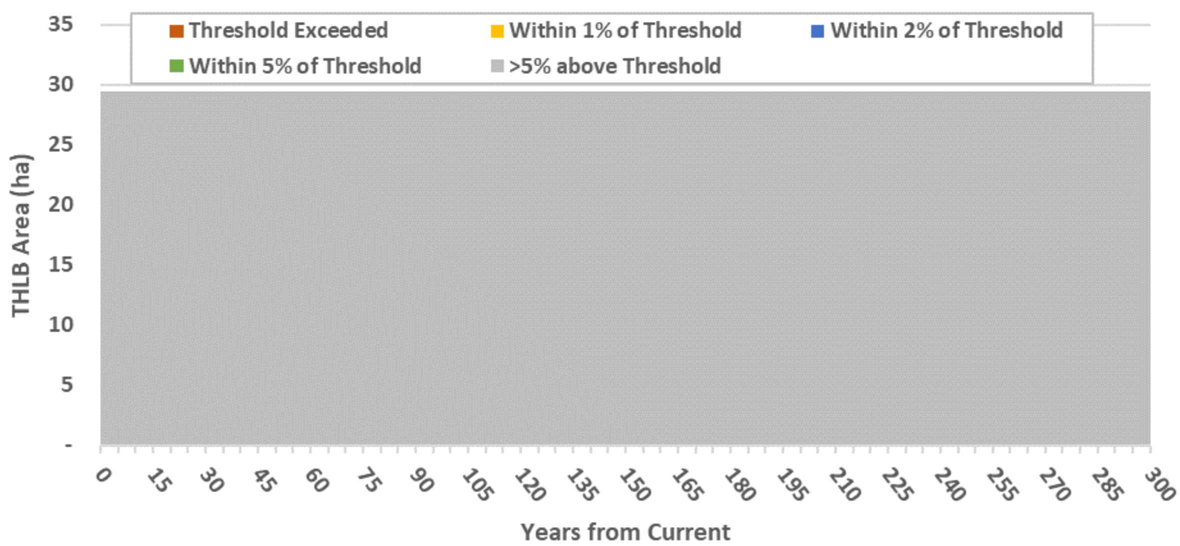



*Figure 29 Mountain goat maximum disturbance objective status*

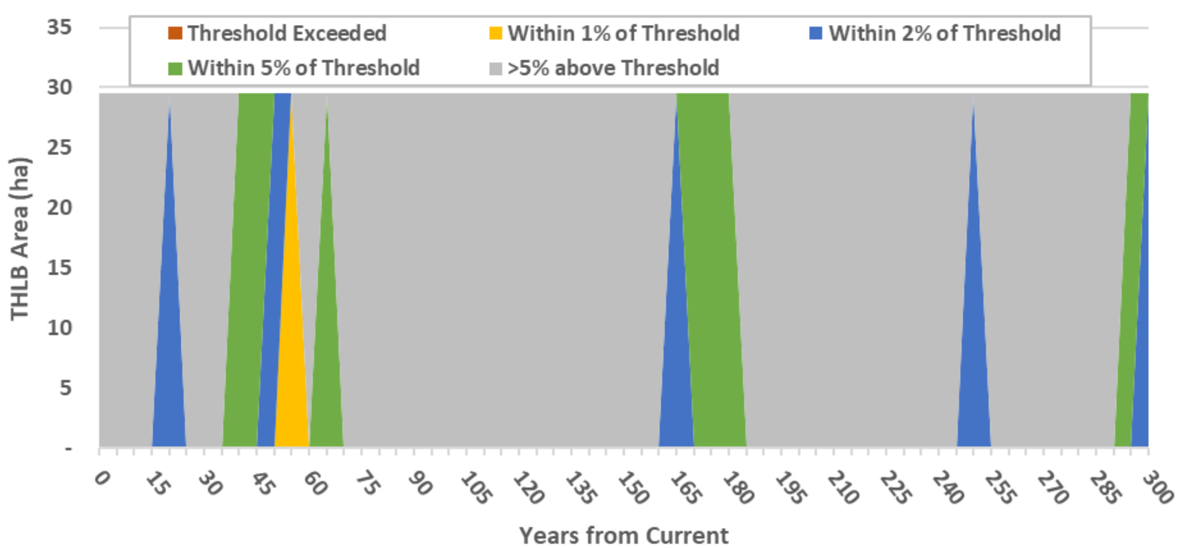



*Figure 30 Mountain goat rotation length objective status*

### 4.4.7 Bear Creek Trails

Tolko has committed to modified harvesting within 100 metres of the extensive Bear Creek trail network (REC 166988) that is used for dirt bike riding. These requirements were modelled by allowing no more than 10% of the productive forest land base within the trail buffers to be less than 5 metres tall. Figure 31 summarizes the status of this objective. The full 2,900 hectares within the trail buffers initially has disturbance that exceeds the threshold. Recovery occurs after 10 years but the area less than 5 metres tall continues to be within 1% of the threshold throughout the remainder of the planning horizon. As this area represents 3.4% of the THLB within the TFL, there will be a small downward pressure on the overall timber supply.

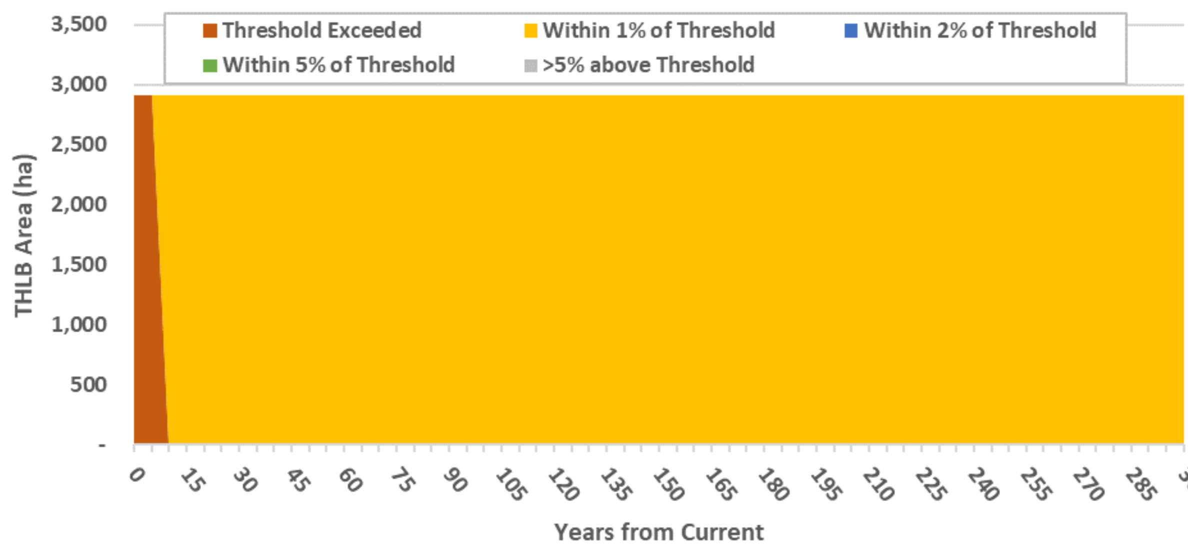



*Figure 31 Bear Creek trails disturbance objective status*

### 4.4.8 Watershed Health

There are three community watersheds and one fisheries sensitive watershed that partially overlap TFL 49. In addition, Tolko has identified twelve other watershed reporting units that overlap the TFL. Watershed health was modelled by implementing equivalent clearcut area (ECA) limits for the portions of these watersheds above the snowline, as follows:

- Community Watersheds: ECA limited to 40% above the snowline, which is intended to approximate Tolko's current practice to manage to a moderate peak flow hazard.
- Fisheries Sensitive Watershed: ECA limited to 40% above the snowline.
- Other Watershed Reporting Units: ECA limited to 50% above the snowline.

The status of these ECA objectives throughout the planning horizon are summarized in Figure 32 to Figure 34. It is concluded that the 40% ECA limits for the three community watersheds and the fisheries sensitive watershed are not limiting timber supply. However, there are initially about 17,575 hectares of THLB within the other watershed reporting units where the 50% maximum ECA threshold is exceeded because of the 2021 White Rock Lake fire. About half of this area recovers after 10 years, with the remainder below the threshold after 35 years.

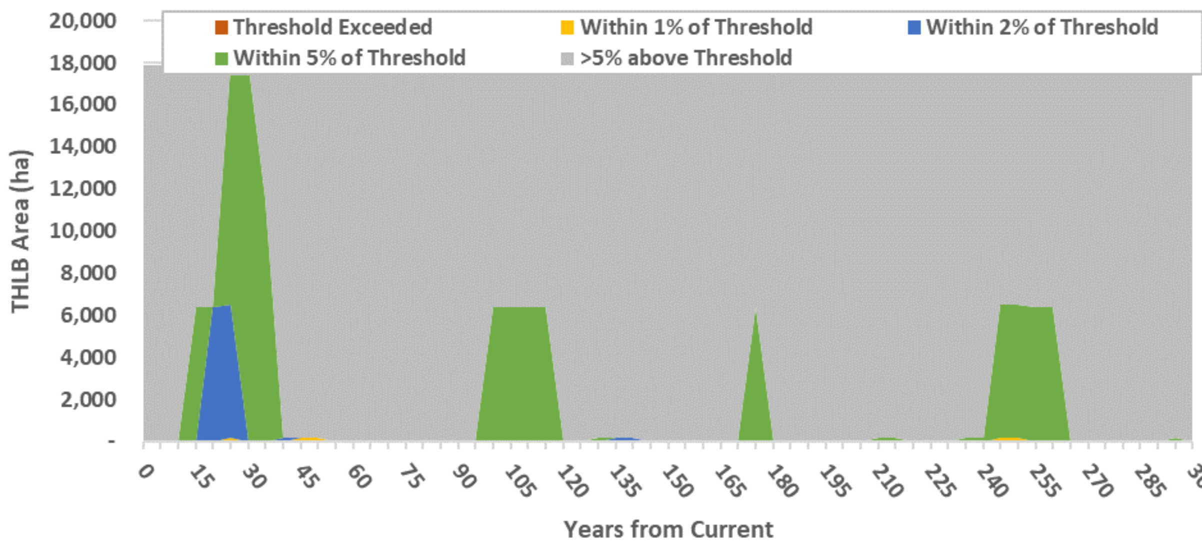



*Figure 32 Community watershed ECA status*

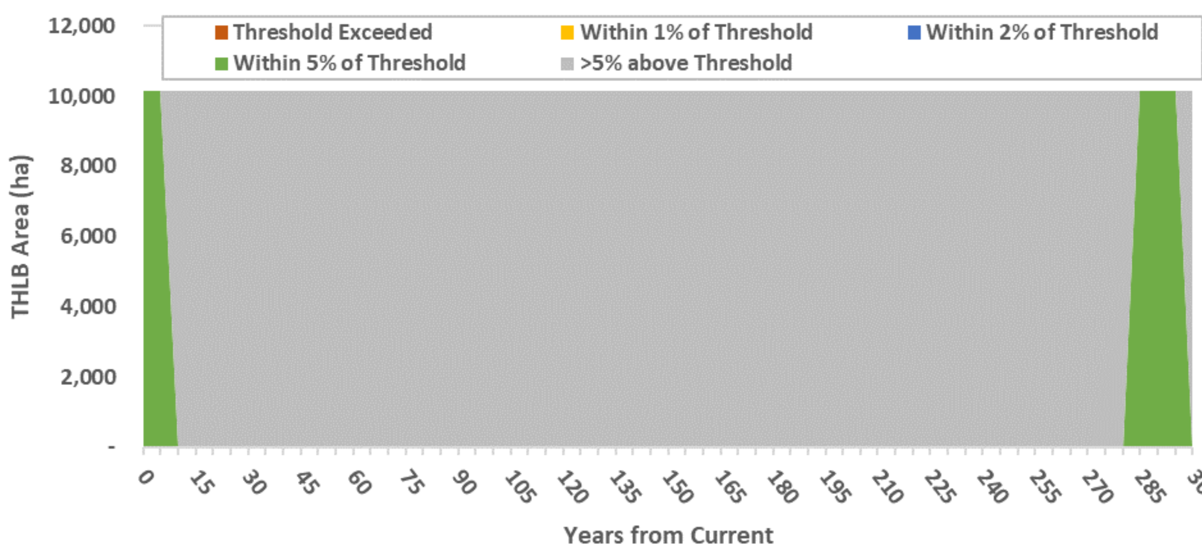



*Figure 33 Fisheries Sensitive watershed ECA status*

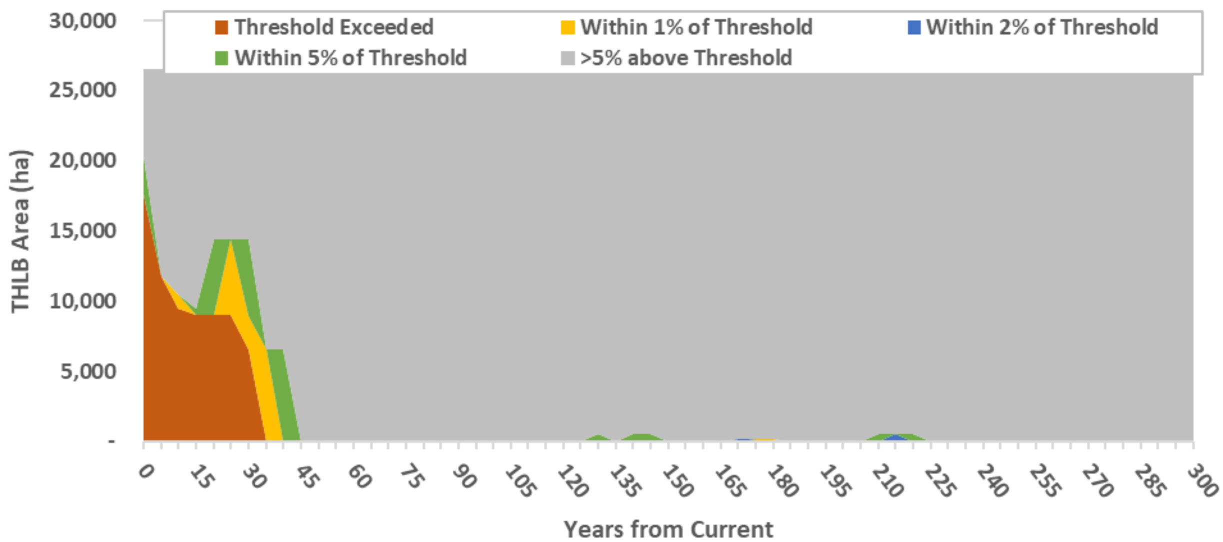



*Figure 34     Other watershed ECA status*

### 4.4.9 Patch Size Distribution

Young seral (<20 years old) patch size objectives were modelled for each TFL block/natural disturbance type, using the target ranges outlined in Table 3. These patch size targets were not modelled as a rigid constraint, but rather, were weighted so that the desired patch size distributions were encouraged without unduly limiting timber supply. This is because initial patch size distributions are often not aligned with the desired condition and it takes time to effect change. In addition, the targets should often be applied to a larger land base that includes areas outside the TFL with the result that the modelled area is too small to achieve the targets.

*Table 3     Patch size targets*

| NDT | Patch Size | Target Distribution |
|---|---|---|
| **NDT 3a (fir absent)** | Small: (0 to 40 hectares)<br>Medium: (40 to 250 hectares)<br>Large: (250 to 1000 hectares) | 10 to 20% of land base<br>10 to 20% of land base<br>60 to 80% of land base |
| **NDT 3b (fir throughout)** | Small: (0 to 40 hectares)<br>Medium: (40 to 80 hectares)<br>Large: (80 to 250 hectares) | 20 to 30% of land base<br>25 to 40% of land base<br>30 to 50% of land base |
| **NDT4** | Small: (0 to 40 hectares)<br>Medium: (40 to 80 hectares)<br>Large: (80 to 250 hectares) | 30 to 40% of land base<br>30 to 40% of land base<br>20 to 30% of land base |

Figure 35 to Figure 37 summarize the resulting young seral patch size distributions for the Base Case. The effect of the 2009 Terrace Mountain fire and 2021 White Rock Lake fire on the initial patch size distribution is evident. It is also noted that the small patch size is over-represented on an ongoing basis for most TFL Block/NDT combinations.

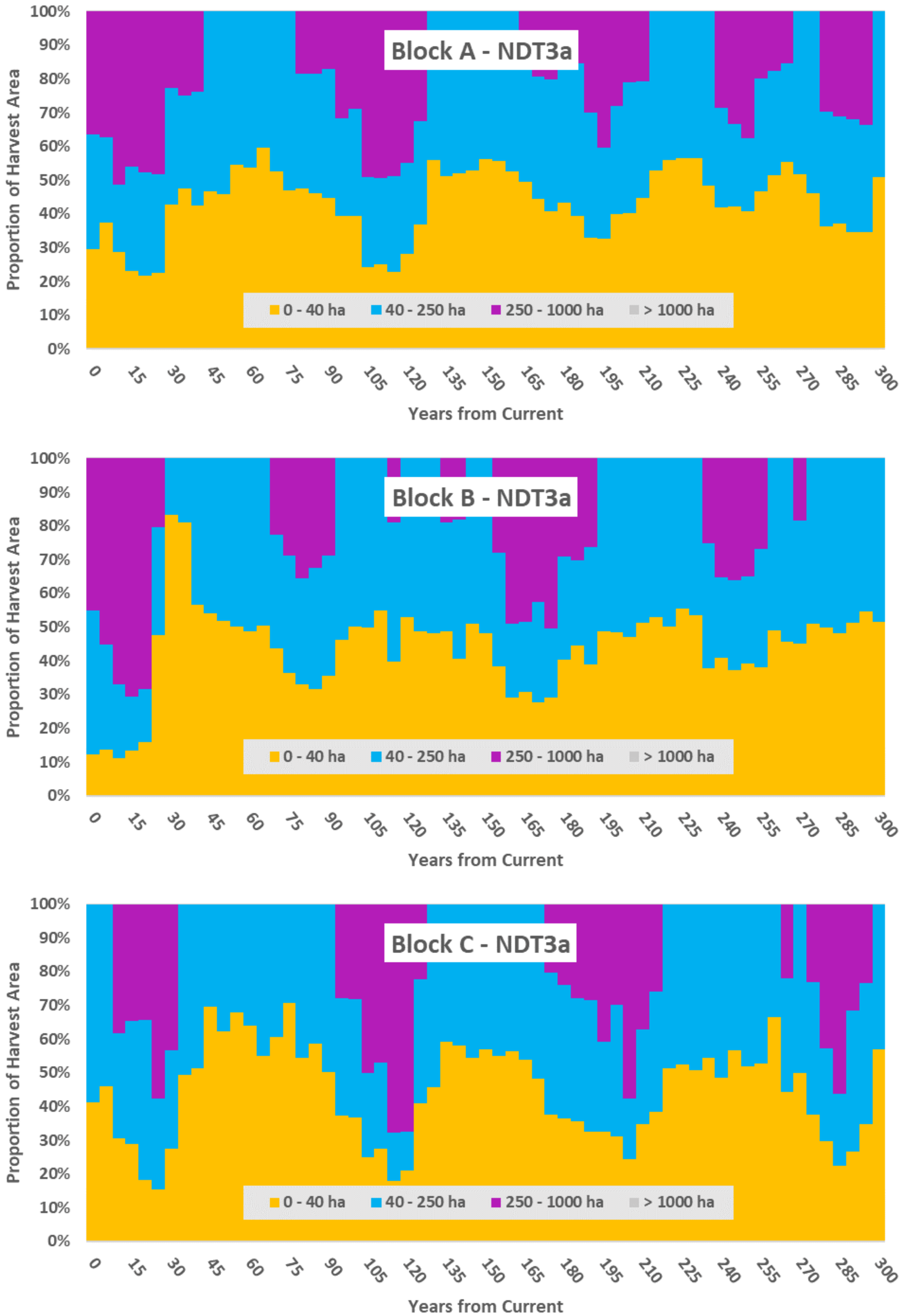



*Figure 35 Patch size distribution for NDT3a*

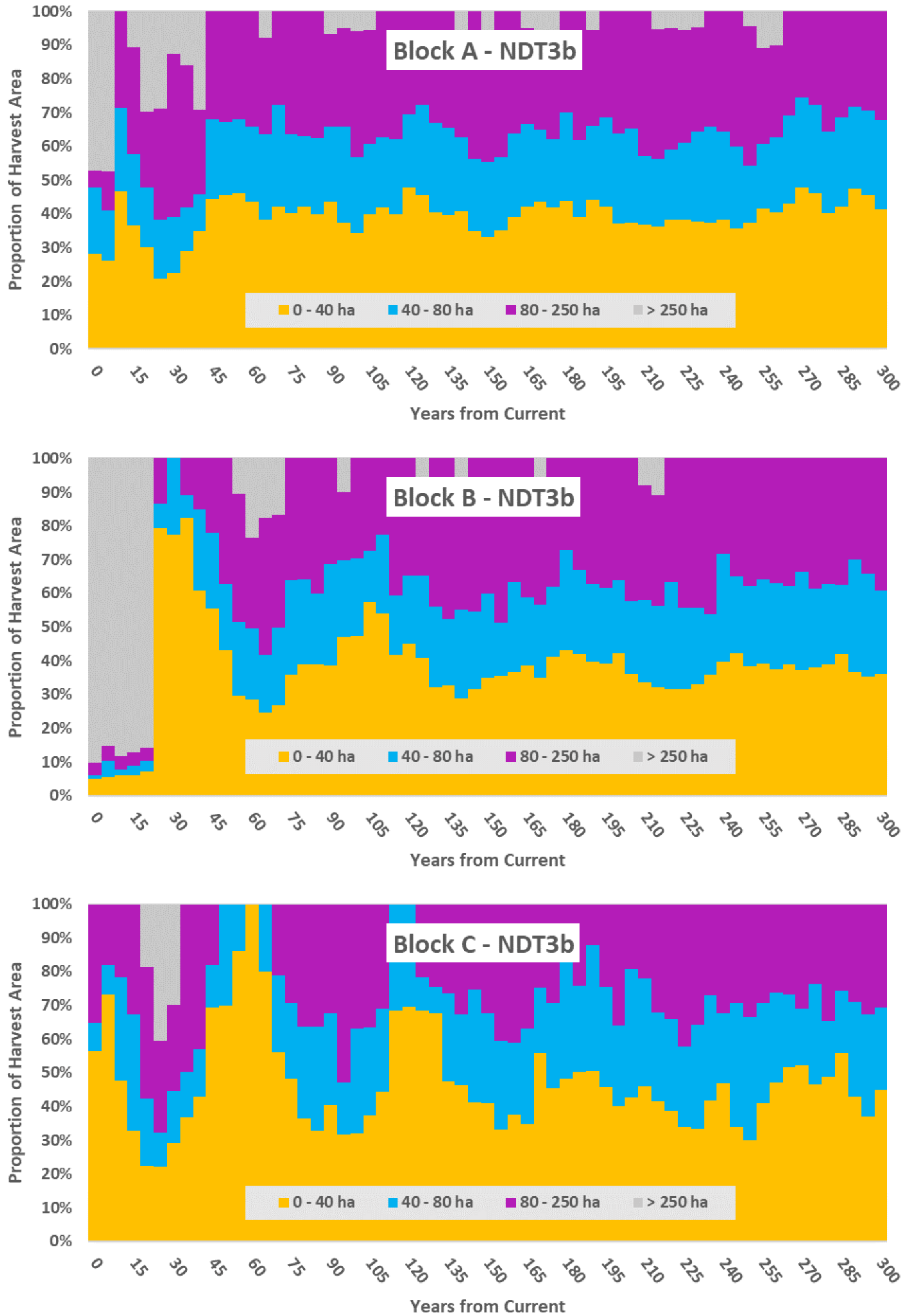



*Figure 36 Patch size distribution for NDT3b*

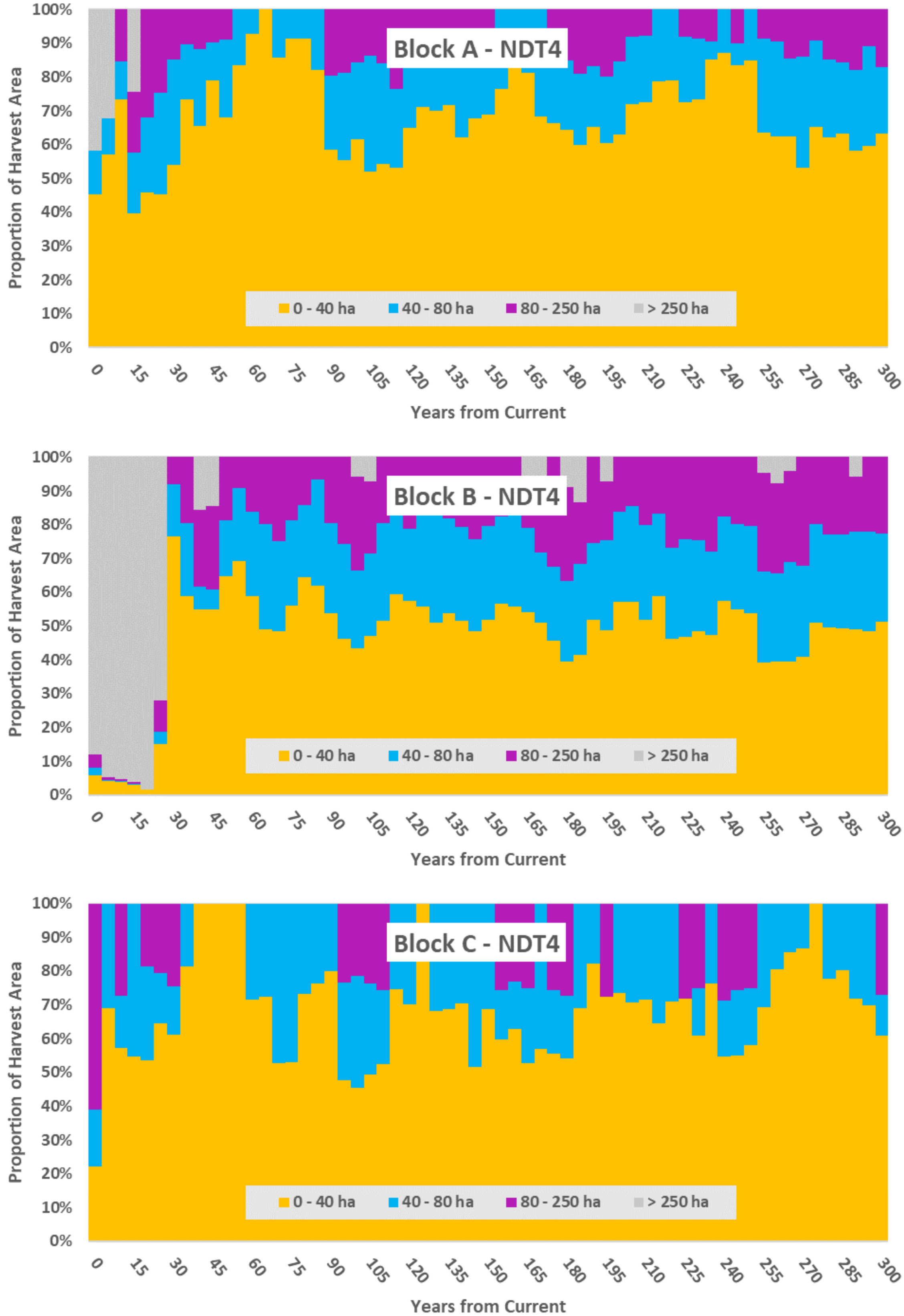



*Figure 37 Patch size distribution for NDT4*



FORSITE

## 4.5 DIFFERENCES IN THE BASE CASE FROM THE PREVIOUS (2011) ANALYSIS

Figure 38 shows a comparison of the projected harvest flows for the Base Case scenario with those from the analysis completed in 2011. Because 12 years have passed since the previous management plan was completed, the harvest flow for the 2011 analysis in the graph has been adjusted by subtracting 10 years from the start of the planning horizon. These results are not directly comparable because the 2011 analysis included 31,500 hectares in the Browns Creek (Birch Creek) area that has since been removed from the TFL. In May 2011, TECO Natural Resource Group Limited provided a short memo to Tolko that provided estimates of the timber supply attributable to the Brown's Creek area. Information in this memo was used to estimate a harvest flow for the remainder of the TFL after Brown's Creek was removed.

It is noted that the Base Case for the current analysis has a higher initial harvest than in 2011. However, the 2011 analysis started to transition to the long-term harvest level 25 years earlier than the Base Case for the current analysis. To understand if this earlier transition could account for the difference in initial harvest level, an alternate model run for the Base Case was completed where the harvest level began to increase at the same time as in the 2011 analysis. It can be seen on Figure 38 (green dashed line) that this results in a similar initial harvest flow to that modelled in the 2011 analysis.

Based on the process used to update the inventory to account for the 2021 White Rock Lake fire, it is estimated approximately 725,000 m$^3$ of mature timber above the minimum harvest threshold will not be salvaged. While this is expected to reduce short-term harvest levels compared to the 2011 modelled results, there are other changes in this analysis that make it difficult to undertake a direct comparison with the 2011 analysis. Most significantly, the current analysis is based on a completely new inventory. Additionally, the minimum volume that is considered economic for harvest has been reduced from 150 m$^3$/hectare to 75 m$^3$/hectare. From year 6 to year 45 of the Base Case scenario, approximately 5.9% (426,762 m$^3$) of the harvest is from stands less than 150 m$^3$/hectare, which is equivalent to about 10,670 m$^3$/year.

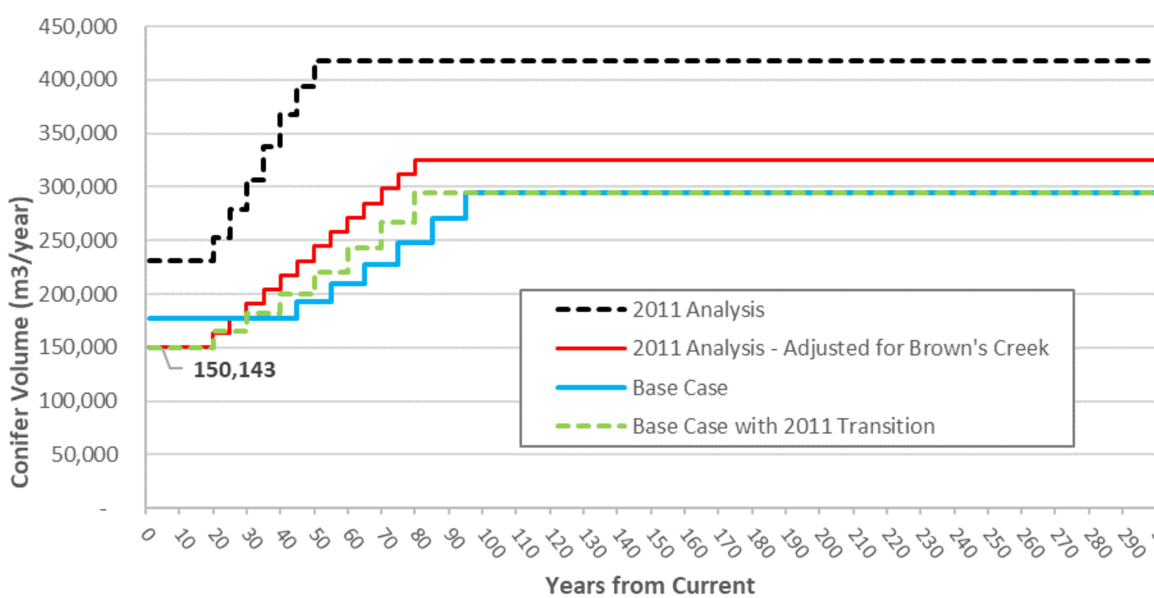



*Figure 38 Base Case comparison with 2011 analysis*

## 4.6 BASE CASE SENSITIVITY ANALYSES

The data and assumptions used in timber supply analyses are often subject to uncertainty. To provide perspective on the impacts of changes to data or assumptions, sensitivity analyses are commonly performed. Usually only one variable (data or assumption) from the information used in the Base Case is changed to explore the sensitivity of that variable. Sensitivity analysis is a key component of the timber supply analysis process as it provides the Chief Forester with the information necessary to gauge the potential impact of uncertainty around assumptions and data that make up the Base Case.

Table 4 lists the sensitivity analyses that were completed against the TFL 49 Base Case scenario. Further details and the results from the sensitivity analyses are provided in subsequent sections.

Determining harvest flows for sensitivity analyses is subjective as multiple harvest flows are often possible. To provide meaningful comparisons with the Base Case, harvest flows were generally chosen so that the transition from the short/mid-term to the long-term occurs at the same time and with the same number of steps as the Base Case. Note that these steps may be greater than 10% per decade depending on the difference between the short and long-term.

Three of the sensitivity analyses changed the area of the Timber Harvesting Land Base. For these, the annual unsalvaged losses were adjusted to reflect the revised area because the losses are calculated only for the THLB.

Another consideration when evaluating the sensitivity analyses is that the heuristic nature of the PATCHWORKS™ model can make it difficult to achieve harvest flows that are exactly equal despite identical harvest requests and target weighting in different scenarios. When interpreting the results from the sensitivity analyses, this report assumes that differences in harvest levels less than or equal to 0.1% are not indicative of a significant difference. In other words, changes of less than 177 $m^3$/year in the short-term and 294 $m^3$/year in the long-term are not considered significant.

*Table 4 Base Case Sensitivity analyses*

| Category | Sensitivity | Description of Change |
|---|---|---|
| **Land Base Definition** | THLB Area | Change the THLB Area by +/- 10%. |
| **Growth and Yield** | Natural Stand Yields | Change the natural stand yields by +/- 10%. |
| | Managed Stand Yields | Change the managed stand yields by +/- 10%. |
| | Minimum Harvest Ages | Change the minimum harvest ages for all stands by +/- 10 years. |
| | OAF1 | Decrease Operational Adjustment Factor 1 (OAF1) from 15% to 10%. |
| **Integrated Resource Management** | Disturbance in the non-THLB | Increase disturbance in the non-THLB by 10% |
| | Old Seral Targets | Apply full old seral targets immediately instead of using the 2/3 reduction. |
| | Old Growth Deferrals | Do not allow harvest in Technical Advisory Panel recommended old growth deferral areas. |
| **Timber Harvesting** | Minimum Cutblock Size | Turn off minimum cutblock size requirements. |
| | Douglas-fir beetle salvage | Remove the requirement for 250,000 $m^3$ of Douglas-fir beetle salvage in green stands in first five years. |

### 4.6.1 Size of the Timber Harvesting Land Base

Several factors that determine the size of the THLB have uncertainty around their definitions (steep slopes, unstable terrain, low site, non-merchantable, riparian management, roads, etc.). Different market conditions in the future or changes in harvesting or mill technology can also serve to reduce or expand the land base considered to be economic.

To understand the risks associated with THLB estimation, two sensitivity model runs have been completed that increase and decrease the size of the THLB by 10%. This was accomplished by increasing/decreasing the area of THLB polygon in the model and increasing/decreasing each non-THLB polygon by the proportional amount so that the total productive forested land base remained the same, as shown in Table 5.

*Table 5 Modelling approach for the THLB +/- 10% sensitivity analyses*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Each polygon assigned as THLB/non-THLB according to the Base Case netdown, with these areas used in the model. |
| **THLB Plus 10%** | Each THLB polygon area increased by 10% in the model. Each non-THLB polygon decreased by 49.1% to maintain the original PFLB area. |
| **THLB Less 10%** | Each THLB polygon area decreased by 10% in the model. Each non-THLB polygon increased by 49.1% to maintain the original PFLB area. |

A percentage increase or decrease in the THLB typically results in a proportional change in the harvest flow. Figure 39 and Table 6 summarize the resulting harvest flows when the THLB area is increased/decreased by 10 percent. The results are as expected in both the short/mid and the long-term.

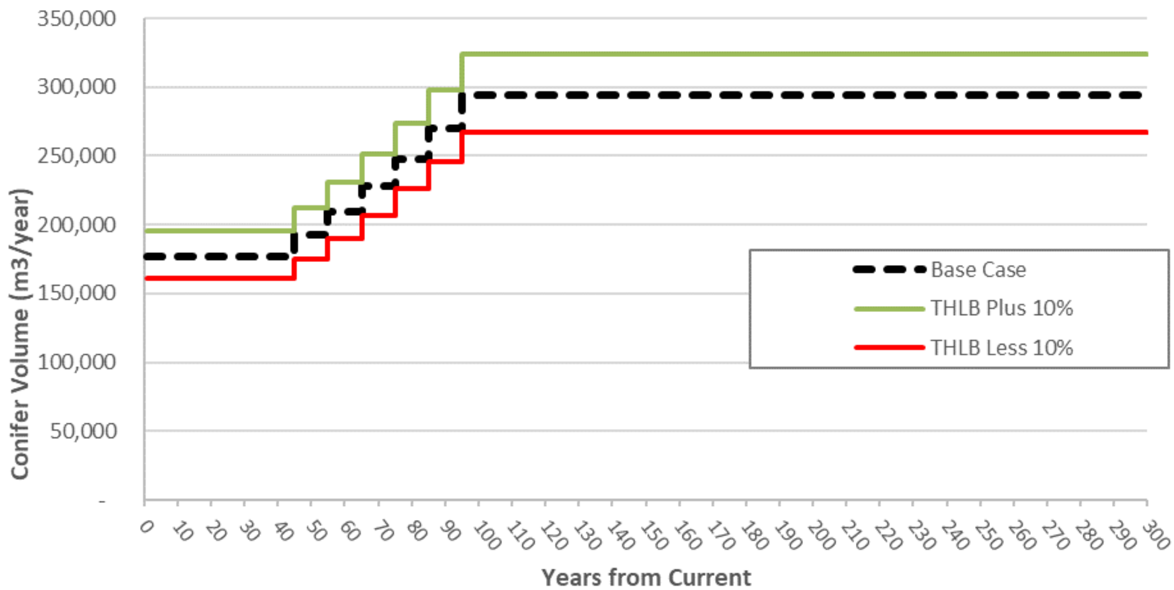



*Figure 39 Harvest flows for the THLB +/- 10% sensitivity analyses*

*Table 6 Harvest flow differences for the THLB +/- 10% sensitivity analyses*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **THLB Plus 10%** | Increase in harvest level of 10.3% to 195,200 $m^3$/year. | Increase in harvest level of 10.3% to 324,320 $m^3$/year. |
| **THLB Less 10%** | Decrease in harvest level of 9.2% to 160,750 $m^3$/year. | Decrease in harvest level of 9.1% to 267,240 $m^3$/year. |

### 4.6.2 Natural Stand Yields

Stand yields are a critical input into timber supply analyses. The short and mid-term timber supply is often heavily influenced by the availability of timber in natural stands that make up the current growing stock, because these stands provide the only timber harvesting opportunities before managed stands reach minimum harvest age.

Natural stand yields were created using the VDYP yield model, which predicts yields from stand attributes determined at the time the forest inventory was created. Uncertainty in these yields can result from inaccuracies in the VDYP model, in decay estimates, or in the stand attributes themselves. The approach used to investigate uncertainty in natural stand yields is summarized in Table 7.

*Table 7 Modelling approach for the natural stand yield sensitivity analyses*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Yield tables for each stand were created using VDYP7 and VRI inventory attributes. The yield associated with each natural stand analysis unit was then created by area weighting these individual stand yield tables. |
| **Natural Stand Yields Plus 10%** | The yield associated with each natural stand analysis unit in the Base Case was increased by 10%. Height was not adjusted. Minimum harvest ages were re-calculated based on the new volumes and the minimum harvestable volume criteria. |
| **Natural Stand Yields Less 10%** | The yield associated with each natural stand analysis unit in the Base Case was decreased by 10%. Height was not adjusted. Minimum harvest ages were re-calculated based on the new volumes and the minimum harvestable volume criteria. |

Changes in natural stand yields are expected to primarily affect short/mid-term harvest levels. The changes to harvest flow when varying natural stand yields are shown in Figure 40 and Table 8. As expected, there is no change in long-term harvest when natural stands yields are increased/decreased. When natural yields are increased by 10%, there is a corresponding 8.9% increase in short-term harvest level. However, when natural yields are reduced by 10%, the reduction in short-term harvest level is only 0.2%. Further investigation of this unusual result indicates that during the 45-year short-term period, the volume contribution from natural stands is decreased by 9.3%. However, there are enough existing managed stands above the minimum harvest threshold to replace the natural stand harvest without affecting future harvest levels.

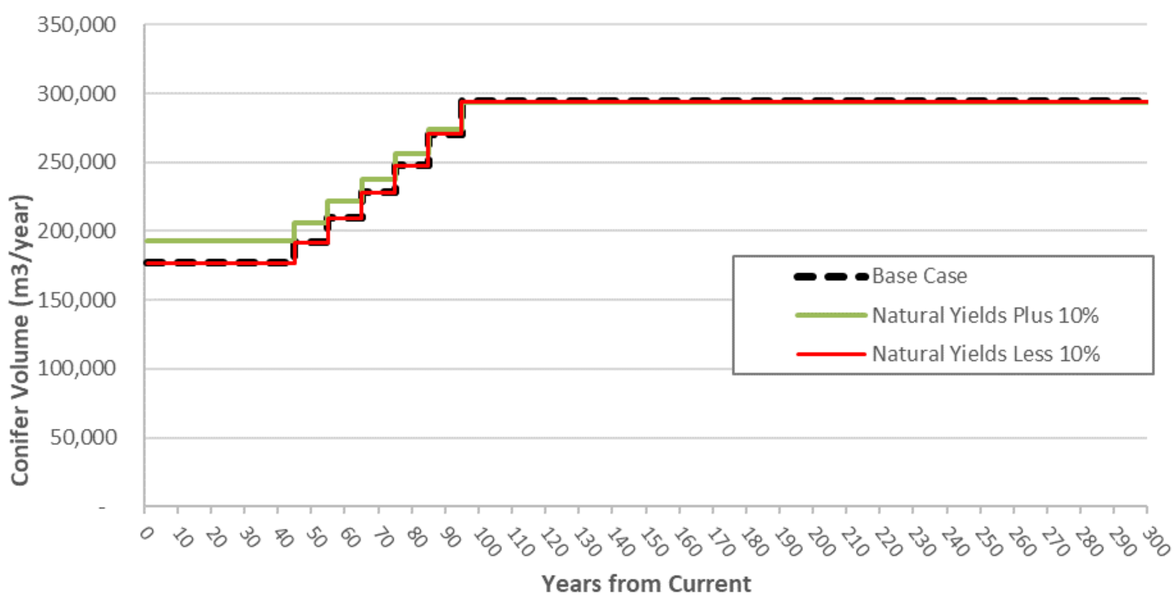



*Figure 40 Harvest flows for the natural stand yield table sensitivity analyses*

*Table 8 Harvest flow differences for the natural stand yield sensitivity analyses*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Natural Stand Yields Plus 10%** | Increase in harvest level of 8.9% to 192,640m$^3$/year. | No change. |
| **Natural Stand Yields Less 10%** | Decrease in harvest level of 0.2% to 176,670 m$^3$/year. | No change. |

### 4.6.3 Managed Stand Yields

Managed stand yields are created with the TIPSY model, which predicts yields for managed stands using site index and stand attributes such as species, density, operational adjustment factors, and expected gains from planting stock grown using select seed. The over or under estimation of any of these factors can lead to uncertainties in the yields of these stands. The approach used to investigate uncertainty in managed stand yields is summarized in Table 9.

*Table 9 Modelling approach for managed stand yield sensitivity analyses*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Yield tables for each managed stand analysis unit were created using TIPSY v4.5 with site index from LiDAR or the provincial site productivity layer and other inputs based on historic and anticipated silviculture regimes. Minimum harvest ages were determined based on stands achieving minimum harvestable volumes and at least 90% of the maximum mean annual increment. |
| **Managed Stand Yields Plus 10%** | The yield table volume for each managed stand analysis unit in the Base Case was increased by 10%. Height was not adjusted. Minimum harvest ages were re-calculated based on the new volumes and the minimum harvestable volume criteria. |
| **Managed Stand Yields Less 10%** | The yield table volume for each managed stand analysis unit in the Base Case was decreased by 10%. Height was not adjusted. Minimum harvest ages were re-calculated based on the new volumes and the minimum harvestable volume criteria. |

Figure 41 and Table 10 summarize the changes to harvest flows when managed stand yields are increased/decreased by 10%. As expected, long-term harvest levels are proportionately increased/decreased because most of the harvest is coming from managed stands during this portion of the planning horizon.

There is an 8.3% increase and a 6.8% decrease in the short/mid-term harvest level when managed stand yields are varied by +/- 10%. This indicates that managed stands are an important component of the harvest during the short/mid-term.

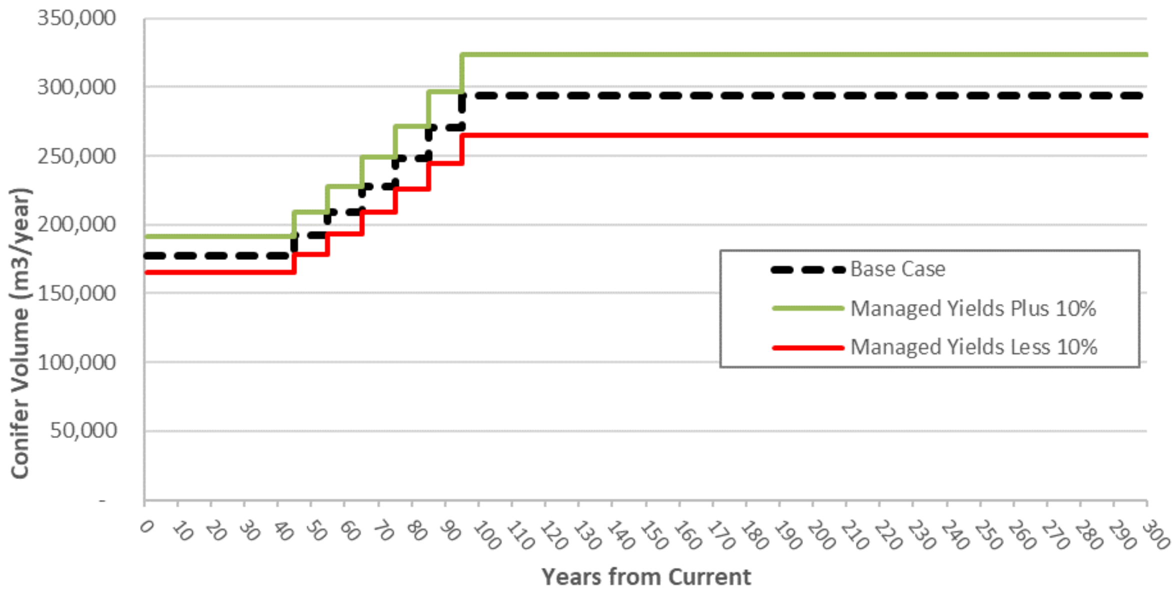



*Figure 41 Harvest flows for the managed stand yield sensitivity analyses*

*Table 10 Harvest flow differences for the managed stand yield sensitivity analyses*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Managed Stand Yields Plus 10%** | Increase in harvest level of 8.3% to 191,560 $m^3$/year. | Increase in harvest level of 10.0% to 323,510 $m^3$/year. |
| **Managed Stand Yields Less 10%** | Decrease in harvest level of 6.8% to 164,960 $m^3$/year. | Decrease in harvest level of 9.9% to 265,000 $m^3$/year. |

### 4.6.4 Minimum Harvest Ages

Uncertainty around the age that stands become merchantable and available for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions such as markets and products that will define merchantability.

Two sensitivity analyses were completed to understand the potential changes to timber supply that result from changing minimum harvest ages, as outlined in Table 11.

*Table 11 Modelling approach for the minimum harvest age sensitivity analyses*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Minimum harvest ages for each analysis unit were based on achieving: 1) 75 $m^3$/hectare; 2) at least 15 metres tall; 3) at least 60 years old for natural stands or 50 years old for managed stands; and 4) at least 90% of culmination (maximum) mean annual increment for managed stands. |
| **Minimum Harvest Ages Increased by 10 Years** | Increase minimum harvest ages by 10 years from those used in the Base Case. Stands must still be above minimum harvestable volume criteria. |
| **Minimum Harvest Ages Decreased by 10 Years** | Decrease minimum harvest ages by 10 years from those used in the Base Case. Stands must still be above minimum harvestable volume criteria. |

The short/mid-term harvest level is often influenced by a change in minimum harvest age because the timing of the transition to harvesting managed stands can be critical. Reducing minimum harvest age can result in increased short/mid-term harvest and increasing minimum harvest ages can lead to decreased short/mid-term harvest.

Figure 42 and Table 12 summarize the changes to timber supply when minimum harvest ages are varied by +/- 10 years. The short/mid-term harvest is very sensitive to an increase in the minimum harvest age, with a 12.1% reduction in harvest level. This highlights the importance of existing managed stands to the short/mid-term harvest level. Although the short/mid-term harvest level decreases, the long-term harvest level increases by 2.4% as stands are harvested closer to the optimum age. In comparison, there is very little change to harvest levels when minimum harvest ages are decreased by 10 years.

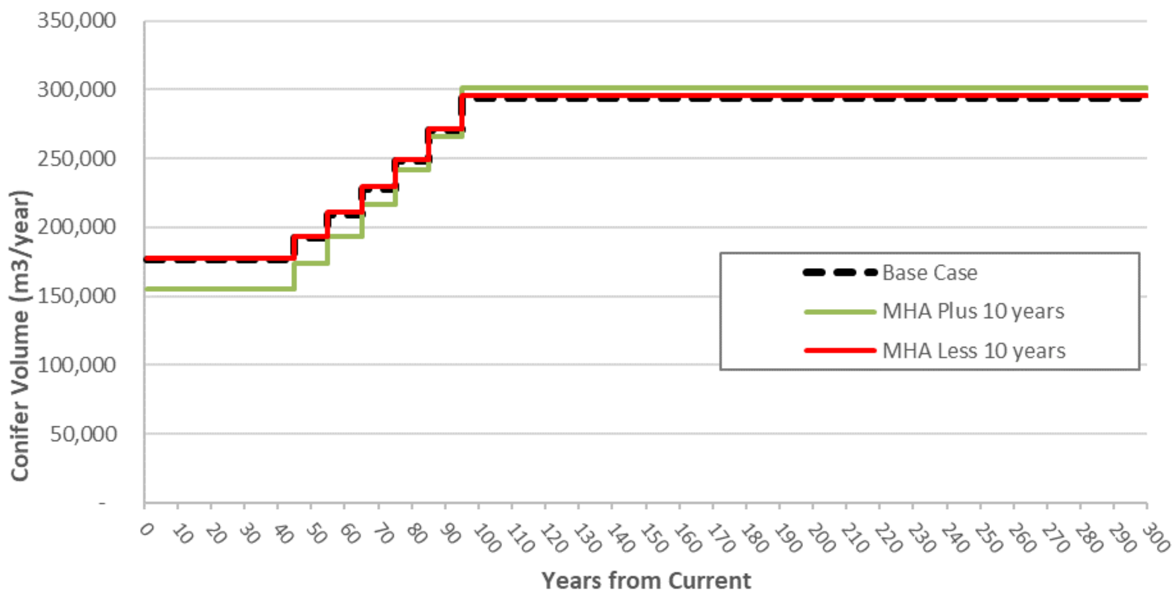



*Figure 42 Harvest flows for the minimum harvest age sensitivity analyses*

*Table 12 Harvest flow differences for the minimum harvest age sensitivity analyses*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Minimum Harvest Ages Increased by 10 Years** | Decrease in harvest level of 12.1% to 155,550 $m^3$/year. | Increase in harvest level of 2.4% to 300,980 $m^3$/year. |
| **Minimum Harvest Ages Decreased by 10 Years** | Increase in harvest level of 0.5% to 177,910 $m^3$/year. | Increase in harvest level of 0.6% to 295,780 $m^3$/year. |

### 4.6.5 Reduce OAF1 to 10%

Operational adjustment factors (OAFs) are used in TIPSY to adjust managed stand yields for a wide range of abiotic and biotic factors that cause TIPSY predictions to differ from operational yields. OAF1 is applied to all ages and is typically used to reduce yields for small unmapped non-productive areas, growing space occupied by non-commercial species or brush, and endemic losses due to pests and disease.

The Base Case used the Ministry of Forests default of 15% for OAF1. However, previous management plans for TFL 49 used 10% for OAF1 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 15%. Table 13 summarizes the modelling approach used for this sensitivity analysis.

*Table 13 Modelling approach for the 10% OAF1 sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Managed stand yields were created using TIPSY with the default value of 15% for OAF1. |
| **Reduce OAF1 to 10%** | Managed stand yields were created using TIPSY with OAF1 set to 10%. All other TIPSY inputs remained the same. |

Figure 43 and Table 14 summarize the resulting harvest flow when OAF1 is reduced to 10% for managed stand yields. There is a 6.4% increase in short/mid-term and a 6.7% increase in long-term harvest level.

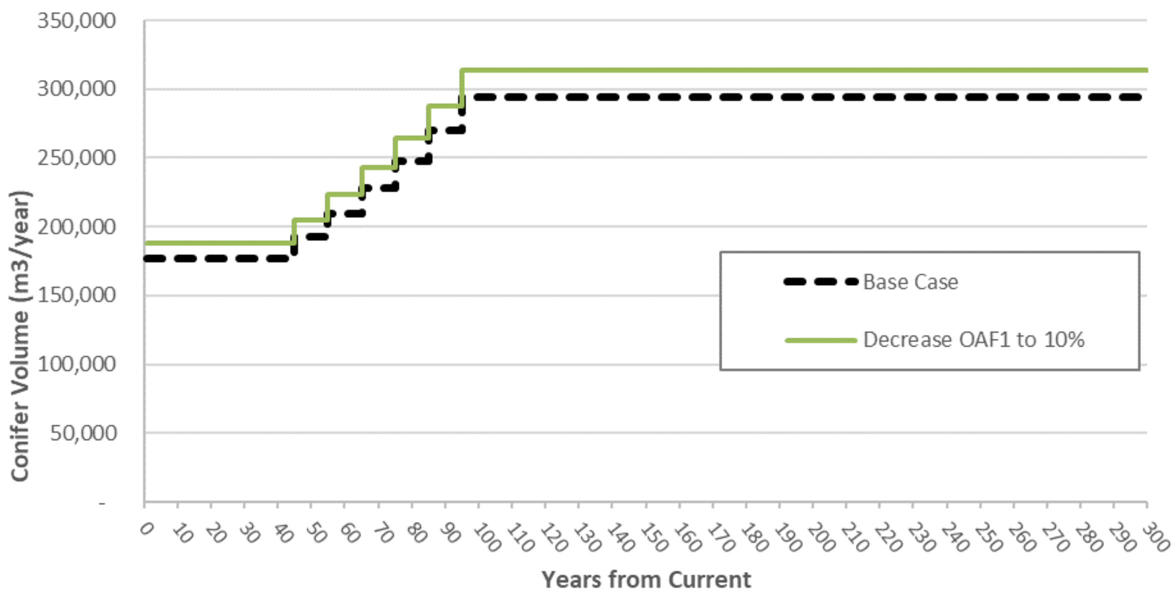



*Figure 43 Harvest flow for the 10% OAF1 sensitivity analysis*

*Table 14 Harvest flow difference for the 10% OAF1 sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Seral Targets Using BEC Version 12** | Increase in harvest level of 6.4% to 188,340 m$^3$/year. | Increase in harvest level of 6.7% to 313,680 m$^3$/year. |

## 4.6.6 Increased Disturbance in the Non-THLB

Natural disturbances such as fires and epidemic insect infestations occur on the land base. It is anticipated that climate change will result in an increase in the frequency and magnitude of these disturbances in the future. Within the THLB, timber that is affected by these natural disturbances are typically addressed through harvest, with unsalvaged areas accounted for through the allowance for unsalvaged losses as described in Section 3.4.2.

Natural disturbances that occur in the non-THLB can affect the status of non-timber objectives such as old seral requirements and are accounted for in the model through resetting of stand age to zero for stands randomly selected according to the expected disturbance interval. This sensitivity analysis investigates the implications for timber supply when the amount of annual disturbance in the non-THLB is increased by 10%, as outlined in Table 15.

*Table 15 Modelling approach for the increased natural disturbance sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Natural disturbance intervals and effective rotation ages were determined for each biogeoclimatic subzone based on Appendix 8 of the "*Old Growth Technical Advisory Panel Old Growth Deferral Background and Technical Appendices (2021).*" Stands were randomly selected to be disturbed in the model according to the expected frequency. The annual area disturbed is approximately 61 hectares. |
| **Double the Natural Disturbance in the Non-THLB** | Effective rotation ages and disturbance intervals were recalculated so that the annual disturbed area for each biogeoclimatic subzone is increased by 10%. Stands were randomly selected to be disturbed in the model using these revised parameters. |

Figure 44 and Table 16 summarize the changes to harvest flow when the annual area of natural disturbance in the non-THLB is increased by 10%. There is a small (0.2%) reduction in both short/mid-term harvest level and long-term harvest level. Because the disturbance schedule is assigned to stands randomly, care must be taken not to interpret these results as an absolute indication of the magnitude of harvest level change. Some of the change may be due to the timing of when the individual stands are chosen for disturbance rather than the increase in disturbance. However, these results do provide insight into the potential reductions to timber supply that might occur if natural disturbance increases.

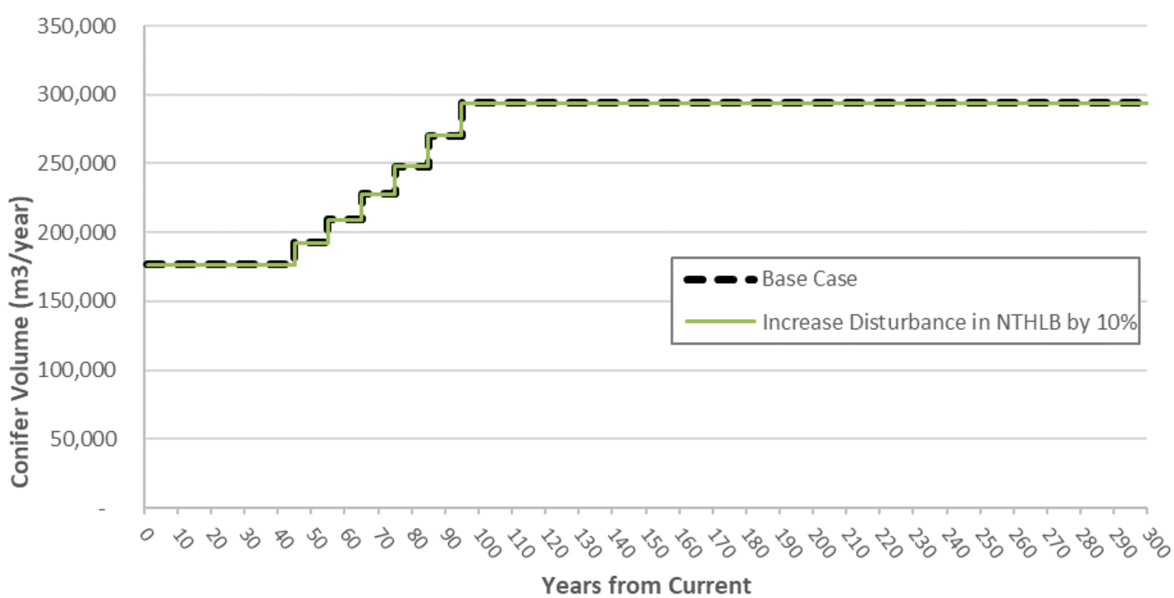



*Figure 44 Harvest flow for the increased natural disturbance sensitivity analysis*

*Table 16 Harvest flow difference for the increased natural disturbance sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Double the Natural Disturbance in the Non-THLB** | Decrease in harvest level of 0.2% to 176,560 $m^3$/year. | Decrease in harvest level of 0.2% to 293,510 $m^3$/year. |

### 4.6.7 Apply Full Old Seral Targets Immediately

The Base Case is consistent with the *Order Establishing Provincial Non-Spatial Old Growth Objectives, June 2004* which allows for an initial 2/3 reduction in old seral targets, with the full target being me by the end of the third rotation, or 240 years from the date of the order. This sensitivity analysis investigates the implications of implementing full old seral targets immediately for all landscape unit/BEC subzone combinations, as outlined in Table 17.

*Table 17 Modelling approach for the full old seral targets immediately sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Old seral targets included provision for the initial 2/3 drawdown of the full requirements in low biodiversity emphasis landscape units. Full targets were required at the end of the third rotation (240 years from the date of the Order), and 2/3 of the full targets were required by the end of the second rotation (160 years from the date of the Order). |
| **Apply Full Old Seral Targets Immediately** | Full old seral targets were applied immediately and throughout the entire planning horizon. |

Figure 45 and Table 18 summarize the changes to harvest flow when the full seral targets are implemented immediately. The short/mid-term harvest level is reduced by 5.5% and the long-term harvest level is reduced by 0.7%.

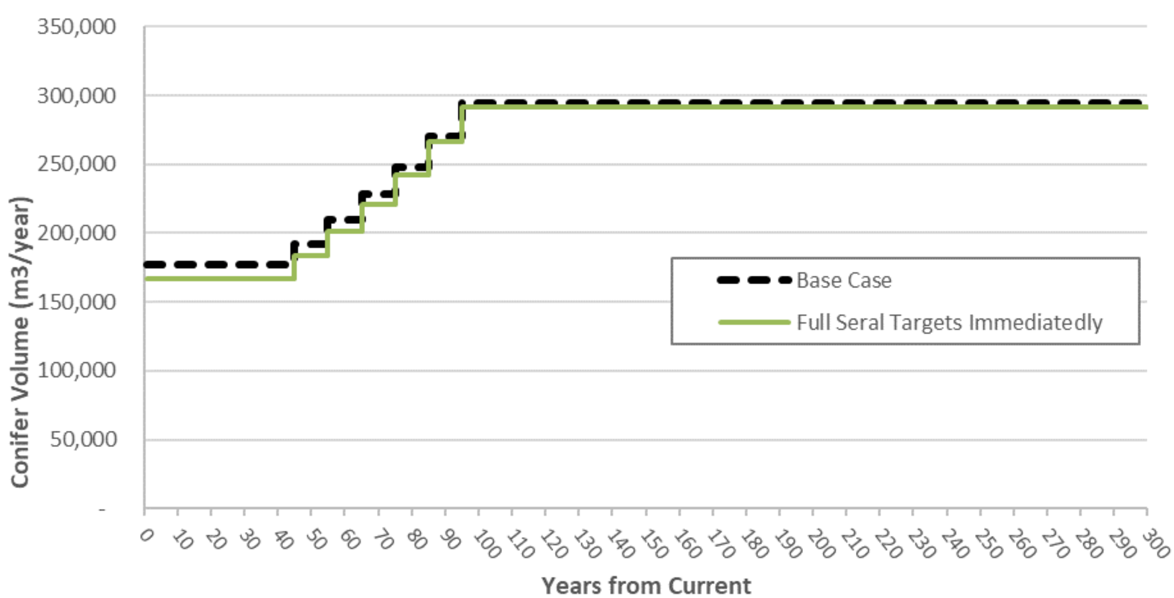



*Figure 45 Harvest flow for the full old seral targets immediately sensitivity analysis*

*Table 18 Harvest flow difference for the full old seral targets immediately sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Apply Full Seral Targets Immediately** | Decrease in harvest level of 5.5% to 167,180 $m^3$/year. | Decrease in harvest level of 0.7% to 291,830 $m^3$/year. |

### 4.6.8 Old Growth Deferral Areas

The Old Growth Technical Advisory Panel has identified priority old growth areas where harvesting has been temporarily deferred by the provincial government to allow time to work with First Nations to decide how old growth should be managed in the long term. It is not yet known how many of these deferrals may become permanent reserves in the future. This sensitivity analysis investigates the implications for timber supply by preventing harvest in these deferred areas throughout the planning horizon, as outlined in Table 19.

*Table 19 Modelling approach for permanent old grow deferral areas sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Harvest was allowed within the Technical Advisory Panel priority old growth areas throughout the planning horizon. |
| **Permanent Old Growth Deferral Areas** | Harvest was not allowed within the Technical Advisory Panel priority old growth deferral areas. The allowance for unsalvaged losses was reduced by 165 $m^3$/year to reflect the reduced THLB area. |

Figure 46 and Table 20 summarize the resulting harvest flow if the old growth deferrals become permanent. The short/mid-term harvest is reduced by 6.1%, which is slightly higher than the THLB reduction of 5.3%. The reduction in long-term harvest flow is lower at 2.5%.

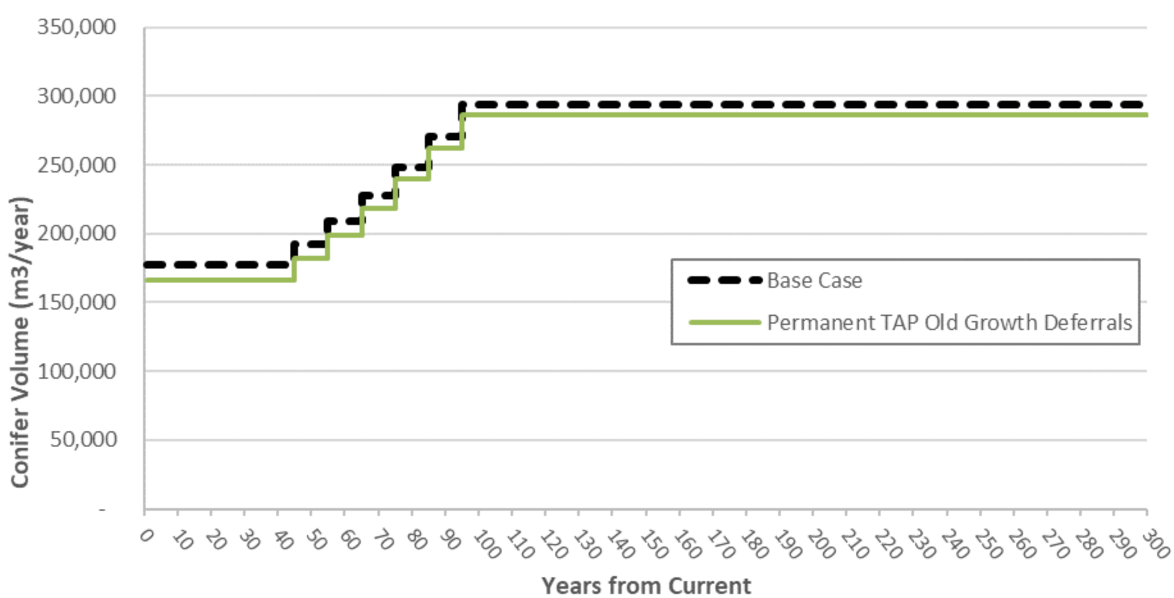



*Figure 46 Harvest flow for the permanent old growth deferral areas sensitivity analysis*

*Table 20 Harvest flow difference for the permanent old growth deferral areas sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Permanent Old Growth Deferral Areas** | Decrease in harvest level of 6.1% to 166,080 $m^3$/year. | Decrease in harvest level of 2.5% to 286,690 $m^3$/year. |

### 4.6.9 Remove Minimum Block Size Requirement

Unlike many strategic timber supply analyses, the Base Case implemented restrictions on small cut blocks so that the analysis represents operational reality by avoiding harvest of small, isolated units, or "slivers." This was accomplished by configuring the model to prevent harvesting any units less than one hectare in size (see Section 3.3.3). A sensitivity analysis was undertaken to evaluate the change to timber supply when this objectives for cut block size area removed, as summarized in Table 21.

*Table 21 Modelling approach for the remove minimum block size requirement sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | Harvest aggregation (patching) was used to limit minimum cutblock sizes. No blocks less than one hectare were allowed. |
| **Remove Minimum Block Size Requirement** | No restrictions on minimum block size were implemented. |

Figure 47 and Table 22 summarize the change to timber supply when restrictions on small cutblocks are removed. There are increases in harvest level in the short/mid-term and long-term of 2.8% and 2.7% respectively.

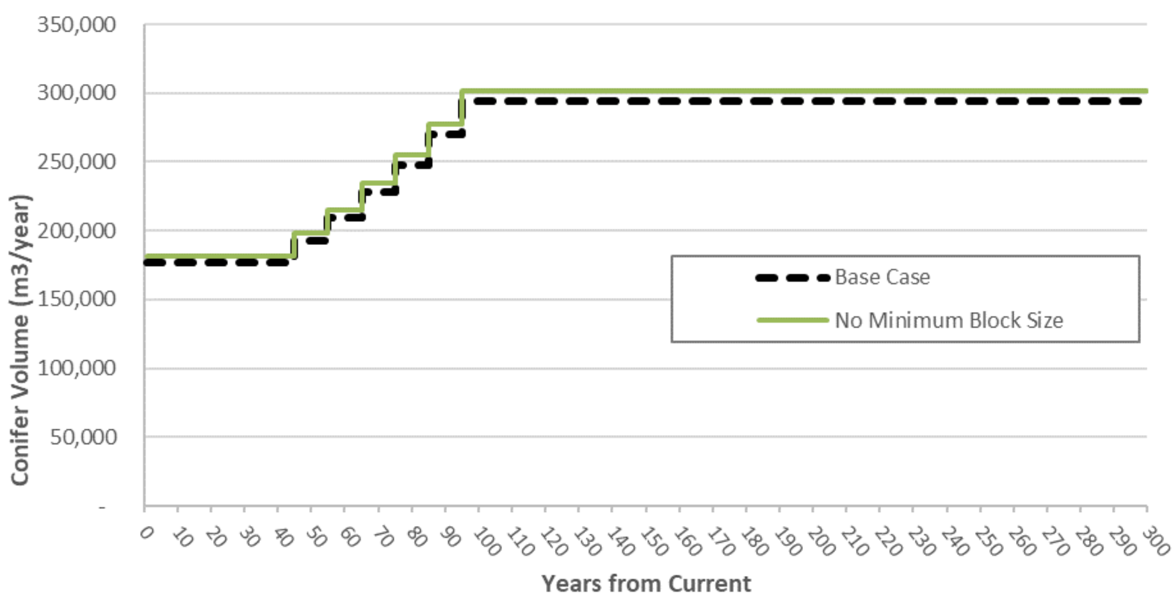



*Figure 47 Harvest flow for the remove minimum block size requirement sensitivity analysis*

*Table 22 Harvest flow difference for the remove minimum block size requirements sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Remove Minimum Block Size Requirements** | Increase in harvest level of 2.8% to 181,900 m³/year. | Increase in harvest level of 2.7% to 302,050 m³/year. |

## 4.6.10 Turn Off Douglas-fir Beetle Salvage

The Base Case included harvest of 250,000 m³ of unburned, primarily Douglas-fir leading stands within the White Rock Lake Fire perimeter in the first five-year period to account for expected Douglas-fir beetle infestations. Ministry of Forests staff have asked for a sensitivity analysis that does not include this harvest as outlined in Table 23.

*Table 23 Modelling approach for the turn off Douglas-fir beetle salvage sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Base Case** | The model was configured to harvest a total of 250,000 m³ in the first five years from unburned stands in the low and unburned burn severity classes within the White Rock Lake fire perimeter. Douglas-fir leading stands had the highest priority for this harvest. |
| **Turn off Douglas-fir Beetle Salvage** | The requirement to harvest 250,000 m³ of unburned stands within the low and unburned burn severity classes was turned off. |

Figure 48 and Table 24 summarize the harvest flow when the requirement to harvest 250,000 m³ of unburned Douglas-fir leading stands within the White Rock Lake fire perimeter is turned off There is a 1.5% increase in short/mid-term harvest and a 0.8% increase in long-term harvest. It is likely that removing this requirement allows the model to adjust harvest priorities to allow harvest of stands closer to their optimum harvest age.

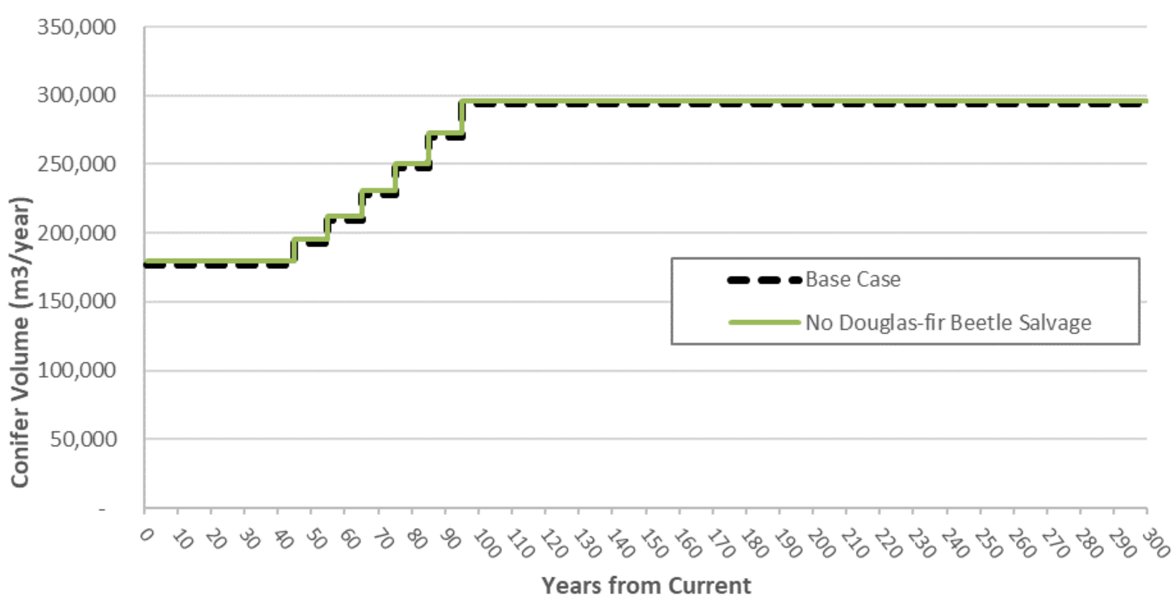



*Figure 48 Harvest flow for the turn off Douglas-fir beetle salvage sensitivity analysis*

*Table 24 Harvest flow difference for the turn off Douglas-fir beetle salvage sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Turn off Douglas-fir Beetle Salvage** | Increase in harvest level of 1.5% to 179,650 $m^3$/year. | Increase in harvest level of 0.8% to 296,450 $m^3$/year. |

# 5.0 Syilx Forest Management Scenario

The Syilx Forest Management scenario developed collaboratively with the Okanagan Nation Alliance (ONA) envisions different forest management direction for the TFL than that modelled in the 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 not require additional objectives for meeting other non-timber values such as visual quality and wildlife.

## 5.1 LAND BASE DEFINITION

The timber harvesting land base for the Syilx Forest Management scenario is reduced compared to the Base Case scenario because of increased riparian retention and increased in-block retention. However, this is partially offset by the inclusion of Old Growth Management Areas in the THLB. A full description of these changes is included in the accepted Information Package (Appendix 1). Table 25 summarizes the PFLB and the THLB for the Syilx Forest Management scenario. The current THLB is reduced by 14,279 hectares (16.7%) when compared with the Base Case scenario.

*Table 25 Land base area summary for the Syilx Forest Management scenario*

| 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 | 2,859 | | 2,859 | 2.6% | |
| Existing Roads | 1,617 | | 1,574 | 1.4% | |
| **Productive Forest Land Base** | | | **105,993** | **96.0%** | **100.0%** |
| Less: | | | | | |
| Unstable Terrain | 4,048 | 3,876 | 3,876 | 3.5% | 3.7% |
| Steep Slopes | 728 | 678 | 38 | 0.0% | 0.0% |
| Non-merchantable | 7,210 | 6,444 | 5,549 | 5.0% | 5.2% |
| Wildlife Habitat Areas | 7 | 7 | 7 | 0.0% | 0.0% |
| Riparian Areas | 11,537 | 9,431 | 7,895 | 7.1% | 7.4% |
| Enhanced Riparian Reserves | 1,350 | 1,278 | 723 | 0.7% | 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 | 3 | 0.0% | 0.0% |
| Existing Wildlife Tree Patches | 2,315 | 2,259 | 1,623 | 1.5% | 1.5% |
| Future WTR (spatial) | 129 | 128 | 109 | 0.1% | 0.1% |
| Future WTR (aspatial) | | | 2,454 | 2.2% | 2.3% |
| Additional in-block retention (aspatial) | | | 12,504 | 11.3% | 11.8% |
| **Timber Harvesting Land Base - Current** | | | **71,175** | **64.5%** | **67.2%** |
| Less: | | | | | |
| Future Roads (aspatial) | | | 279 | 0.3% | 0.3% |
| **Future Timber Harvesting Land Base** | | | **70,896** | **64.2%** | **66.9%** |

## 5.2 MANAGEMENT ZONATION

Two broad zones have been identified within the TFL that will be used for the Syilx Forest Management scenario analysis. The primary objective within Zone 1 is management 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. 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 the Base Case. 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.

## 5.3 NON-TIMBER OBJECTIVES

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

### 5.3.1 Old Growth Management

Old growth management for the Syilx Forest Management scenario is focused within the Zone 1 land base described in Section 5.2. Old Growth Management Areas have been included in the THLB, and three modelling objectives for old growth management for Zone 1 were implemented in the model.

#### 5.3.1.1 Old Seral Targets

Old seral targets were relocated to the Zone 1 land base and assigned at the TFL Block/biogeoclimatic subzone level. In addition, the initial 2/3 reduction was not applied and achievement of the full targets was required immediately, if possible.

#### 5.3.1.2 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 implemented mature plus old seral targets by TFL Block/biogeoclimatic subzone within the Zone 1 land base.

#### 5.3.1.3 Rate of Cut

The rate of harvest within the Zone 1 THLB was 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).

### 5.3.2 Watershed Health

The Base Case scenario implemented 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 reporting units. In comparison, the Syilx Forest Management scenario implemented ECA targets of 40% above the snowline for all watershed reporting units.

### 5.3.3 Patch Size /Cutblock Adjacency

The Base Case scenario implemented patch size objectives for stands less than 20 years old. The Syilx Forest Management scenario does not use patch size objectives as they are not compatible with ONA preferences for smaller cutblocks. Instead, a disturbance objective was used that limits the proportion of the THLB that is less than 2 metres tall to no more than 30% in each landscape unit/biogeoclimatic subzone combination.

### 5.3.4 Other Non-Timber Values

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

## 5.4 UNSALVAGED LOSSES

The unsalvaged losses for the Syilx Forest Management scenario were reduced proportionately to account for the smaller THLB relative to the Base Case. The revised unsalvaged losses are 2,614 $m^3$/year (525 $m^3$/year less than the Base Case).

## 5.5 HARVEST FLOW

The short/mid-term harvest level for the Syilx Forest Management scenario is 141,370 $m^3$/year and the long-term harvest level is 231,390 $m^3$/year as shown in Figure 49. These values are 20.1% and 21.3% less than the Base Case.

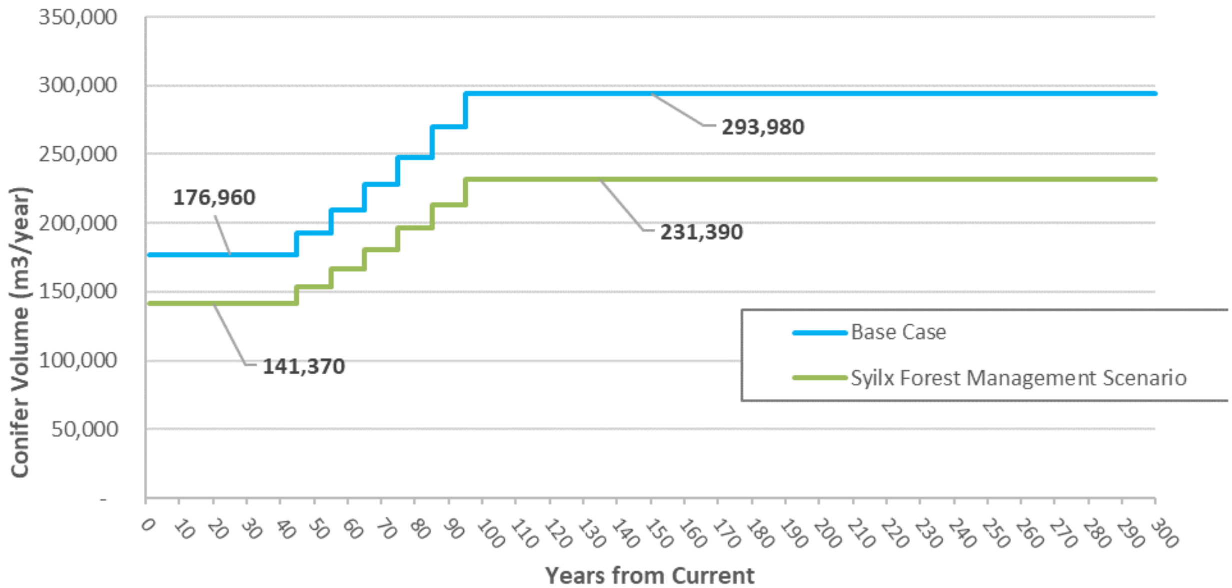



*Figure 49 Harvest flow for the Syilx Forest Management scenario*

The proportion of harvest coming from each of two management zones is summarized in Figure 50. The proportion occurring in Zone 1 which is managed primarily for old growth attributes is small, averaging 2.8% throughout the planning horizon.

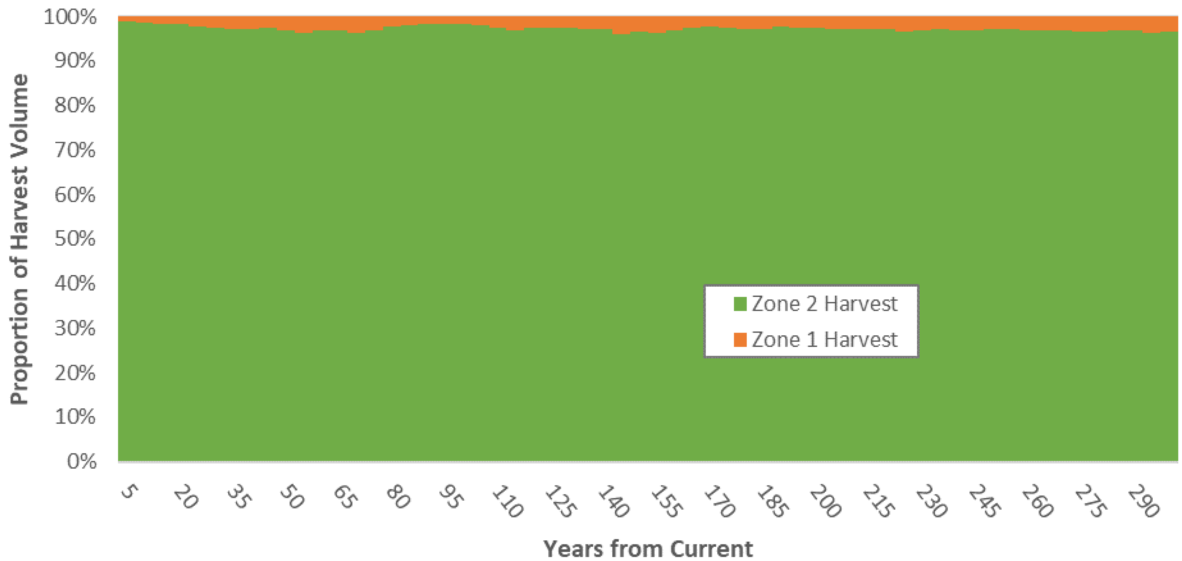



*Figure 50 Harvest proportion by management zone*

## 5.6 AGE CLASS

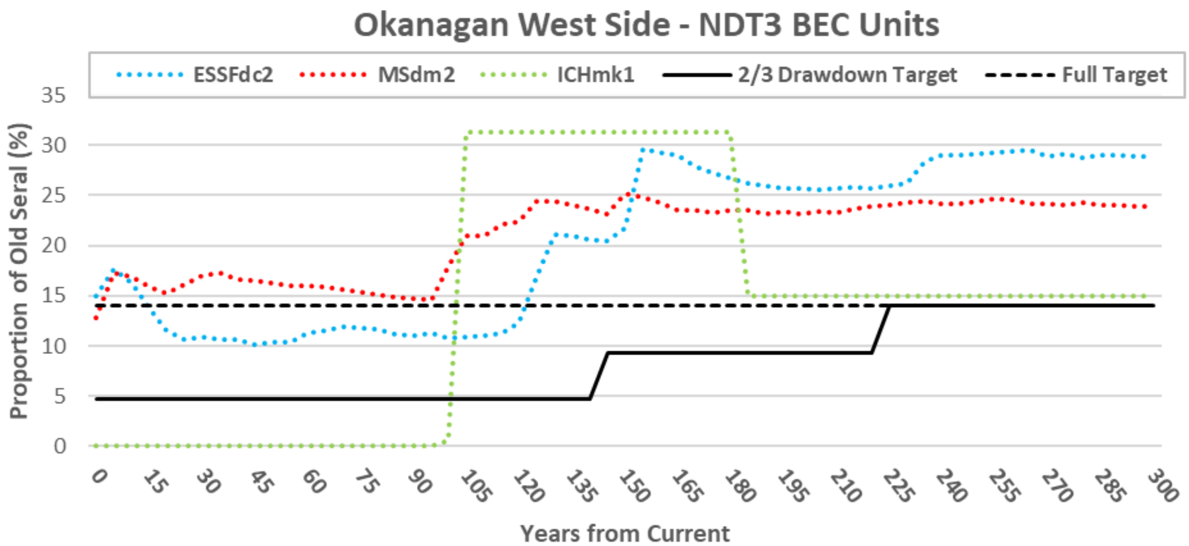
Figure 51 summarizes the age class distribution of the THLB at year 0, year 100, year 200, and year 300 of the planning horizon, and Figure 51 provides similar information for the entire productive forest land base. By the end of the planning horizon, 8.6% of the productive forested land base is between 141 and 250 years old, and 30.1% is at least 251 years old.


*Figure 51 Age class of THLB for the Sylix Forest Management scenario*


*Figure 52 Age class of the PFLB for the Sylix Forest Management scenario*

## 5.7 OLD SERAL

The Syilx Forest Management scenario has an increased emphasis on managing for old seral stands using a zonation approach. Within the model, the old seral targets were transferred to Zone 1 where it is envisioned that forest practices will focus on managing for old seral attributes. In addition, the full seral targets were set immediately without a 2/3 reduction applied. Although no specific targets were set, old seral stands will also develop within the rest of the TFL (Zone 2), primarily in areas that are not considered part of the timber harvesting land base. To allow comparison with the Base Case and assess the overall spatial representation of old seral within the TFL relative to the *Provincial Non-Spatial Old Growth Order*, the status of old seral was summarized for the same landscape unit/biogeoclimatic subzone combinations used for the Base Case (see Figure 53 to Figure 55). Although it takes a number of years to reach the full targets, it can be seen that the Syilx Forest Management scenario exceeds the required old seral in the long-term for all landscape units/biogeoclimatic subzones as set out in the *Provincial Non-Spatial Old Growth Order*.



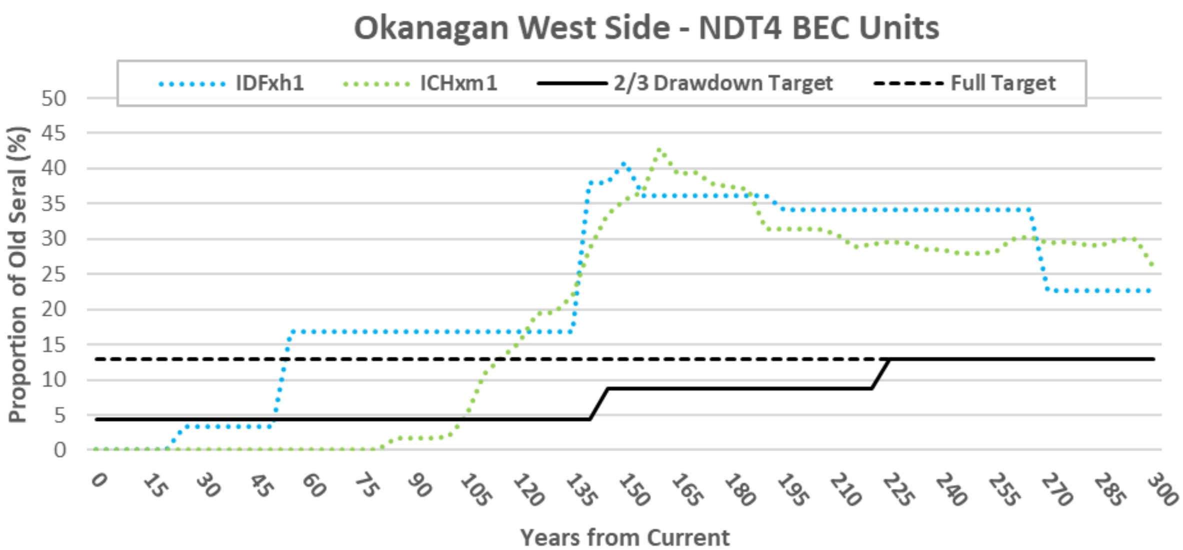
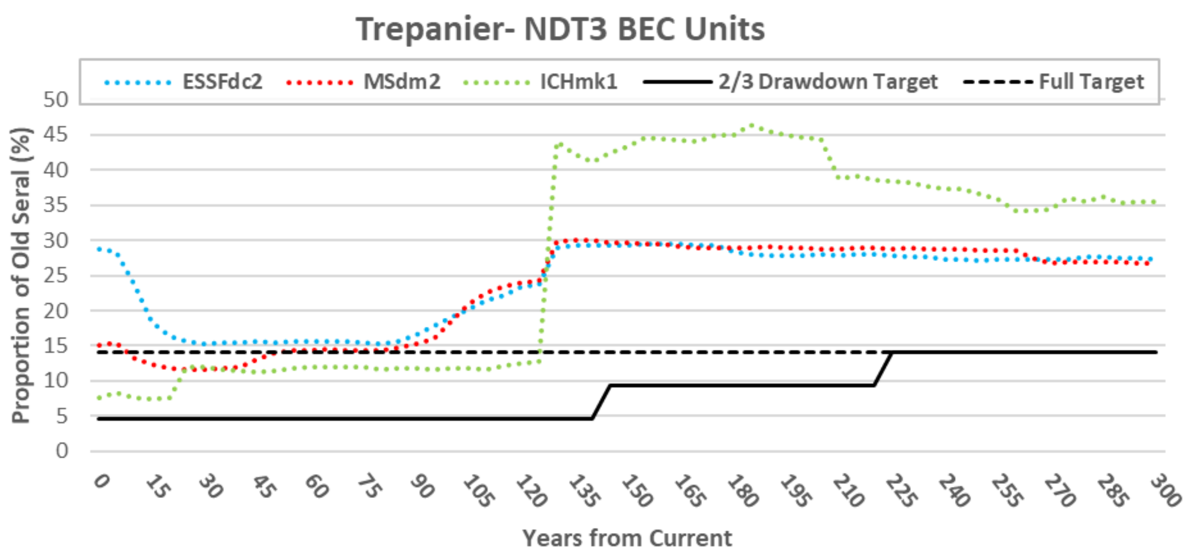




*Figure 53 Old seral status for the Okanagan West Side landscape unit (Syilx Forest Management scenario)*



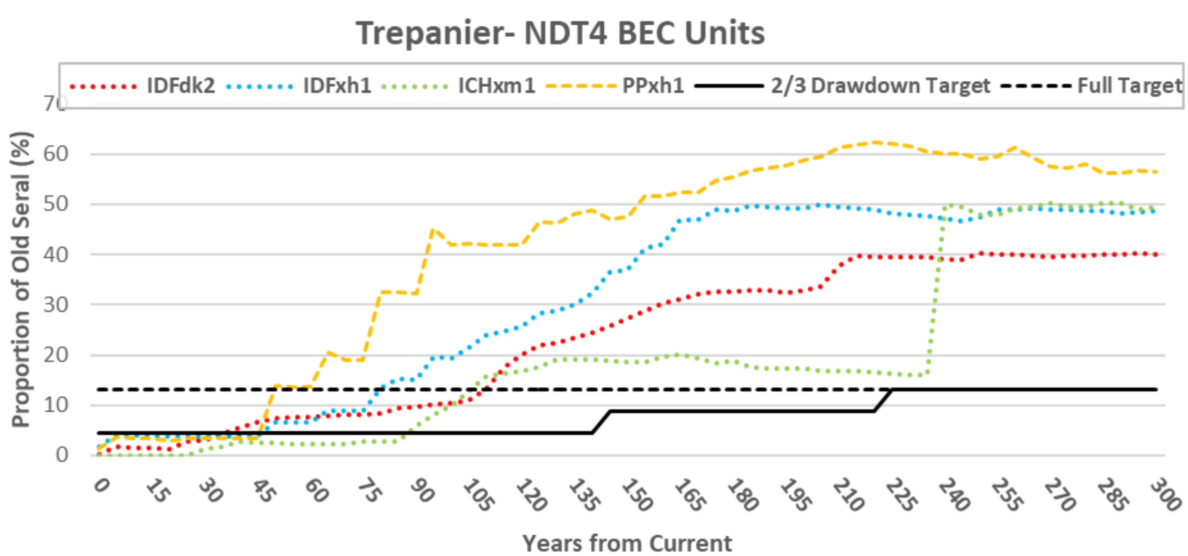




*Figure 54 Old seral status for the Trepanier landscape unit (Syilx Forest Management scenario)*

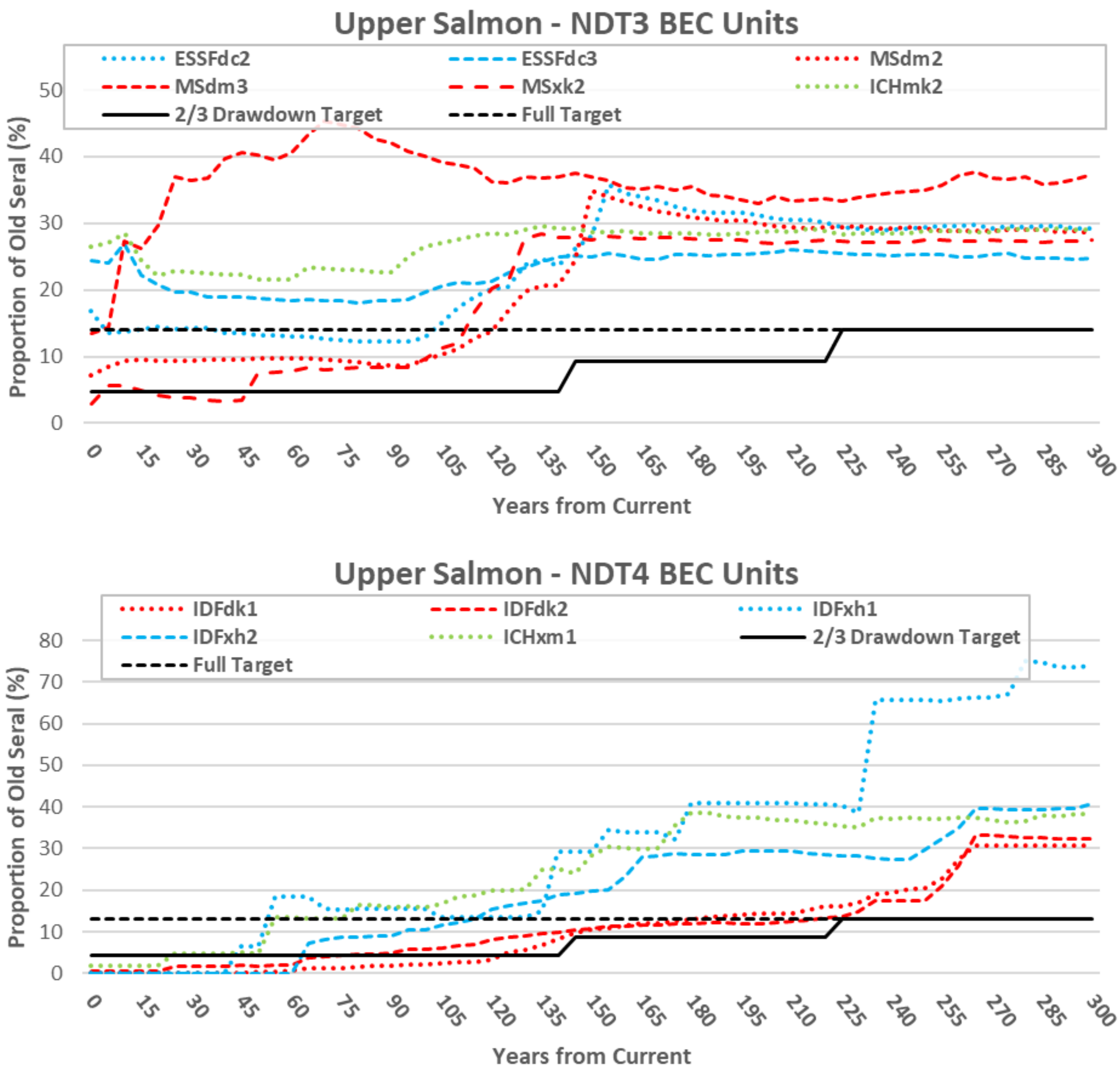



*Figure 55 Old seral status for the Upper Salmon landscape unit (Sylix Forest Management scenario)*

## 5.8 SENSITIVITY ANALYSES

Four sensitivity analyses were completed with reference to the Syilx Forest Management scenario, as outlined in Table 26.

*Table 26 Syilx Forest Management scenario sensitivity analyses*

| Category | Sensitivity | Description of Change |
|---|---|---|
| **Growth and Yield** | Increase Minimum Harvest Ages | Increase the minimum harvest age for managed stands to at least 20 years older than when maximum MAI is reached. |
| | Reduce Class A Seed Use | Do not use improved Class A seed for future managed stands. |
| **Integrated Resource Management** | Reduce Maximum ECA | Decrease maximum ECA above the snowline to 30% for all watersheds. |
| | Implement FRPA Non-Timber Values | Implement the Base Case objectives for non-timber values. |

### 5.8.1 Increase 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 analysis increases the minimum harvest age to 20 years greater than the age at which maximum mean annual increment is achieved, as summarized in Table 27. Two additional versions of this sensitivity analysis that delay the transition to the long-term harvest level have also been provided.

*Table 27 Modelling approach for the Syilx minimum harvest age sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Syilx Forest Management Scenario** | Minimum harvest ages for each analysis unit were based on achieving: 1) 75 $m^3$/hectare; 2) at least 15 metres tall; 3) at least 60 years old for natural stands or 50 years old for managed stands; and 4) at least 90% of culmination (maximum) mean annual increment for managed stands. |
| **Increase Minimum Harvest Ages to CMAI Age Plus 20 Years** | Increase minimum harvest ages for managed stands to at least 20 years greater than the age at which maximum mean annual increment is achieved. Minimum harvestable volume of 75 $m^3$/hectare and minimum height of 15 metres must also be achieved. In addition to maintaining the timing of the transition to the long-term harvest level, two additional runs were completed where the transition is delayed by 20 years and 30 years respectively. |

Figure 56 and Table 28 summarize the changes to harvest flow when the minimum harvest age is increased. There is a very significant decrease in short/mid-term harvest levels. Note that the harvest in the first five-year period is higher than the rest of the short/mid-term because of the White Rock Lake Fire salvage program. Once the salvage is complete, the short/mid-term harvest is reduced by 49.5% compared to the Syilx Forest Management scenario. This can be attributed to the reliance on existing managed stands early in the planning horizon. The average minimum harvest age for existing managed stands increased by 40 years relative to the Syilx Forest Management scenario which requires that harvest in the existing natural stands be reduced until the managed stands are old enough to harvest.

Two additional model runs were completed to determine if delaying the transition to the long-term harvest level could partially mitigate this large reduction in short/mid-term harvest. Although there is a small improvement to the short/mid-term harvest level, the reduction compared to the Syilx Forest Management scenario is still significant.

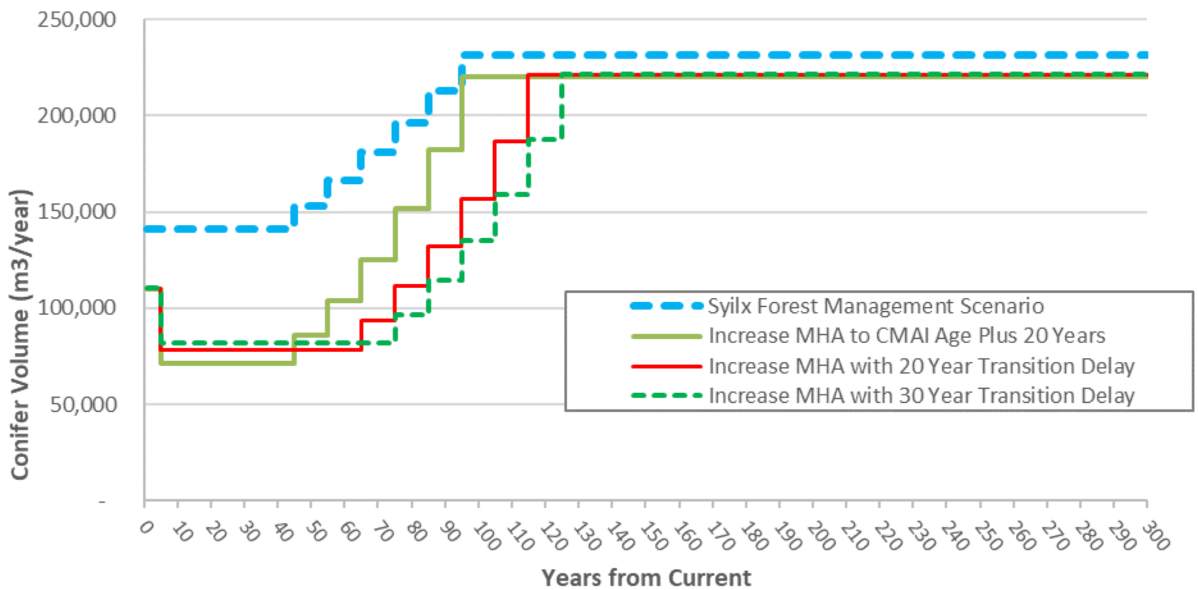



*Figure 56 Harvest flow for the Syilx increased minimum harvest age sensitivity analysis*

*Table 28 Harvest flow difference for the Syilx increased minimum harvest age sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Increase Minimum Harvest Age** | Decrease in harvest level of 22.0% to 110,240 $m^3$/year in the first five years. Decrease in harvest level of 49.5% to 71,460 $m^3$/year for the remainder of the short/mid-term. | Decrease in harvest level of 4.9% to 219,990 $m^3$/year. |
| **Increase Minimum Harvest Age and Delay Transition to Long-term Harvest for 20 Years** | Decrease in harvest level of 22.0% to 111,250 $m^3$/year in the first five years. Decrease in harvest level of 44.5% to 78,520 $m^3$/year for the remainder of the short/mid-term. | Decrease in harvest level of 4.3% to 221,470 $m^3$/year. |
| **Increase Minimum Harvest Age and Delay Transition to Long-term Harvest for 30 Years** | Decrease in harvest level of 22.0% to 110,250 $m^3$/year in the first five years. Decrease in harvest level of 42.0% to 82,030 $m^3$/year for the remainder of the short/mid-term. | Decrease in harvest level of 4.2% to 221,710 $m^3$/year. |

### 5.8.2 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 removes the use of Class A seed for future stands, as outlined in Table 29.

*Table 29 Modelling approach for the reduced use of Class A seed sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Syilx Forest Management Scenario** | TIPSY yield tables for existing managed stands include genetic worth for each silviculture era using historic planting records. TIPSY yield tables for future managed stands include genetic worth based on planting records from 2018 to 2021. |
| **Reduced Use of Class A Seed** | TIPSY yield tables for existing managed stands include genetic worth for each silviculture era using historic planting records. TIPSY yield tables for future managed stands do not include genetic worth. |

Discontinuing the use of Class A seed is expected to result in a reduction in long-term yields because it reduces the yields of future managed stands. Figure 57 and Table 30 summarize the changes to harvest levels when Class A seed is removed from future planting. As expected, the long-term harvest level decreases by 9.2% and there is minimal change to the short/mid-term harvest level.

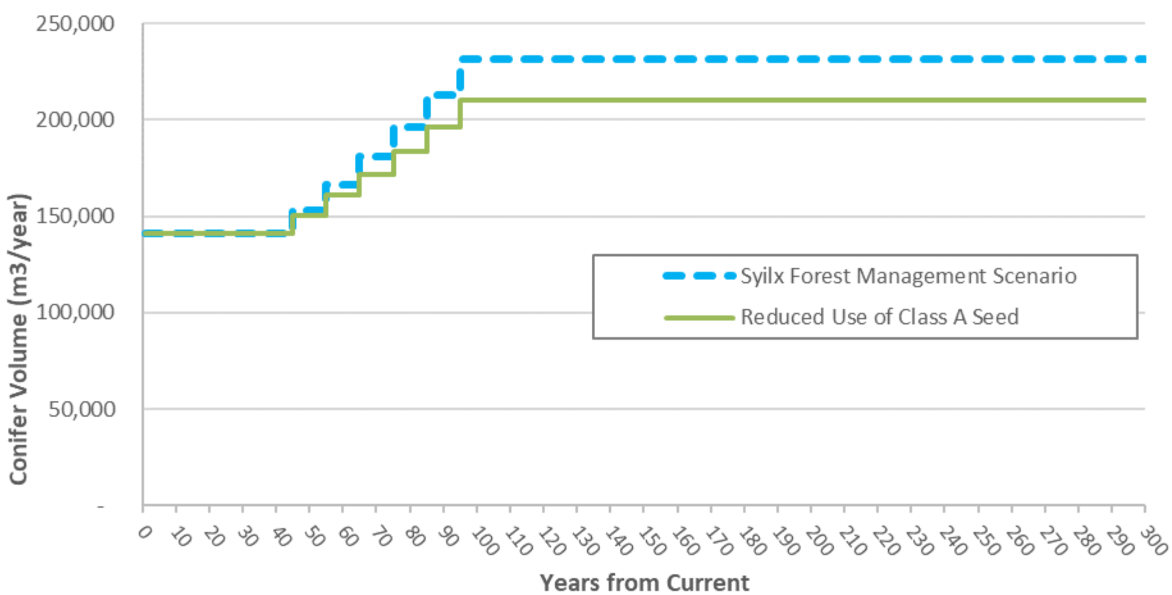



*Figure 57 Harvest flow for the reduced use of Class A seed sensitivity analysis*

*Table 30 Harvest flow difference for the reduced use of Class A seed sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Reduced Use of Class A Seed** | Decrease in harvest level of 0.2% to 141,140 $m^3$/year. | Decrease in harvest level of 9.2% to 209,980 $m^3$/year. |

### 5.8.3 Reduce Maximum ECA to 30%

The Syilx Forest Management scenario implemented maximum ECA targets of 40% above the snowline for all watershed units. ONA representatives have indicated that they would like to see a sensitivity analysis that restricts the maximum ECA to 30%, as outlined in Table 31.

*Table 31 Modelling approach for the reduce maximum ECA to 30% sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Syilx Forest Management Scenario** | Maximum ECA above the snowline was capped at 40% for each of the three community watersheds, the fisheries sensitive watershed, and the other 12 watershed reporting units. |
| **Reduce Maximum ECA to 30%** | The maximum ECA above the snowline was capped at 30% for each of the three community watersheds, the fisheries sensitive watershed, and the other 12 watershed reporting units. |

Figure 58 and Table 32 summarize the changes to harvest flow when ECA above the snowline is capped at 30% for all watershed units. The short-term harvest is reduced by 2.3% and the long-term harvest is reduced by 0.9%.

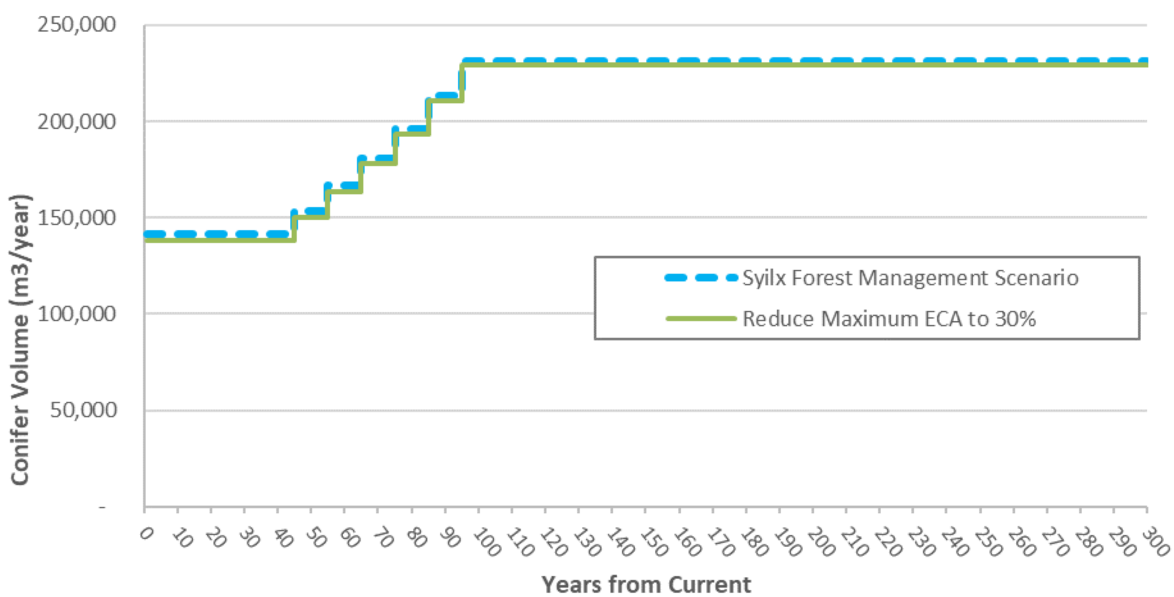



*Figure 58 Harvest flow for the reduce maximum ECA to 30% sensitivity analysis*

*Table 32 Harvest flow difference for the reduce maximum ECA to 30% sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Reduce Maximum ECA to 30%** | Decrease in harvest level of 2.3% to 138,050 $m^3$/year. | Decrease in harvest level of 0.9% to 229,350 $m^3$/year. |

### 5.8.4 Implement FRPA Non-Timber Objectives

The Syilx Forest Management scenario did not implement FRPA based objectives for visual quality, mule deer, moose, sheep, mountain goat, and the Bear Creek trails. This sensitivity analysis required that these objectives be met, as outlined in Table 33.

*Table 33 Modelling approach for the implement FRPA non-timber values sensitivity analysis*

| Scenario | Modelling Approach |
|---|---|
| **Syilx Forest Management Scenario** | FRPA based objectives for visual quality, mule deer, moose, sheep, mountain goat, and the Bear Creek trails were not activated. |
| **Implement FRPA Non-Timber Objectives** | The objectives for visual quality, mule deer, moose, sheep, mountain goat, and the Bear Creek trails were activated. Note that no changes were made to old growth management areas (i.e. they were still available for harvest). |

Figure 59 and Table 34 summarize the changes to harvest flow when FRPA non-timber objectives are implmented. There is a 3.0% reduction in short/mid-term harvest level and a 2.1% reduction in long-term harvest level.

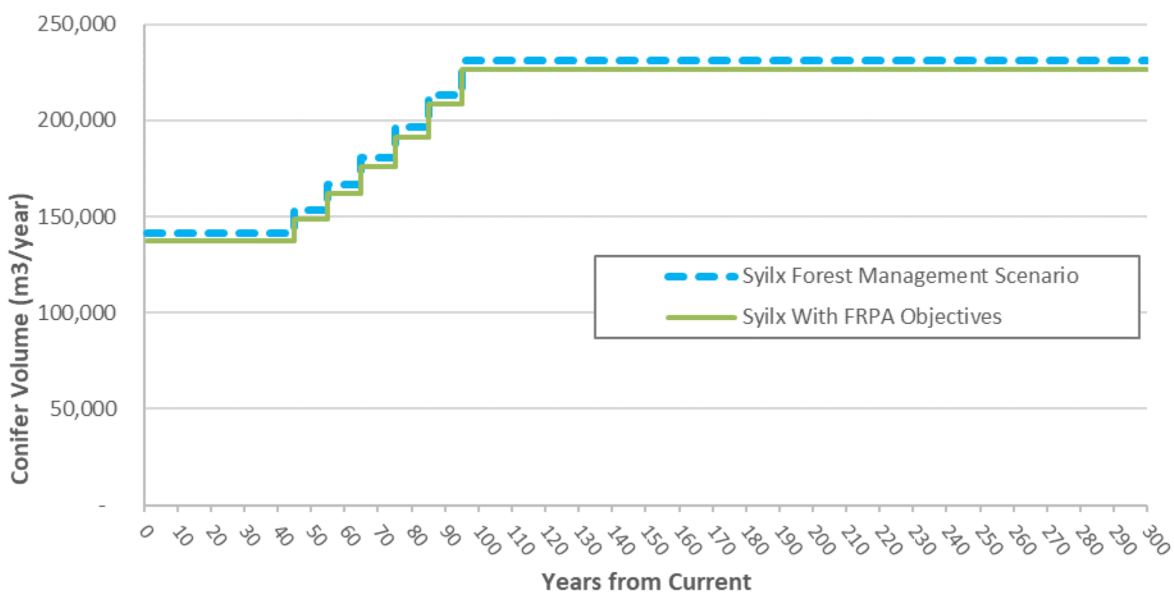



*Figure 59 Harvest flow for the implement FRPA non-timber objectives sensitivity analysis*

*Table 34 Harvest flow difference for the implement FRPA non-timber objectives sensitivity analysis*

| Scenario | Short/Mid-term | Long-term |
|---|---|---|
| **Implement FRPA Non-Timber Objectives** | Decrease in harvest level of 3.0% to 137,130 $m^3$/year. | Decrease in harvest level of 2.1% to 226,480 $m^3$/year. |

# 6.0 Summary

The Base Case harvests 176,960 $m^3$/year for 45 years and then transitions over a 50-year period to the long-term harvest level of 293,980 $m^3$/year. In addition to the Base Case scenario, the Syilx Forest Management scenario was created collaboratively with representatives from the Okanagan Nation Alliance to model a different vision for forest management direction in the TFL. Key differences between this scenario and the Base Case 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 not require additional objectives for meeting other non-timber values such as visual quality and wildlife.

The Syilx Forest Management scenario results in a short/mid-term harvest level of 141,370 $m^3$/year and a long-term harvest level of 231,390 $m^3$/year. These harvest levels represent a 20.1% reduction to short/mid-term harvest and a 21.3% reduction to long-term harvest when compared with the Base Case.

Several sensitivity analyses were completed with reference to the Base Case to assess the impacts of potential uncertainty in data and modelling assumptions. The results from these model runs are summarized in Table 35.

Harvest flow changes because of changes to THLB area are in line with those expected. Although increases to natural stand yields allowed for higher initial harvest levels, decreases to natural stand yields had limited impact on harvest flows. In contrast, the harvest flow is very sensitive to changes in managed stand yields in both the short/mid-term and long-term. The short/mid-term harvest flow is also very sensitive to an increase in minimum harvest age. These results highlight the importance that existing managed stands have on short/mid-term harvest in the TFL.

Application of full old seral targets immediately would result in a 5.5% decrease in short/mid-term harvest, and permanently establishing the old growth deferral areas would reduce short/mid-term harvest by 6.1% and long-term harvest by 2.5%.

Four sensitivity analyses were also completed with reference to the Syilx Forest Management scenario to understand the implications of including additional management objectives in the scenario. Increasing minimum harvest age to be 20 years older than the age when maximum mean annual increment is reached was extremely limiting to short/mid-term harvest levels, with a 49.5% reduction. Eliminating the use of Class A seed for future managed stands primarily affected long-term harvest levels, with a reduction of 9.2%. Reducing the maximum ECA above the snowline to 30% for all watersheds reduced short/mid-term harvest levels by 2.3% and long-term harvest by 0.9%. Finally, if it is necessary to implement FRPA based objectives for visual quality, mule deer, moose, sheep, mountain goat, and the Bear Creek trails there would be a 3.0% reduction in short/mid-term harvest and a 2.1% reduction in long-term harvest.

*Table 35 Summary of Base Case sensitivity analysis results*

| Scenario | Difference from the Base Case | |
|---|---|---|
| | Short/Mid-term | Long-term |
| **THLB Plus 10%** | + 10.3% | + 10.3 % |
| **THLB Less 10%** | - 9.2% | - 9.1% |
| **Natural Stand Yields Plus 10%** | + 8.9% | No Change |
| **Natural Stand Yields Less 10%** | - 0.2% | No Change |
| **Managed Stand Yields Plus 10%** | + 8.3% | + 10.0% |
| **Managed Stand Yields Less 10%** | - 6.8% | - 9.9% |
| **Minimum Harvest Age Plus 10 years** | - 12.1% | + 2.4% |
| **Minimum Harvest Age Less 10 years** | + 0.5% | + 0.6% |
| **Reduce OAF1 to 10%** | + 6.4% | + 6.7% |
| **Increase Disturbance in non-THLB by 10%** | - 0.2% | - 0.2% |
| **Apply Full Old Seral Targets Immediately** | - 5.5% | - 0.7% |
| **Permanent TAP Old Growth Deferrals** | - 6.1% | - 2.5% |
| **Remove Minimum Block Size Requirements** | + 2.8% | + 2.7% |
| **Turn Off Douglas-fir Beetle Salvage** | + 1.5% | + 0.8% |

*Table 36 Summary of Syilx Forest Management scenario sensitivity analyses*

| Scenario | Difference from the Syilx Forest Management Scenario | |
|---|---|---|
| | Short/Mid-term | Long-term |
| **Increased Minimum Harvest Age** | -22.0% (1st five years),<br>- 49.5% (next 40 years) | - 4.9% |
| **Increased Minimum Harvest Age With 20 Year Delay in Transition to Long-term** | - 22.0% (1st five years),<br>-44.5% (next 60 years) | - 4.3% |
| **Increased Minimum Harvest Age With 30 Year Delay in Transition to Long-term** | - 22.0% (1st five years),<br>-42.0% (next 70 years) | - 4.2% |
| **Reduced Use of Class A Seed** | - 0.2% | - 9.2% |
| **Reduced Maximum ECA** | - 2.3% | - 0.9% |
| **Implement FRPA Non-Timber Values** | - 3.0% | - 2.1% |

# 7.0 References

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# Appendix 1 Accepted Information Package