Tumbler Ridge Community Forest Agreement (K2O) Timber Supply Analysis Report

Presented To: Tumbler Ridge Community Forest Corp.

Submitted By: Ecora Engineering and Resource Group Ltd.
210 – 490 Quebec St.
Prince George, BC V2L 5N5
Canada

Hui Yu Zheng, FIT
grace.zheng@ecora.ca

Dated: September 04, 2020

Ecora File No.: [FG-19-695-DTR]

THIS PAGE IS INTENTIONALLY LEFT BLANK

Presented To:

Duncan McKellar, RPF Tumbler Ridge Community Forest Corp.
District of Tumbler Ridge,
PO Box 523, 270 Southgate St.,
Tumbler Ridge, BC V0C 2W0

Prepared by:

Sept 4,2020

Hui Yu (Grace) Zheng, FIT Date
Junior Resource Analyst
grace.zhengl@ecora.ca

Reviewed by:

Sept 4,2020

Jay Greenfield, RPF Date
Director of Forestry
jay.greenfield@ecora.ca

Reviewed by:

Aug 24,2020

Shuyan Jiang, FIT Date
Junior Resource Analyst
shuyan.jiang@ecora.ca

Version Control and Revision History

Version	Date	Prepared By	Reviewed By	Notes/Revisions
1	21 July 2020	Grace Zheng		First Draft
2	10 August 2020	Grace Zheng	Shuyan Jiang	
3	24 August 2020	Grace Zheng	Jay Greenfield	
4	26 August 2020	Grace Zheng	David Coster/Duncan McKellar	
5	4 September 2020	Grace Zheng	Jay Greenfield/Duncan McKellar	Revised base case

Limitations of Report

This report and its contents are intended for the sole use of the Tumbler Ridge Community Forest Corporation and their agents. Ecora Engineering & Resource Group Ltd. does not accept any responsibility for the accuracy of any data, analyses, or recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Tumbler Ridge Community Forest Corporation and their agents. Any such unauthorized use of this report is at the sole risk of the user.

Executive Summary

Tumbler Ridge Community Forest Corp. has initiated a timber supply analysis in support of an allowable annual cut (AAC) determination for the combined landbase of Tumbler Ridge Community Forest Agreement (licence # K2O) (TRCF) that includes the original community forest (CF) area as well as the expansion CF area. This document describes the results of the recently completed timber supply analysis and should be viewed in conjunction with the detailed description of the data and assumptions provided in the *Tumbler Ridge Community Forest Agreement (K2O) Timber Supply Analysis Data Package* (Ecora, 2020), here by referred to as the Data Package.

Through a landbase classification process, area is systematically removed from the gross landbase area to establish both the productive crown forested landbase (CFLB) and timber harvesting landbase (THLB). The THLB for this analysis is calculated at 22,120 ha.

The base case timber supply analysis includes:

- A minimum harvestable volume of 120 m^3/ha;
- Meeting all forest cover constraints detailed in the Data Package;
- A 3% step-down in harvest level in year 21 starting from 43,540 m^3/yr; and
- A sustainable long-term growing stock at 1,660,000 m^3 from year 155.

The base case harvest forecast is shown in Figure 1-1 and shows the harvest level starting at approximately 43,540 m^3/yr and decreasing to approximately 42,910 m^3/yr at year 21 for the remainder of the planning horizon. These values are net of non-recoverable losses.

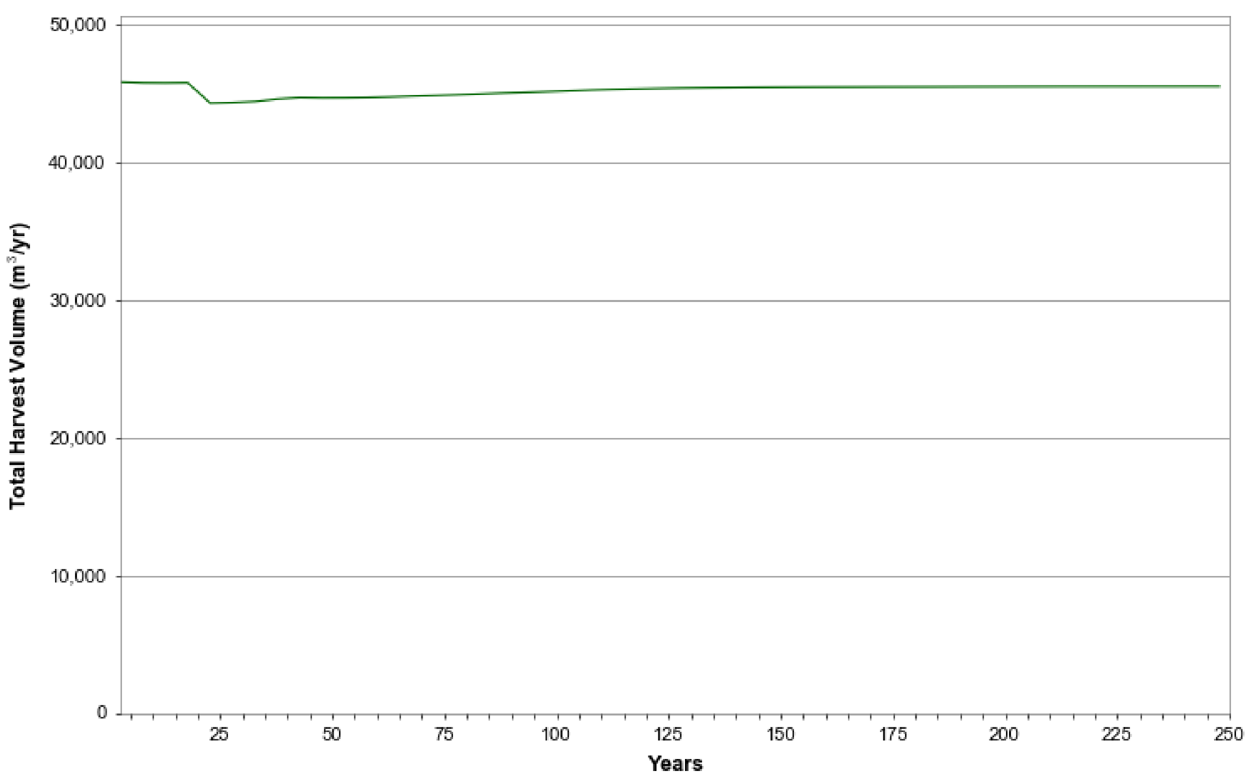

Figure 1-1 Base Case Harvest Flow

Sensitivity analysis provides information on the degree to which uncertainty in the base case data and assumptions might affect the proposed harvest level for the landbase. A summary of the sensitivity analysis results and their variation from the base case are shown in Table 1-1. In general, the sensitivities and the base case show that the scenario with low elevation winter range excluded from the timber harvestable landbase has the largest negative impact on the total harvest level. Meanwhile, increasing the managed stand site index by 4m has the most positive impact on the total harvest level. Individual sensitivities are discussed in detail in Section 4.

Table 1-1 Average Harvest Level – All Scenarios

Sensitivity	Harvest Volume (m^3/yr)		% Change from the Base case	
	1 to 20	21 to 250	1 to 20	21 to 250
Base case	43,490	42,910		
Even flow	42,430	43,020	-3%	0%
Lower Visual Quality Class by one class	47,860	45,450	9%	6%
Minimum harvest volume 140 m^3/ha	43,840	43,000	0%	0%
Natural stands yield curves + 10%	46,740	45,410	7%	6%
Natural stands yield curves - 10%	39,640	42,060	-9%	-2%
Managed stands yield curves + 10%	47,660	45,460	9%	6%
Managed stands yield curves - 10%	41,440	40,360	-5%	-6%
Non-spatial seral targets and patch distribution targets on	43,650	42,940	0%	0%
Low elevation winter range excluded from THLB	27,760	28,200	-37%	-34%
Low elevation winter range target off	50,630	47,310	16%	10%
Site Index Adjustment +2m	48,770	54,820	12%	28%
Site Index Adjustment +4m	54,960	63,200	26%	47%
Deciduous-leading harvest unrestricted	43,730	42,970	1%	0%
Deciduous-leading harvest restricted	40,420	40,930	-7%	-5%

Table of Contents

List of Tables in Text

List of Figures in Text

Acronyms and Abbreviations

AAC	Allowable Annual Cut
BEC	Biogeoclimatic Ecosystem Classification
BWBS	Boreal White and Black Spruce Zone
CF	Community Forest
CFA	Community Forest Agreement
CFLB	Crown Forested Landbase
DC	Dawson Creek
ESSF	Engelmann Spruce – Subalpine Fir Zone
EVQO	Established Visual Quality Objective
FTEN	Forest Tenure
FSP	Forest Stewardship Plan
Ha	Hectares
LEWR	Low Elevation Winter Range
MFLNRORD	Ministry of Forest, Lands, Natural Resource Operation and Rural Development
MHV	Minimum Harvest Volume
MSYT	Managed Stand Yield Tables
NDT	Natural Disturbance Type
NRL	Non-Recoverable Losses
NSYT	Natural Stand Yield Tables
OGMA	Old Growth Management Areas
PSPL	Provincial Site Productivity Layer
RESULTS	Reporting Silviculture Updates and Land Status Tracking System
THLB	Timber Harvesting Landbase
TRCF	Tumbler Ridge Community Forest
TSA	Timber Supply Area
TSR	Timber Supply Review
VDYP	Variable Density Yield Prediction Growth and Yield Model
VLI	Visual Landscape Inventory
VQO	Visual Quality Objectives
VRI	Vegetation Resources Inventory
WTP	Wildlife Tree Patch

1. Introduction

The Tumbler Ridge Community Forest Agreement (CFA) (Licence # K2O) covers 39,986 hectares (ha) within the Dawson Creek (DC) Timber Supply Area (TSA), and was awarded with an initial allowable annual cut (AAC) of 20,000 m^3/year in January 2011 for the original community forest (CF) area of 19,852 ha. On June 27, 2019, an expansion area of 20,134 ha was awarded in addition to the original CF area to support an AAC of 15,500 m^3/year of coniferous and 2,000 m^3/year of deciduous volume per year.

Tumbler Ridge Community Forest Corp. contracted Ecora Engineering & Resource Group Ltd. (Ecora) to undertake a timber supply analysis in support of an updated AAC determination for the combined Tumbler Ridge Community Forest (TRCF) landbase.

The purpose of this analysis report is to document the results of modelled scenarios in support of the new AAC determination. This analysis report should be viewed in conjunction with the recently completed *Tumbler Ridge Community Forest Agreement (K2O) Timber Supply Review Data Package* (the Data Package; Ecora, 2020) which describes the input data and assumptions used in this analysis.

2. Landbase Description

The TRCF covers 39,986 ha within the DC TSA. The CF includes the original CF area of 19,852 ha as well as an expansion area of 20,134 ha. The townsite of Tumbler Ridge situates at the intersection of Highway 52 and Highway 29 overlooking the confluence of the Murray and Wolverine Rivers. Figure 2-1 illustrates the geographical location of TRCF.

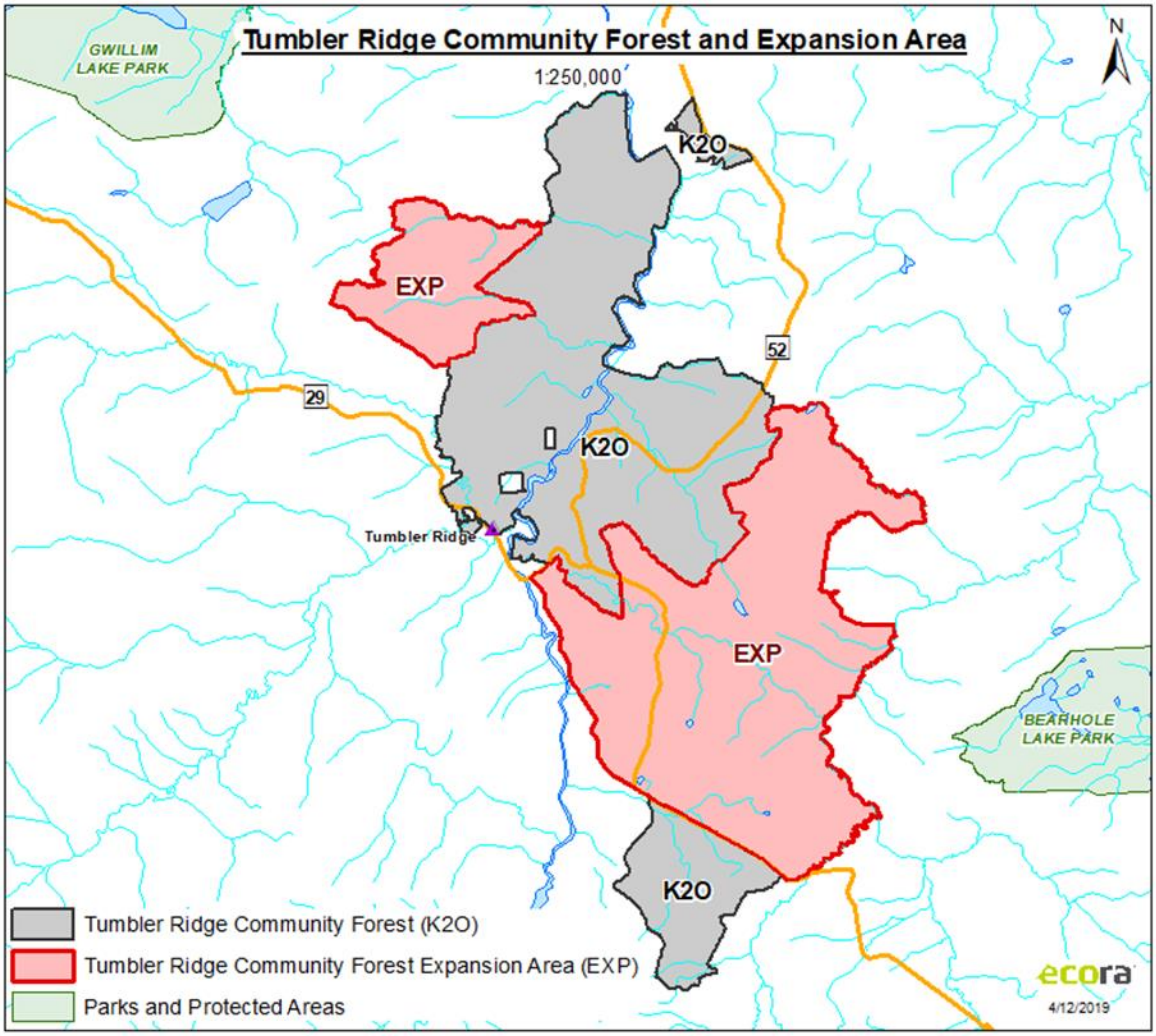

Figure 2-1 Community Forest Agreement K2O Licence Area

2.1 Landbase Classification

The landbase classification process begins with the total area of TRCF and removes area incrementally according to the classification criteria detailed in the Data Package. Through this process, area is systematically removed to establish both the crown forested landbase (CFLB) and the timber harvesting landbase (THLB). Table 2-1 summarizes the area removed under each classification to reach a THLB of 22,120 ha.

Table 2-1 Landbase Classification

Landbase Classification	Area (ha)	% of CFLB
Total Area	**39,986**	
Non-community Forest Agreement Area	1,083	
Non-forested and Non-productive	2,132	
Existing Roads, Trails, Landings, and seismic lines	1,552	
Archeological sites	7	
CFLB	**35,212**	
Recreational Trails	10	0%
Riparian Areas	1,869	5%
Isolated Patches	76	0%
Old Growth Management Areas	4,134	12%
Section 11 Moratorium Areas	275	1%
Physical Inoperability	242	1%
Problem Forest Types	3,787	11%
Economical Inoperability	964	3%
Existing Wildlife Tree Patches (WTP)	402	1%
Future Roads	528	2%
Future WTP Retention	802	2%
THLB	**22,120**	**63%**

2.2 Leading Species

The CFLB includes both the THLB and the productive non-THLB. Figure 2-2 shows the leading species within the CFLB. The THLB is predominantly pine (PLI) leading. Pine leading stands represent 49% of the THLB, followed by spruce (SX) at 30%, aspen (AT) at 11%, black spruce (SB) at 5%, cottonwood (AC) at 2%, subalpine fir (BL) 1%, and recently regenerated stands with unknown species composition at 2%. Areas with a historic logging record or planned to be harvested in the future are included in the THLB, this resulted in areas otherwise would have been categorized as problem forest types or non-treed to be included in the THLB.

Ecora completed a new Vegetation Resources Inventory (VRI) for the entire TRCF area in 2020 using 2019 aerial photography under the 2019 provincial VRI standards, and subsequently produced a report comparing the 1991 vintage inventory which was completed under the Forest Inventory Planning standards to the 2020 VRI. The results for the new VRI are summarized in the *Tumbler Ridge Community Forest Vegetation Resources Inventory with Ecosystem Mapping Project Report* (Ecora, 2020).

One of the key findings from the 2020 VRI report is that there has been an overestimation in pine composition and an underestimation in black and hybrid spruce in the vintage inventory. This is primarily due to attribution biases.

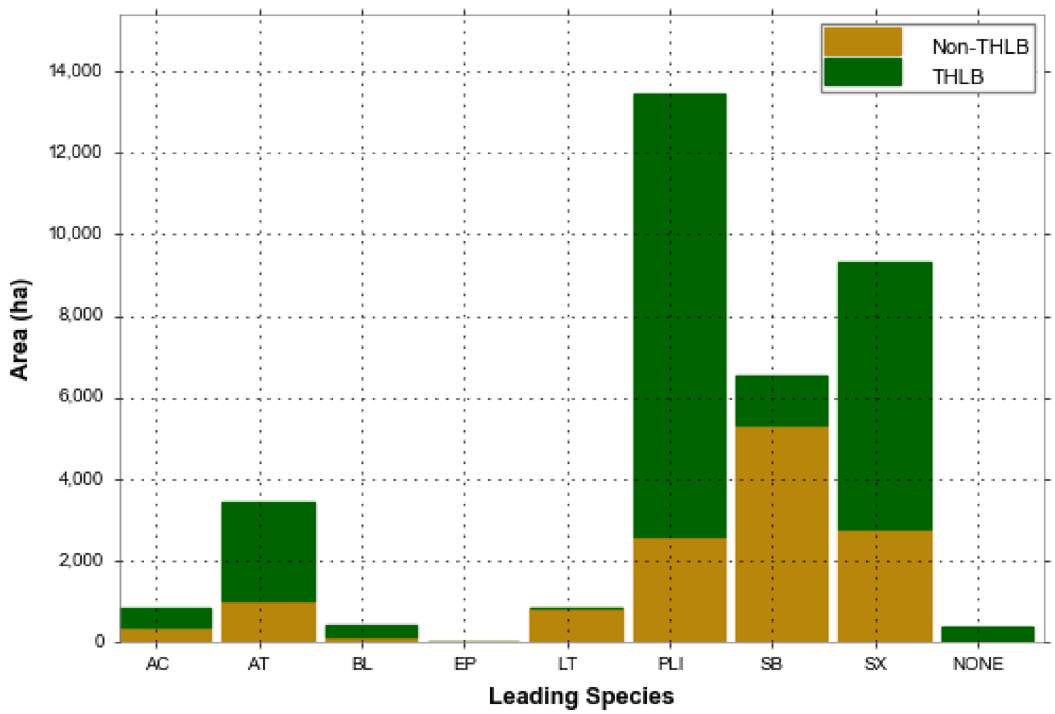

Figure 2-2 CFLB Breakdown by Leading Species

2.3 Logging History

Logging history for the analysis was derived from VRI disturbance history, 2016 and 2019 West Fraser blocks, Reporting Silviculture Updates and Land Status Tracking System (RESULTS), and Forest Tenure (FTEN) cutblock data sets. VRI disturbance history was updated to June 2019; West Fraser blocks were updated to December 2019; RESULTS openings were updated to January 2020 and FTEN cutblock data were updated to March 2020. The end date of the operation was used when available.

Figure 2-3 summarizes the THLB and non-THLB harvesting activities by the five-year periods. Harvesting activity has been relatively consistent on the TRCF landbase since 1987 ranging from 500 ha to 1,000 ha per five-year period. Harvest activities peaked since 2015 in response to the Mountain Pine Beetle infestation, representing 17% of the THLB. Approximately 11,098 ha (50%) of the THLB remains unharvested.

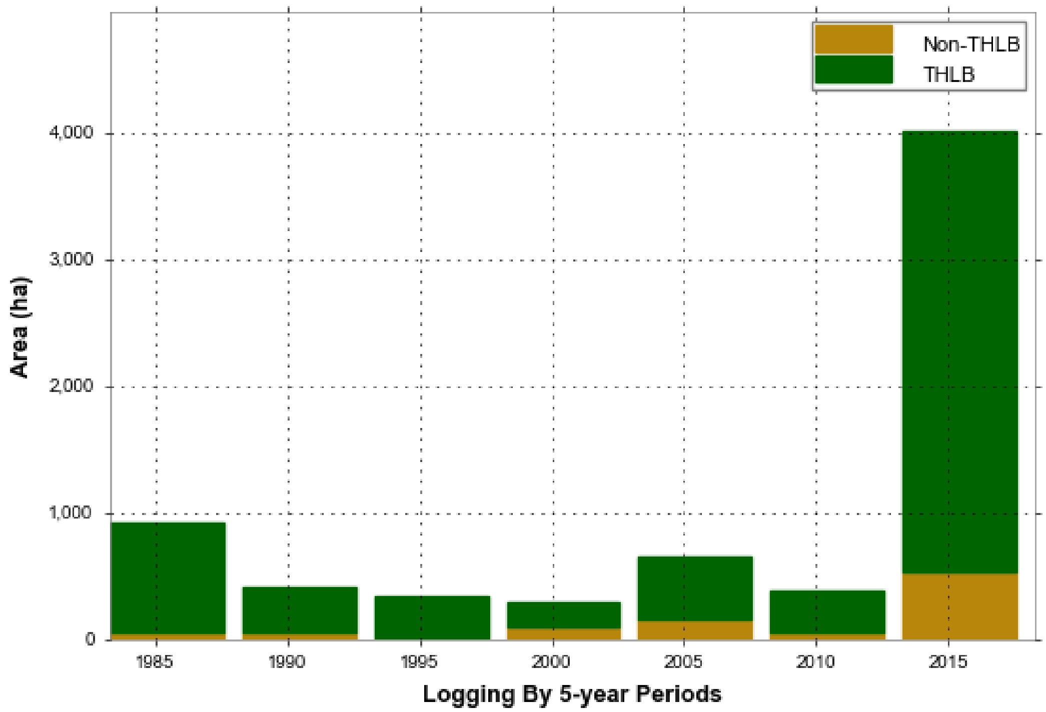

Figure 2-3 CFLB Breakdown by 5-year Logging Periods

2.4 Age Class Distribution

This analysis uses an age updated to December 31, 2020. Figure 2-4 shows the current age class distribution. Table 2-2 lists the range of age each age class represents. The majority of the THLB is in age class 1,2,7 and 8, reflecting a recent logging disturbance history and overall infrequent stand replacing natural disturbance history. Harvest activities since 2015 places 17% of the THLB in age class 1. There is a shortage in age classes 3, 4, 5 and 6 as shown in Figure 2-4 due to infrequent stand replacing natural disturbances and infrequent harvesting activities pre-1980. Overall, the landbase is composed of primarily immature stands and old forests. This can be particularly constraining on the short term harvest level if the non-THLB portion of the landbase in age class 7 and 8 is insufficient to meet the non-timber objectives, making the THLB portion of the old forest unavailable for harvest, and at the same time not enough mature stands available for harvest. The shortage in age classes 3 and 4 might result in the lack of mature merchantable timber available for harvest in the short term for the next 40 years.

Table 2-2 Age Class and the Represented Range

Age Class	Range of Age
1	0 to 20
2	21 to 40
3	41 to 60
4	61 to 80
5	81 to 100
6	101 to 120
7	121 to 140
8	141 to 250
9	251+

Figure 2-4 CFLB Breakdown by Age Class

2.5 Site Index

Inventory site index (SI) values are used to estimate natural stands' productivity, while SI values from the Provincial Site Productivity Layer (PSPL) estimate the productivity of managed stands. In this analysis, inventory SI values are primarily used to generate natural stand yield curves and are also used when PSPL estimates are not available for managed stand yield curves. PSPL SI are intended to capture forest management practices that increase forest productivity such as planting and spacing. Figure 2-5 and Figure 2-6 show the inventory SI and PSPL SI distributions in TRCF respectively, with values rounded to the nearest 3 meters.

Figure 2-5 shows the inventory SI distribution for TRCF with the majority of the THLB between 10.5 and 19.5 meters.

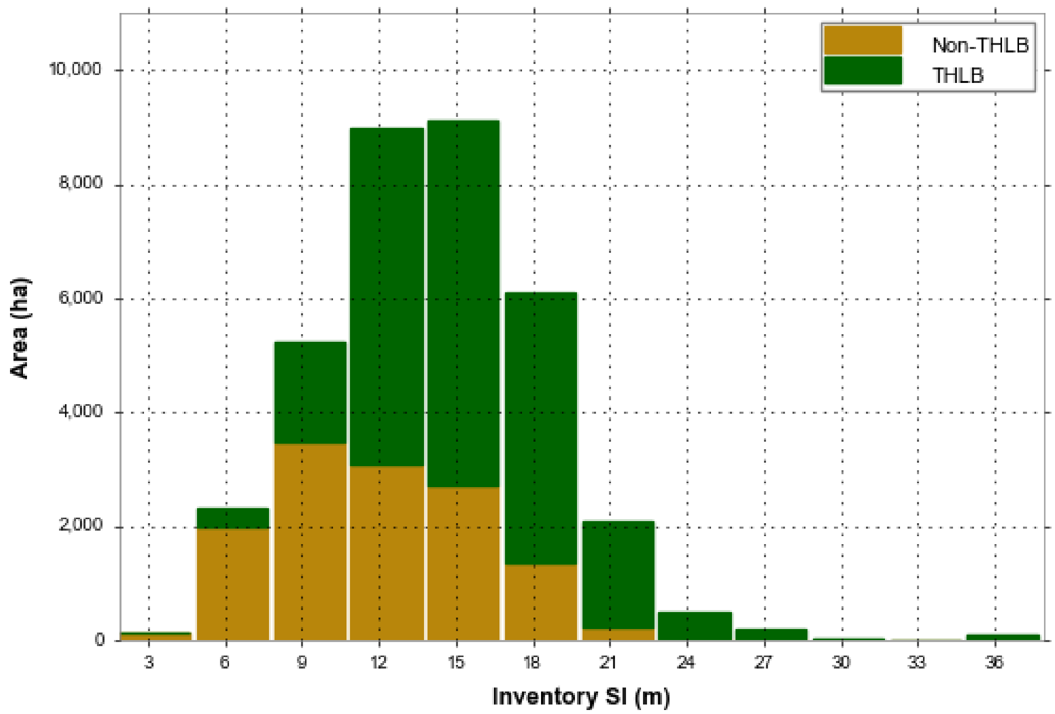

Figure 2-5 CFLB Breakdown by Inventory Site Index (m)

Figure 2-6 shows the distribution of PSPL SI values across the CFLB. Most of the THLB PSPL SI range from 10.5 to 22.5 meters. The PSPL estimates are slightly higher than the inventory SI, as more THLB falls within the 18- and 21-meter range compared to the inventory SI distribution. PSPL was developed to better represent the site productivity of the managed stands which is normally more productive than natural regenerated stands because the managed stands are tended with more care and sometimes planted with seeds with genetic gain.

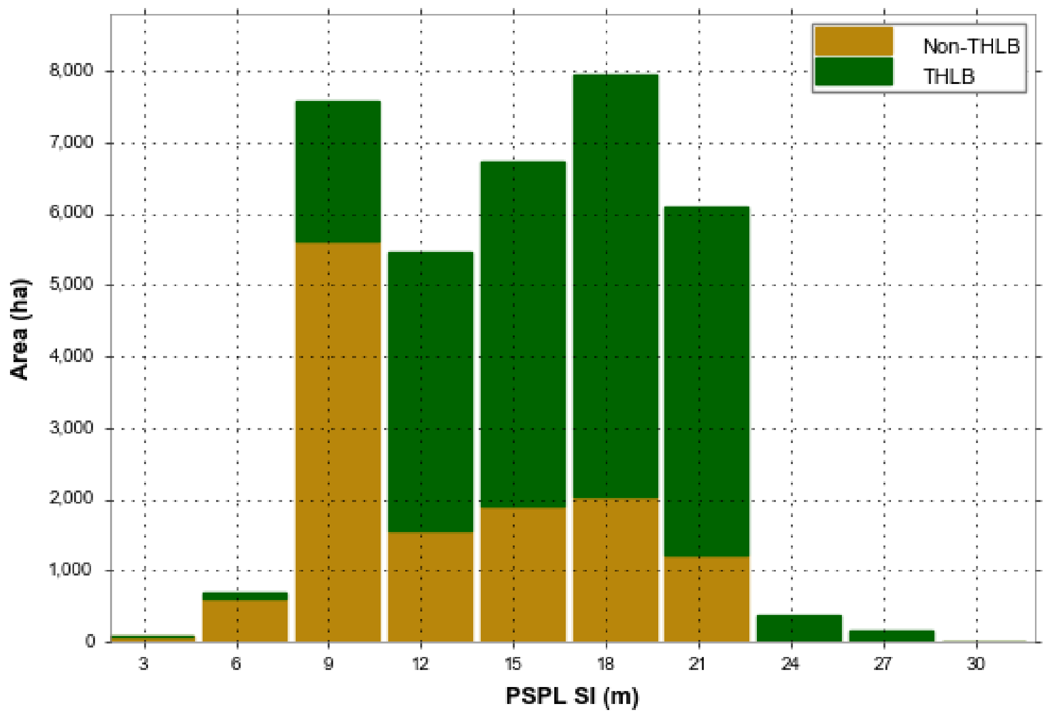

Figure 2-6 CFLB Breakdown by PSPL Site Index

2.6 Biogeoclimatic Ecosystem Classification

TRCF biogeoclimatic ecosystem classification (BEC) variants include the Boreal White and Black Spruce (BWBS) mw (Peace Moist Warm), BWBS wk1 (Murray Wet Cool), and Engelmann Spruce Subalpine Fir (ESSF) mv2 (Bullmoose Moist Very Cold) as shown in Figure 2-7.

The climate of the BWBS zone features extended cold winters and short growing seasons. The mean annual temperature of the BWBS zone is between -2.9 to 2 degrees Celsius, the annual precipitation average ranges between 330 and 570 mm with approximately half of the precipitation falling as snow (BC Forest Research Branch, 1993). The ESSF zone commonly occurs in high elevation and mountainous terrain with even cooler and shorter growing season and longer colder winters compared to the BWBS zone. The mean monthly temperature are below 0 degrees Celsius for half of the year, with only 0 to 2 months above 10 degrees Celsius. Overall, the ESSF zone receives more precipitation than the BWBS zone even in the relatively dry portion of the zone. The drier subzones receive on average 500mm of precipitation and the wetter area can receive up to 2200 mm of precipitation with 50 to 70% of it falls as snow (BC Forest Research Branch, 1993).

Approximately 46% of the THLB is located within BWBS wk1, 38% in BWBS mw and 16% in ESSF mv2. The overall harsh climate of the TRCF landbase resulted in the overall low site productivity of the landbase.

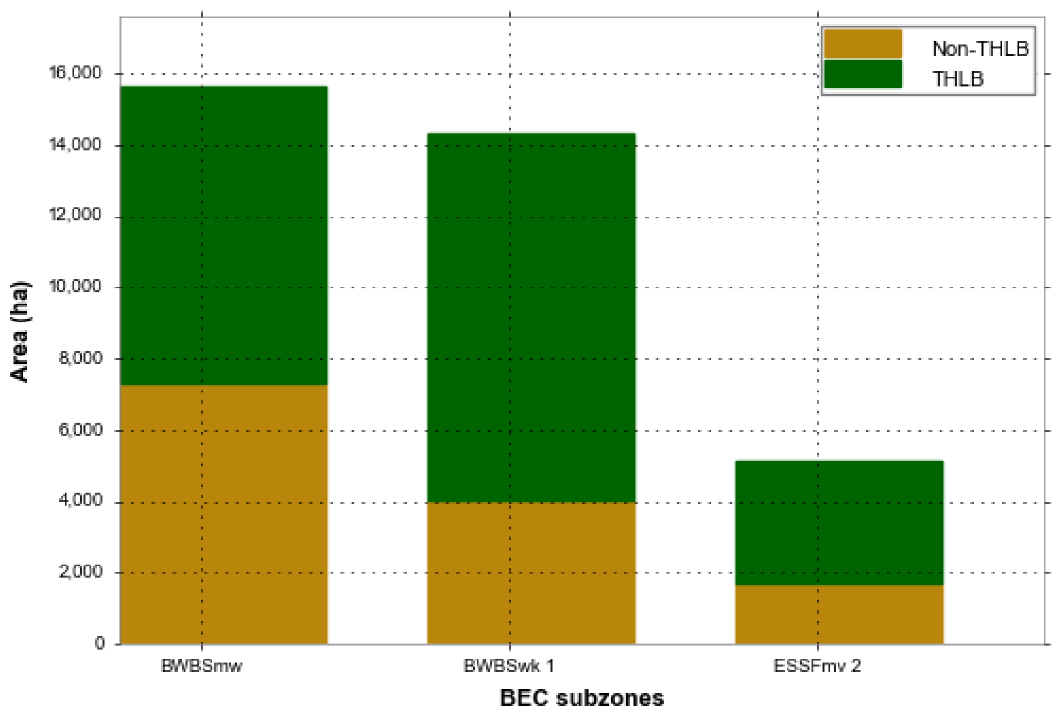

Figure 2-7 CFLB Breakdown by BEC Zone

2.7 Volume Classes

Figure 2-8 displays the volume per hectare characteristics of the CFLB rounded into 100 m³/ha classes. Table 2-3 lists the range of volume within each volume class. There are 32% of the THLB that falls within volume class 0, this represents the currently immature stands. There are 24% of the THLB in the 100-volume class, 30% within the 200-volume class, and 14% of the THLB within volume class 300,400 and 500. These areas represent the mature stands currently available on the landbase. The overall low volume distribution reflects the overall low site productivity of the landbase as well as a recent harvest history.

Table 2-3 Volume Class and the Represented Range

Volume Class	Range of Volume (m^3/ha)
0	0 to 49
100	50 to 149
200	150 to 249
300	250 to 349
400	350 to 449
500	450 to 549

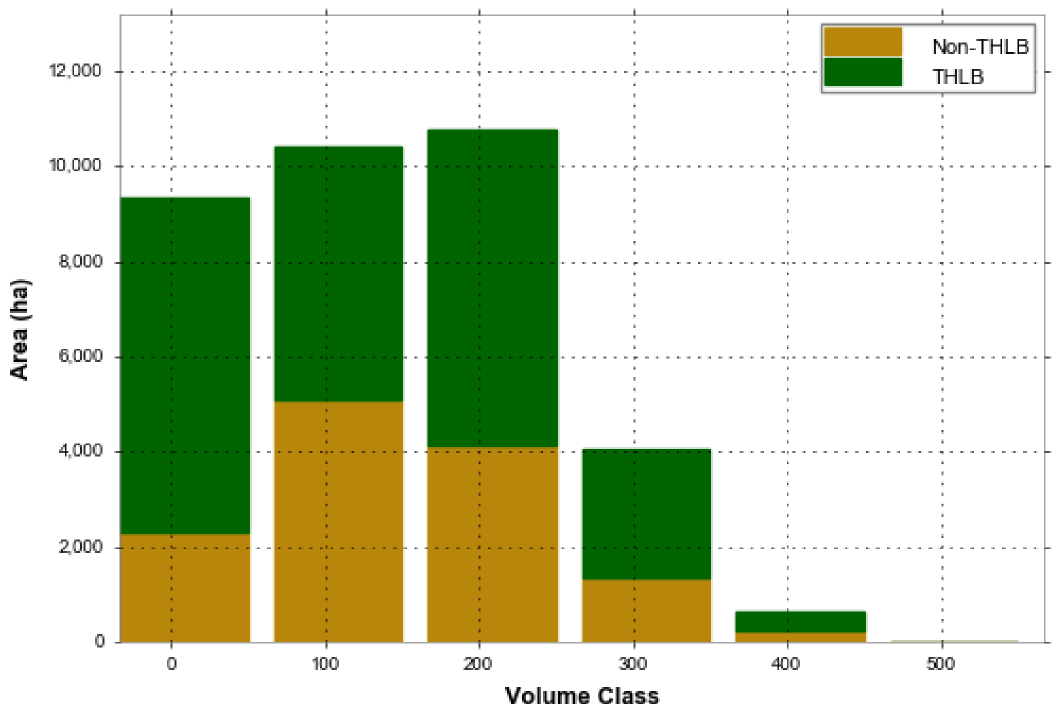

Figure 2-8 CFLB Breakdown by Volume Class

3. Base Case Timber Supply Analysis

The base case is the best representation of "current management" of TRCF. It contains the data and assumptions that combined, form the best estimate of the timber supply for the landbase. Recognizing that uncertainty exists in both data and assumptions, sensitivity analyses are undertaken to attempt to quantify the impact of this uncertainty on the overall harvest level for TRCF.

This section presents the results of the base case timber supply analysis and provides background information on different aspects of the timber supply. The base case and all sensitivity analyses have been carried out using the forest estate model Patchworks. This model is set up to maximize harvest volume subject to the constraints needed to effectively manage the non-timber resources. All harvest levels are reported for the total volume net of non-recoverable losses (2,277m^3/year) of coniferous species only. The forest estate model uses five-year planning periods over a 250-year planning horizon. Harvest volumes for each scenario have been summarized as average values for each planning period.

3.1 Harvest Forecast

Figure 3-1 and Table 3-1 show the average harvest level over the first 20 years at 43,540 m^3/year (m^3/yr), with the harvest level decreasing by 3% at year 21 reaching approximately 42,910 m^3/yr. The base case follows a stepdown harvest pattern to help the landbase transition into managed stands faster while retaining most of the existing old forests for biodiversity purposes. Currently, most of the THLB falls within volume class 0 and 100 as noted in Section 2.7, this is because most of the stands are either still immature or already in old age classes growing on low productivity sites. By transitioning these stands into managed stands, the mean annual increment will increase due to the use of genetically improved stocks and the general care provided to these stands under the current silviculture obligation. Therefore, this long-term harvest plan will meet both the timber and the non-timber objectives.

The current market for deciduous volume in the region is limited. However, due to the proximity of this land base to historically productive deciduous markets and production facilities it was not appropriate to remove these stands from the THLB entirely. However, due to the currently depressed market for deciduous volume the base case does not allow the harvest of deciduous leading stands for the first 20 years of the planning horizon. Scenarios described in Section 4.7 show that the impacts of restricting the harvest of deciduous leading stands through the entire planning horizon have an impact on the conifer harvest of between 5% and 7%.

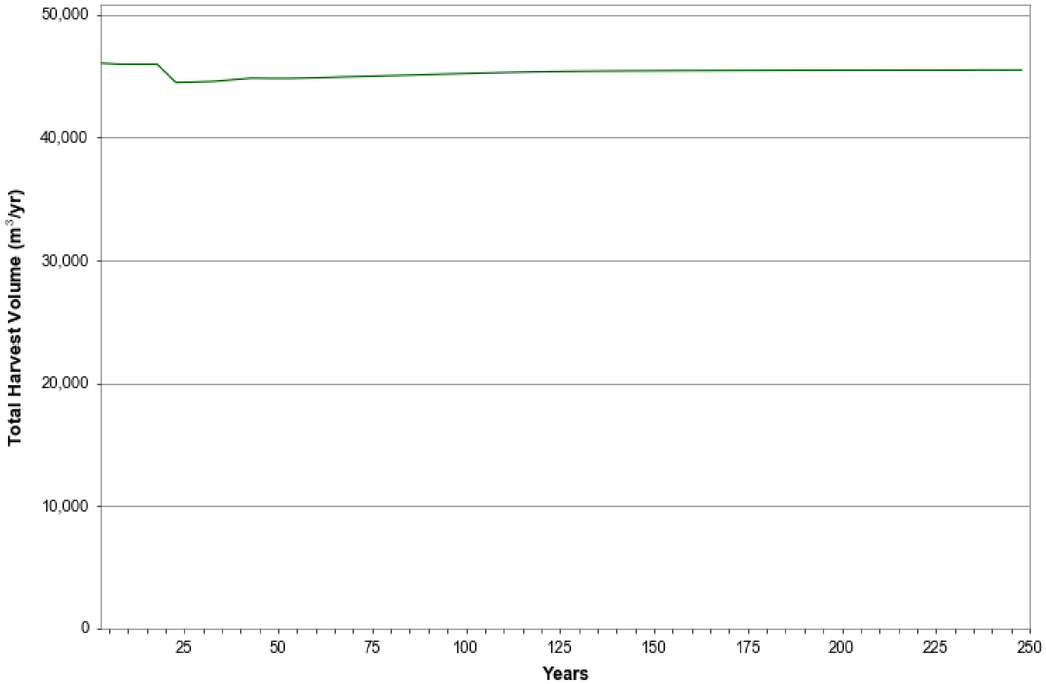

Figure 3-1 Total Coniferous Harvest Volume

Table 3-1 Base Case Average Annual Harvest Levels

Years	Coniferous Volume (1000's of m^3/yr)	Deciduous Volume (1000's of m^3/yr)	Dead Volume (1000's of m^3/yr)	Total Coniferous Volume (1000's of m^3/yr)
1 to 5	39.02	7.60	4.51	43.54
6 to 20	43.48	4.82	0.00	43.48
21 to 250	42.91	2.18	0.00	42.91

3.2 Base Case Harvest Characteristics

The total THLB growing stock by managed and natural stand breakdown is shown in Figure 3-2. The initial total growing stock of 2,918,751 m^3 decreases gradually in the first 120 years as old natural stands are being harvested. The total growing stock reaches the lowest level at years 120 through 140, when most of the existing natural stands have been harvested and most of the future managed stands have not yet reached the minimum harvestable volume. Harvesting is most constrained biologically at this point, and this represents the "pinch point" in the harvest schedule. As more future managed stands reach maturity, the growing stock begins to increase and eventually reach an equilibrium with the harvest level at year 160 and remain relatively constant until the end of the planning horizon. This future trend indicates that the proposed harvest level is sustainable. Natural growing stock remains at on average 16% of the total growing stock from year 160 to 250. This is the result of the existing natural stands that were never harvested within the 250-year period. There are 442 ha of THLB where the volumes never reach the minimum harvestable volume, these stands were not captured in the non-economic operability step in the THLB netdown process because they have been harvested in the past or if they are less than 120 years old according to the VRI. These are naturally regenerated stands on low-productivity sites, whose volume will never reach the minimum harvestable volume based on the Variable Density Yield Prediction Growth and Yield Model (VDYP) projection. In addition, there are 1,201 ha of THLB that were unharvested within the 250-year periods. Based on the non-timber forest cover constraints acting on these stands, the model decided that these less productive stands would be better left unharvested to meet the non-timber objectives rather than to meet the timber objectives.

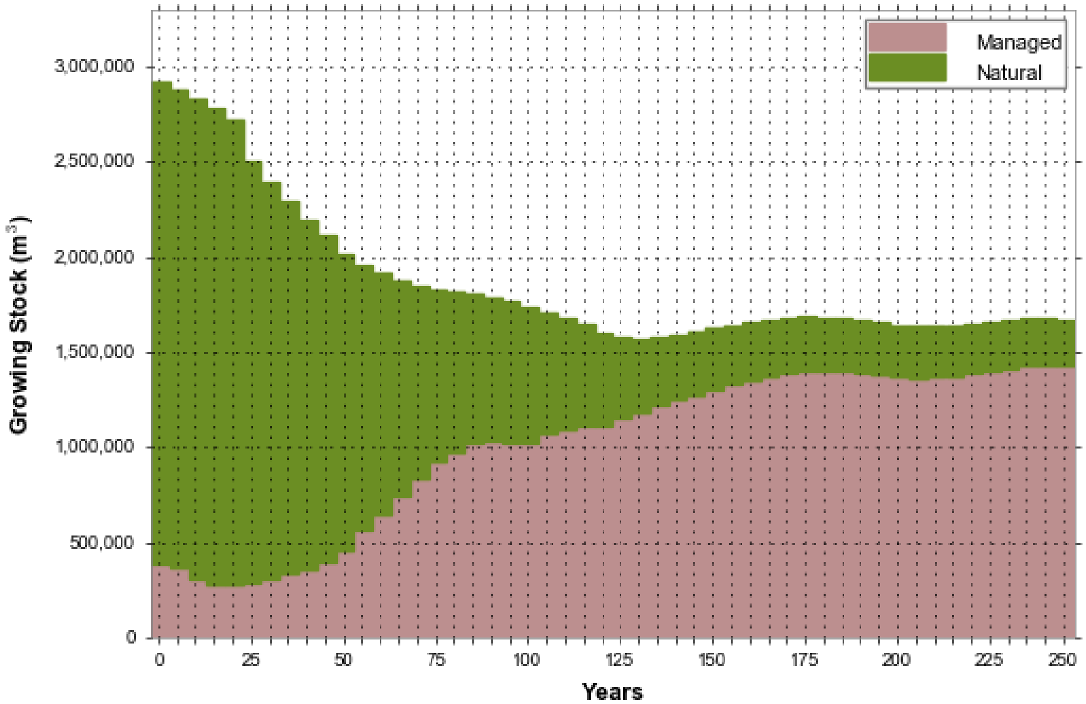

Figure 3-2 Total Growing Stock by Managed and Natural Stands

Figure 3-3 shows the distribution and transition of the harvest volume (including deciduous) between natural and managed stands. For the first 70 years, harvesting is almost exclusively in natural stands as shown in Figure 3-3. At year 75, harvesting begins to transition into mostly managed stands as existing natural stands are harvested. This transition occurs over a span of 60 years where the managed stands represents on average 80% of the harvest volume. From year 150, managed stand represents 98% of the harvest volume until the end of the planning period. The natural stands in the harvest profile is the result of the delayed harvest on the existing natural stand. In the first 20 years, harvesting of deciduous-leading stands are restricted due to current market condition. From year 25, harvesting in the deciduous-leadings stands are no longer restricted, this resulted in the model scheduling most of the deciduous-leading stands for harvest in that period. The model prioritizes harvesting these stands because they are high in site productivity and would be more beneficial for the LTHL if they can be converted to productive managed stands sooner.

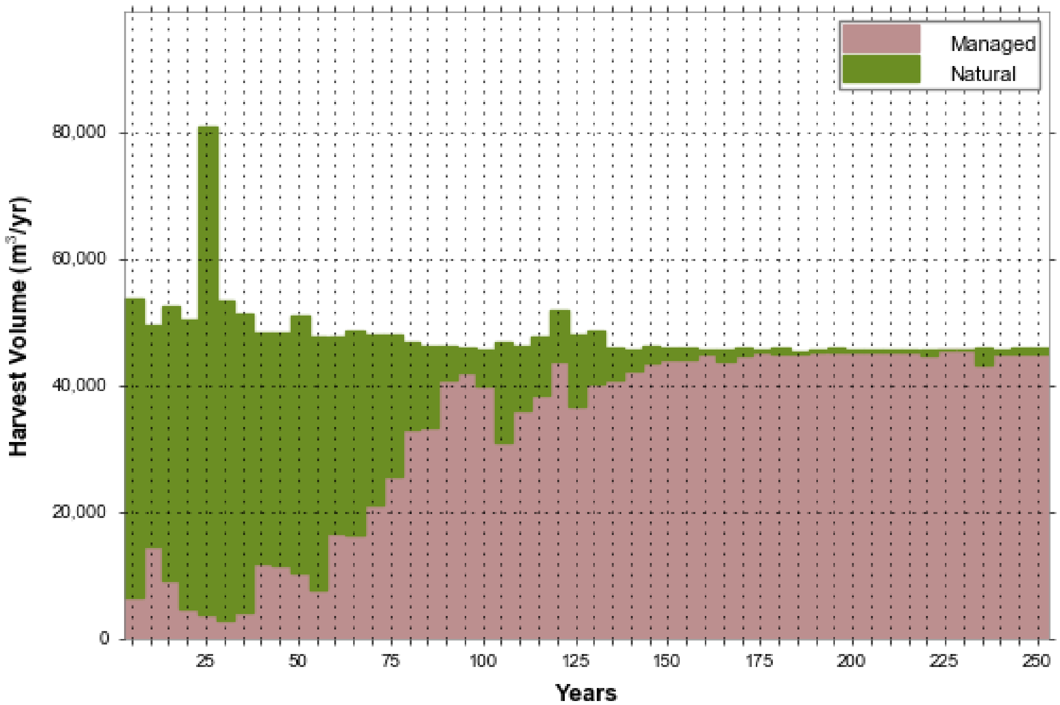

Figure 3-3 Harvest Volume by Natural and Managed Stands

Figure 3-4 shows the change in average harvest age of the base case. The average harvest age for the first 70 years is 137 years old as harvesting occurs exclusively within the natural stands. As harvesting transitions into younger and more productive managed stands after year 75, the average harvest age drops to 101 years old. After year 150, harvesting transitioned into all managed stands and the average harvest age oscillates between 100 and 85 years old. The minimum harvest age in the base case was determined as the age when the stand reaches 95% of the mean annual increment and at the same time volume exceeds the minimum harvest volume. After this age, the growth slows down while decay, waste and breakage increase in the stand. Therefore, average harvest age for managed stands are lower than the natural existing stands.

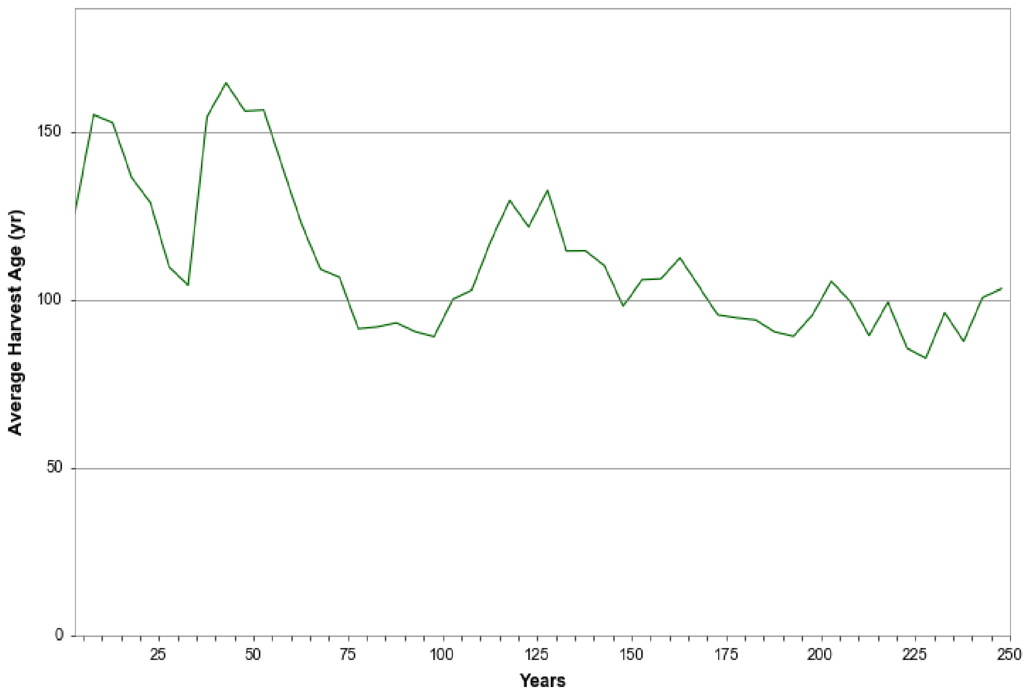

Figure 3-4 Average Harvest Age

The average conifer harvest volume per hectare (VPH) is averaging at 179 m^3/ha for the first 5 years as shown in Figure 3-5. This is because the model is set out to convert the high site productivity, high volume, natural existing conifer stands into even more productive future managed stands as soon as possible while meeting the timber objective. As these stands are harvested, harvesting shifts to higher conifer volume but medium site productivity stands in year 10 to 40. The average conifer harvest VPH is significantly low from year 25 to 30, averaging at 130 m^3/ha, this is because from year 25 harvesting in the deciduous-leading stands are no longer restricted based on the assumption as noted in Section 5.7 of the Data Package. This results in the model setting out to harvest the high site productivity low volume deciduous-leading stands and convert them to productive managed stands. The average harvest VPH then steadily incline and reaches the highest level in year 55 when the harvest profile began to consist the most productive existing managed stands. The average harvest VPH at this time is 330 m^3/ha. After year 110, the harvest level began to encounter the "pinch point" when existing natural and managed stands are harvested but the future managed stands are not yet available for harvest. The average harvest VPH drops to 154 m^3/ha in year 120 then oscillates between 250 and 200 m^3/ha as harvesting transitions into primarily future managed stands.

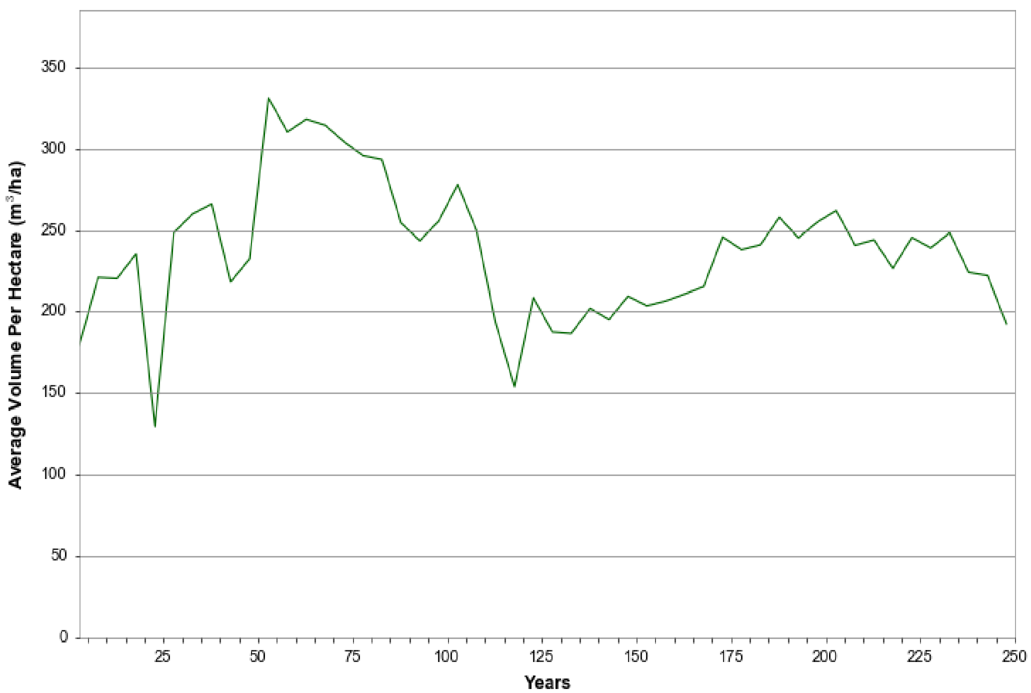

Figure 3-5 Average Harvest Volume Per Hectare

Figure 3-6 shows the harvest volume by conifer, deciduous and dead. Dead volume is shown in dark green in Figure 3-6, it only appeared in the first period because it has been set to be only available for 2 years in the model as noted in Section 6.4 of the Data Package. The combined harvest level spiked between year 25 to 30, due to the release of the deciduous-leading stands, causing the model to harvest 36,600 m^3/yr of deciduous volume. These deciduous-leading stands are high in site productivity, by allowing and prioritizing these stands for harvest, this allows these stands to transition into high volume managed stands. Under the current market condition, deciduous species are not merchantable and therefore are not targeted for harvest. However, 20 years into the future, the deciduous market could change for the better, therefore no specific limitations were placed on the deciduous harvest after year 20 to allow flexibility in the model. From year 30 to 130, the deciduous harvest volume is on average 7% of the total harvest volume. After year 135, deciduous harvest volume is on average 0.6% of the total harvest volume because at this point onwards, all harvest volume is derived from future managed stands.

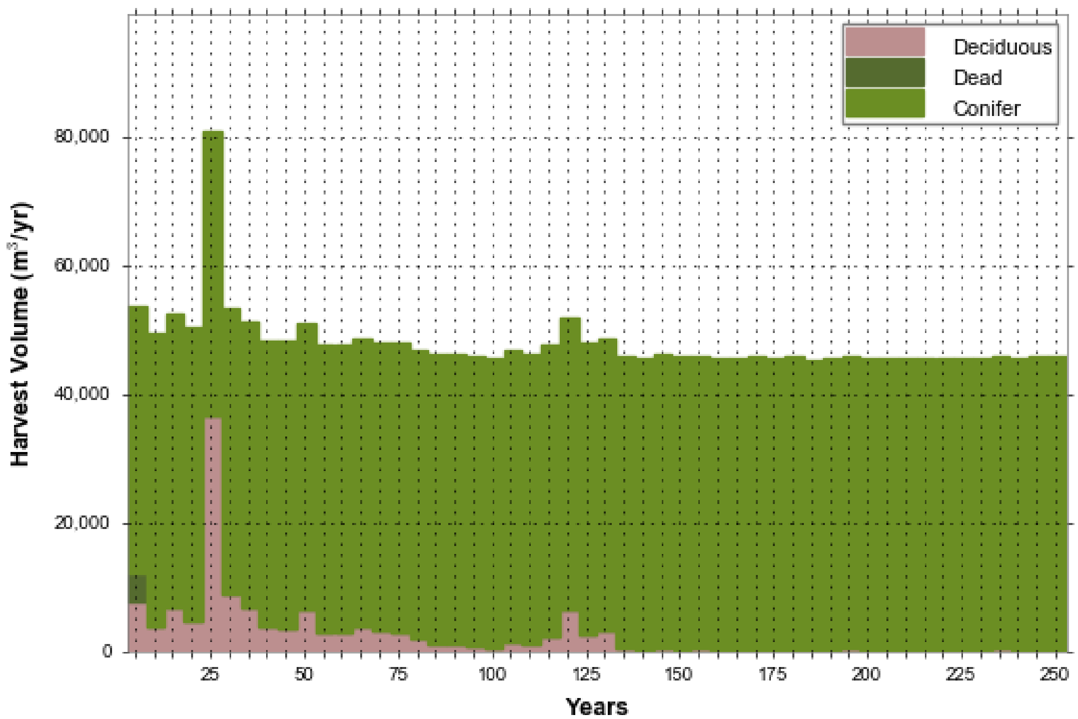

Figure 3-6 Harvest Volume by Conifer, Deciduous and Dead Distribution

3.3 Age Class Distribution

The age class progression graphs in Figure 3-7 display the changing age class distribution of TRCF over the 250-year planning horizon. Initially, the THLB is mainly composed of stands in age classes 1, 2, 7 and 8 (i.e. 0 to 40 and 121 to 250 years old). This age class distribution supports the step-down harvest flow of the base case because the high initial harvest volume would transition these older natural existing stands into more productive managed stands sooner as shown in Year 10 of Figure 3-7. As time progresses, the model modifies the age class distribution, while managing the transition from old natural stands to young managed stands. The non-THLB areas remain at the old age classes, reaching age class 9 by the final periods of the planning horizon. Eventually, the THLB portion of the landbase shares a relatively balanced distribution of area in age classes 1 through 8, with more area located in age class 1 to 3. Normally, on a more productive landbase that can satisfy the non-timber objectives with the non-THLB portion of the landbase in the long term, the age class distribution at year-250 would allocate all of the non-THLB in age class 9 while distributing the THLB evenly within the younger and mature age class groups (e.g. age classes 1 to 5) with very little to none THLB located within the mature to old age class groups (e.g. age class 6 to 9). On TRCF however, a noticeable portion of the THLB is located within the mature to old age class groups at the end of the planning period, this is primarily because of two reasons. First, the site index distribution of TRCF ranges from low to medium as discussed in Section 2.5, which means the harvest age based on Culmination Mean Annual Increment (CMAI) would vary by decades for each stand. Therefore, some stands can only be harvested once they reach the mature to old age class groups, while some can be harvested sooner. Second, the model has made the decision not to harvest 1,643 ha of the THLB within the 250-year period due to forest cover constraints. For instance, the LEWR require 65% of the CFLB be greater than 80 years old, the non-THLB portion of this resource management zone is only 41% of the CFLB, therefore, 41% of the THLB within the LEWR need to be maintained greater than 80 years old. In the base case, the model prioritizes harvesting on the more productive stands in the LEWR because they yield more return in a shorter time span, while maintaining the less productive stands as old forests to meet the forest cover requirements. This resulted in THLB in the older age classes.

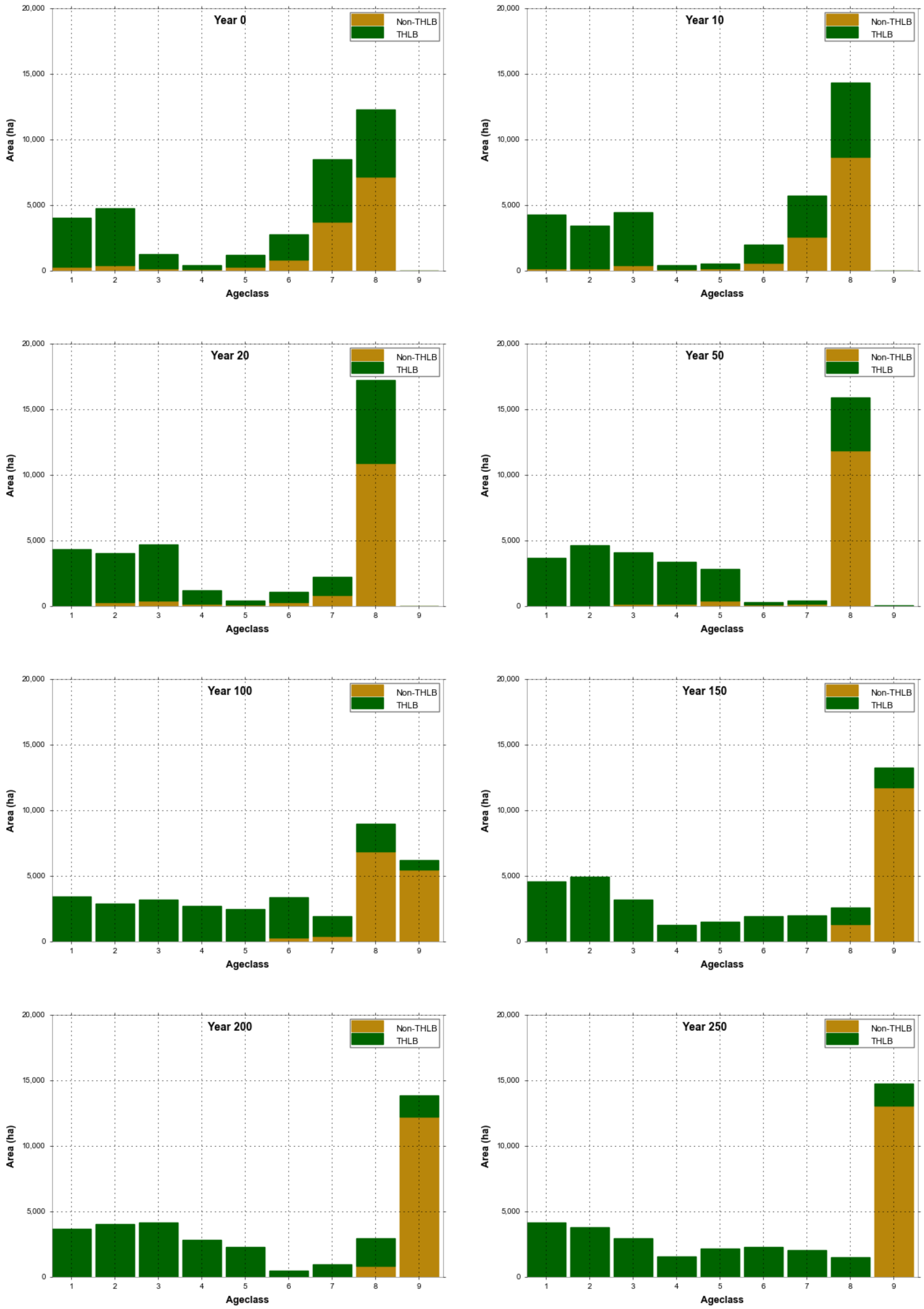

Figure 3-7 Age Class Distribution Within the 250-years Planning Period

3.4 Alternative Harvest Flow

An even harvest flow (evenflow) scenario tests the highest level that the long-term harvest level (LTHL) can reach. This scenario acts as a guidance for the LTHL of the base case in a step-down harvest pattern. Figure 3-8 shows the harvest flow comparison of the base case and the evenflow scenario. Table 3-2 shows the average harvest volume between the two. The base case allows the model to harvest more volume in the first two periods without compromising the LTHL and the non-timber objectives compared to the evenflow scenario. In the evenflow scenario, the average harvest level in the first 20 years is approximately 500 m^3/yr lower than the LTHL. Meanwhile, in the base case, the harvest level for the first 20 years can achieve as high as 43,540 m^3/yr without dropping the LTHL. This is because, in the evenflow scenario, the model uses the THLB in age class 7 and 8 to meet the non-timber objectives rather than maximize harvesting, whereas in the base case, the model is more motivated to harvest the volume from the THLB in age class 7 and 8 to meet the timber objectives in the short-term rather than satisfying the non-timber objectives. In both scenarios, the non-timber objectives are met in the long-term.

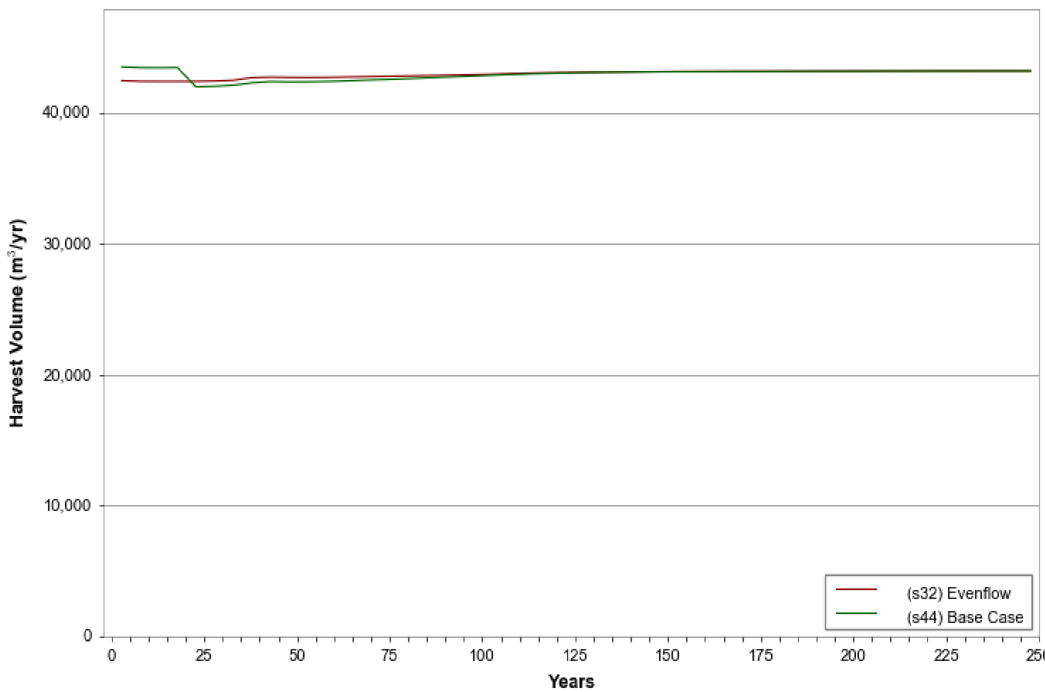

Figure 3-8 Harvest Level of Evenflow vs Base Case

Table 3-2 Harvest Level Comparison – Evenflow

Years	Base Case (1000's m^3/yr)			Evenflow (1000's m^3/yr)			% Change from Base Case (Total)
	Conifer	Dead	Total	Conifer	Dead	Total	
1 to 5	39.02	4.51	43.54	37.96	4.51	42.48	-2%
6 to 20	43.48	0	43.48	42.42	0	42.42	-2%
21 to 250	42.91	0	42.91	43.02	0	43.02	0%

4. Sensitivity Analysis

Sensitivity analysis provides information on the degree to which uncertainty in the base case data and assumptions might affect the proposed harvest level for the landbase. The magnitudes of the change in the sensitivity variable(s) reflect the degree of risks associated with a particular uncertainty – a very uncertain variable that has minimal impact on the harvest forecast represents a low risk. By developing and testing a number of sensitivity issues, it is possible to determine which variables most affect the results and make management decisions based on these uncertainties.

Each sensitivity listed in Table 4-1 is modelled as its own scenario to test the impact of changing a variable from the base case. The impacts are measured against the base case scenario. The reported results shown in the following sections display the total harvest level net of non-recoverable losses.

Table 4-1 Sensitivity Analysis Scenarios

Sensitivity	Range Tested	Scenario Description
VQO	Assess the impact on harvest level with reduced VQO target applied	Reduce VQO target by one class
Yield Assumption	Increase / decrease both managed and natural stand yields	Natural Stand Yield Tables (NSYT) +/- 10%
		Managed Stand Yield Tables (MSYT) +/- 10%
Minimum Harvest Volume (MHV)	Assess the impacts of increasing MHV	Increase MHV to 140 m^3/ha
LEWR	Assess the impact of altering LEWR related targets	Exclude LEWR from THLB
		Turn off LEWR target
Non-spatial seral target and patch size targets	Assess the impact to harvest level when applying the non-spatial seral target and the patch target from TSR 2	Apply landscape level non-spatial old forest retention targets and patch distribution target
Site Index Adjustment Assumption	Assess the change in harvest level when applying a potential site index adjustment	Managed stand site index +2m
		Managed stand site index +4m
Deciduous-leading Stand Harvest	Assess the change in harvest level when restricting or relaxing harvest in deciduous-leading stands	No harvest of deciduous-leading stands
		Harvest of deciduous-leading stands is unrestricted

4.1 Visual Quality Objectives

The established visual quality objective code (EVQO) assigned to a visual landscape inventory (VLI) polygon has been lowered by one class to assess the impact on timber supply in TRCF by visual quality objectives (VQO). This means a VLI polygon with EVQO code in partial retention has been lowered to modification to allow for more harvesting. Figure 4-1 and Table 4-2 shows the impact on harvest level when the EVQO is lowered.

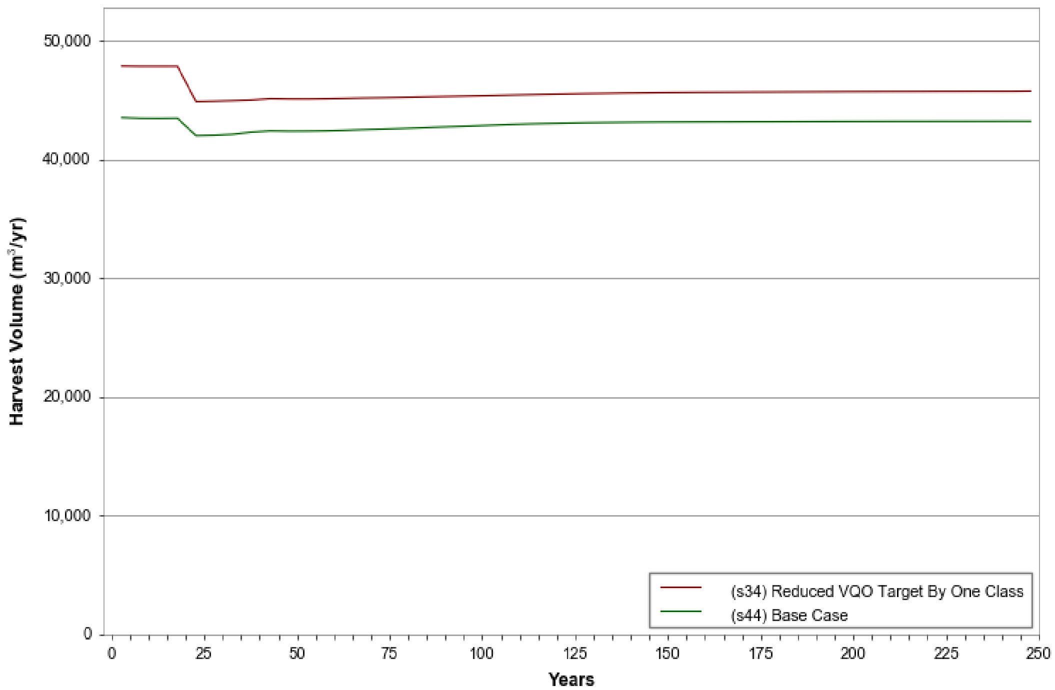

Figure 4-1 Harvest Level of Reduced VQO Requirement vs Base Case

Table 4-2 Harvest Level Comparison – Reduced VQO Requirement

Years	Base Case (1000's m3/yr)			Reduced VQO (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	43.36	4.51	47.87	10%
6 to 20	43.48	0	43.48	47.85	0	47.85	10%
21 to 250	42.91	0	42.91	45.45	0	45.45	6%

By lowering the EVQO by one class, the harvest level increased by 10% for the first 20 years, and 6% for the LTHL. The impact is significant because there are 8,345 ha of THLB covered by VLI polygons, which account for 38% of the THLB. Despite the large area, the EVQO for these VLI polygons are not very restrictive and most of the VLI polygons can achieve the VQO target with the non-THLB. Therefore, the total impact on the harvest level is 10% in the short term and 6% in the long term.

4.2 Yield Assumptions

Sensitivity analyses around natural and managed stand yields help us understand the degree to which uncertainty in yield models and assumptions may affect the short, mid, and long-term harvest forecast for the TRCF landbase.

Figure 4-2, Table 4-3 and Table 4-4 show the impact of increasing and decreasing natural stand yield tables (NSYT) by 10%. Decreasing the natural stand yield tables by 10% has a -9% impact on the short-term harvest level (first 20 years), -6% on the mid-term harvest level (21 to 100 years) and no impact on the LTHL. Conversely, when NSYT are increased by 10%, the model shows a 7% increase in harvest volume for the first 20 years and 6% increase for the rest of the planning horizon compared to the base case. The changes in the short-term harvest level is more significant than the LTHL because within the first 70 years, natural stands comprise of the more than 50% of the harvest profile.

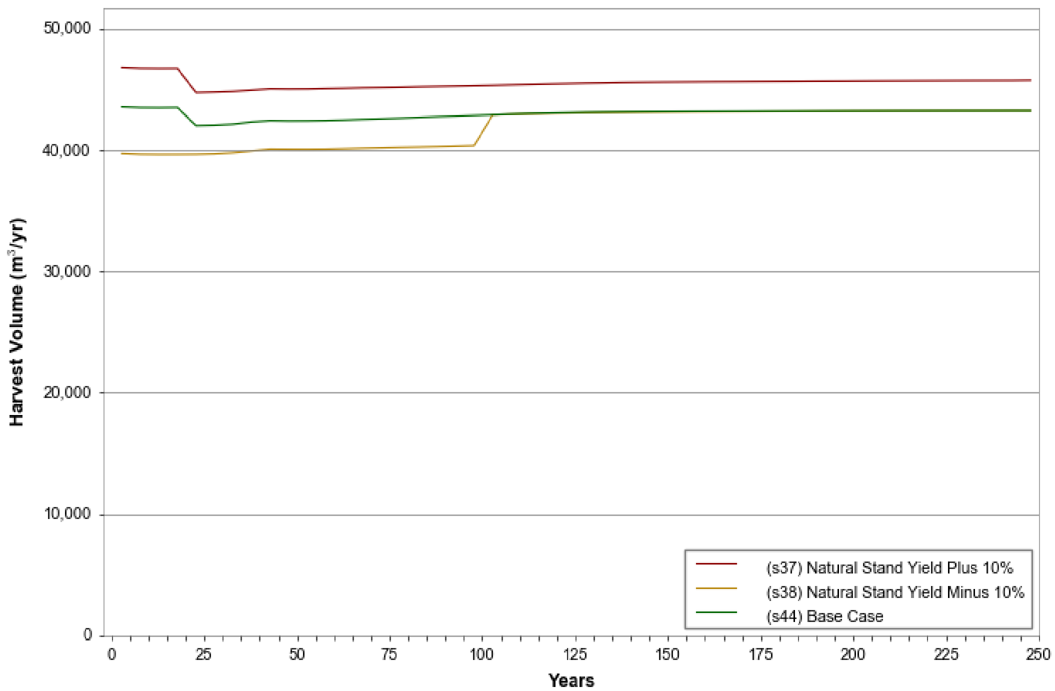

Figure 4-2 Harvest Level of NSYT plus and minus 10% vs Base Case

Table 4-3 Harvest Level Comparison – NSYT Plus 10%

Years	Base Case (1000's m3/yr)			NSYT plus 10% (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	41.98	4.81	46.79	7%
6 to 20	43.48	0	43.48	46.72	0	46.72	7%
21 to 100	42.45	0	42.45	45.05	0	45.05	6%
101 to 250	43.16	0	43.16	45.61	0	45.61	6%

Table 4-4 Harvest Level Comparison – NSYT Minus 10%

Years	Base Case (1000's m3/yr)			NSYT minus 10% (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	36.22	3.48	39.70	-9%
6 to 20	43.48	0	43.48	39.62	0	39.62	-9%
21 to 100	42.45	0	42.45	40.06	0	40.06	-6%
101 to 250	43.16	0	43.16	43.14	0	43.14	0%

Figure 4-3, Table 4-5 and Table 4-6 show the impact on timber supply if managed stand yield tables (MSYT) are increased and decreased by 10%. Decreasing managed stand yields decreases the harvest level by approximately 5% in the first 20 years while decreasing the LTHL by 6%. When the MSYT are increased by 10%, there is a 6% increase in the LTHL, and a 10% increase in the first 20 years. The impact on the LTHL is higher than the short-term because the harvest profile transitions into mostly managed stands after year 75.

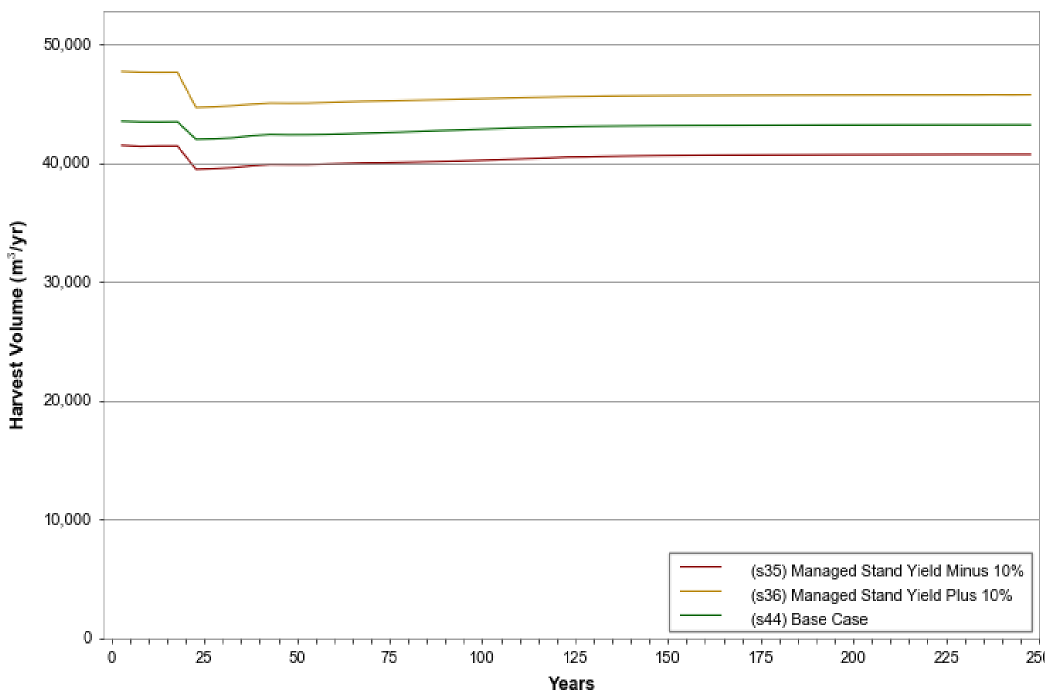

Figure 4-3 Harvest Level of MSYT plus and minus 10% vs Base Case

Table 4-5 Harvest Level Comparison – MSYT Plus 10%

Years	Base Case (1000's m3/yr)			MSYT Plus 10% (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	43.20	4.51	47.71	10%
6 to 20	43.48	0	43.48	47.64	0	47.64	10%
21 to 250	42.91	0	42.91	45.46	0	45.46	6%

Table 4-6 Harvest Level Comparison – MSYT Minus 10%

Years	Base Case (1000's m3/yr)			MSYT Minus 10% (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	36.98	4.51	41.49	-5%
6 to 20	43.48	0	43.48	41.42	0	41.42	-5%
21 to 250	42.91	0	42.91	40.36	0	40.36	-6%

4.3 Minimum Harvest Volume

The minimum harvestable criteria provide the timber supply analysis with operational and economic feasibility. Minimum harvestable age (MHA) and minimum harvest volume (MHV) are often used independently or together when establishing the minimum harvestable criteria.

MHV controls the earliest harvestable age of a stand, by setting the treatment age to the age when the stand reaches 95% of the mean annual increment (MAI) and the MHV. If a stand does not reach 95% of the MAI before or while it reaches the MHV, then the treatment age will be set to the age at which the stand reaches 95% of the MAI. The MHV for TRCF is 120 m^3/ha, a sensitivity analysis was conducted to test the impact on the harvest level when the MHV is increased 140 m^3/ha. Increasing the MHV means that the model has less flexibility around scheduling stands for harvest.

Figure 4-4 shows the harvest flow of increasing MHV to 140 m^3/ha compared to the base case. Table 4-7 shows the average harvest volume comparison. The result shows that by increasing the MHV to 140 m^3/ha the harvest level experienced a 0% impact. The reason is that based on the site productivity of TRCF, most stands reach the MHV long before they reach 95% of the MAI, and because the model harvest age was set to the age at which the stand reaches 95% of the MAI, increasing the MHV to 140 m^3/ha is not significant enough to negatively impact the harvest level.

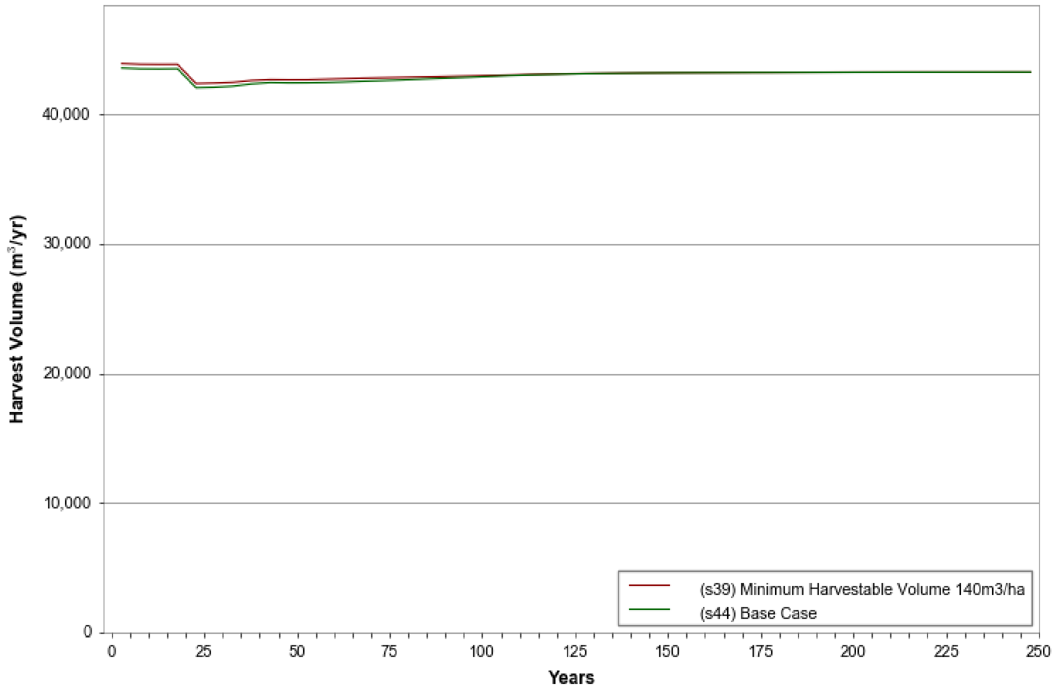

Figure 4-4 Harvest Level of MHV 140 m³/ha vs Base Case

Table 4-7 Harvest Level Comparison – MHV 140 m³/ha

Years	Base Case (1000's m3/yr)			MHV 140 (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	39.37	4.51	43.89	0%
6 to 20	43.48	0	43.48	43.83	0	43.83	0%
21 to 250	42.91	0	42.91	43.00	0	43.00	0%

4.4 Low Elevation Winter Range

The Low Elevation Winter Range (LEWR) covers 14,135 ha or 40% of the CFLB in TRCF. The base case modelling criteria for the LEWR is required to maintain a minimum 65% of CFLB greater than 80 years old. This management guidance was provided and confirmed by the Major Projects Team Lead of the Omineca Region and the North Eastern Caribou Team Lead. A sensitivity analysis was conducted to test the impact on the harvest level when the LEWR target is excluded from the base case. Additionally, a sensitivity analysis that excludes the LEWR from the THLB was conducted based on the suggestion from the District Timber Tenures Specialist. These scenarios test the impact on the harvest level if the management criteria for the LEWR has changed.

Figure 4-5, Table 4-8 and Table 4-9 show the impact on timber supply if the LEWR target is excluded from the base case or is excluded from the THLB. The short-term harvest level (first 20 years) is 16% higher and the LTHL is 10% higher than the base case when the LEWR target is excluded from the base case. In the base case scenario, there is not enough mature and old forest on the non-THLB portion of the landbase to meet the target in the short-term, as more CFLB reach the older age classes, the LEWR target can be met and maintained with the long-term harvest schedule, therefore the harvest level impact is less in the long-term. When the LEWR was excluded from the THLB and be treated as a no harvest zone, harvest level decreased by 33% in the first 5 years, 37% from year 6 to 20, and 34% for the rest of the planning horizon. There are 8,337 ha of THLB located in the LEWR, this represents 38% of the THLB in TRCF. When the modelling criteria for the LEWR change from conditional harvest to no harvest, the change in harvest level mimics the change in the THLB.

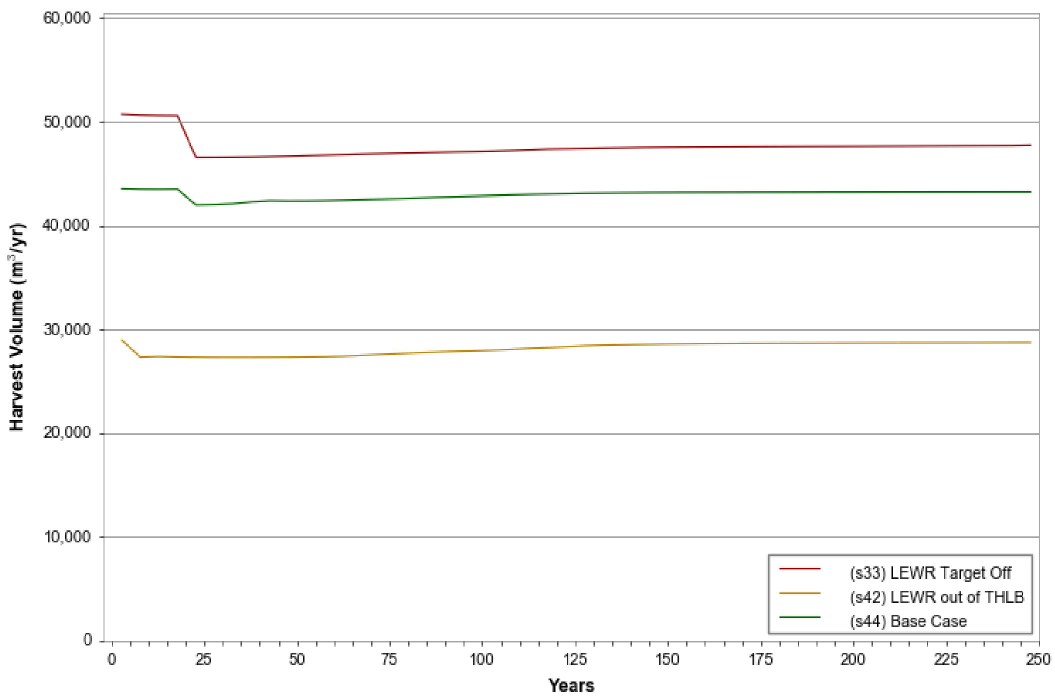

Figure 4-5 Harvest Level of LEWR Scenarios vs Base Case

Table 4-8 Harvest Level Comparison – LEWR Target Off

Years	Base Case (1000's m3/yr)			LEWR Target Off (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	44.90	5.82	50.72	17%
6 to 20	43.48	0	43.48	50.60	0	50.60	16%
21 to 250	42.91	0	42.91	47.31	0	47.31	10%

Table 4-9 Harvest Level Comparison – LEWR Out of THLB

Years	Base Case (1000's m3/yr)			LEWR Out of THLB (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	24.57	4.40	28.98	-33%
6 to 20	43.48	0	43.48	27.35	0	27.35	-37%
21 to 250	42.91	0	42.91	28.20	0	28.20	-34%

4.5 Non-spatial Seral and Patch Size Distribution Targets

In the 2011 DC TSA TSR Data Package, Old Growth Management Area (OGMA) has replaced the non-spatial old growth objectives and patch size distribution targets in the base case. In this analysis, the base case followed the TSR approach because there are 4,514 ha of CFLB within TRCF that are spatially allocated as OGMA to meet the old growth objectives. A scenario with the landscape-level retention and patch size distribution targets included in the base case was examined.

The harvest level comparisons are shown in Figure 4-6 and Table 4-10. There is no considerable impact on the harvest level when the landscape-level retention and patch size distribution targets are included in the base case. This shows that the current age class distribution and patch size distribution can meet the targets without impacting the harvest flow.

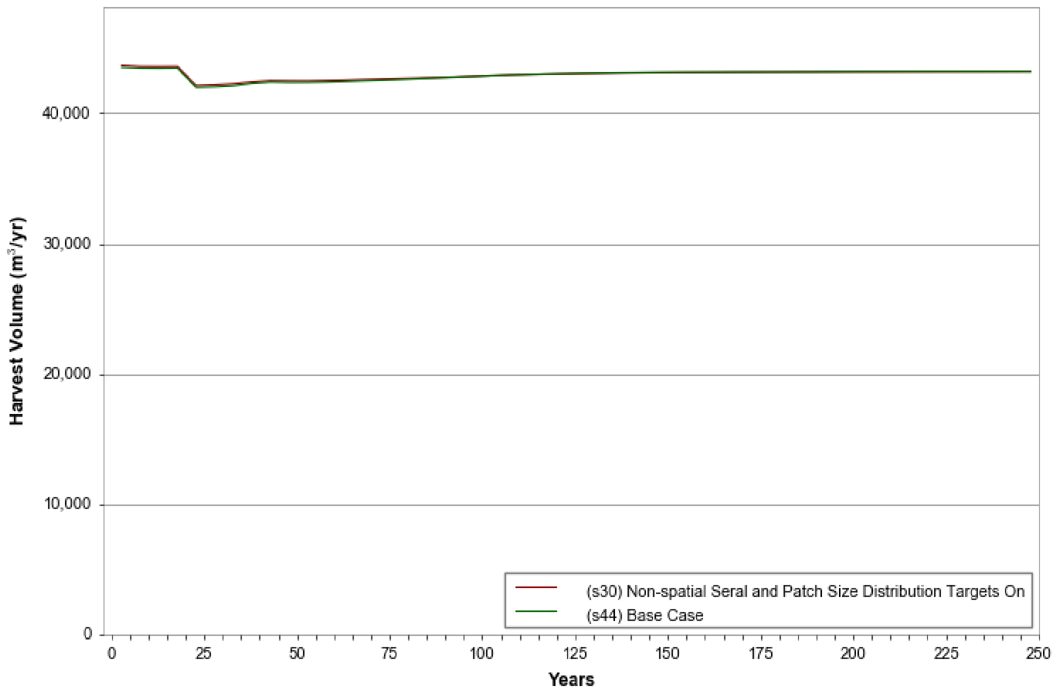

Figure 4-6 Harvest Level of Landscape Level and Patch Distribution Targets Turned On vs Base Case

Table 4-10 Harvest Level Comparison – Landscape Level and Patch Distribution Targets Turned On

Years	Base Case (1000's m3/yr)			Seral and Patch (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	39.20	4.51	43.71	0%
6 to 20	43.48	0	43.48	43.63	0	43.63	0%
21 to 250	42.91	0	42.91	42.94	0	42.94	0%

4.6 Site Index Adjustment Assumptions

Ecora collected some preliminary managed stand site index samples across all the BEC variants in TRCF for spruce and pine leading stands while conducting the Ecosystem Mapping fieldwork. A total of 66 tree samples were collected among the existing managed stands within the three BEC variants. The Resource Analysis Team then produced a subsequent summary of the THLB weighted site index by BEC variant and leading species and compared with the PSPL SI values. While further sampling and analysis are recommended, these preliminary results suggest that site index on BWBS wk1 and BWBS mw sites may be underestimated in the PSPL layer by between 4 and 7 m, while the ESSF mv site index might be closer to the PSPL values. On average, the PSPL SI could be underestimated by 4 m. The details of the field sampling procedure and the summary approach are not specified in this analysis as they only serve as a preliminary guidance for our assumption about the PSPL SI in TRCF. Based on these preliminary results, two sensitivity analyses were conducted to test the impacts on the timber supply if a government-approved Site Index Adjustment (SIA) Project in TRCF was conducted and resulted in a 2 m increase in managed stand site index or a 4 m increase.

As shown in Figure 4-7, Table 4-11 and Table 4-12, the impacts of these assumptions are significant. With increased managed stand site index, the harvest flows of the two SIA sensitivity adopt a step-up pattern with a major increase in harvest level at year 75 when harvesting shifts into managed stands. With a 2m increase in managed stand SI, the harvest level experiences a 12% increase in the first 20 years, 16% from year 21 to 75, and 31% for the rest of the planning horizon. With a 4m increase in managed stand SI, the harvest level experiences a 26% increase for the first 20 years, 31% from year 21 to 75, and 52% from year 75 to 250. This shows the potential harvest level increase from a positive SIA and provide the CF Manager with relevant information to decide whether a SIA project would be beneficial for future management.

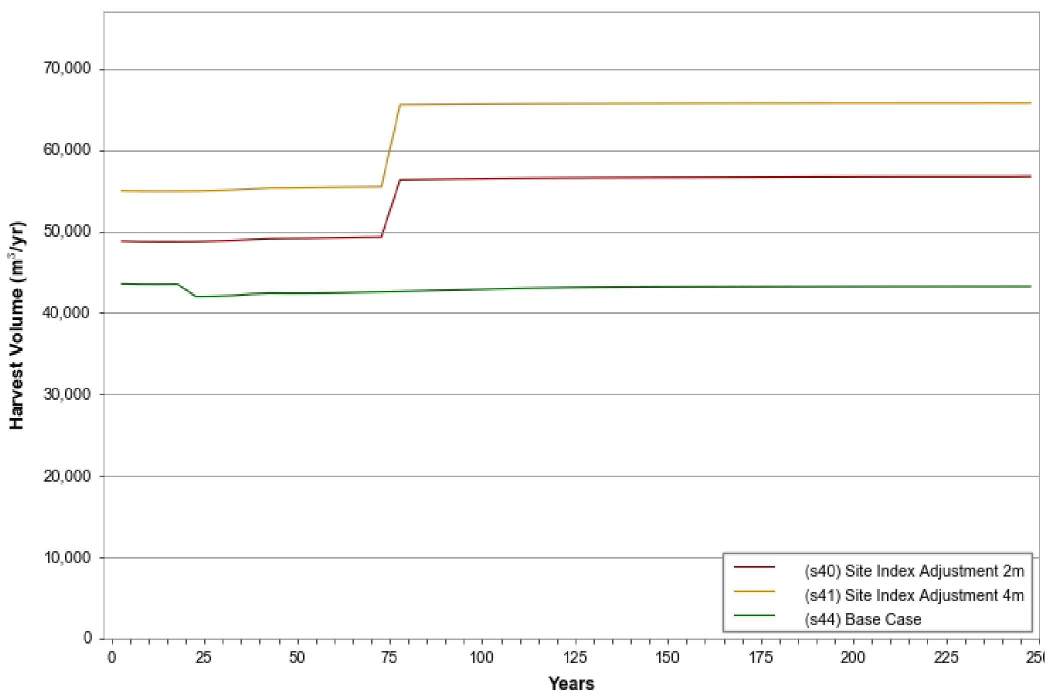

Figure 4-7 Harvest Level of Site Index Adjustment Scenarios vs Base Case

Table 4-11 Harvest Level Comparison – Site Index Adjustment Plus 2m

Years	Base Case (1000's m3/yr)			SIA 2m (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	44.31	4.51	48.82	12%
6 to 20	43.48	0	43.48	48.76	0	48.76	12%
21 to 75	42.33	0	42.33	49.09	0	49.09	16%
76 to 250	43.09	0	43.09	56.62	0	56.62	31%

Table 4-12 Harvest Level Comparison – Site Index Adjustment Plus 4m

Years	Base Case (1000's m3/yr)			SIA 4m (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	50.47	4.51	54.99	26%
6 to 20	43.48	0	43.48	54.95	0	54.95	26%
21 to 75	42.33	0	42.33	55.29	0	55.29	31%
75 to 250	43.09	0	43.09	65.68	0	65.68	52%

4.7 Harvesting in Deciduous-leading Stands

Deciduous-leading stands represent 13% of the THLB, and currently TRCF does not target deciduous-leading stands for harvest due to the current local market condition. However, given the proximity of the land base to other deciduous processing facilities, and the declining timber supply provincially, it is anticipated that there will be a market for deciduous in the future. In the base case, the model is restricted from harvesting in the deciduous-leading stands for the first 20 years, after year 20, the model is free to schedule those stands for harvest without any limitations. Two sensitivity scenarios were conducted to test the impacts of the harvest level if the deciduous-leading stands are not restricted in the 250-year planning period and if no harvesting is allowed for the deciduous-leading stands completely.

Figure 4-8, Table 4-13 and Table 4-14 shows the harvest level impact when the assumptions around harvesting in the deciduous-leading stand are changed. When harvesting is unrestricted in the deciduous-leading stands, the harvest level increases by 1% in the first 20 years compared to the base case, while the LTHL is not impacted. The small impact in the harvest level is caused by allowing the model to schedule stands based on its optimization algorithm. In this case, the model schedules the harvest these deciduous-leading stands in the first period to convert them into more productive managed stands, maximizing the LTHL, while the conifer component of the deciduous-leading stands would also contribute towards maximizing the short-term harvest level. When harvesting is restricted in the deciduous-leading stands for the entire planning horizon, the short-term harvest level decreases by 7% while the LTHL decreases by 5%. This number reflects the conifer component of the deciduous-leading stands that are now unavailable for harvest.

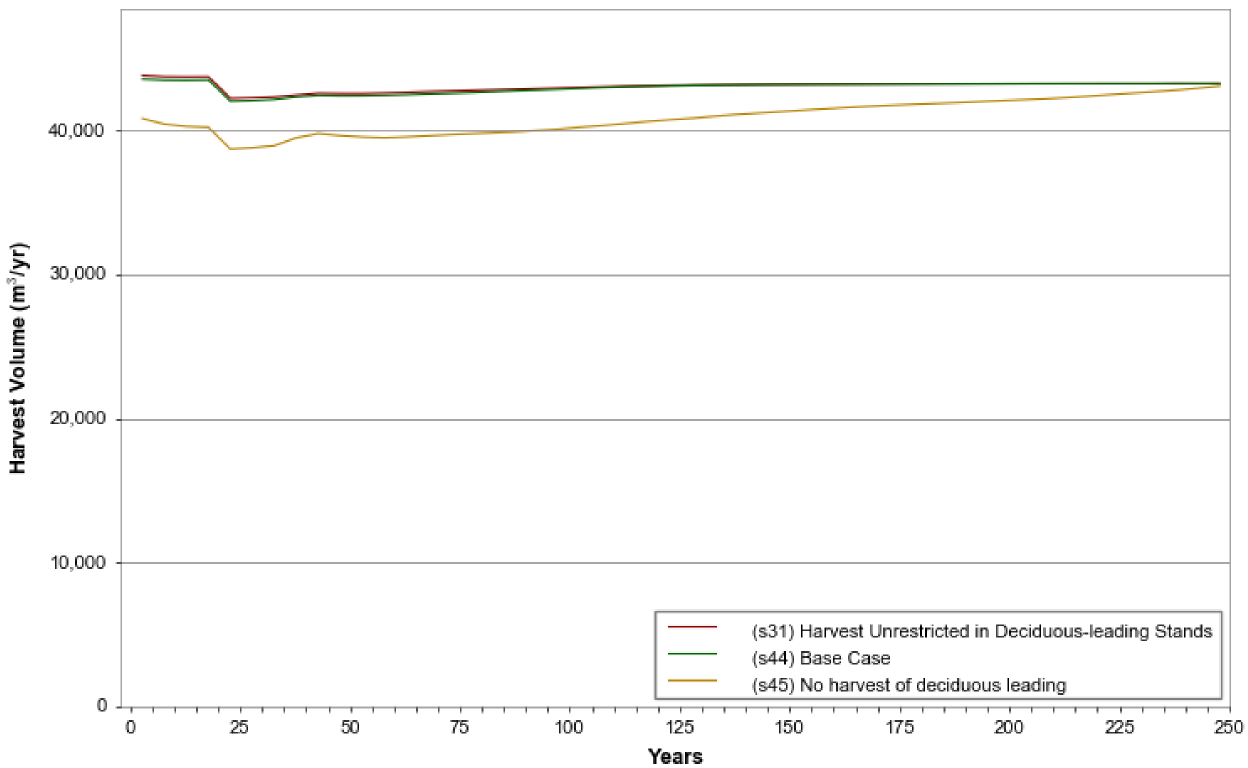

Figure 4-8 Harvest level of the Deciduous-leading Stand Harvest Scenarios

Table 4-13 Harvest Level Comparison – No Harvest of Deciduous-leading Stands

Years	Base Case (1000's m3/yr)			No Deciduous-leading (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	36.29	4.51	40.80	-6%
6 to 20	43.48	0	43.48	40.29	0	40.29	-7%
21 to 250	42.91	0	42.91	40.93	0	40.93	-5%

Table 4-14 Harvest Level Comparison – Unrestricted Harvest in Deciduous-leading Stands

Years	Base Case (1000's m3/yr)			Unrestricted Deciduous (1000's m3/yr)			% Change
	Conifer	Dead	Total	Conifer	Dead	Total	from Base Case (Total)
1 to 5	39.02	4.51	43.54	39.28	4.51	43.79	1%
6 to 20	43.48	0	43.48	43.71	0	43.71	1%
21 to 250	42.91	0	42.91	42.97	0	42.97	0%

5. Discussion

The role of the base case in timber supply analysis is to present the set of data and assumptions that best reflects current management, harvest forecast and representation of timber supply available on the TRCF landbase over the next 250 years. The base case scenario demonstrates the potential harvest forecast based on the timber and non-timber objectives.

This timber supply analysis for TRCF is consistent with the assumptions and methodology from the *Dawson Creek Timber Supply Area Timber Supply Review* (MFLNRORD, 2011), *Tumbler Ridge Community Forest Expansion Area Timber Supply Analysis Report* (Ecora, 2019), *Chetwynd Multi Licensees Forest Stewardship Plan* (BC Timber Sales, 2019) as well as some recent updates to the management practices on TRCF as instructed by the CF Manager and the District Timber Tenures Specialist.

This analysis is completed with the most recent VRI data, classified riparian data, integrated roads data, depletion data, and other spatial input data for forest resource management. The landbase classification process has also undergone rigorous checks both internally and externally. The regeneration assumption for managed stands was consulted with the CF Manager and the genetic gain information was obtained from the Seed Planning & Registry Application. The management assumption and spatial location of the Low Elevation Winter Range was confirmed with the North Eastern Caribou Team Lead. The deciduous-leading stand harvest assumption is reviewed by the CF Manager, reflecting the current market condition. All assumptions and methodology used in the base case is consistent with the current legal requirements and the current best management practice. The arrived base case level presents the maximum harvest level the landbase can sustain while meeting the non-timber objectives without compromising the long-term growing stock.

Sensitivity analysis provides information on the degree to which uncertainty in the base case data and assumptions might affect the proposed harvest level for the landbase. Table 5-1 shows a summary of the harvest impacts of each scenario relative to the base case and the percentage of how much that scenario varies from the base case.

Table 5-1 Summary of Analysis Results

Sensitivity	Harvest Volume (m^3/yr)		% Change from the Base case	
	1 to 20	21 to 250	1 to 20	21 to 250
Base case	43,490	42,910		
Even flow	42,430	43,020	-3%	0%
Lower Visual Quality Class by one class	47,860	45,450	9%	6%
Minimum harvest volume 140 m^3/ha	43,840	43,000	0%	0%
Natural stands yield curves + 10%	46,740	45,410	7%	6%
Natural stands yield curves - 10%	39,640	42,060	-9%	-2%
Managed stands yield curves + 10%	47,660	45,460	9%	6%
Managed stands yield curves - 10%	41,440	40,360	-5%	-6%
Non-spatial seral targets and patch distribution targets on	43,650	42,940	0%	0%
Low elevation winter range excluded from THLB	27,760	28,200	-37%	-34%
Low elevation winter range target off	50,630	47,310	16%	10%
Site Index Adjustment +2m	48,770	54,820	12%	28%
Site Index Adjustment +4m	54,960	63,200	26%	47%
Deciduous-leading harvest unrestricted	43,730	42,970	1%	0%
Deciduous-leading harvest restricted	40,420	40,930	-7%	-5%

A step-down harvest pattern can best accommodate the management objectives of TRCF mainly because of the high natural to managed stand ratio. The step-down harvest pattern of the base case allows for a faster transition from natural stands to more productive managed stands, and a sustainable LTHL can be reached sooner by harvesting the natural stands earlier in the planning horizon. All this is accomplished while maintaining all the non-timber objectives defined for the landbase.

The scenario that excludes the LEWR from the THLB has the largest negative impact on the harvest forecast (-34%). Increasing the managed stand site index by 4m has the greatest positive impact on the harvest level (47%) than its counterpart scenario.

Assumptions around landscape-level retention targets and increasing the MHV to 140 m^3/ha do not significantly impact the harvest level. The harvest age is affected by when the stand reaches the culmination mean annual increment (CMAI) and not so much by when the stand reaches the MHV because the CMAI age is later than the age of MHV.

As harvesting in natural stands transitions into managed stands after year 75, changes in MSYT would impact the LTHL more than changes in NSYT. Increases in MSYT such as through SIA would lead to a significant increase in both short-term and LTHL in TRCF. On the contrary, changes in NSYT impact the short-term and mid-term harvest level more than the LTHL.

The management decision on the LEWR has high degree of impact on the harvest level. The LEWR forest cover objective is the deciding variable for the base case harvest level and harvest pattern. Without the LEWR constraint, the short- to mid-term harvest level would be higher because 41% of the THLB in the LEWR otherwise reserved to meet the habitat requirement would be available for harvest. On the other hand, if the LEWR management requirement becomes even more restrictive, to the point that the entire LEWR would be set aside as a no-harvest-zone, then the impact on the harvest level would reflect the reduction in THLB which is close to 38%.

Restricting the harvest of the deciduous-leading stands has a negative impact on the harvest level, as this will result in the decrease of the productive managed stands in the long run because there will be no conversion from higher productivity natural existing deciduous stands to conifer. In the short-term, the conifer volume of the deciduous-leading stands becomes unavailable when deciduous-leading harvest is prevented or deferred. On the other hand, by allowing to harvest in the deciduous-leading stands in the first 20-years the total harvest level does not see a significant increase either.

This timber supply analysis indicates that the base case harvest level is sustainable and suitable for the TRCF, after considering the results of the sensitivity analyses.

References

BC Timber Sales et al.,2019. *Chetwynd Multi Licensee Forest Stewardship Plan*.pdf

British Columbia Environmental Reporting, 2018. http://www.env.gov.bc.ca/soe/indicators/land/silviculture.html Web. (June 7, 2020).

British Columbia Ministry of Forests, Land and Natural Resource Operations (MFLNRORD). 2013. *Dawson Creek Timber Supply Area Timber Supply Analysis Technical Report*

British Columbia Ministry of Forests, Land and Natural Resource Operations (MFLNRORD). 2011*. Dawson Creek Timber Supply Area Timber Supply Review Data Package*

British Columbia Ministry of Forests Land and Natural Resources Operations (MFLNRORD), 2004. *Forest Planning and Practice Regulation.* Retrieved from http://www.bclaws.ca/civix/document/id/complete/statreg/14_2004

British Columbia Ministry of Forests Land and Natural Resources Operations (MFLNRO), 1999. *Dawson Creek Land and Resource Management Plan.*

British Columbia Ministry of Forests, 1995b. *Biodiversity Guidebook* - Forest Practices Code of British Columbia. Retrieved from https://www.for.gov.bc.ca/hfd/library/documents/bib19715.pdf

British Columbia Forest Service Research Branch, 1993. *Land Management Handbook - A Field Guide for Site Identification and Interpretation of Forest Ecosystems.* Retrieved from https://www.for.gov.bc.ca/hre/becweb/resources/classificationreports/subzones/index.html

DeLong, S.C., 2011. Technical Report 059*. Land Units and Benchmarks for Developing Natural Disturbance-based Forest Management Guidance for Northeastern British Columbia*. Forest Science Program. Retrieved from https://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr059.pdf

Ecora, 2020. *Tumbler Ridge Community Forest Vegetation Resources Inventory with Ecosystem Mapping Project Report*.pdf

Ecora, 2019. *Tumbler Ridge Community Forest Expansion Area Timber Supply Analysis Report*.pdf

Environment Canada, 2014. *Recovery Strategy for the Woodland Caribou, Southern Mountain population (Rangifer tarandus caribou) in Canada*. Species at Risk Act Recovery Strategy Series. Ottawa. viii + 103 pp.

Ministry of Forests Lands and Natural Resource Operations (MFLNRORD). 2020. *Projects and Management Activities.* Retrieved June 8, 2020, from https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/caribou/management-activities